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Resource Misallocation in India: the Role of Cross-State Labor Market Reform

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Resource Misallocation in India: The Role of Cross-State Labor Market Reform

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Abstract

At the macro level, productivity is driven by technology and the efficiency of resource allocation, as outcomes of firms' decision making. The relatively high level of resource misallocation in India's formal manufacturing sector is well documented. We build on this research to further investigate the drivers of misallocation, exploiting micro-level variation across Indian states. We find that states with less rigid labor markets have lesser misallocation. We also examine the interaction of labor market rigidities with informality which is a key feature of India's labor markets. Our results suggest that reducing labor market rigidities in states with high informality has a net positive effect on aggregate productivity.

JEL Classification Numbers: D24, O40, O43, O47

Keywords: Total factor productivity, Misallocation, India, Firm level, Structural reforms.

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[1] This paper builds on India's selected issues paper on "Resource Misallocation and the Role of Labor Market Reform," which accompanied India's Staff Report for the 2018 Article IV Consultation. It has benefited from discussions with Romain Duval and seminar participants at APD discussion forum, as well as comments from IMF departments and Indian authorities provided in the earlier version of the paper. The paper was presented at the 2nd IZA/World Bank/NJD Conference on Jobs and Development: Improving Jobs Outcomes in Developing Countries" held at the World Bank in Washington D.C. in June 2019.

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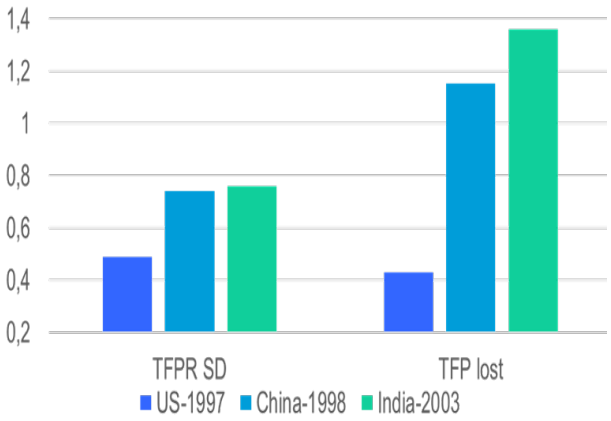
I. INTRODUCTION

Promoting long-term economic development and improving living standards are the key challenges for developing countries. Studies find *productivity*—output per unit of input—is the main driver underlying cross-country differences in GDP per capita (see Jones (2016), Restuccia and Rogerson (2017)). Lower productivity can be a consequence of slow progress in adopting frontier techonologies and best practices in the productive process, as well as the lack of efficiency in allocating productive resources. Productivity gains, therefore, are vital for developing countries to climb up the ladder of economic development. Our focus in this paper is the latter channel of inefficient resource allocation.

Institutional features and government policies can have important effects on efficiency, as they determine firms' decision making on production, investment, and the allocation of their limited resources. Policies may impede factors of production from being allocated to their best use, so-called *misallocation*, hindering growth at the macro level. Such policies may include barriers to entry/exit of firms, limits on firm capacity, tax and subsidy policies, etc. that may cause deviations from optimal allocative choices. Addressing such distortionary policies would help reduce misallocation and raise aggregate productivity.

Focusing on India, evidence suggests that the extent of resource misallocation is quite significant and likely driven by distortionary policies and other structural impediments. Hsieh and Klenow (2009) found sizeable misallocation in China and India compared to that of the United States, and showed that eliminating misallocation to achieve US efficiency could result in manufacturing productivity gains of about 40-60 percent in India (Figure 1).[2]

Figure 1. Resource misallocation in India compared to China and the United States



Source: Authors' calculations. China and US statistics are from Hsieh and Klenow (2009)

Note: Statistics are for the standard deviation of revenue productivity or TFPR (in logs) from industry means. The TFP gap is derived by equalizing TFPR within industries. See section III for details.

This paper investigates the drivers of the relatively high misallcation in India, focusing on labor market rigidities in the formal manufacturing sector across Indian states. We empirically illustrate how institutional and market distortions change the allocation of resources across firms. Using micro-level balance sheet data, we calculate the aggregate total factor productivity (TFP) and the dispersion of firms' revenue productivity, which is a standard measure of resource misallocation as outlined in Hsieh and Klenow (2009). In addition, we calculate the skewness of the

[2] The extent of misallocation in India relative to US efficiency is discussed in Rotemberg and White (2017) and Blis et al (2020).

distribution of revenue productivity, which allows us to assess the prevalance of firms within a state-sector that are too small or too large relative to a distribution with no misallocation (see Section III for details).

We find that the magnitude of misallocation across sector-states in India's formal manufacturing sector is sizable and there is significant heterogeneity across Indian states. Econometric evidence also suggests that reforms to increase labor market flexibility are associated with higher TFP and lower misallocation, especially in states where informality is relatively high.

This paper contributes to the existing literature by addressing a number of common themes in the productivity debate on India including labor laws and informality, particularly at the state level. It has been documented that India's labor laws have remained among the more restrictive laws in the world, and that strict labor laws may relate to a large informality in the Indian economy (Dougherty, 2008). Labor laws in India are concurrently legislated by both center and state governments which lead to very complex, numerous, and rigid labor legislations. Some efforts have been made more recently by individual states and limited reforms have been implemented at the federal level as well.[3] It is thus important to guage the effectiveness of state-level labor reforms on state-level resource misallocation, and productivity and growth.

The rest of the paper is organized as follows. Section II provides a literature review of misallocation and productivity growth in India. Section III describes the methodology used for measuring misallocation. Section IV explains data used for the analysis and presents stylized facts on misallocation across Indian states. Section V and VI lay out the econometric analysis and empirical results of the key drivers of misallocation in India respectively. Section VII concludes.

II. LITERATURE REVIEWS

One of the most important developments in growth literature of the last decade is the enhanced appreciation of resource misallocation across firms and sectors to explain low aggregate productivity (Jones, 2016). In the seminal paper by Hsieh and Klenow (2009), firm-level price distortions create resource misallocation that explains the productivity gaps observed between the U.S., China, and India. Low productivity growth can be a consequence of slow adoption of frontier technologies and best practices as well as the lack of efficiency in allocating productive resources, caused in part by institutional features and government policies.

In India, differences in the institutional and regulatory framework are found to be key drivers of different aspects of firms' performance across states. Besley and Burgess (2004), Gupta et al (2008), and Kapoor (2015) showed significant heterogeneity in firms' output performance

[3] Current efforts attempt to rationalize the various labor laws into four Labor Codes; however, there has been no change to the Industrial Disputes Act of 1947 and restrictive clauses under the Factories Act of 1948 which are key to enhance labor market flexibility. See Box 1 for more details.

across states, which are likely driven by state-specific labor and product market regulations, financial development, and investment in infrastructure. Dougherty et al (2011) focused on firm-level productivity across states and found that firms in labor-intensive industries located in states with flexible labor markets have higher productivity than those in states with more stringent labor laws. Dougherty et al (2014) analyzed productivity effects of deregulation related to state-level variation in policy across Indian states and found firms would benefit substantially through gains in total factor productivity growth in states with higher levels of pro-employer reform. In addition, Chatterjee (2011) extended Hsieh and Klenow (2009)'s methodology to analyze the linkages and key drivers of resource misallocation and productivity in Indian manufacturing at the aggregate level. She found distortionary policies including firm-size tax distortions and strict labor laws, as well as shortage of capital and limited access to intermediate inputs, contributed to misallocation across Indian manufacturing firms.[4]

Our work is also related to the literature on the role of informality in emerging market economies. While there is a large literature examining the economic effects of informality including on aggregate productivity, the role of informality remains debatable. In connection to India, Chatterjee (2011) found that misallocation in the formal manufacturing sector tends to be larger compared to the informal sector as formal firms may face larger distortions than informal firms, and the formal sector has less efficiency gains from reallocation than the informal sector. Nevertheless, she cautioned that the results are sensitive to the methodology used to measure productivity. Ulyssea (2018) applied a general equilibrium model as in Melitz (2003) to firm-level data for Brazil to analyze the implication of informality on output and productivity growth. He showed that lower informality can be, but is not necessarily associated with higher output, total factor productivity growth, or welfare. Using a similar framework, Alvarez and Ruane (2019) found that removing formal sector regulatory labor distortions increases the share of employment in the formal sector but has no significant impact on misallocation or aggregate productivity in Mexico. However, Misch and Saborowski (2018) showed that higher levels of informality in Mexico are associated with higher resource misallocation. Since our focus in this paper is limited to formal sector characteristics, the reduction in informality would be considered beneficial, to the extent that this reduces misallocation and increases productivity in the formal sector. Section III describes the channels that link the formal and informal sector in more details.

The main contribution of our paper is, therefore, to uncover the sector-state pattern of resource of misallocation in India, and to highlight the role of labor market rigidities, given

[4] There is also a large literature focusing on capital misallocation, for instance, Midrigan and Xu (2014), Gopinath et al. (2015), Gamberoni et al (2016), and Misch and Saborowski (2018) showed that restrictive bank credit standards and credit availability are among the key drivers of misallocation in Korea, Colombia, Mexico, and Europe. Leon-Ledesma and Christopoulos (2016) found that access-to-finance and credit to private sector increase firm-level distortions and misallocation in 45 countries including India. Bas and Berthou (2014) found that constraints in access to finance and credit availability to firms across Indian states resulted in capital misallocation through financial markets. Duranton et al. (2015) computed an index to measure misallocation in financial markets and showed significant spatial disparities in access to finance due to land misallocation across Indian states that could lead to capital misallocation. Nevertheless, our work remains focused on labor market issues, given their relevance to the Indian context.

the important role of states in setting labor regulations in India. We also propose a new measure of sector-level misallocation based on the Hsieh and Klenow (2009) framework.

III. EMPIRICAL FRAMEWORK

In a simplified framework, we show how firm-level distortions on input and output prices affect resource allocation across firms within a sector and a state. We follow the theoretical approach developed by Hsieh and Klenow (2009). Then, we describe how informality interacts with productivity and misallocation.

A. Measuring Misallocation

Assume each state *j* is composed by a continuum of $s_j=1,...S_j$ manufacturing sectors producing differentiated goods under monopolistic competition. There are M_{js} firms in each of the continuum of S_j industries of state *j*.

The focus is on decision problem of firms in a given sector *s* and state *j*. Firms use Cobb-Douglas technology for producing a differentiated good such as:

$$Y_{jsi} = A_{jsi}\, K_{jsi}^{\alpha_s} L_{jsi}^{1-\alpha_s}$$

Firm combines labor L_{jsi} with capital K_{jsi} in a Cobb-Douglas fashion with firm-specific efficiency A_{jsi}. Factor elasticities, α_s, measured the relative importance of each input for production and are assumed to be identical for all firms within a sector (and for all states).

Firms choose the amount of labor and capital to maximize their profits π_{jsi}:

$$\pi_{jsi} = \max_{K,L} P_{jsi}Y_{jsi}\left(1-\tau_{Y,jsi}\right) - R_{js}\left(1+\tau_{K,sji}\right)K_{sji} - w_{js}\left(1+\tau_{L,jsi}\right)L_{sji}$$

where P_{jsi} is the price of the good, w_{js} is the wage rate, R_{js} is the rental price of capital. As factor markets are assumed to be competitive, there is a single unit cost for capital and labor within each sector and state, respectively R_{js} and w_{js}. However, firms can face market frictions and poorly-designed regulations and taxes that distort the unit costs of capital $\left(1+\tau_{K,sji}\right)$, labor $\left(1+\tau_{L,jsi}\right)$ and final goods $\left(1-\tau_{Y,jsi}\right)$.[5]

As firms face a constant elasticity of substitution (CES) demand function with an elasticity of substitution between varieties $\theta > 1$, the first order condition yields the standard result that firm's output price is a fixed markup over marginal cost:

[5] Distortions $\tau_{K,sji}$, $\tau_{L,sji}$ and $\tau_{Y,sji}$ can be positive (i.e., taxes) or negative (i.e., subventions). While positive distortions on capital and labor increase their unit cost, positive distortions on final output reduce firm's revenue.

$$P_{jsi} = \frac{\theta}{1-\theta}\left(\frac{R_{js}}{\alpha_s}\right)^{\alpha_s}\left(\frac{w_{js}}{1-\alpha_s}\right)^{1-\alpha_s}\left(\frac{\left(1+\tau_{K,jsi}\right)^{\alpha_s}\left(1+\tau_{L,jsi}\right)^{1-\alpha_s}}{A_{jsi}\,(1-\tau_{Y,jsi})}\right)$$

In absence of market frictions, constant markup of price over marginal cost ensures that higher firm productivity is passed on fully to consumers in the form of a lower price (Melitz and Redding (2014)). Capital-to-labor ratio is equalized across firms and firms' relative market share is a function of firms' relative efficiency.

In presence of market frictions, idiosyncratic frictions on input markets prevent firms from equalizing their capital-to-labor ratio and impact the measured TFP in data. As we do not observe firm-level prices in data, we measure the firm-level revenue TFP, so-called revenue productivity (TFPR), $TFPR_{jsi} = P_{jsi}A_{jsi}$, such that:

$$TFPR_{jsi} = \frac{\theta}{1-\theta}\left(\frac{R_{js}}{\alpha_s}\right)^{\alpha_s}\left(\frac{w_{js}}{1-\alpha_s}\right)^{1-\alpha_s}\left(\frac{\left(1+\tau_{K,jsi}\right)^{\alpha_s}\left(1+\tau_{L,jsi}\right)^{1-\alpha_s}}{(1-\tau_{Y,jsi})}\right) \qquad (1)$$

In order to capture and synthesize all firm-level distortions, we compute revenue productivity at the sector level. The output of each sector *s,* Y_{js}, is a CES aggregate of output produced by each firm Y_{jsi}:

$$Y_{js} = \left(\sum_{i\epsilon M_{js}} Y_{jsi}^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}} \qquad (2)$$

Using the CES aggregator, the aggregate TFP is:

$$TFP_{js} = \left(\sum_{i\epsilon M_{js}}\left(A_{jsi}\cdot\frac{\overline{TFPR_{js}}}{TFPR_{jsi}}\right)^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}} \qquad (3)$$

The main measure of misallocation used in the literature is the dispersion of firm TFPR. To derive this, we suppose that $TFPR_{jsi}$ and true firm productivity A_{jsi} are jointly log-normally distributed, analogous to Hsieh and Klenow (2009). The dispersion of TFPR is summarized by the variance of the log of $TFPR_{jsi}$. Details are described in Appendix I.

The second measure of misallocation is the deviation of the median firm's TFPR from the industry mean. It measures the skewness of the distribution of TFPR and reveals about the nature of distortions faced by firms (Figure 2).

The industry mean of TFPR is:

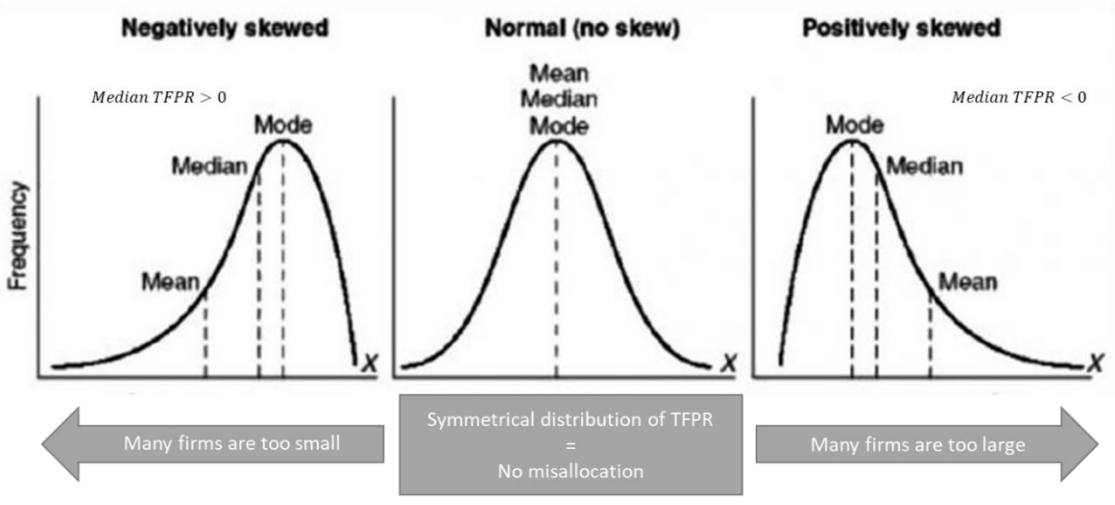
$$\overline{TFPR_{js}} = \left(\frac{R_{js}}{\alpha_s}\sum_{i\epsilon M_{js}}\frac{(1+\tau_{K,jsi})}{(1-\tau_{Y,jsi})}\frac{P_iY_i}{P_sY_s}\right)^{\alpha_s}\left(\frac{w_{js}}{1-\alpha_s}\sum_{i\epsilon M_{js}}\frac{(1+\tau_{L,jsi})}{(1-\tau_{Y,jsi})}\frac{P_iY_i}{P_sY_s}\right)^{1-\alpha_s}$$

The skewness of the distribution of TFPR is:

$$\overline{TFPR_{js,p50}} = \left(\frac{TFPR_{js,p50}}{\overline{TFPR_{js}}}\right)$$

- If $\overline{TFPR_{js,p50}} = 1$ or $log\overline{TFPR_{jsi,p50}} = 0$, the median TFPR is equal to the industry mean. Firms' marginal products are equalized. There is no resource misallocation.
- If "Median TFPR" $= log\left(\frac{TFPR_{js,p50}}{\overline{TFPR_{js}}}\right) > 0$: The distribution of TFPR has a negative skewness. The median firm has a TFPR level above its optimal level from the lognormal distribution. This suggests that the median firm faces distortions that reduce its size relative to optimal. It can be the case when firms faced poorly-designed regulations or size-dependent taxes.
- If "Median TFPR" $= log\left(\frac{TFPR_{js,p50}}{\overline{TFPR_{js}}}\right) < 0$: The distribution of TFPR has a positive skewness. The median firm is sub-optimally too large relative to its true productivity, meaning that the median firm faces distortions that increase its size relative to optimal. It can be the case when firms received subsidies.

Figure 2. Illustration of the TFPR Distribution in Presence of Firm-Level Price Distortion



We also construct the "TFP gap" to measure the distance between "efficient" and "observed" output. Details are described in Appendix I.

B. Misallocation and Informality

Given the prevalence of informality across Indian states, we proceed on the intuition that easing labor market regulations—our main focus of policy—would produce different outcomes in the formal sector depending on the level of informality. Where informality is relatively high, easing labor market regulations would produce more sizable improvements in formal sector outcomes than where it is low. To illustrate, intrinsically more productive formal sector firms may be unable to reach their optimal size in places where informality is relatively high, due to competition from intrinsically less productive informal sector firms, that are able to evade costly regulations and taxes. The level of informality is of course likely to be endogenous to labor market regulations and may be capturing the restrictiveness of these regulations; easing regulations where they bind the most is likely to produce the most sizable effects on formal sector outcomes. High informality may also indicate a relatively larger mass of firms that would enter the formal sector if entry costs were lower. Reducing firms' entry costs into the formal sector, including by easing labor market regulations, could enable such firms to grow to their optimal size, thus reducing misallocation.[6] While we do not test for a particular channel by which informality affects formal sector outcomes, we look for suggestive evidence in the interaction of employment legislation with the magnitude of informality.

IV. Data and Stylized Facts

In this section, we describe data used for the analysis of firm-level distortions in India and the impacts of labor market reforms on misallocation.

A. Firm-Level Balance Sheet Data

We use firm-level data from the Annual Survey of Industries (ASI) which is compiled by the Central Statistical Organization (CSO) in India. It covers factories in manufacturing industries under the Factories Act, 1948: firms employing more than 10 workers using power and those employing more than 20 workers without using power. This survey is a census of all registered manufacturing units with 100 or more employees and a random sample of one-fifth of the remaining registered firms. The survey data is based on India's fiscal years 2003/04, 2006/07, 2008/09, and 2010/11. As firms change in the random sample over time,

[6] In Ulyssea (2018), regulations such as firing costs are treated as entry costs; and he finds that lowering entry costs on the extensive margin increases the mass of relatively less productive firms in the formal economy and lowers aggregate TFP, based on data for Brazilian firms.

we do not have panel data at firm level.[7] The variables of interest include capital stock, labor compensation, gross output, intermediate inputs, and value-added.[8]

Industry classification is crucial to compute the extent of misallocation within each sector and state. Sector classification in the ASI data changes over time (NIC-1998 in 2003/04, NIC-2004 in 2006/07, and NIC-2008 in 2008/09 and 2010/11). As NIC-2008 is equivalent to ISIC rev.4 classification at the 4-digit level, we convert NIC-1998 and NIC-2004 into NIC-2008 and we keep only manufacturing industries. Then, sectors are defined at the 3-digit level.

As in Hsieh and Klenow (2009), and Chatterjee (2011), we set the factor shares in the Cobb-Douglas production function equal to those in the corresponding U.S. manufacturing industry in order to identify distortions in the data.[9] Industry capital and labor shares are from the NBER productivity database available by sector defined at the 3-digit level between 1958 and 2011. We compute the average factor shares over the period and augment labor shares by a scaling of 3/2 to reflect nonwage forms of compensation.[10] As outlier correction, we replace negative values of value-added, capital, and labor compensation with missing values. We trim the 1 percent tails of firm productivity ($\log TFPR_{jsi}$) by year and then the 1 percent tails of firm relative distortions ($\log(\text{TFPR}_{jsi}/\overline{TFPR_{js}})$) and firm relative productivity ($\log(\text{A}_{jsi}/\overline{A_{js}})$) by 3-digit industry and year. Table 1 and 3 present the summary statistics of firms' total factor productivity from ASI database by states.

[7] We limit our analysis to four time points since the objective is to test if state-level labor market reforms measured as of 2007 are associated with lower misallocation. In the econometric analysis, we estimate coefficients from the variation across states within sector and year.

[8] The variables of interest are defined as follows. *Capital stock* is the net book value of the firms' machinery, equipment, and structures at the end of the year. *Labor compensation* is the sum of wages, benefits, and bonuses. *Gross output* is the sum of the total annual sales, trade income, and other income such as rent or commissions received. *Intermediate inputs* are the sum of total values of domestic and imported material inputs; rent and royalties paid for land on lease, mines, quarries, and similar assets; total expenses for work performed by others; repair and maintenance; operating and non-operating expenditure; insurance charges: and rent paid for structures, plant, and machinery. *Value-added* is the difference between gross output and intermediate inputs.

[9] Chatterjee (2011) shows labor share in the formal sector in India is below that observed in the US data revealing significant resources misallocation across sectors in India. To quantify the extent of resource misallocation in India, the US labor share is used as the benchmark of efficient allocation of resources. Using factor shares based on ASI data would under-estimate misallocation This assumption is common in the literature.

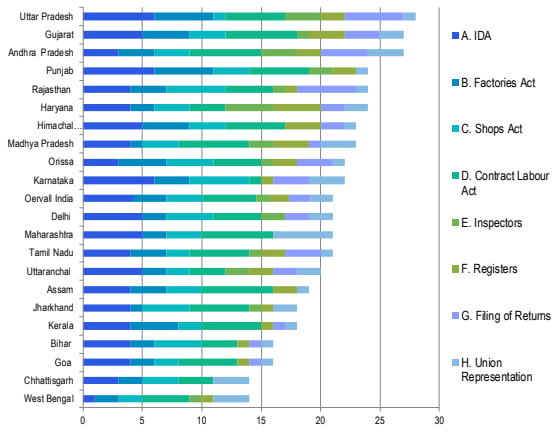
[10] The U.S. shares are from the NBER Productivity Database based on the Census of Manufactures (CM) and Annual Survey of Manufactures (ASM). Nevertheless, it is important to note that payments to labor from the CM/ASM survey omit fringe benefits and employer social security contributions. The CM/ASM manufacturing labor share accounts for about two-thirds of the manufacturing labor share observed from the National Income and Product Accounts (NIPA), in which NIPA incorporates non-wage forms of compensation. We therefore rescaled the US labor share by 3/2 as in Hsieh and Klenow (2009).

B. State and Sector Characteristics in India

Data from various sources are mapped with India's state and sector characteristics, particularly to capture differences in institutional settings and pace of reforms across Indian states. Table 2 presents the list of Indian states and their main characteristics. We have 20 Indian states, 41 sectors, and four years. States have on average 64 sector-year observations.

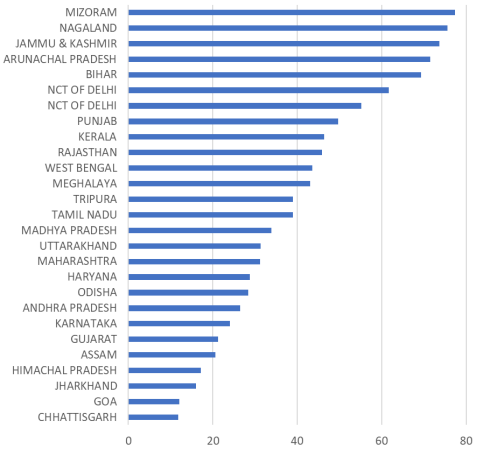
First, we use the index of changes in Employment Protection Legislation (EPL) as in Dougherty (2008), presented in Figure 3. We use the ordinal EPL count index, after rescaling it from zero to one. The index captures the percentage of areas in which labor reforms at Indian states occurred over the 1990s and 2000s. It was computed in 2007 and is thus time invariant.[11] The index takes into account legal changes involving Industrial Dispute Act, Factories Act, Shop Act, Contract Labour Act, as well as procedural changes related to registration, return filing, and union representation. These changes are exclusively related to issues that affect the transaction costs of labor market arrangements (e.g., hiring and firing costs). A higher EPL is associated with more reforms towards labor market flexibility. As in Figure 3 and Table 2, Andhra Pradesh and Gujarat are the states with the most labor market reforms (EPL=0.96), and West Bengal and Chhattisgarh are ones with the least (EPL=0.5). Box 1 explains labor market regulations and reforms in India in more details.

Figure 3. India: Employment Protection Legislation Reform Index



Source: Dougherty (2008)
The EPL reform index reflects the extent to which procedural or administrative changes have reduced transaction costs in relation to labor issues. Higher score means more reforms implemented.

Figure 4. India: Share of Unregistered Activities in Manufacturing NSDP (2003, percent)



Source: Author's calculation.

[11] Many states have implemented reforms in labor market regulations after 2007 which are not captured in the analysis, being outside the time-span captured by the EPL index.

Secondly, we use data from the state database by the Center for Monitoring Indian Economy (CMIE) for (logs of) credit per capita, the road density (kilometer per thousand square kilometers), and unregistered manufacturing net state domestic product (NSDP). Credit per capita is our measure of state financial development or capital availability. Delhi has the highest level of credit per capita or about 1.5 times that of Bihar—the lowest one (see Table 2). Road density is considered a proxy for infrastructure development. Informality is proxied by the share of unregistered manufacturing NSDP to state NSDP as presented in Figure 4.[12]

Thirdly, the index of product market regulation (PMR) is drawn from Conway and Herd (2009). It reflects differences across states in terms of general regulatory practice that has a bearing on competition. The index was computed in 2006 and is based on 16 level indicators that fall into three broad regulatory areas: state control, barriers to entrepreneurship, and barriers to international trade and investment. We re-scaled it to a range from zero to three. A higher PMR means that regulatory environment is more supportive of competition. In Table 2, Goa and Haryana have the most competitive environment, while West Bengal and Gujarat have the least.

Finally, we use the World Bank Enterprise Surveys collected in 2014. We compute the share of firms for which access to electricity or inadequately educated workforce is an obstacle by state.[13] They respectively capture human capital and infrastructure at a given point in time (see descriptive statistics in Table 2).

[12] CMIE data for unregistered manufacturing NSDP are missing for some states such as Uttar Pradesh.

[13] More details on the World Bank Enterprise Surveys can be found here: http://www.enterprisesurveys.org

Box 1. Labor Market Regulations and Reforms in India

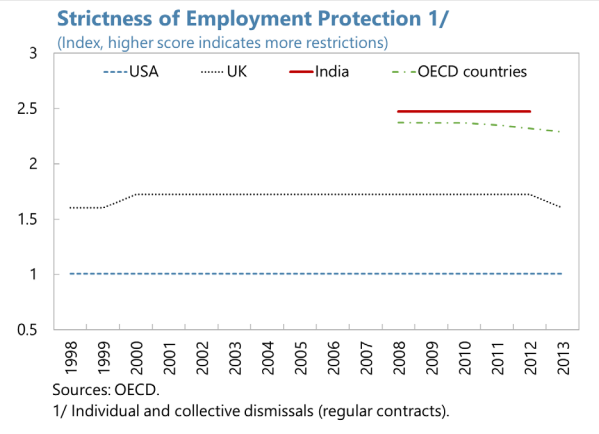
India's labor market regulations are relatively strict, numerous, and outdated including at the sub-national level. The strictness of labor regulations, to a large extent, are attributed to Chapter V-B of the Industrial Disputes Act (IDA) that requires government approval for layoffs, retrenchments, and closures where this law applies on all factories with 100 or more workers. Prior to 2017, labor laws at both the center and states in India numbered to around 250 laws. These laws governed different aspects of the labor market such as minimum wages, resolution of industrial disputes, conditions for hiring and firing workers, and conditions for the closure of establishments.

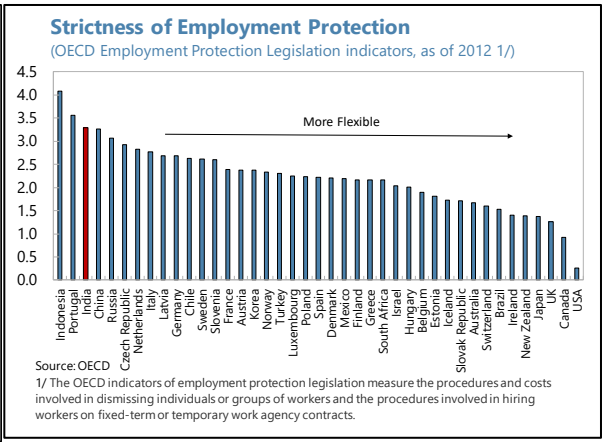
Strict labor market regulations in India can have detrimental economic effects (Besley and Burgess (2004), Dougherty et al (2011, 2014)). India's employment protection is highly restrictive for the organized or formal manufacturing sector, given particularly that it interferes significantly with firms' hiring and severance decisions. High implicit costs of employment especially for large firms have induced many entrepreneurs to start small and stay small (Dougherty (2008)). Firms in the unorganized and often informal sector with fewer than 10 or 20 workers are subject to very few labor regulations and can employ casual or contract labor freely. Such high implicit costs of employment can also cause larger firms to substitute more capital for labor than the optimal allocation, given the apparently low wages that prevail in India.

In recent years, some Indian states have gone ahead with labor reforms to improve labor market flexibility. Rajasthan, Madhya Pradesh, and Haryana in 2014 modified their Industrial Disputes Act to allow automatic retrenchment for a factory with less than 300 workers. Gujarat has allowed automatic retrenchment of workers in any factory in the Specialized Economic Zones, Special Investment Regions, and National Investment and Manufacturing Zones, given that employers provide severance payment of 60 days of wages for every year of employment. Maharashtra in 2017 allowed automatic retrenchment for up to 300 workers.

Since 2017, the central government has attempted to amalgamating 44 central labor laws into four codes on (i) industrial relations, (ii) wages, (iii) social security and welfare, and (iv) safety and working conditions. While some elements of the draft code would create more flexibility, other draft codes would likely backtrack (e.g. by increasing firing costs from ½ to 1½ months of salary) and the Chapter V-B of the IDA has not been altered. The new social security code could constitute a major reform, but it would also depend on the design of the new social security schemes by the central government. The Code on Wages was passed by the Parliament in August 2019, and the remaining three codes were passed in September 2020.

Amid the Novel Coronavirus (COVID-19) pandemic, some Indian states have temporarily relaxed their labor laws to stimulate employment and attract foreign investment. Madhya Pradesh provided exemption for new investors from existing labor laws for 1,000 days from the announcement in May 2020. Similarly, Gujarat granted labor-law exemptions for 1,200 days from the start of production of any new venture in the state. Assam, Haryana, Odisha, Punjab, Rajasthan and Uttarakhand all have announced emergency ordinances to provide similar incentives.



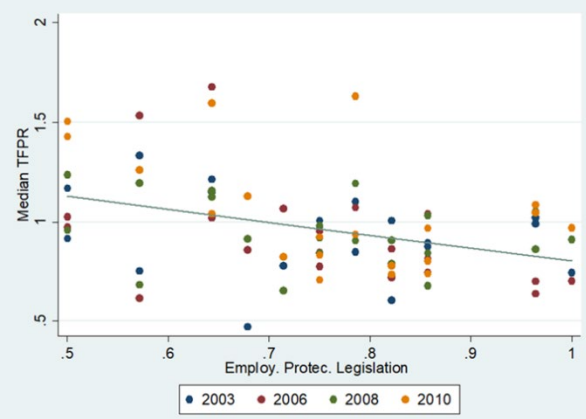


C. Stylized Facts

As we showed earlier, resource misallocation in India appears to be large compared to the United States,[14] where the variance of TFPR and the TFP gap are respectively 1.5 and 3 times higher in India in 2003 than in the U.S. in 1997. [15] But misallocation appears to be comparable to other emerging economies (Chatterjee (2011) and Misch and Saborowski (2018)). Table 3 provides TFPR dispersion statistics in India between 2003 and 2010. At the aggregate, the extent of misallocation was relatively stable in 2006, but lower in 2008 and 2010 compared to 2003. The variance, the ratio of 75th to 25th percentiles, and the ratio of 90th to 10th percentiles of log TFPR were relatively stable in 2006, and then declined in 2008 and 2010 compared to 2003. The negative skewness of TFPR as measured by the median-mean ratio followed the path. The objective of the empirical part is to test if labor market reforms at the state-level is associated with lower misallocation by reducing policy-related distortions that prevent productive firms to grow.

Misallocation is heterogenous across Indian states, which may be related to the state-level institutional and regulatory framework. As shown in Table 1, the aggregate manufacturing TFP (in logs) in a state can vary from as low as 3.2 in Bihar to as high as 5.1 in Maharashtra, representing a significant range in productivity performance. The average variance of revenue productivity in states appears to vary within a narrow range, although the variation at sector-state level at which the regressions are performed is greater, varying between 0.9 and 2.4.

Figure 5. TFPR Skewness and Employment Protection



Source: Authors' calculations.
Note: Median-mean TFPR is a simple average of the median-mean TFPR ratio computed by year, state, and sector. There is no misallocation if median distortion median-mean TFPR is equal to 1. EPL is time invariant.

Finally, the skewness measure relative to the log-normal distribution also shows that 12 out of 20 states in the sample have median TFPR below state-industry mean TFPR, indicating the presence of larger-than-optimal firms is more prevalent in Indian states. Five states have a ratio exceeding 1 (substantial presence of smaller than optimal firms), and the remainder equal to 1. Relating

[14] For cross-country comparison of misallocation, a few caveats are that misallocation in Hsieh and Klenow (2009) is measured by TFP dispersion and is sensitive to data outliers by definition and that the firm-level industry survey data may not be comparable across countries. The cross-country results may partially be subject to measurement errors as described in Nishida et al (2016) and Blis et al (2020). Nevertheless, this study focuses on the extent of misallocation across Indian states and the impact of cross-state labor reforms. Given also that the ASI survey is similarly designed across Indian states for each year, the main conclusions of this study are not likely be affected.

[15] Variance of TFPR and the TFP gap are two measures of misallocation described in Section III and Appendix I.

this to labor market regulation, we suggestively find that lower levels of labor market reforms are correlated with the prevalence of smaller-than-optimal firms. As labor market regulations become less restrictive, the ratio declines below 1 (Figure 5).

For instance, median TFPR is above 1 in Bihar, Jharkhand, West Bengal and Kerala (states that suggestively also have lower employment protection legislation (EPL) indices). These states had implemented fewer labor market reforms in the 1990s and early 2000s (EPL=0.5). On the other hand, the median-mean ratio is around 1 or there was little misallocation in Gujarat and Andhra Pradesh—the states that implemented the most labor market reforms over the 1990s and 2000s (EPL=0.96). For several states that made intermediate progress on labor market reforms, the TFPR skewness suggests that the median firms are sub-optimally too large. This indicates that even as labor market rigidities are lowered, other distortions including those induced by policies such as preferential subsidies could cause deviations from the optimal size. However, our focus remains on the role of rigid labor laws and how this may constrain firms to stay less than optimal size.

In addition to low EPL, Indian states are often characterized by a large informal sector which can interact with formal labor markets and influence firm choices—potentially leading to smaller formal-sector firm size. Firms can outsource labor-intensive activities to the informal sector. It would increase their capital-to-labor ratio and reduce their TFPR. This would be suboptimal from the point of view of the social planner as these firms would be smaller than predicted by their true productivity. As aggregate productivity depends on both the intensive and extensive margin, firms entry/exit from informality could impact aggregate formal-sector productivity.

In Figure 6, the median-mean ratio of TFPR and the share of unregistered net state domestic product (NSDP) in manufacturing are positively correlated; thus, high informality appears to be associated with the presence of too many sub-optimally small firms (negative skew of the TFPR distribution), hinting towards the role of the outsourcing channel in reducing firms' incentives to expand within the formal sector. In Figure 7, the mean and median of TFPR are almost equal in Karnataka, while the median is above the mean of TFPR in Orissa. The negative skewness of the TFPR distribution in Orissa highlights the presence of distortions that reduce the size of many firms. Even if those states have implemented the same amount of labor market reforms (EPL is 0.79 for both states), Karnataka is characterized by a relatively small informal sector compared to Orissa (see more descriptive statistics in Table 2). In addition, Table 4 presents the dispersion of firm-level TFPR across Indian states, comparing states with high informality (Unregistered NSDP median =1) and low informality (Unregistered NSDP median =0). It appears that, on average, firm productivity is lower and the TFPR distribution is negatively skewed in states with high informality.

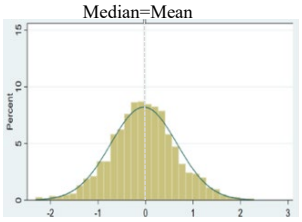
In what follows, we formally test how the presence of informality can change the impact of labor market reforms on the distribution of TFPR and aggregate TFP within an econometric framework.

Figure 6. TFPR Skewness and Informality

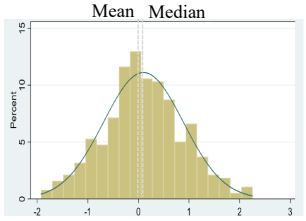
Source: Authors' calculations.
Note: Median-mean TFPR is a simple average of the median-mean TFPR ratio computed by year, state, and sector. There is no misallocation if median-mean TFPR is equal to 1. Share of unregistered NSDP is ratio of unregistered NSDP in manufacturing sector over total NSDP by state and year.

Figure 7. Distribution of TFPR in two states with low EPL, 2010

A. Karnataka: State with relatively low informality (Median = Mean)



B. Orissa: State with relatively high informality (Median > Mean)



Source: Authors' calculations.
Note: TFPR is the ratio of firm-level TFPR over the sector-state average TFPR and measures firm-level distortions in 2010.

V. Econometric Analysis

In this section we examine the drivers of misallocation, including labor market reforms and other features.

A. Baseline Regression

As labor market reforms are heterogenous across states, we employ the following baseline OLS specification:

$$TFP_{sjt} = \beta_0 + \beta_1 EPL_j + \beta_2 Informality_{jt} + \Gamma Z_{jt} + \varphi_{st} + \varepsilon_{ikt}$$

The main dependent variables are the aggregate TFP, the variance of TFPR, and the median-mean ratio of TFPR in sector s, state j and year t. We focus on the aggregate TFP as a measure of firm's productivity. We use the variance of TFPR as our main measure of misallocation, and the median-mean ratio of TFPR as an indicator of the skewness of the distribution of firm-level distortions. In order to limit the effect of outliers in the regressions,

we exclude observations at the state-sector-year level that have been aggregated across fewer than 10 firms[16].

The main coefficient of interest, β_1, identifies the impact of labor market reforms on aggregate TFP and misallocation. Rigid labor laws disincentivize firm's expansion, thus affecting employment in larger firms. We expect that states doing reforms in favor of more flexible labor markets have (i) higher TFP, (ii) lower dispersion of TFPR, and (iii) less negative skew or increased positive skew of the TFPR distribution via a lower median TFPR, and thus expect β_1 to be negative.[17]

Informality enters linearly in the baseline specification. If the presence of a large informal sector leads to firms in the formal sector outsourcing labor-intensive activities (the so-called intensive margin), these firms would then become more capital intensive than in the absence of informality, thus increasing misallocation (positive β_2). Conversely, the composition effect of small and unproductive firms avoiding the formal sector (or the extensive margin) would decrease measured misallocation in the formal sector (negative β_2). Informality is measured by the ratio of unregistered NSDP in manufacturing sector over total NSDP by state and year.[18]

We control for state characteristics including the size of the manufacturing sector using the total number of firms (in logs), infrastructure development using road density (in logs) and the percentage of firms for which electricity is an obstacle. We expect lower median distortions in states with good infrastructure and large trade openness. The total number of firms also controls for sample selection bias.

Finally, we include industry-year pair fixed effects, φ_{ts}, such that coefficients are identified from the variation across states within sector and year. The standard errors are clustered by states as EPL is time-invariant.

As robustness check, we include measures of credit availability, product market regulation and human capital in an alternative specification. Firms can also face price distortions due to imperfect credit markets. Firms in states with high credit per capita have an easier access to external finance thanks to better credit availability. This reduces firm-level distortions by helping more productive firms to get their optimal size. In addition, we include an index of product market regulation (PMR) computed in 2007 for each state to separate the specific impact of labor market reforms from other reforms and regulations. We also control for

[16] We keep 46 percent of the sample after excluding observations at the state-sector-year level that have been aggregated across fewer than 10 firms.
[17] States with low productivity and high misallocation may have a higher incentive to implement labor market reforms. In that case, we would have a reverse causality bias and β_1 would be biased downwards.
[18] The ratio over the total NSDP by year and state also controls for state size over time.

human capital using the percentage of firms for which inadequately educated workforce is an obstacle.[19]

B. Links Between Labor Market Regulations and Informality

The link between labor market reforms and informality is complex. Tight labor regulations may constrain firms from expanding in size and gaining economies of scale (Besley and Burgess (2004) and Dougherty et al. (2011)), where some firms may set up a number of smaller and/or potentially unregistered firms to avoid labor regulations. We test the link between labor market reforms and informality as in the following:

$$TFP_{sjt} = \beta_0 + \beta_1 EPL_s + \beta_2\, EPL_s * Informality_{st}\,(d) + \beta_3\, Informality_{st}\,(d) + \Gamma\, Z_{st} + \varphi_{jt} + \varepsilon_{ikt}$$

The interaction between EPL index and informality dummy is added to the baseline regression to test whether easing EPL has larger effects where informality is relatively high. The dummy variable is equal to 1 if the share of unregistered net state domestic product in manufacturing is in the highest quartile across all Indian states—easing labor regulations may be more impactful in terms of reducing misallocation in states with relatively high informality.[20] This is the main specification of interest.

We also include several other control variables to alleviate concerns with omitted variable bias, measurement error, and sample selection as in the baseline.

VI. Empirical Results

A. Baseline regression

Table 5 presents the regression results from baseline regression. Column 1 – 3 show results for the level of aggregate TFP, the dispersion of TFPR measured by the variance, and the median-mean ratio of TFPR respectively as dependent variables. The summary of findings is as follows:

(i) Implementing labor market reforms (higher EPL) significantly shrinks negative distortions on firm-level prices as measured by the skewness (median-mean ratio) of

[19] We do not include credit per capita, PMR and education in the baseline model because of multicollinearity. Firm access to credit is easier in states with low informality. Credit per capital and education are both highly correlated with the share of unregistered NSDP (the coefficient of correlation is above 40 percent for both). In addition, states engaged in many labor market reforms tend to implement product market reforms at the same time. EPL and PMR are both time invariant and correlated (the coefficient of correlation is about 20 percent). Results are relatively unchanged after controlling for credit per capita, PMR and education despite the multicollinearity issue.

[20] States with a share of unregistered net state domestic product higher than 60 percent (which is the value of the highest quartile across all Indian states) are Jammu and Kashmir (2003), Chandigarh (2003, 2006, 2008), Delhi (2006, 2008, 2010), Bihar (2003, 2006, 2008, 2010), Nagaland (2003, 2006, 2008), Manipur (2003, 2006, 2008, 2010), Tripura (2006, 2008).

TFPR (column 3). Labor market reforms would likely reduce the dispersion of TFPR and increase the productivity, but the results are not significant (column 2).

(ii) Informality is associated with lower aggregate TFP in the formal sector (column 1), even though it is associated with lower dispersion of firm-level TFPR (column 2). This suggests that the intensive margin is more important in determining the effect on aggregate TFP. Although the coefficient on the skewness measure (column 3) is positive, indicating that informality would tend to reduce the size of median firms, it is not significant.

(iii) Better infrastructure such as high road density and lower electricity constraints is significantly correlated with greater aggregate TFP.

The results are also broadly hold, despite adding more controls to the baseline regression (Table 6).

B. Regression with interaction between EPL and informality

Table 7 presents the regression results including interactions of labor market regulation and informality:

(i) The interaction term of interest shows that easing EPL in states with high informality has a large, significant effect on TFP levels (column 1). Even though the dispersion of TFPR increases (column 2), likely due extensive margin effects, overall there are efficiency gains. The negative and significant coefficient in column 3 indicates that the median-mean ratio of TFPR falls, thus reducing the negative skew and/or increasing the positive skew. In other words, negative price distortions on firms shrink in states with high informality when labor markets become more flexible[21].

(ii) Finally, controls for infrastructure appear robust with respect to their effect on TFP (column 1).

C. Robustness Check and Scenario Analysis

Olley and Pakes Decomposition

Our previous measures of misallocation are based on strong assumptions including CES demand and a Cobb-Douglas production function with constant return to scale that are difficult to verify (Haltiwanger et al, 2018). We test the robustness of our results to an

[21] Large gains from reducing distortions in labor markets where initially there is a lot of informality, may also reflect rigid labor markets in the past. In future work, we will explore further the causal link between informality, labor market reforms and productivity.

alternative measure of misallocation using the decomposition of labor productivity from Olley and Pakes (1996):

$$Agg.L.Prod_{sjt} = \left(\frac{1}{N_{sjt}}\right)\sum_{i} L.Prod_{sjti} + \sum_{i}(\theta_{sjti} - \overline{\theta_{sjt}})(L.Prod_{sjti} - \overline{L.Prod_{sjt}}) \qquad (4)$$

Where $L.Prod_{sjti}$ and θ_{sjti} are respectively the labor productivity and the size of firm *i* in sector *s* and state *j* at time *t*; $N_{sjt}$is the number of firms in each state, sector and year; Aggregate labor productivity is measured as value-added per worker defined by state, sector and year. It comprises a simple average of firm-level productivity (first term in equation 4) and the covariance between firm-level employment and labor productivity (second term). The simple average approximates technical efficiency and the covariance term captures the efficiency of resource allocation across firms. High covariance means that firms with higher productivity have greater market share and reveals the allocation of resources across firms.

Table 8 presents results of the decomposition exercise. The dependent variable in column 1 is aggregate labor productivity by sector, state, and year; in column 2 the average of firm level productivity; and in column 3 the covariance between firm employment and labor productivity. Mainly, we find the interaction term between EPL and informality has a strong positive relationship with the covariance term, where this implies easing labor market regulations is associated with an improvement in allocative efficiency (and with an increase in labor productivity on average as seen in column 2) and positively contributes to aggregate labor productivity (column 1). This result is also consistent with the earlier set of regressions.

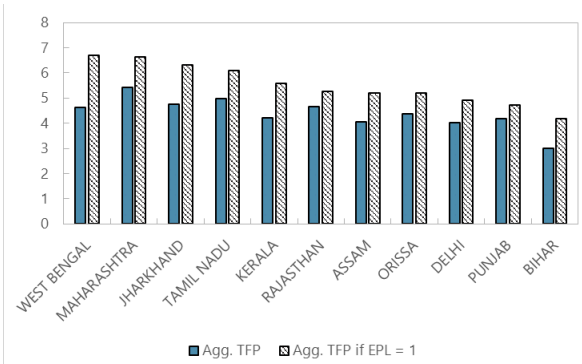
Reforms and Time for Implementation

Indexes for progress on labor market reforms (EPL) and product market regulation (PMR) are computed in 2006 and 2007, respectively. To be sure that our previous results capture progress on economic reforms, we replicate the exercise restricting the firm-level data to years 2008 and 2010 as presented in Table 9. Compared to the main specification, the qualitative results remain broadly unchanged. The coefficient on the interaction between EPL and the share of unregistered NSDP remain positive in columns 1 and 2, and negative in column3, emphasizing the effect of easing labor market regulations on the size of the median firms. Among other covariates, we find qualitatively similar results except for the product market reforms and expenditure on education which are positively associated with higher aggregate TFP.

The Potential Economic Impact of Labor Market Reforms on Aggregate TFP

To give a sense of the economic signficance of our findings, we show what labor market reforms could potentially mean in terms of increasing aggregate TFP of states (Figure 8). The scenario analysis focuses on the potential TFP gains from the reallocation resulting from labor reforms, particularly in states with high informality. The impact of labor reforms is calibrated by calculating the impact of advancing labor market reforms of an Indian state to the same level of the best performer (index=1) from the estimated coefficients from Equation 1 in Table 7. The results show the aggregate TFP can be significantly increased, with West Bengal, Maharashtra and Jharkhand likely benefiting most in terms of absolute TFP gains. These findings suggest that removing structural rigidities in labor market would reduce distortions and contribute to productivity gains and higher long-term growth.

Figure 8. Observed Aggregate TFP and Aggregate TFP after Optimal Labor Market Reforms in States with High Informality
(Data in logs as of 2010)



Source: Authors' calculation

VII. Conclusions and Policy Recommendations

To conclude, misallocation appears to be large in India and heterogenous across states. This sizable heterogeneity appears in part explained by differences in progress of labor market reforms. In a model with firm heterogeneity following Melitz (2003), distortions on capital, labor, and final output markets affect firm-level decision making. These distortions alter firms' marginal cost of production and change their relative size. Firm size is therefore no longer proportional to their productivity, leading to within-sector resource misallocation. These distortions can be, for instance, due to strict labor market regulations. In this study, we employ three measures of sector-level productivity and resource misallocation: the level of TFP, the variance of TFPR, and the median-mean ratio of TFPR, and quantify the impacts of labor market reforms on these measures across Indian manufacturing sectors and states.

Empirically, we find that states that made more progress on labor market reforms tend to have lower degree of misallocation as measured by the dispersion of TFPR and its skewness. This result is even more marked in states with a relatively large informal sector. In such states, labor market reforms are also associated with a significant increase in productivity as measured by TFP.

Additionally, we find that informality has a complex relationship with productivity and resource misallocation. While it exerts a negative effect on TFP, it appears to reduce the dispersion of TFPR, suggesting that the "positive" effect via the extensive margin is offset by the negative intra-firm effects. Moreover, it tends to increase the negative skewness of the TFPR distribution, implying that high informality is associated with smaller than optimal size firms in the formal sector. We note, however, that our work in this regard is preliminary, and warrants future work including to identify causal links between informality, labor regulation, and resource misallocation. In addition, a deeper analysis of underlying firm characteristics in both formal and informal sectors could help understanding the link between informality and productivity in the formal sector.

Addressing distortionary policies such as stringent employment protection legislation is key to helping reduce resource misallocation, thereby raising aggregate productivity, as well as improving growth and employment prospects (also in line with Government of India (2019)). An important policy priority is, therefore, to modernize labor regulations to help improve labor market flexibility, increase formal employment, and enhance capital allocation. Reforms to the Industrial Disputes Act of 1947 and restrictive clauses under the Factories Act of 1948 are key to enhance labor market flexibility and allow firms to expand and reach economies of scale. Labor market reforms will also help reap the full benefits of the demographic dividend and economies of scale from the new national goods and services tax.

More broadly, fostering flexibility while strengthening safety nets can play an important role in delivering inclusive growth (Duval and Loungani, 2019). In India, insurance against income loss tends to rely only on distortionary policies such as overly stringent EPL, which protects only a fraction of formal and regular workers. Rebalancing away from stringent EPL toward broad-based unemployment insurance would foster both efficiency (high and stable employment and productivity) and equity (adequate protection to workers) ensuring inclusive growth.

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Appendix I. Alternative Measures of Misallocation

a. Variance of TFPR

With the expression of TFPR in equation (1), we can express industry TFP in state *j* and sector *s* using the CES aggregator defined in equation (2):

$$TFP_{js} = \left[\sum_i \left(A_{jsi}\frac{\overline{TFPR_{js}}}{TFPR_{jsi}}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}$$

As $TFPR_{jsi}$ and A_{jsi} are jointly lognormally distributed, we decompose the aggregate TFP as in Hsieh and Klenow (2009):

$$\log TFP_{js} = \frac{1}{\sigma-1} log\left(\sum_i A_{jsi}^{\sigma-1}\right) - \frac{\sigma}{2}\, var(\log TFPR_{jsi})$$

The first term captures productivity gains due to technical efficiency. The second summarizes the negative effect of firm-level distortions on aggregate TFP, capturing the extent of misallocation within each sector and state. The variance is the main measure of misallocation in the paper.

b. TFP gap

The distance between "efficient" and "observed" output captures the TFP gap attributable to misallocation. We aggregate the ratio of actual sector TFP (TFP_{js}) and the efficient level of TFP (TFP_{js}^{*}) as in equation (3):

$$\frac{TFP_{js}}{TFP_{js}^{*}} = \left[\sum_i \left(\frac{A_{jsi}}{\overline{A_{js}}}\frac{\overline{TFPR_{js}}}{TFPR_{jsi}}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}$$

The TFP gap, which is the gap from the efficient level, is then:

$$TFP\ gap_{js} = \frac{TFP_{js}^{*}}{TFP_{js}} - 1$$

For measuring TFP gap at the state level, we use the Cobb-Douglas aggregator such as:

$$TFP\ gap_j = \prod_s TFP\ gap_{js}^{\rho s}$$

For computing the TFP gap for India's entire economy, we treat the entire India as one state.

Table 1: Summary Statistics by State—ASI database

State	# Sector-Year Obs.	Avg # Firms per sector and year	Agg. TFP	Avg. Variance TFPR	Avg. Median TFPR
MAHARASHTRA	197	72	5.12	0.71	1.00
TAMIL NADU	189	87	4.77	0.67	0.95
GUJARAT	174	67	4.84	0.69	0.94
ANDHRA PRADESH	173	61	4.61	0.73	0.95
KARNATAKA	160	47	4.64	0.69	0.98
WEST BENGAL	139	37	4.41	0.73	1.16
PUNJAB	136	50	4.19	0.64	1.06
RAJASTHAN	128	37	4.45	0.69	0.94
HARYANA	127	36	4.73	0.64	0.89
MADHYA PRADESH	113	26	4.68	0.71	0.91
KERALA	105	32	4.03	0.71	1.03
DELHI	88	29	3.92	0.63	0.94
UTTARANCHAL	72	21	4.36	0.73	0.99
ORISSA	68	24	4.04	0.72	1.11
CHHATISGARH	61	26	4.59	0.74	1.01
JHARKHAND	59	23	4.24	0.73	1.07
ASSAM	51	44	3.98	0.68	0.95
BIHAR	50	25	3.20	0.67	1.08
HIMACHAL PRADESH	47	21	4.70	0.76	0.98
GOA	28	20	4.85	0.75	0.72
Average	108	39	4.42	0.70	0.98

Notes: Annual Survey of Industries (ASI) database. # Sector-Year Obs. is the total number of observations per sector and year in each state. Avg # Firms per sector and year is the average number of firms per sector and year in each state. Aggregate TFP is the simple average of sector-level aggregate TFP in logs. Avg. Variance TFPR is the simple average of the variance of TFPR in logs. Avg. Median TFPR is the simple average of median-mean ratio of TFPR. We exclude sectors in each state with less than 10 firms per year.

Table 2: Summary Statistics—State Characteristics

State	EPL	Unreg. NSDP	Credit per capita	PMR	Road density	Education obstacle	Electricity Obstacle
GUJARAT	0.96	0.26	9.71	0.68	-0.73	0.04	0.00
ANDHRA PRADESH	0.96	0.32	9.57	1.27	2.12	0.04	0.36
RAJASTHAN	0.86	0.48	8.98	0.93	2.12	0.06	0.20
PUNJAB	0.86	0.53	9.91	1.6	-1.97	0.01	0.32
HARYANA	0.86	0.32	9.68	1.83	2.14	0.06	0.33
MADHYA PRADESH	0.82	0.37	8.71	1.34	1.85	0.11	0.08
HIMACHAL PRADESH	0.82	0.19	9.48	1.16	0.37	0.19	0.31
KARNATAKA	0.79	0.26	10.01	1.52	-0.53	0.02	0.17
ORISSA	0.79	0.37	8.66	0.9	0.75	0.05	0.25
MAHARASHTRA	0.75	0.33	10.69	1.71	2.70	0.07	0.03
TAMIL NADU	0.75	0.41	10.16	1.65	2.17	0.17	0.48
DELHI	0.75	0.66	11.68	1.7	-1.05	0.07	0.06
UTTARANCHAL	0.71	0.19	9.28	1.56	0.16	0.08	0.57
ASSAM	0.68	0.33	8.29	1.07	0.50	0.19	0.55
JHARKHAND	0.64	0.22	8.28	1.41	-0.31	0.08	0.12
KERALA	0.64	0.56	9.67	1.1	2.19	0.42	0.20
GOA	0.57	0.15	10.23	2.23	0.33	0.19	0.31
BIHAR	0.57	0.85	7.49	1.08	1.27	0.08	0.28
WEST BENGAL	0.50	0.55	9.27	0.29	1.57	0.08	0.08
CHHATISGARH	0.50	0.14	8.59	0.9	1.07	0.07	0.08
Average	0.74	0.37	9.42	1.30	0.84	0.10	0.24

Notes: EPL is the index of Employment Protection Legislation in 2007 from OECD. Unreg NSDP is the ratio of unregistered NSDP in the manufacturing sector over total manufacturing NSDP. Credit per capita is the average of credit per capita (in logs) over time. PMR is the index of Product Market Regulation in 2006 from Conway and Herd (2009). Road density is the average of road density (in logs) over time from CMIE database. Education obstacle and Electricity obstacle respectively represent the average share of firms for which access electricity or inadequately educated workforce is an obstacle from World Bank Enterprise Surveys collected in 2014.

Table 3: Dispersion of Firm-Level TFPR (in logs) in India by year

	Median	Variance	P75/P25	P90/P10	# Firms	Share of firms with non-missing TFPR
2003	-0.20	0.79	0.93	1.86	50,600	0.68
2006	-0.32	0.79	0.96	1.86	59,819	0.56
2008	-0.16	0.79	0.95	1.83	50,261	0.59
2010	-0.11	0.70	0.89	1.71	48,120	0.72

Notes: Annual Survey of Industries (ASI) database. Statistics are for deviation of TFPR (in logs) from industry-state mean. P75/P25 is the difference between the 75th and 25th percentiles, and P90/P10 the 90th vs 10th percentiles. Industries are weighted by their value-added shares. Share of firms with non-missing TFPR is the ratio of the number of firms with non-missing TFPR over the total number of firms in the raw database.

Table 4: Dispersion of Firm-Level TFPR (in logs) in India by state in 2010

	Unreg. NSDP (Median) = 0				Unreg. NSDP (Median) = 1		
	Agg. TFP	Variance TFPR	Median TFPR		Agg. TFP	Variance TFPR	Median TFPR
				PUNJAB	4.19	0.55	1.06
HIMACHAL PRADESH	4.85	0.78	1.01	DELHI	4.02	0.64	0.92
UTTARANCHAL	4.94	0.80	0.87	RAJASTHAN	4.67	0.66	0.98
HARYANA	4.98	0.55	0.99	BIHAR	3.02	0.60	1.16
CHHATISGARH	4.84	0.73	0.91	ASSAM	4.05	0.73	0.97
MADHYA PRADESH	4.85	0.59	0.90	WEST BENGAL	4.63	0.74	1.20
GUJARAT	5.03	0.61	0.95	JHARKHAND	4.77	0.94	1.07
ANDHRA PRADESH	4.97	0.75	0.89	ORISSA	4.37	0.85	1.07
KARNATAKA	4.92	0.67	0.98	MAHARASHTRA	5.42	0.73	0.99
GOA	5.14	0.82	0.81	KERALA	4.21	0.67	0.97
				TAMIL NADU	4.98	0.66	0.98
AVERAGE	4.95	0.70	0.92	AVERAGE	4.39	0.71	1.03

Notes: Annual Survey of Industries (ASI) database. Agg. TFP is the simple average of sector-level TFP in logs. TFPR(SD) is the simple average variance of TFPR in logs. Median TFPR is the simple average of median-mean ratio of TFPR. Sectors in each state with less than 10 firms per year are excluded.

Table 5: Aggregate TFP, Misallocation and Labor Market Reforms – Baseline 1/

	(1) Aggregate TFP	(2) Variance TFPR	(3) Median TFPR
Employ. Protec. Legislation	**0.039**	**-0.164**	**-0.275****
	(0.266)	**(0.107)**	**(0.105)**
Share of Unregistered NSDP	**-1.470*****	**-0.207*****	**0.129**
	(0.212)	**(0.056)**	**(0.090)**
Access to Electricity as an obstacle	-0.555***	-0.045	-0.086*
	(0.155)	(0.081)	(0.049)
Road density	0.073***	0.012	-0.009
	(0.023)	(0.007)	(0.007)
# Firms	0.510***	-0.018*	0.021
	(0.024)	(0.010)	(0.013)
Observations	2,017	2,017	2,017
R-squared	0.467	0.467	0.191

Source: Authors' calculations.
1/ The outcome variable is aggregate TFP, the variance of firm-level TFPR and the median-mean TFPR defined by state, sector at the 3-digit level and year. The number of firms and road density are in logs. All columns include industry-year fixed effects. Standard errors clustered by state are in parentheses. The constant term is not reported. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Baseline with Additional Control Variables 1/

	(1) Aggregate TFP	(2) Variance TFPR	(3) Median TFPR
Employ. Protec. Legislation	**-0.120**	**-0.147**	**-0.264****
	(0.270)	**(0.090)**	**(0.092)**
Share of Unregistered NSDP	**-1.467*****	**-0.224*****	**0.118**
	(0.220)	**(0.061)**	**(0.086)**
Credit per Capita	0.071	0.004	-0.004
	(0.070)	(0.013)	(0.017)
Product Market Regulation	-0.005	-0.045	-0.060*
	(0.105)	(0.029)	(0.031)
Inadequately educated workforce as an obstacle	-0.608*	0.023	-0.050
	(0.336)	(0.105)	(0.125)
Access to Electricity as an obstacle	-0.444*	-0.004	-0.029
	(0.217)	(0.099)	(0.069)
Road density	0.090***	0.012	-0.007
	(0.023)	(0.008)	(0.008)
# Firms	0.480***	-0.017	0.025*
	(0.033)	(0.010)	(0.013)
Observations	2,017	2,017	2,017
R-squared	0.470	0.470	0.196

Source: Authors' calculations.

1/ The outcome variable is aggregate TFP, the variance of firm-level TFPR and the median-mean TFPR defined by state, sector at the 3-digit level and year. Credit per capita, the number of firms, and road density are in logs. All columns include industry-year fixed effects. Standard errors clustered by state are in parentheses. The constant term is not reported. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Aggregate TFP, Misallocation, Labor Market Reforms and Informality 1/

	(1) Aggregate TFP	(2) TFPR (SD)	(3) Median TFPR
Employ. Protec. Legislation	-0.516	-0.274***	-0.058
	(0.305)	(0.079)	(0.138)
EPL*Unreg. NSDP (Median)	**1.413***	**0.248***	**-0.376***
	(0.721)	**(0.137)**	**(0.180)**
Unregistered NSDP (Median)	-1.413**	-0.230*	0.332**
	(0.598)	(0.114)	(0.147)
Access to Electricity as an obstacle	-0.655***	-0.064	-0.056
	(0.226)	(0.087)	(0.054)
Road density	0.111***	0.017**	-0.013
	(0.029)	(0.007)	(0.009)
# Firms	0.550***	-0.012	0.013
	(0.029)	(0.009)	(0.012)
Observations	2,017	2,017	2,017
R-squared	0.446	0.463	0.194

Source: Authors' calculations.
1/ The outcome variable is aggregate TFP, the variance of firm-level TFPR and the median-mean TFPR defined by state, sector at the 3-digit level and year. Informality (d) is a dummy variable equal to 1 if the share of unregistered NSDP is above the median across all Indian states. The number of firms and road density are in logs. All columns include industry-year pair fixed effects. Standard errors clustered by state are in parentheses. The constant term is not reported. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Aggregate Labor Productivity and the Covariance Between Labor and Labor Productivity as a Measure of Misallocation 1/

	(1) Aggregate Labor Productivity	(2) Average Labor Productivity	(3) Cov (L, VA/L)
Employ. Protec. Legislation	-0.579*	-0.587***	0.008
	(0.291)	(0.176)	(0.197)
EPL*Unreg. NSDP (Median)	**1.584*** **	**1.071** **	**0.513** **
	(0.444)	**(0.399)**	**(0.238)**
Unregistered NSDP (Median)	-1.431***	-1.001***	-0.430**
	(0.375)	(0.333)	(0.196)
Access to Electricity as an obstacle	-0.172	-0.202	0.031
	(0.137)	(0.151)	(0.136)
Road density	0.034	0.023	0.012
	(0.021)	(0.015)	(0.010)
# Firms	-0.024	-0.060*	0.036*
	(0.033)	(0.030)	(0.017)
Observations	2,017	2,017	2,017
R-squared	0.260	0.380	0.175

Source: Authors' calculations.
1/ The outcome variable is aggregate labor productivity (value-added/wage bill), the unweighted average of firm-level labor productivity and the covariance between firm-level wage bill and labor productivity defined by state, sector at the 3-digit level and year. Informality is a dummy variable equal to 1 if the share of unregistered NSDP is above the median across all Indian states. The number of firms and road density are in logs. All columns include industry-year pair fixed effects. Standard errors clustered by state are in parentheses. The constant term is not reported. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Restricting Sample to Years 2008 and 2010 1/

	(1) Aggregate TFP	(2) TFPR (SD)	(3) Median TFPR
Employ. Protec. Legislation	-0.627*	-0.378***	-0.167
	(0.350)	(0.129)	(0.156)
EPL*Unreg. NSDP (Median)	**1.241****	**0.226**	**-0.189**
	(0.565)	**(0.137)**	**(0.166)**
Unregistered NSDP (Median)	-1.328**	-0.219*	0.171
	(0.475)	(0.115)	(0.143)
Access to Electricity as an obstacle	-0.304	0.082	-0.105**
	(0.222)	(0.099)	(0.047)
Road density	0.101***	0.008	-0.019***
	(0.033)	(0.010)	(0.006)
# Firms	0.520***	-0.005	0.030*
	(0.044)	(0.014)	(0.017)
Observations	944	944	944
R-squared	0.452	0.522	0.167

1/ The outcome variable is aggregate TFP, the variance of firm-level TFPR and the median-mean TFPR defined by state, sector at the 3-digit level and year. The number of firms and road density are in logs. All columns include industry-year pair fixed effects. Standard errors clustered by state are in parentheses. The constant term is not reported. *** p<0.01, ** p<0.05, * p<0.1