Input Tariffs, Speed of Contract Enforcement, and the Productivity of Firms in India

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Abstract

This paper extends the literature on trade liberalization and firm productivity by examining the complementarities between the speed of contract enforcement and the productivity gains from input tariff liberalization. It does so by using firm-level panel data from India along with objective measures of judicial efficiency at the state level. The results strongly support the notion of complementarities between the speed of contract enforcement and input tariff liberalization. In particular, the paper finds that for a 10 percentage point decline in input tariffs, firms in the state at the 75th percentile of judicial efficiency gain an additional 3.5 percentage points in productivity when compared to firms in the state with the median level of judicial efficiency. The results also suggest that the complementarities are strongest for firms in institutionally dependent and imported capital-intensive industries. These findings are robust to the inclusion of other state controls such as state GDP per capita, distance of state capital to ports, measures of overall business environment, labor market flexibility, access to finance, and infrastructural quality. They are also robust to using a matching estimator to address the self-selection of firms in high judicial efficiency states and an IV approach to instrument input tariffs. Thus, the results indicate that rapid contract enforcement is necessary to maximize the productivity benefits from input tariff liberalization.

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1. Introduction

The effect of trade liberalization on firm productivity has been widely studied. For example, Harrison (1994), Krishna and Mitra (1998), Pavcnik (2002), Trefler (2004), and Topalova and Khandelwal (2011) suggest that output tariff liberalization has led to significant increases in firm productivity. In addition, work by Schor (2004) and Amiti and Konings (2007) find significant productivity gains from input tariff liberalization. However, the focus thus far in the literature has been on the average effect of tariff liberalization, and little attention has been paid to the differential effect of tariff liberalization based on the level of institutions faced by firms. This is problematic given the evidence that institutions, especially contract enforcement, have a strong impact on economic performance (Acemoglu, Antras, and Helpman, 2007; Cowan and Neut, 2007). [1]

This paper looks to address this gap in the literature by examining the interaction between the speed of contract enforcement and the productivity gains from input tariff liberalization using firm-level data from India. Central to such complementarities is the idea that firm productivity is increasing in the range of intermediate inputs used (Kasahara and Rodrigue, 2008; Halpern, Koren, and Szeidl, 2009). Thus, by lowering input tariffs, trade liberalization raises both the use of imported inputs as well as the productivity of the firms that use them. While the import of generic inputs is relatively straightforward, imported inputs that require relationship-specific transformations pose a greater degree of complexity. Recall that such inputs lead to a well known holdup problem in which the supplier under invests in the production of relationship-specific inputs as the buyer may back out at any moment. To avoid this, buyers and input sellers need to agree on a contract. Because such contracts are only credible if they can be properly enforced in a court of law, buyers in states with greater judicial inefficiency are at a disadvantage. Thus, while the liberalization of input tariffs increases the range of intermediate inputs

[1] Some papers, however, have looked at the interaction between input tariffs and labor market institutions in Indian states (Topalova and Khandelwal, 2011) as well as between output tariffs and state labor market rigidity **(**Aghion, Burgess, Redding, and Zilibotti, 2008). Neither of these papers looks at the effect of contract enforcement. See also Sharma (2008) for an interesting examination of the complementarities between trade liberalization and other concurrent reforms in India.

available to all firms, it is the firms in states with more efficient judiciaries that are better able to sign the contracts necessary to access these inputs.[2] As a result, it is these firms that see a higher productivity benefit from lower input tariffs.

A second contribution of this paper is the use of a time-varying and objective measure of the speed of contract enforcement. In particular, I use detailed data from the Indian National Crime Records Bureau's annual *Crime in India* report to construct several proxies for the speed of contract enforcement in each state. The main measure of the speed of contract enforcement is the fraction of cases in each state that is resolved within a year and is intended to capture the efficiency of the judiciary. By concentrating on cross state differences in judicial efficiency I am able to circumvent some of the common problems that arise when using cross country data on institutions.[3] In addition, I examine whether the complementarities between input tariffs and speed of contract enforcement vary by industry characteristics. These industry characteristics include the complexity of production (i.e. its institutional dependence) and whether or not it is imported capital intensive.

The methodology used to examine the complementarities mentioned above consists of first calculating total factor productivity (TFP) at the firm level. This is done by estimating production functions using the Levinsohn and Petrin (2003) approach. This approach allows me to correct for the simultaneity bias in the choice of inputs and thus provides more accurate estimates of firm-level TFP. Second, these TFP estimates are regressed on lagged input tariffs, speed of contract enforcement, and their interaction. The results point towards strong complementarities between judicial efficiency and input tariff liberalization. In particular, the paper finds that for a 10 percentage point decline in input tariffs, firms in the state at the 75th percentile of judicial efficiency experience a 5.8 percent increase in productivity. On the other hand, for a 10 percentage point decline in input tariffs, firms in the state at the median level of judicial efficiency experience a 2.3 percent increase in productivity. The results also suggest that the complementarities are strongest for firms in industries that are institutionally intensive

[2] While 'institutions' is a fairly nebulous term, in this paper I will use it to refer to the speed of contract enforcement.

[3] These problems include failure to capture the impact of history, geography etc.

(i.e. industries that require the use of more relationship-specific inputs) and imported capital intensive. These results are robust to using a matching estimator to address the self-selection of firms into states with high judicial efficiency and an IV approach to instrument input tariffs. In addition, the results are robust to the inclusion of other state controls such as state GDP per capita, distance of state capital to ports, access to finance, ranking of business environment, labor market flexibility, infrastructural quality, as well as state and time interaction effects.

This paper complements earlier work by Schor (2004), Amiti and Konings (2007), and Topalova and Khandelwal (2011). They use firm-level data to show that input tariff liberalization has a strong positive impact on firm productivity.[4] This result confirms the theoretical findings of Grossman and Helpman (1991), who show that trade liberalization raises productivity by increasing the range of inputs available. These papers, however, do not account for the speed of contract enforcement. Another strand of the literature includes Acemoglu et al. (2007) and Cowan and Neut (2007), who show that better contract enforcement increases productivity by allowing firms to gain access to relationship-specific inputs. They, however, do not examine the effect of input tariffs. Thus, the contribution of the paper is that it is able to combine the two strands of the literature and examine the complementarities between the productivity gains from input tariff liberalization and judicial efficiency.[5]

The remainder of the paper is structured as follows. Section 2.1 reviews the legal system in India and explains why it provides an ideal setting in which to examine the question posed in this paper. Section 2.2 describes the relevance of courts to import-oriented Indian firms and provides a simple explanation as to why the productivity enhancing effects of input tariff liberalization will be stronger for firms in states with more rapid contract enforcement. Section 3 describes the data used in this paper while

[4] Although it's worth pointing out that Muendler (2004) concludes that access to foreign inputs played, at best, a minor role in the increase in productivity among Brazilian firms after trade liberalization.

[5] The results of this paper also complement the findings of Acemoglu, Johnson, and Robinson (2005). They argue that the rise of Western Europe after 1500 was due to the combination of access to Atlantic trade and nonabsolutist monarchies at home. In other words, countries that had better initial political institutions (nonabsolutist monarchies such as Britain and the Netherlands) were the ones that gained the most from access to Atlantic trade. On the other hand, absolutist monarchies such as Spain and Portugal experienced weaker gains from Atlantic trade due to their weaker initial political institutions.

Section 4 discusses the empirical strategy. Section 5 presents the results and Section 6 describes various robustness and sensitivity tests conducted. Finally, Section 7 provides a conclusion.

2. Background

2.1 The Legal System in India

India has a three-tiered legal system: a Supreme Court at the federal level represents the apex of the hierarchy followed by High Courts in each state and finally lower-level courts at the local level. The President of India appoints judges to the Supreme Court and High Courts after consultation with the Chief Justice of India and the relevant State Governor (in the case of High Court Judges). The appointments are generally made based on seniority and not political preference. While state High Court appointments are made at the federal level, state governments control the administration of the state legal system (High Courts and local courts) and the Supreme Court has limited supervision over them. As a result, significant differences have emerged across states with regard to the speed and efficiency with which cases are disposed.

The rules and regulations at all three levels of the legal system are outlined by the Code of Civil Procedure, which is uniform across all states. However, while the underlying laws are the same, significant differences in the manner in which rules and procedures are implemented in each state have emerged over time (Kohling, 2000). This difference is mainly due to the common law system that is used in India. This system is less codified and provides High Court judges with greater degree of flexibility in how they interpret certain rules and procedures. Importantly, the interpretations of a High Court are binding for all lower level courts within that state. As a result, differences in High Court interpretations can lead to significant variation in the interpretation of rules and procedures over time.[6]

Thus, state courts in India vary along two dimensions: (a) differences in the interpretation of rules and procedures, and (b) differences in efficiency due to state courts being under the administrative control

[6] The reconciliation of these differences requires either an amendment to the Code of Civil Procedure or a Supreme Court verdict.

of state governments. This paper is interested in the impact of the latter on the performance of firms after trade liberalization. However, data on the speed of courts will conflate the role of both dimensions. In other words, if the data suggest that State A has speedier courts than State B, it could mean that State A has more efficient courts or that State A has inefficient courts but that their rules and procedures are less onerous. Thus, the ideal scenario would be one where the interpretation of rules and procedures were harmonized across Indian states such that any difference in the speed of state courts were purely due to differences in efficiency. Fortunately the 2002 Amendment Act to the Civil Procedure Code of 1908 enacted by the Indian Parliament moved us closer to the ideal scenario. According to Chemin (2009), this judicial reform Act placed various effective restrictions on judicial discretion, frivolous litigation, and adjournments. While the 89 amendments in the Act were intended to improve the efficiency of court across India, a large number of these amendments had already been enacted by various state governments. As a result, the 2002 Amendment Act had the effect of partly harmonizing the interpretation of rules and procedures across state courts in India. Thus, after 2002, differences in the speed of courts across India were more likely to be as a result of differences in efficiency and not differences in the interpretation of rules and procedures. As a result, in this paper I will focus on the complementarities between the speed of contract enforcement and the productivity gains from input tariff liberalization in the period after 2002.

2.2 The Implications of the Legal System for Indian Firms

Before examining the manner in which judicial efficiency affects the productivity gains from input tariff liberalization, it is instructive to first ask how relevant courts are for Indian firms engaged in import of relationship-specific intermediate inputs. While the primary firm-level data used in this paper do not ask firms to report on the relationship-specificity of its inputs or how it resolves disputes, we can get a sense of the importance of these factors using the 2005 Indian Enterprise Surveys conducted by the World Bank.[7] In Table 1 I tabulate firm responses to questions regarding the number of suppliers used, the complexity of inputs used, as well as the manner in which disputes are resolved. To ensure that the

[7] Note that while the surveys were conducted in 2005, firms were generally asked to report data from 2004.

comparisons are appropriate I dropped all non-manufacturing firms from the Enterprise Surveys sample before constructing Table 1. The data in the first two rows suggest that about 44.7% of firms use more than five suppliers for its primary input and 58.4% of firms purchased inputs that were relationship specific. Importantly, among importers, 51% used more than five suppliers and 77% purchased relationship-specific inputs. This is fairly strong suggestive evidence that importers use more complex intermediate inputs and deal with a greater number of suppliers.

The fact that importers are more likely to use relationship-specific inputs does not necessarily imply that the efficiency of courts is particularly relevant for them. It may be the case that importers bypass the judiciary and rely disproportionately on alternate dispute settlement mechanisms and thus the courts may not be a binding constraint to these firms in India. To address this I next examine the extent to which manufacturing firms in the 2005 Enterprise Surveys use courts to settle disputes and the extent to which they consider the legal system to be a constraint. The data in Table 1 suggest that 22.5% of firms report the legal system as an obstacle to doing business. Among importers this number is 25.7%. Thus, while courts may not be the most important constraint to doing business, its impact on firms in India is not trivial. Next, the data suggest that 12.5% of Indian firms have been involved in court cases over the past three years. Among importers this number is 24.5% while among non-importers it is 10.5%. Thus, importers are much more likely to be involved in court cases when compared to non-importers. Finally, in Table 1 I also examine the way in which these firms settle disputes. Approximately 69.4% of firms use other methods, primarily direct negotiations, to resolve disputes over overdue payments while about 7.4% of firms use courts to resolve such disputes. Thus, while direct negotiations are the most popular form of dispute settlement, a considerable fraction of firms do rely on courts. In fact, among importers, 14.1% of firms use courts to settle disputes.

Data on the percentage of firms that use the legal system to resolve disputes is likely to underestimate the importance of courts (Johnson, McMillan, and Woodruff, 2002). A good legal system can act as an ‘arbiter of last resort’ in the sense that firms know that were direct negotiations to break

down they could always pursue their dispute through the courts. To see this more clearly, consider a scenario where an Indian firm (ABC Inc.) refuses to pay the stipulated amount for an imported input. The victim, a foreign input supplier, initiates direct negotiations with ABC Inc. in the hopes of recovering the overdue payment. Suppose for simplicity that ABC Inc. is obviously the guilty party and that were the case ever brought before the courts it would be found guilty. ABC Inc. knows that if the direct negotiations break down its expected punishment would depend on the efficiency of the judiciary in its state. In particular, if the judiciary is inefficient then the likelihood of being punished is low. Under these circumstances ABC Inc. would have a greater incentive to terminate the direct negotiations. [8]

The discussion above implies that a good legal system facilitates alternate dispute settlement mechanisms by giving agents confidence that they have an adequate back-up option should these alternate mechanisms fail. Without adequate courts a larger fraction of these disputes may remain unresolved. Thus, courts can have both direct and indirect effects on dispute settlement, which implies that data on the percentage of firms that use the legal system to resolve disputes underestimates the true importance of courts for Indian importing firms.

While courts are important for importing firms in India, it is not immediately clear why they should affect the productivity gains from input tariff liberalization. While there is considerable evidence that input tariff liberalization raises firm productivity (Schor 2004; Amiti and Konings, 2007; Topalova and Khandelwal, 2011), little is known about whether this affect depends on the level of judicial efficiency in a particular region. Before examining these complementarities it is useful to first examine the impact of lower input tariffs on the use of imported inputs. In theory, lower input tariffs can alter the input use of domestic firms in two ways: (a) by allowing them to use newer varieties of inputs from abroad, and (b) by lowering the price of existing imported inputs and thereby allowing a wider number of

[8] Of course, even if the legal system is inefficient, ABC Inc. may engage in direct negotiations to avoid the reputational cost of reneging on contracts. Thus, the probability of a breakdown in direct negotiations will be small even with inefficient courts. While this may be true, the point here is that this probability of breakdown, even if it is small on average, will be higher in states with inefficient judiciaries as there is a lower likelihood of future punishment from the courts.

domestic firms to use imported inputs. The primacy of the former channel depends on both the substitutability between domestic and imported inputs as well as the substitutability between different varieties of imported inputs. If, for example, new imported varieties are perfect substitutes for domestic and existing imported varieties, then input tariff liberalization will have no effect on the extensive margin. If, on the other hand, new imported varieties are weak substitutes for existing varieties then input tariff liberalization will have large effects on the import of new input varieties. Thus, the question of which of the two channels discussed above is dominant is an empirical one. While the data used in this paper is not rich enough to examine the importance of each channel, this issue has been addressed by Goldberg, Khandelwal, Pavcnik, and Topalova (2010). They use product-level import data from India to examine the impact of trade reform in India on both the intensive and extensive margins of import as well as on the product scope of a panel of Indian firms. They find that increases in intermediate input variety represent 66% of the overall growth in intermediate imports over their sample period. The remaining 34% comprises of changes in the import of existing varieties. They also show that this increase in the extensive margin is due to the lower tariffs brought on by the trade reforms.[9]

The Goldberg et al. (2010) results suggest that the varieties of imported intermediate inputs available to domestic firms in India increased rapidly after the 1991 trade reforms. While this allows the average domestic firm to become more productive, not all firms will be equally able to utilize these imported inputs. This is particularly true if we assume that each variety of intermediate input is relationship specific. The presence of such inputs creates a well known holdup problem, where input suppliers have an incentive to under invest in the production of such inputs as the buyer can back out at any moment. One way to overcome this holdup problem is to use a contract that explicitly commits the buyer to a particular input supplier. From the perspective of the input supplier there is greater risk associated with contracts where the buyer is located in a state with an inefficient judiciary. This is because if the legal resolution of disputes takes too long, it may not be worthwhile for the input supplier to pursue the matter in court. Thus, the unpaid amount is effectively lost to the input supplier. This implies that, all

[9] See Klenow and Rodriguez-Clare (1997) for more evidence that trade liberalization increases import variety.

else equal, Indian firms in states with more efficient judiciaries will be better able to form relationships with foreign input suppliers.[10] As a result, it is these firms that will use a wider range of imported intermediate inputs after trade liberalization. Given that firm productivity is increasing in the number of intermediate inputs used (Grossman and Helpman, 1991), the discussion above yields the following hypothesis:

Hypothesis: *the positive effect of lower input tariffs on productivity is strengthened for firms in states with more efficient judiciaries.*

3. Data

3.1 Data on Speed of Contract Enforcement

The data used to construct the efficiency of the judiciary are collected from the Indian National Crime Records Bureau's *Crime in India* report. This is an annual publication of the Ministry of Home Affairs that details the trends and patterns in crime throughout India. The report provides detailed information on the duration of all cases brought before the lower-level courts in each state in any given year. This information was used to calculate the fraction of cases that were resolved within a year. This is the main measure of judicial efficiency used in the paper and is intended to capture the speed of courts in each state. As mentioned earlier, this measure has the advantage of being an objective measure of judicial efficiency. [11] Nonetheless, to check the robustness of my results, I use several alternate measures. The

[10] An alternate scenario is one where a domestic Indian firm negotiates with a domestic bank to obtain a loan to purchase imported inputs. In such a scenario, the foreign supplier is likely to be paid in full before any shipments are made. Even in this alternate setting firms in states with more efficient judiciaries will be at an advantage as, with all else equal, they will be more likely to obtain bank financing to purchase imported inputs. Thus, these firms will see larger productivity gains from input tariff liberalization.

[11] The focus of *Crime in India* is on criminal cases. Thus, it is reasonable to wonder whether these data are reflective of the inefficiency of the civil court system, which is the system that is relevant for this application. To address this issue I use 1997 case backlog data from Singh (2003) to calculate the number of civil and criminal pending cases per 1,000 citizens in each state in India. The correlation coefficient between these two measures is 0.54. This gives me confidence that the *Crime in India* data on criminal cases is a reasonable reflection of the inefficiency of the civil court system. In fact, given that there were approximately 7 pending civil cases per pending criminal case in India in 1997, the *Crime in India* data is likely to underestimate the inefficiency of civil courts. Furthermore, when using these data on pending civil cases as a measure of judicial efficiency I obtain results that are qualitatively similar to

first alternate measure is defined as the fraction of cases in each state that is pending during any given year and has been used previously by Chemin (2009). A second subjective measure of judicial quality captures the confidence in each state's judiciary. This is based on firm-level data from the 2005 Enterprise Surveys conducted by the World Bank. Firm managers that took part in the survey were asked the extent to which they agree with the following statement: "I am confident that the judicial system will enforce my contractual and property rights in business disputes." Responses were on a scale of one to six with six indicating full confidence in the judiciary. The firm-level responses were aggregated to the state level. Note that following the common approach in the literature (see, for example, Hasan, Mitra, and Ramaswamy, 2007) I restrict the sample to the 16 major states in India. This is particularly important in this application as a large number of the smaller, excluded states have been plagued by insurgency movements that are likely to skew the filing and resolution of court cases. In addition, the data from these conflict-ridden states are unlikely to be comparable with the data from larger and more stable states.[12]

Table 2 lists the two objective measures of the speed of contract enforcement used in the paper along with the subjective measure of confidence in the state judiciary. Column (1) suggests that, on average, 26% of cases are resolved within a year in India. This measure of the speed of courts has a high range with only 4% of cases being resolved within a year in Uttar Pradesh and 49% being resolved within a year in Tamil Nadu. Column (2) indicates that about 81% of all cases in India are pending resolution. This variable ranges from 59% in Tamil Nadu to 93% in Gujarat and West Bengal. [13] Finally, column (3) suggests that, on average, firms respond with a score of four when asked to judge their confidence in the state judiciary. A score of four implies that firms "tend to agree" with the statement, "I am confident that the judicial system will enforce my contractual and property rights in business disputes." This variable

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my primary findings. However, as these data are only available for 1997, i.e. six years prior to the period examined in this paper, I do not treat it symmetrically as the other alternate measures of judicial efficiency.

[12] In column (7) of Table 12 I add these excluded states to the sample. The results are very similar to the baseline.

[13] Note that in subsequent tables pendency ratio is changed to one minus pendency ratio to ensure that a higher number indicates more rapid contract enforcement.

ranges from 4.55 for Punjab to 3.33 for Gujarat. One could argue that this latter variable ought to be treated symmetrically with my objective measure of judicial efficiency. However, while this measure is positively correlated with the primary measure of judicial efficiency used in the paper, it does not have much cross-state variation. Table 2 indicates that the coefficient of variation for this subjective measure is only 0.08. Not surprisingly, when this subjective measure is used as the proxy for judicial efficiency in column (6) of Table 11 the coefficient of interest retains the correct sign but is not precisely estimated.[14]

While the use of objective measures of judicial efficiency is a clear advantage, the measures themselves are susceptible to their own biases. For example, it can be argued that firms in states with slow courts may refrain from pursuing a contractual dispute through the judicial system. In such a situation, the speed of the court system will be overstated. While it is difficult to conclusively disprove such an assertion, the evidence suggests that my measures of judicial efficiency are in fact accurate. For example, Table 3 lists the pair-wise correlation between the measures of judicial efficiency used in this paper and other proxies for institutional quality. Not surprisingly, the two objective measures used in the paper are highly correlated with each other and with a third measure defined as the ratio of total cases pending at the beginning of the year divided by the number of cases disposed of in a given year. This is a proxy for the time taken to clear the backlog of cases in each state and is similar to the measure used by Kohling (2000). More importantly, the primary measure of the speed of courts (i.e. the fraction of cases resolved within a year) is also positively correlated with a ranking of business environment in each state (Iarossi, 2009) as well as with the subjective measure of the confidence in each state's judiciary. The positive correlation between my main measure of judicial efficiency and other proxies for institutional quality and efficiency suggest that the former is an accurate proxy of the contracting environment faced by firms in my sample.

[14] Moreover, Olken (2009) highlights the general limitations of using subjective perceptions in place of more objective measures. He compares the actual corruption in road building projects in Indonesia with the perception of corruption among locals and finds a very small positive correlation between them. To the extent that his results are relevant for this application, it calls into question the efficacy of using subjective data on judicial efficiency in place of objective measures.

3.2 Firm Data

The firm-level data used in this paper are from the Prowess database collected by the Center for Monitoring the Indian Economy (CMIE) and has been previously used by Goldberg et al. (2010) and Topalova and Khandelwal (2011). This database consists of all firms traded on India's major stock exchanges as well as other public sector enterprises. Information in the database is collected from the income statements and balance sheets of these firms. Together the firms in the sample comprise 60 to 70 percent of output in the organized industrial sector and 75 percent of all corporate taxes paid in India (Goldberg et al., 2010). The key strength of Prowess is that it provides data on a panel of firms in a developing country over an extended period of time. However, since the database consists of publicly traded firms, the data are not representative of small and informal Indian firms. For this analysis I restrict my attention to the 56 three-digit manufacturing industries available in my sample. Data on output, material costs, and wage bill are deflated using industry-level wholesale price indices (WPI) with 1993 as the base year. Data on capital is deflated using an investment deflator, which is constructed by taking the average of the WPI for the "manufacture of general purpose machinery" and the "manufacture of special purpose machinery" industries respectively. The industry deflator is also constructed with 1993 as the base year.

3.3 Import Tariff Data

Data on output tariffs are at the three digit National Industrial Classification (NIC) level and are an extension of the series used by Hasan et al. (2007). The following procedure was used to convert the output tariffs data into input tariffs. First, the 2003-2004 Indian input-output (IO) table was used to generate an input-output share matrix. The original IO table consists of 130 sectors of which 68 belong to manufacturing. These sectors were reclassified into three-digit NIC industries.[15] A typical cell ij within

[15] The concordance used for this classification is available upon request.

this matrix lists the share of inputs in industry i that come from industry j. These shares were then multiplied by output tariffs using the following formula:

$$input\ tariff_i = \sum_j s_{ij} * output\ tariff_j$$

The weight s_{ij} represents the share mentioned above. To illustrate, if industry i uses 80% wool and 20% cotton in its production, its input tariff will give a weight of 80% to the output tariff on wool and 20% to the output tariff on cotton.[16] As Table 4 demonstrates, there is significant variation in input tariffs across industries. In particular, input tariffs vary from a maximum of 68.9% in the beverage manufacturing industry to a minimum of 18.5% in the Printing industry. Input tariffs also fell from an average of 30.9% in 2003 to 25.6% in 2004.

As mentioned in Section 2.1, I will restrict the focus of the paper to the period after the enactment of the 2002 Amendment Act. Recall that this act harmonized some of the differences in rules and procedures across state courts in India. As a result, the data on the speed of contract enforcement after 2002 are more likely to reflect actual differences in judicial efficiency and not differences in the interpretation of rules and procedures. While the firm-level and judicial efficiency data are available for the period 2003-2007, the tariff data are only available until 2003. Given the use of lagged tariff measures in the estimating equation, the final sample consists of the years 2003-2004 and includes 3,597 firms with a total of 6,331 observations. Summary statistics for all variables used are listed in Table 5. The typical firm in the sample has sales of about Rs. 172.3 crores (1 crore = 10 million; this amount translates to US $35.2 million)[17] and is 25.2 years old. Approximately 65% of firms import raw materials from abroad, 7% of firms are foreign owned and 2% are owned by the state.

[16] Firms in industries without three-digit input tariffs were assigned the corresponding input tariff at the two-digit level.

[17] This conversion uses an exchange rate of Rs. 49 to the US dollar.

4. Estimation Strategy

To test the hypothesis that the productivity gains from input tariff liberalization are higher for firms in states with more rapid contract enforcement I will employ a two-stage approach. Variants of this approach has been used previously by Pavcnik (2002), Fernandes (2007), Amiti and Konings (2007), and Topalova and Khandelwal (2011). In the first stage, I will calculate total factor productivity (TFP) at the firm level. In the second stage, I will regress firm-level TFP on measures of trade policy, judicial efficiency, and their interaction.

4.1 Productivity

Consider a standard Cobb-Douglas production function,

$$Y_{it} = A_{it} L_{it}^{\beta_l} K_{it}^{\beta_k} Q_{it}^{\beta_q} \tag{1}$$

where Y represents output for firm i at time t, A is productivity, L is labor, K measures capital, and Q is raw materials. Taking the natural logarithm of the above equation and rearranging yields:

$$va_{it} = \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \epsilon_{it} \tag{2}$$

where lower caps indicate that the variables are expressed in natural logarithm. $va_{it} = y_{it} - \beta_q q_{it}$ represents the natural logarithm of value added. ω_{it} represents firm-level TFP and is unobservable to the econometrician while ϵ_{it} is a classical error term. Using OLS to estimate equation (2) will lead to biased coefficients since the input choice for each firm will be correlated with its productivity level. For example, if more productive firms are also the ones that are more capital intensive, then OLS on (2) will lead to a downward bias on β_k and an upward bias on β_l. On the other hand, a standard fixed effects estimator will ignore time-varying shocks to productivity. As a result, to obtain consistent estimates of the input coefficients in equation (2) I will use the Levinsohn and Petrin (2003) methodology. This approach uses intermediate inputs to proxy the unobservable productivity variable, ω_{it}, which then yields

consistent estimates for β_l and β_k. I will use this procedure to estimate the production function separately for each two-digit industry.[18]

Next, I use the production function estimates obtained from the Levinsohn and Petrin (2003) methodology to calculate the natural logarithm of TFP for each firm using the following:

$$tfp_{it} = va_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} \tag{3}$$

The actual estimated coefficients $(\hat{\beta}_l, \hat{\beta}_k)$ are listed in Table 6 along with production function estimates obtained from using OLS on equation (2). As expected, on average, OLS overestimates the coefficients for labor and underestimates the coefficient for capital.

4.2 The Role of Trade Policy and Judicial Efficiency

To examine the effect of trade policy and the speed of contract enforcement on productivity I use the TFP measure from equation (3) to estimate the following equation:

$$tfp_{ijst} = \alpha + \beta_1 Input\ Tariff_{jt-1} + \beta_2 Judicial\ Efficiency_{st} + \beta_3 Input\ Tariff_{jt-1} * Judicial\ Efficiency_{st} + \beta_4 X_{ijst} + \theta_t + \theta_s + \theta_j + \varepsilon_{ijst} \tag{4}$$

where i denotes firm, j denotes industry, s denotes state and t denotes time. $Input\ Tariff_{jt-1}$ measures the tariff placed on inputs used by firms in a particular industry and is lagged by one period. $Judicial\ Efficiency_{st}$ is measured by the fraction of cases that are resolved within a year in state s. In further robustness checks I will also use the ratio of pending cases to all cases in a state as well as a subjective measure of judicial quality that captures the confidence in each state's judiciary. β_3 captures the complementarities between contract enforcement and input tariff liberalization and is the main coefficient of interest. Based on the discussion in Section 2.2, I expect this coefficient to be negative.

[18] Due to a lack of data the estimation technique does not run for all three digit industries.

X_{ijst} includes other firm controls such as indicators for large and medium firms[19], the natural logarithm of age and age squared, and indicators for foreign and government ownership. These variables will capture the fact that larger, older, and foreign owned firms tend to be more productive. Finally, θ_j, θ_s, and θ_t are three-digit industry, state, and time effects while ε_{ijst} is a classical error term.

4.2.1 Endogeneity of Judicial Efficiency

A concern with the estimation strategy used in this paper is the potential endogeneity of judicial efficiency. For example, it may be the case that both firm TFP and a state's judicial efficiency are correlated with the economic and political conditions of a state. While the inclusion of state fixed effects in the baseline specification will control for time-invariant state characteristics, it will not control for time-varying unobservables. I address this issue by sequentially adding a number of alternate state characteristics and its interaction with input tariffs to my baseline specification. I also add state and time interaction effects to my baseline specification to examine whether my main results are robust to controlling for time-varying, unobservable state characteristics.

A related issue is the potential for the results in this paper to be contaminated by self-selection of firms in states with more efficient judiciaries. For example, if high productivity firms locate in states with more efficient judiciaries and these firms also receive more rapid declines in input tariffs (through effective lobbying), then the results in this paper will simply reflect this spurious correlation.[20] There are two mitigating factors for this. First, by comparing the TFP of firms in states with judicial efficiency above the sample median (high judicial efficiency) with the TFP of firms in remaining states (low judicial efficiency), I find no evidence to suggest that high TFP firms locate in high judicial efficiency states. Furthermore, when comparing the distribution of industries across states, I also do not observe any

[19] These firm size indicators were calculated as follows. First, I used the sales data (deflated by the wholesale price index) for the entire sample period (2003-2004) to calculate the 33rd and 67th percentile of the sales distribution. I then classified a firm as large if its annual sales were above the 67th percentile. Similarly, I classified a firm as small if its annual sales were below the 33rd percentile. Both of these indicators are time varying.

[20] I thank an anonymous referee for raising this issue and offering potential solutions.

evidence of systematic agglomeration in the data. Such systematic agglomeration (i.e. if industries that were disproportionately liberalized or protected were located in a handful of states) would raise serious concerns about the identification strategy used in this paper. Fortunately, the three-digit industries included in the sample are fairly well spread out across the various states. Thus, the potential selection of high TFP firms in high judicial efficiency states that also experience higher declines in input tariffs is an unlikely explanation for the results documented in this paper.

Nonetheless, to further address these concerns I use a matching estimator to construct a control group of firms in states with low judicial efficiency that have firm characteristics similar to that of firms in states with high judicial efficiency. By matching firms in this manner I attenuate any bias that may arise due to systematic observable differences between firms in states with high judicial efficiency and firms in states with low judicial efficiency.

To match firms in high and low judicial efficiency states I use propensity score matching (Rosenbaum and Rubin, 1983). To implement this I first calculate the sample median for the fraction of cases resolved within a year for the period 2003-2004. I then use each state's average value of the fraction of cases resolved within a year (averaged over the period 2003-2004) to classify it as having high or low judicial efficiency. In particular, if a state's average fraction of cases resolved within a year is equal to or greater than the sample median, it is classified as having high judicial efficiency. If the state's fraction of cases resolved within a year is below the sample median it is classified as having low judicial efficiency. Using this information I next construct an indicator variable JE_i that is one if firm i is in a state at or above the sample median judicial efficiency and zero otherwise.[21] This indicator variable is then used to construct propensity scores by estimating the following probit model:

$$P_i = Pr\{JE_i = 1 | X_{it-1}, tfp_{t-1}\} = \Phi(\gamma_1 X_{it-1} + \gamma_2 tfp_{t-1}) \quad (5)$$

[21] Since JE_i is time invariant I convert my sample to a cross section by keeping one observation per firm. This cross-sectionalized data is only used for estimating the propensity scores and matching firms in high judicial efficiency states with its nearest neighbor among firms in low judicial efficiency states.

where Φ(•) is the normal cumulative distribution function, X_{it-1} are the control variables listed in equation (4) lagged by one year, and tfp_{t-1} is the natural logarithm of TFP also lagged by one year. Thus, firms are matched based on their lagged large and medium size indicators, lagged age and age squared (both in natural logarithm), lagged foreign and government ownership indicators, and lagged natural logarithm of TFP. Using the estimated propensity scores, $\widehat{P_i}$, I match each firm in a state with high judicial efficiency (treatment) with its nearest neighbor among firms in states with low judicial efficiency (control). In other words, for each matched pair I minimize $|\widehat{P_{i,H}} - \widehat{P_{i,L}}|$, where $\widehat{P_{i,H}}$ and $\widehat{P_{i,L}}$ are the estimated propensity scores of a firm in a state with high judicial efficiency and its nearest neighbor in a state with low judicial efficiency respectively.[22] This process matches 1,382 treatment firms with 736 control firms. [23,24]

The balancing exercise above produces a sample of firms that are similar based on a set of observable controls. Of course, this procedure does not address selection bias due to unobservables. With this matched sample in hand I next estimate the following econometric specification:

$$tfp_{ijst} = \alpha^M + \beta_1{}^M Input\ Tariff_{jt-1} + \beta_2{}^M Input\ Tariff_{jt-1} * Treatment_{\ i} + \theta_t{}^M + \theta_s{}^M + \theta_j{}^M + \varepsilon_{ijst}{}^M \quad (6)$$

where $Treatment_{\ i}$ is one for firm i if it is in a state at or above the sample median for judicial efficiency and is zero if firm i is in a state with below median judicial efficiency and is the nearest neighbor for a

[22] To reduce the bias in the matched sample I remove treatment firms with propensity scores above the maximum propensity score of the control sample. I also remove treatment firms with propensity scores below the minimum propensity score of the control sample.

[23] To further reduce the bias of the matched sample I conduct the matching process with replacement. In other words, after a control firm has been matched to a treatment firm it is returned to the sample so that it can be matched to another treatment firm, if necessary. While this reduces the efficiency of the second-stage estimates by lowering the sample size of the control group, it ensures that the control group is a better match to the firms in the treatment group.

[24] I check the usefulness of the matching process by comparing the sample means of the control variables used in equation (5) for the unmated and matched sample. For all control variables the percentage of bias is significantly reduced. In fact, in the matched sample, there is no statistically significant difference between the mean of the control variables across the treatment and control groups.

firm in a high judicial efficiency state. Note that $Treatment_i$ is time invariant and thus its level effect is captured by the state fixed effects. Lastly, as $Treatment_i$ is a function of the propensity score estimated in equation (5) I report bootstrapped standard errors (100 repetitions) for the estimates in equation (6).

4.2.2 Endogeneity of Trade Policy

A second concern with the estimation strategy in this paper is that the input tariffs in (4) may themselves be endogenous. There are several sources of endogeneity. First**,** Karacaovali (2011) uses firm-level data from Colombia to demonstrate that governments target protection towards more productive industries. An alternative story is that governments use trade policy to protect lagging sectors. In either instance the overall effect of tariffs is likely to be biased. Second, in the case of input tariffs, industries may lobby the government for lower tariffs in upstream industries as this will lower their effective rate of protection. Finally, Topalova and Khandelwal (2011) argue that while the Indian trade reforms of 1991 were externally pressured and could be considered exogenous, the same cannot be said of tariffs after 1997. They argue that the external pressure applied by the IMF in 1991 had abated by this time, and that the issue of potential endogeneity of tariffs to political economy factors became more pronounced.

I address concerns about the endogeneity of tariffs in three ways. First, I examine whether past industry characteristics including productivity predict current tariffs. To do so, I calculate the average industry-level TFP for each three-digit industry in the sample. These averages are weighted by the share of each firm's sales in its industry. This was done for each industry-time pair in the sample. I then regressed my measure of input tariffs on lagged industry-level TFP, year effects, and industry effects. The results do not support the notion that current input tariffs are systematically related to past productivity in a particular industry. I next replaced industry TFP with the 5-year growth in industry TFP. The results suggest that current tariffs are also not related to recent growth in an industry's TFP. Lastly, I also regressed input tariffs sequentially on one-year lagged industry-level capital intensity, skill intensity, output per plant (concentration), average wage, share of production workers, total wages, and finally total

output respectively.[25] In all cases there was no statistically significant relationship between the lagged industry-level characteristic and input tariffs. Second, I include industry and time interaction effects to my baseline specification. These interaction effects will control for unobservable, time-varying industry characteristics that are potentially correlated with both input tariffs and firm TFP.

Lastly, I employ an instrumental variable (IV) approach adapted from Goldberg and Pavcnik (2005) to address the potential endogeneity of tariffs. In particular, I first convert my baseline econometric specification to first-differences and then use 1997 input tariffs to instrument the first-differenced tariff term. I use an interaction between 1997 input tariffs and judicial efficiency to instrument the first-differenced interaction between input tariffs and judicial efficiency. The validity of the IV strategy rests on two key assumptions. First, I assume that 1997 input tariffs are correlated with current changes in input tariffs. This is ensured by the fact that one of the goals of the 1991 Indian trade reforms was to harmonize tariffs across industries. Thus, input tariffs at any given point in time are likely to be correlated with future changes in input tariffs. Second, I assume that 1997 input tariffs are uncorrelated with current changes in the error term. Given that 1997 input tariffs are likely to be far removed from current changes in error term this does not appear to be an unrealistic assumption. A concern with this IV strategy is that the choice of 1997 input tariffs as the instrument is somewhat arbitrary. This instrument was selected for the following reason. Prior to the time-period examined in this paper (2003-2004), the Indian government revised its tariff policy on two main occasions: the Ninth Plan (1997) and the Tenth Plan (2002). Given that the proximity of the latter to the period considered in the paper, 2002 input tariffs are less likely to satisfy the exclusion restriction. This leaves 1997 input tariffs as a reasonable instrument to use in this case. Note that the results are qualitatively robust to employing a variant of the Trefler (2004) approach and using 1997 data on the number of workers in an industry and average industry wages as instruments.

[25] These industry-level characteristics are calculated from the Annual Survey of Industries (ASI). Note that these regressions also include industry and year effects.

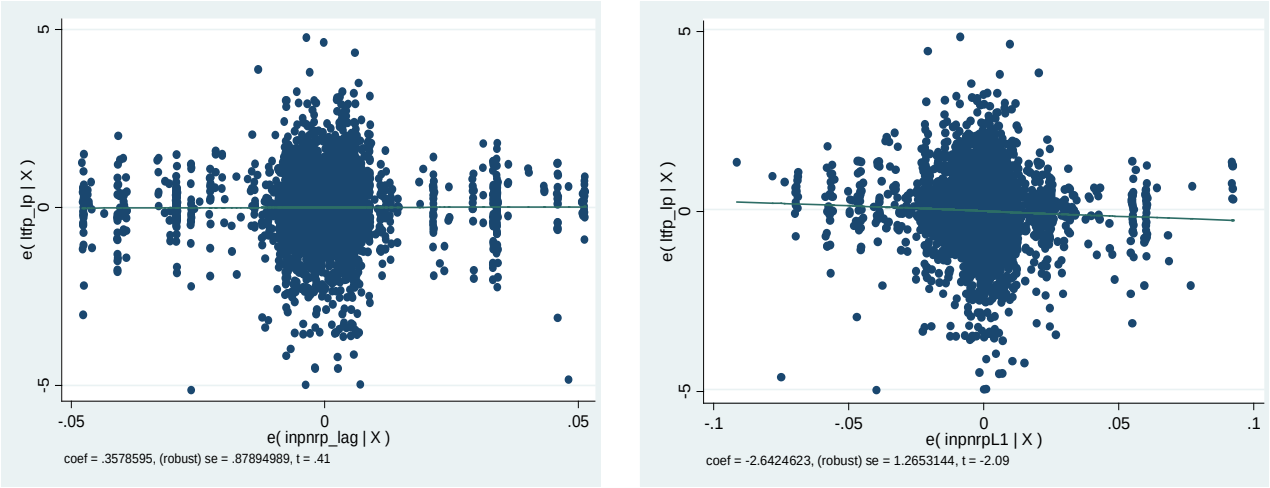
5. Results

Recall that the discussion in Section 2.2 yielded the following hypothesis: the productivity gains from input tariff liberalization are strengthened for firms in states with more rapid contract enforcement. This section tests the above hypothesis using an unbalanced panel with three-digit industry, state, and year effects and with robust standard errors clustered at the industry-state level.

5.1 Basic Results

In column (1) of Table 7 I examine the overall relationship between total factor productivity (TFP) and input tariffs. The negative coefficient indicates that lower input tariffs lead to higher firm-level productivity, although the result is not statistically significant. In column (2) I add the measure of judicial efficiency along with its interaction with input tariffs. Recall that in this case judicial efficiency is proxied by the fraction of cases that are resolved within a year in each state. The coefficient for the interaction term is negative and significant, which suggests that the beneficial effect of input tariff liberalization is strengthened for firms in states with more rapid contract enforcement. The point estimates suggest that, for a 10 percentage point decline in input tariffs, firms in the state at the 75th percentile of judicial efficiency experience a 5.8 percent increase in productivity. On the other hand, for a 10 percentage point decline in input tariffs, firms in the state at the median level of judicial efficiency experience a 2.3 percent increase in productivity.[26] In Figure 1 I report the partial regression plots for both input tariffs and its interaction with judicial efficiency. Neither result appears to be driven by outliers. I confirm this in Section 6 where I show that the main results of this paper are robust to dropping outliers and influential observations.

[26] The coefficients of input tariffs and the interaction term indicates that firms in states where the percentage of cases resolved within a year is below 13.5 see a decrease in productivity after trade liberalization. While this result contradicts the discussion in Section 2.2 it is important to keep in mind that only three states (Bihar, Jharkhand, and Uttar Pradesh) fall into this category. The firms in these states represent only 3.8% of firms in the sample. Thus, due to the small number of observations, the true impact of input tariff liberalization on TFP for firms below the threshold is difficult to estimate accurately.



(a) Input Tariffs (b) Input Tariffs * Judicial Efficiency

Figure 1: Partial regression plot of (a) Input Tariffs and (b) Input Tariffs * Judicial Efficiency.

In columns (3) - (5) I test the robustness of the above result by including other industrial characteristics such as capital intensity, skill intensity, and the degree of production concentration and allowing the effect of judicial efficiency to vary along these additional dimensions. The inclusion of these additional variables addresses the fact that the productivity of Indian firms may be correlated with factors that drive India's patterns of comparative advantage. In column (3) of Table 7 I add each industry's capital intensity and its interaction with judicial efficiency. Capital intensity is defined as one minus the ratio of wage bill to value added and is constructed using industry-level data from the Annual Survey of Industries (ASI). As the results demonstrate, the inclusion of this additional control does not significantly alter the coefficient of interest.[27] In column (4) I add each industry's skill intensity and its interaction with judicial efficiency. Skill intensity is defined as the ratio of non-production workers to all workers in an industry and is constructed using industry-level data from the ASI. Once again, the coefficient of interest remains robust. Next, in column (5) I add each industry's concentration ratio and its interaction with judicial efficiency. Concentration ratio is defined as the natural logarithm of output per plant in the

[27] Note that all of the additional industry characteristics used here are time invariant. Thus, their level effects are wiped out by the industry fixed effects.

industry and is also constructed using industry-level data from the ASI. The inclusion of this additional control has minimal effects on the coefficient of interest.

Lastly, in column (6) I include industry and time interaction effects to my baseline specification. These interaction effects control for unobservable, time-varying industry characteristics that are potentially correlated with both input tariffs and firm TFP. As the results demonstrate, the inclusion of these interaction effects does not significantly alter the baseline specification. Note that in column (6) I have omitted the level effect of input tariffs due to its collinearity with the industry and time interaction effects.

5.2 Industry Characteristics

If differences in the speed of contract enforcement are really driving the results demonstrated thus far we should observe that the complementarities effect is stronger for firms in industries that are institutionally dependent. As is the case in the literature I will define institutional dependence as the complexity of the production process in an industry. That is, if certain industries require a greater number of relationship-specific inputs, then firms in these industries are more likely to be dependent on the speed of contract enforcement. In columns (1) and (2) in Table 8 I distinguish between firms in complex and non-complex industries. Complexity of production is defined as the fraction of an industry's intermediate inputs that require relationship-specific investments. These data, which were originally constructed for US industries, are from Nunn (2007). They were concorded to Indian industries under the assumption that the complexity of production in a particular US industry is an accurate proxy of the complexity of production in the equivalent Indian industry. I classified any industry above the sample median as complex, while the remaining industries were classified as having a simpler production process. The results suggest that the complementarities between input tariff liberalization and judicial efficiency accrue only in complex industries, i.e. those industries that rely more on relationship-specific inputs.

Given that the Nunn measure was calculated for US industries, it may not be an accurate reflection of production complexity in the equivalent Indian industry. To account for this I next classify the complexity of industries using Indian data. In particular, I utilize firm-level input use data from the Prowess database to construct an industry-level Herfindahl index of input use.[28] The correlation between this measure and the Nunn measure is 0.58. Note that slightly less than a half of the firms in the sample report data on their input use. Thus, the complexity classification based on the Prowess data is intended to be no more than a check on the validity of the results in columns (1) and (2). Using the industry-level Herfindahl index, I classified any industry below the sample median as having a complex production process, and industries above the sample median as having a simpler production process. The results in columns (3) and (4) of Table 8 confirm that the complementarities between input tariff liberalization and judicial efficiency occur only in complex industries.

The discussion in Section 2.2 indicates that the complementarities between judicial efficiency and the productivity gains from input tariff liberalization are likely to be strongest for firms in complex industries that *also* import relationship-specific inputs. To examine the importance of this, I use the Prowess data to construct the ratio of average imported capital machinery to sales for each industry. I then classified any industry above the sample median as being imported capital intensive, and industries below the sample median as not being imported capital intensive. To test the prediction above I create two sub-samples: (a) industries that are complex and imported capital intensive and (b) industries that are not complex and are not imported capital intensive. The results in columns (5) and (6) suggest that the complementarities between input tariff liberalization and judicial efficiency occur only for firms in complex industries that are also imported capital intensive. Thus, the results in Table 8 strongly support the notion that differences in judicial efficiency are the key characteristic that is driving the complementarities effect demonstrated thus far in the paper.

[28] This measure is similar to the one used by Levchenko (2007) to capture the institutional intensity of an industry. The main difference is that Levchenko (2007) used an US Input Output table to construct a Herfindahl index of input use.

5.3 Endogeneity of Judicial Efficiency

5.3.1 Bias Due to Unobservable State Characteristics

It can be argued that my proxies for judicial efficiency are picking up the effects of alternate state characteristics such as income, overall business environment, distance to ports, flexibility of labor laws, access to capital, quality of infrastructure, and that contract enforcement is not the relevant state characteristic that explains the productivity premiums observed above. Moreover, it may be the case that both firm TFP and a state's judicial efficiency are correlated with the economic and political conditions of a state. While the inclusion of state fixed effects in the baseline specification will control for time-invariant state characteristics, it will not control for time-varying unobservables. I address these concerns in Table 9 by adding these alternate state characteristics to my baseline specification (column (2) in Table 7) and checking to see if the evidence for the complementarities found above remains.

In column (1) of Table 9 I add the natural logarithm of state GDP per capita and its interaction with input tariffs. This tests the hypothesis that state income and the level of human capital in a state are the key explanation for the productivity premiums observed in Table 7. Despite the inclusion of the additional variables, the coefficient for the interaction between judicial efficiency and input tariffs remains negative and significant with a point estimate that is higher than the baseline. A second alternate explanation for the results in Table 7 is that judicial efficiency is picking up the effects of being in coastal states with lower costs of trading. In other words, the relevant state characteristic is its distance to the nearest port, which drives the cost of acquiring foreign inputs. In column (2) I test this hypothesis by adding the interaction of the distance between each state's capital and the nearest port and input tariffs. [29] The results confirm the complementarities found earlier.[30]

[29] The data on port distances are from Ural (2011).

[30] Note that the distance between each state's capital and the nearest port as well as all subsequent state characteristics included in Table 9 are time invariant. As a result, their level effects are captured by the state fixed effects.

A further caveat to the findings in Table 7 is that it is difficult to disentangle the effect of a particular type of institution (in this case, judicial efficiency) from that of other types of institutions. For example, the results in Table 7 may just be highlighting the effect of labor market institutions or the overall business environment in each state. To address this concern, I add an interaction of an indicator for states with flexible labor laws obtained from Hasan et al. (2007) and input tariffs in column (3). The interaction term between input tariffs and judicial efficiency remains negative and significant. In column (4) I add an interaction between a ranking of state business environments obtained from Iarossi (2009) and its interaction with input tariffs.[31] Once again the coefficient of interest remains negative and significant.

Next, a firm's ability to utilize lower input tariffs may depend on the availability and cost of acquiring finance. In other words, the differential effect found in Table 7 can be explained by the fact that firms in states with superior access to capital are better able to obtain foreign inputs. To account for this, I add an interaction between a measure of the access to finance in each state and input tariffs in column (5).[32] The point estimate for the interaction term of interest remains negative and significant. In column (6) I add the interaction between judicial efficiency and a state-level infrastructure index obtained from the Eleventh Finance Commission Report (Government of India, 2000). The interaction term between input tariffs and judicial efficiency remains negative and significant.

Finally, to account for other unobservable state characteristics I add state and time interaction effects in column (7). The coefficient of interest remains negative and significant. Note that I have omitted the level effect of judicial efficiency here due to its collinearity with the state and time interaction effects. Thus, even when alternate state characteristics are added to the baseline specification the earlier finding of complementarities between input tariff liberalization and the speed of contract enforcement

[31] Note that the ranking has been reversed. As a result, a higher rank number indicates better business environment.

[32] The access to finance classification is from Topalova and Khandelwal (2011) and is calculated using data on credit per capita from the Reserve Bank of India.

remains robust. Furthermore, the fact that the primary results of the paper are robust to the addition of these alternate state characteristics suggest that the potential endogeneity bias due to unobservable state factors are not a first-order concern here.

5.3.1 Bias Due to Self-Selection of Firms in High Judicial Efficiency States

Next I address the concern that the results in this paper can be contaminated by the self-selection of firms in states with more efficient judiciaries. For example, if high productivity firms locate in states with more efficient judiciaries and these firms also receive more rapid declines in input tariffs (through effective lobbying), then the results in this paper will simply reflect this spurious correlation. As described in greater detail in section 4.2.1 there is no evidence in the data that high TFP firms locate in high judicial efficiency states. Moreover, the three-digit industries included in the sample are fairly well spread out across the various states. Thus, the concentration of highly liberalized industries in states with high judicial efficiency is also an unlikely source of bias.

Nonetheless, to further address these concerns I use a matching estimator to construct a control group of firms in states with low judicial efficiency that have characteristics similar to that of firms in states with high judicial efficiency. By matching firms in this manner I attenuate any bias that may arise due to systematic *observable* differences between firms in states with high judicial efficiency and firms in states with low judicial efficiency. The results using the matched sample are listed in columns (1) – (4) of Table 10. The coefficients in column (1) suggest that lower input tariffs are associated with relatively higher productivity for firms in states with high judicial efficiency when compared to control firms in states with low judicial efficiency. Next, I examine whether this result is biased by other state characteristics that are potentially correlated with both firm TFP and a state's judicial efficiency. In particular, in column (2) I add the natural logarithm of state GDP per capita along with its interaction with input tariffs to the baseline specification in equation (6). The primary result remains highly robust. In

column (3) I add the interaction between each state's overall business ranking and input tariffs.[33] Once again the primary result in column (1) remains highly robust.[34] Finally, in column (4) I add the interaction between state fixed effects and the year dummies. This will control for time-varying, unobservable state characteristics that are correlated with both firm TFP and state judicial efficiency. Once again, the interaction between input tariffs and the treatment indicator remains negative and highly significant.

To summarize, the results in columns (1) – (4) of Table 10 are run on a restricted sample of firms in states with high judicial efficiency and their nearest neighbors among firms in states with low judicial efficiency. This matching process creates a sample of firms that are similar based on observable characteristics. While firms across the treatment and control groups may still differ based on unobservable characteristics, the use of such a matched sample is likely to attenuate any bias arising due to the self-selection of firms in states with high judicial efficiency. As a result, it is encouraging that the results in columns (1) – (4) of Table 10 are strongly in line with the earlier findings.

5.4 Endogeneity of Tariffs

As mentioned in Section 4.2.2, it can be argued that governments use trade policy to protect either the most productive industries (Karacaovali, 2011) or to protect lagging sectors. Or in the case of input tariffs, industries may lobby the government for lower tariffs in upstream industries as this will lower their effective rate of protection. In either instance the overall effect of tariffs is likely to be biased. In Table 10 I address concerns about the endogeneity of tariffs by employing an instrumental variable approach adapted from Goldberg and Pavcnik (2005). In particular, I first convert my baseline econometric specification to first-differences and then use 1997 input tariffs to instrument the first-differenced tariff term. I use an interaction between 1997 input tariffs and judicial efficiency to instrument

[33] The level effect of the business environment rankings is time invariant and is captured by the state fixed effects.

[34] The results in column (1) are also robust to the addition of the interaction between input tariffs and other state controls such as rigidity of labor laws, distance of state capital to the nearest port, an indicator for financial development, and an index of infrastructure quality respectively. I have excluded these results from Table 10 to avoid clutter.

the first-differenced interaction between input tariffs and judicial efficiency. The validity of the IV strategy rests on two key assumptions. First, I assume that 1997 input tariffs are correlated with current changes in input tariffs. This is ensured by the fact that one of the goals of the 1991 Indian trade reforms was to harmonize tariffs across industries. Thus, input tariffs at any given point in time are likely to be correlated with future changes in input tariffs. Second, I assume that 1997 input tariffs are uncorrelated with current changes in the error term. Given that 1997 input tariffs are likely to be far removed from current changes in error term this does not appear to be an unrealistic assumption.

The results in column (5) of Table 10 show that the interaction between input tariffs and judicial efficiency remains negative and significant at the 10% level after using the IV approach. The point estimate suggests that the OLS results were biased towards zero. In column (6) I add the interaction between capital intensity and judicial efficiency. The coefficient of interest remains robust. Next, in column (7) I add the interaction between judicial efficiency and skill intensity, while in column (8) I add the interaction between judicial efficiency and the natural logarithm of the concentration ratio. In both cases, the interaction between input tariffs and judicial efficiency remains negative and significant.[35] The first-stage Shea's partial R^2 in columns (5) to (8) ranges from 0.04 to 0.295.

6. Robustness Checks

In Table 11 I test the robustness of the earlier results by using alternative measures of TFP and judicial efficiency. In column (1) I replace the previous measure of TFP with a TFP index. The latter is defined as the TFP of each firm minus the TFP of the firm with the average level of output and inputs within the industry. The results from using this alternate measure correspond to previous findings. In column (2) I generate TFP by estimating the production function in equation (2) using OLS. The coefficient of the interaction term of tariff and judicial efficiency remains negative and significant. In column (3) I use a balanced panel of firms to estimate equation (4). The coefficient of interest remains

[35] The IV results are qualitatively robust to employing a variant of the Trefler (2004) approach and using 1997 data on the number of workers in an industry and average industry wages as instruments for first-differenced input tariffs.

negative and highly significant. Finally, in column (4) I use one-year lagged non-tariff barriers as my measure of trade protection. Once again, the interaction between trade protection and judicial efficiency remains negative and significant.

In columns (5) and (6) I test the robustness of the previous findings by using alternate measures of judicial efficiency. In particular, column (5) uses one minus the fraction of cases pending in each state as the proxy for judicial efficiency. The coefficient of interest remains negative, although it is no longer statistically significant. Finally, in column (6) I use the subjective index of judicial quality to measure contract enforcement. This measure is based on the opinion of firm managers and is from the 2005 Enterprise Surveys conducted by the World Bank. I aggregated the firm-level responses to create a state-level measure of judicial quality. The results in column (6) qualitatively support the earlier findings. The greater imprecision of the results here is not surprising given the lack of variation in the state-level aggregate, as demonstrated in Table 2.

In Table 12 I analyze the robustness of the main results to various sensitivity tests. In column (1) I examine whether my results are robust to dropping outliers. Outliers are defined as observations for which the absolute values of studentized residuals are above two. The results in column (1) indicate that even after outliers have been dropped the interaction between input tariffs and judicial efficiency remains negative and significant. In column (2) I drop observations with high leverage. In particular, I drop observations for which leverage is above $(2k + 2)/n$ where k represents the number of independent variables in the baseline specification. The main coefficient interest remains negative and significant after dropping observations with high leverage. Next, in column (3) I drop influential observations. Influential observations are defined as ones for which the absolute value of Cook's D is above $4/n$, where n represents the number of observations. The results without influential observations in column (3) strongly support the main findings of the paper.

I further test the robustness of my results by dropping various states from the sample. In particular, in column (4) I drop firms located in Maharashtra, a state which includes 34% of the firms in the sample due primarily to its size and the fact that it is the state in which the Mumbai Stock Exchange is located. The results are robust to its exclusion. In columns (5) and (6) I drop observations from the bottom and top 10% of the judicial efficiency distribution respectively. In both cases, the coefficient of interest remains negative and significant. Finally, in column (7) I use the full sample of states in India. Recall that the baseline results exclude smaller and conflict affected Indian states due to questions about the reliability of the judicial efficiency data. The primary results go through when using the full sample of states.

7. Conclusion

This paper addresses a gap in the literature by examining the complementarities between the speed of contract enforcement and the productivity gains from input tariff liberalization. It does so using a firm-level panel data from India along with objective measures of judicial efficiency at the state level. Given that each state court system in India is under the administrative control of the state government, there exists significant variation in state-level judicial efficiency. Thus, it provides an ideal setting in which to examine the question posed in this paper.

The results strongly support the notion of complementarities between judicial efficiency and input tariffs. In particular, the paper finds that for a 10 percentage point decline in input tariffs, firms in the state at the 75^{th} percentile of judicial efficiency experience a 5.8 percent increase in productivity. On the other hand, for a 10 percentage point decline in input tariffs, firms in the state at the median level of judicial efficiency experience a 2.3 percent increase in productivity. The results also suggest that the complementarities are strongest for firms in industries that require a more complex production process (i.e. industries that require the use of more relationship-specific inputs) and that are imported capital intensive. These results are robust to using a matching estimator to address the self-selection of firms into

states with high judicial efficiency and an IV approach to instrument input tariffs. In addition, the results are robust to the inclusion of other state controls such as state GDP per capita, distance of state capital to ports, access to finance, ranking of business environment, labor market flexibility, infrastructural quality, as well as state and time interaction effects. Thus, the results indicate that rapid contract enforcement is necessary to maximize the productivity benefits from input tariff liberalization.

Reference

Acemoglu, Daron, Pol Antràs, and Elhanan Helpman, 2007. "Contracts and Technology Adoption." *American Economic Review*, 97(3): 916–943.

Acemoglu, Daron, Simon Johnson, and James Robinson, 2005. "The Rise of Europe: Atlantic Trade, Institutional Change, and Economic Growth." *American Economic Review*, 95(3): 546–579.

Aghion, Philippe, Robin Burgess, Stephen Redding, and Fabrizio Zilibotti, 2008. "The Unequal Effects of Liberalization: Evidence from Dismantling the License Raj in India." *American Economic Review*, 98(4): 1397-1412.

Amiti, Mary and Jozef Konings, 2007. "Trade Liberalization, Intermediate Inputs and Productivity: Evidence from Indonesia." *American Economic Review*, 97(5): 1611-1638.

Chemin, Matthieu, 2009. "Does Court Speed Shape Economic Activity? Evidence from a Court Reform in India." *Journal of Law, Economics, & Organization (forthcoming)*.

Cowan, Kevin and Alejandro Neut, 2007. "Intermediate Goods, Institutions, and Output Per Worker." *Central Bank of Chile Working Paper*.

Fernandes, Ana M, 2007. "Trade Policy, Trade Volumes and Plant Level Productivity in Colombian Manufacturing Industries." *Journal of International Economics*, 71(1): 52-71.

Goldberg, Pinelopi, Amit Khandelwal, Nina Pavcnik, and Petia Topalova, 2010. "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India." *Quarterly Journal of Economics*, 125(4): 1727-1767.

Goldberg, Pinelopi, and Nina Pavcnik, 2005. "Trade, Wages, and the Political Economy of Trade Protection: Evidence from the Colombian Trade Reforms," *Journal of International Economics*, 66(1): 75-105.

Government of India, 2000. Report of the Eleventh Finance Commission.

Grossman, Gene M., and Elhanan Helpman, 1991. Innovation and Growth in the Global Economy. Cambridge, MA: MIT Press.

Halpern, Lazlo, Miklos Koren, and Adam Szeidl, 2009. "Imported Inputs and Productivity." *CEPR Discussion Paper 5139*.

Harrison, Ann E, 1994. "Productivity, Imperfect Competition and Trade Reform: Theory and Evidence." *Journal of International Economics*, 36(1-2): 53-73.

Hasan, Rana, Devashish Mitra, and K.V. Ramaswamy, 2007. "Trade Reforms, Labor Regulations and Labor Demand Elasticities: Empirical Evidence from India." *Review of Economics & Statistics*, 89(3): 466-481.

Iarossi, Giuseppe, 2009. "The Investment Climate in 16 Indian States." *World Bank Policy Research Working Paper No. 4817*

Johnson, Simon, John McMillan, and Christopher Woodruff, 2002. "Courts and Relational Contracts." *Journal of Law, Economics, & Organization*, 18(1): 221-277.

Karacaovali, Baybars, 2011. "Productivity Matters for Trade Policy: Theory and Evidence." *International Economic Review*, 52(1): 33-62.

Kasahara, Hiroyuki, and Joel Rodrigue, 2008. “Does the use of imported intermediates increase productivity? Plant-level evidence.” *Journal of Development Economics*, 87(1): 106-118.

Klenow, Peter J., and Andres Rodriguez-Clare, 1997. “Quantifying Variety Gains from Trade Liberalization.” Pennsylvania State University, Mimeo.

Kohling, Wolfgang, 2000, "The Economic Consequences Of A Weak Judiciary: Insights From India." *Law and Economics 0212001*, Economics Working Paper Archive at WUSTL.

Krishna, Pravin, and Devashish Mitra, 1998. “Trade Liberalization, Market Discipline and Productivity Growth: New Evidence from India.” *Journal of Development Economics*, 56(2): 447-462.

Levchenko, Andrei, 2007. “Institutional Quality and International Trade.” *Review of Economic Studies*. 74(3): 791-819.

Levinsohn, James and Amil Petrin, 2003. “Estimating Production Functions Using Inputs to Control for Unobservables.” *Review of Economic Studies*, 70(2): 317-342.

Muendler, Marc-Andreas, 2004. “Trade, Technology, and Productivity: A Study of Brazilian Manufactures, 1986-1998.” *University of California at San Diego Economics Working Paper 2004-06*.

Nunn, Nathan, 2007. “Relationship-Specificity, Incomplete Contracts and the Pattern of Trade." *Quarterly Journal of Economics*, 122(2): 569-600.

Olken, Benjamin, 2009. “Corruption Perceptions vs. Corruption Reality.” *Journal of Public Economics*, 93(7-8): 950-964.

Pavcnik, Nina, 2002. “Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants.” *Review of Economic Studies*, 69(1): 245-276.

Rosenbaum, Paul R. and Donald B. Rubin, 1983. “The Central Role of the Propensity Score in Observational Studies for Causal Effects,” *Biometrika*, 70(1): 41-55.

Schor, Adriana, 2004. “Heterogeneous Productivity Response to Tariff Reduction. Evidence from Brazilian Manufacturing Firms.” *Journal of Development Economics*, 75(2): 373-396.

Sharma, Gunjan, 2008. “Competing or Collaborating Siblings? Industrial and Trade Policies in India.” University of Missouri - Columbia, Mimeo.

Singh, Nirvikar, 2003. "Some Consequences of India's Institutions and Governance: A Conceptual Framework." *University of California Santa Cruz Working Paper 556*.

Topalova, Petia, and Amit Khandelwal, 2011. “Trade Liberalization and Firm Productivity: The Case of India.” *The Review of Economics and Statistics*, 93(3): 995-1009.

Trefler, Daniel, 2004. “The Long and Short of the Canada-U.S. Free Trade Agreement.” *American Economic Review*, 94(4): 870-95.

Ural, Beyza, 2011. “Tariff Pass-Through and the Effect of Trade Liberalization on Household Welfare.” University of Alberta, Mimeo.

Table 1
Production Complexity and Dispute Settlement Among Indian Firms

	All Firms	Importers	Non-Importers
Production Complexity			
Percentage of Firms that Use More Than Five Suppliers for Primary Input	44.73	51.05	43.63
Percentage of Firms Using Relationship-Specific Inputs	58.37	76.99	56.37
Contract Enforcement as a Constraint			
Percentage of Firms That Report the Legal System as an Obstacle to Doing Business	22.48	25.73	21.67
Use of Courts			
Percentage of Firms Involved in Court Cases in the Last Three Years	12.45	24.46	10.46
Dispute Settlement			
Percentage of Firms Using Courts to Resolve Disputes	7.40	14.10	6.20
Percentage of Firms Using Business Associations to Resolve Disputes	6.39	7.81	5.32
Percentage of Firms Using Arbitration Agency to Resolve Disputes	3.63	6.25	3.55
Percentage of Firms Using Other Methods to Resolve Disputes	69.37	65.62	70.39
Percentage of Firms with Unresolved Disputes	13.21	6.25	14.54

Notes: These numbers are author's calculations based on data from the 2005 Enterprise Surveys conducted by the World Bank. The data on dispute resolution refer to disputes over overdue payments.

Table 2

Contract Enforcement Across Indian States

State	Fraction of Cases Resolved Within A Year	Pendency Ratio	Confidence in State Judiciary
Andhra Pradesh	0.36	0.67	3.91
Assam	0.28	0.79	-
Bihar	0.04	0.89	3.65
Gujarat	0.21	0.93	3.33
Haryana	0.37	0.79	4.36
Jharkhand	0.06	0.80	4.45
Karnataka	0.36	0.71	4.07
Kerala	0.35	0.79	4.54
Madhya Pradesh	0.44	0.78	4.11
Maharashtra	0.14	0.92	4.05
Orissa	0.18	0.88	4.32
Punjab	0.35	0.82	4.55
Rajasthan	0.23	0.81	3.56
Tamil Nadu	0.49	0.59	3.92
Uttar Pradesh	0.04	0.82	3.68
West Bengal	0.23	0.93	4.40
Mean	0.26	0.81	4.06
Coefficient of Variation	0.53	0.15	0.08

Notes: The reported numbers are sample averages for each state for the period 2003-2004. Pendency ratio is the ratio of the number of pending cases to the number of registered cases. Confidence in state judiciary captures the response of firms who were asked the extent to which they agree with the following statement: "I am confident that the judicial system will enforce my contractual and property rights in business disputes." Responses were on a scale of one to six with six indicating full confidence in the state judiciary. The firm-level responses are from the 2005 Enterprise Surveys conducted by the World Bank and were aggregated to the state level.

Table 3
Correlation Between Various Measures of Judicial Efficiency

	Fraction of Cases Resolved Within A Year	Pendency Ratio	Time to Clear Current Case Backlog	Business Environment Ranking	Confidence in State Judiciary
Fraction of Cases Resolved Within A Year (Judicial Efficiency)	1.00				
Pendency Ratio	0.64	1.00			
Time to Clear Current Case Backlog	0.61	0.98	1.00		
Business Environment Ranking	0.43	0.18	0.18	1.00	
Confidence in State Judiciary	0.25	0.09	0.13	0.28	1.00

Notes: Pendency ratio is one minus the ratio of the number of pending cases to the number of registered cases. Time to clear current case backlog is the ratio of all registered cases to the number of cases resolved that year. This has been inverted so that a higher number refers to better contract enforcement. Business environment ranking is from Iarossi (2009) and has been reversed such that a higher rank score indicates a better environment. Confidence in state judiciary captures the response of firms who were asked the extent to which they agree with the following statement: "I am confident that the judicial system will enforce my contractual and property rights in business disputes." The firm-level responses are from the 2005 Enterprise Surveys conducted by the World Bank. The responses were aggregated to the state level.

Table 4
Tariff Variation Across Industries

The Ten Most Protected Industries			The Ten Least Protected Industries		
Industry Code	Industry Name	Average Input Tariff	Industry Code	Industry Name	Average Input Tariff
155	Beverages	0.689	222	Printing	0.185
154	Other Food Products	0.566	221	Publishing	0.185
152	Dairy Products	0.499	322	Television and Radio Transmitters	0.205
153	Grain Mill Products	0.434	231	Coke Oven Products	0.213
151	Production, Processing, and Preservation of Meat, Fish etc.	0.373	313	Insulated Wire and Cable	0.217
359	Other Transport Equipment	0.327	323	Television and Radio Receivers	0.217
160	Tobacco Products	0.315	300	Office, Accounting, and Computing Machinery	0.220
341	Motor Vehicles	0.298	321	Electronic Valves and Tubes	0.220
343	Parts and Accessories for Motor Vehicles	0.298	319	Other Electrical Equipment	0.220
353	Aircraft and Spacecraft	0.291	272	Basic Precious and Non-Ferrous Metals	0.221

Notes: Industries are designated as most or least protected based on their average input tariff for the period 2003-2004.

Table 5
Summary Statistics

	Obs.	Mean	Standard Deviation
Input Tariff$_{t-1}$	6,331	0.28	0.10
Judicial Efficiency	6,331	0.26	0.14
Pendency Ratio	6,331	0.18	0.13
Time to Clear Current Case Backlog	6,331	0.16	0.13
Sales	6,331	172.31	1856.11
Material Costs	6,331	71.46	641.05
Wage Bill	6,331	8.43	38.88
Capital	6,331	88.12	694.41
Import Dummy	6,331	0.65	0.49
Age	6,233	25.19	19.53
Indicator for Foreign Ownership	6,331	0.07	0.25
Indicator for Government Ownership	6,331	0.02	0.15

Notes: All monetary values are in crores of 1993 Rupees. One crore equals 10 million. The current exchange rate is approximately 49 Rupees to the US dollar. Judicial efficiency measures the fraction of cases that are resolved within a year. Pendency ratio is one minus the ratio of the number of pending cases to the number of registered cases. Time to clear current case backlog is the ratio of all registered cases to the number of cases resolved that year. This has been inverted so that a higher number refers to better contract enforcement.

Table 6
Production Function Estimates

		Labor		Capital	
Industry	Name	OLS	Levinsohn-Petrin	OLS	Levinsohn-Petrin
15	Food and Beverage	0.46	0.33	0.54	0.42
16	Tobacco	0.48	0.19	0.53	0.79
17	Textiles	0.50	0.32	0.41	0.69
18	Wearing Apparel	0.53	0.47	0.50	1.58
19	Leather	0.60	0.52	0.37	0.78
20	Wood	0.53	0.62	0.32	0.39
21	Paper	0.69	0.58	0.27	0.48
22	Printing and Publishing	0.75	0.79	0.27	0.08
23	Refined Petroleum	0.66	0.74	0.48	0.44
24	Chemicals	0.70	0.65	0.34	0.52
25	Rubber	0.68	0.51	0.40	0.51
26	Non-Metallic Minerals	0.55	0.35	0.47	0.55
27	Basic Metals	0.41	0.25	0.46	0.56
28	Fabricated Metal Products	0.55	0.42	0.47	0.41
29	Machinery & Equipment	0.67	0.61	0.39	0.43
30	Office, Accounting, and Computing Machinery	0.63	0.40	0.55	0.39
31	Electrical Machinery	0.74	0.67	0.31	0.50
32	Communications Equipment	0.77	0.80	0.38	0.99
33	Precision Instruments	0.84	1.00	0.15	0.47
34	Motor Vehicles	0.54	0.43	0.45	0.61
35	Other Transport	0.38	0.30	0.47	0.65
36	Furniture	0.38	0.42	0.71	0.62
	Mean	0.59	0.52	0.42	0.58

Table 7
Basic Results

	(1)	(2)	(3)	(4)	(5)	(6)
Input Tariff$_{t-1}$	-0.66	0.36	0.33	0.35	0.31	
	(0.850)	(0.879)	(0.875)	(0.881)	(0.876)	
Judicial Efficiency		0.63	1.61	0.98	2.38*	0.71
		(0.503)	(2.275)	(0.777)	(1.410)	(0.467)
Input Tariff$_{t-1}$ * Judicial Efficiency		-2.64**	-2.57**	-2.65**	-2.46**	-2.75**
		(1.265)	(1.244)	(1.268)	(1.251)	(1.263)
Capital Intensity * Judicial Efficiency			-1.14			
			(2.496)			
Skill Intensity * Judicial Efficiency				-1.26		
				(1.977)		
Log of Concentration Ratio * Judicial Efficiency					-0.15	
					(0.116)	
Constant	1.38***	1.14***	1.15***	1.15***	1.15***	1.68***
	(0.308)	(0.334)	(0.334)	(0.334)	(0.333)	(0.255)
Industry * Time Effects	No	No	No	No	No	Yes
Observations	6,233	6,233	6,229	6,229	6,229	6,233
R-squared	0.283	0.284	0.284	0.284	0.284	0.288

Notes: Dependent variable is the log of total factor productivity (TFP) calculated using the Levinsohn and Petrin (2003) approach. Judicial efficiency measures the percentage of cases that are resolved within a year. Capital intensity is defined as 1 minus the ratio wage bill to value added and is calculated using 1997 industry-level data from the Annual Survey of Industries (ASI). Skill intensity is the ratio of non-production workers to all workers in an industry and is calculated from the 1997 ASI data. Concentration Ratio is defined as the output per plant in an industry and is also calculated from the 1997 ASI data. In column (6) the level effect of input tariffs is dropped due to its collinearity with the industry and time interaction effects. All regressions include indicators for large and medium firms, the log of age, age squared, and indicators for foreign and government ownership. All regressions also include industry, state, and year effects. Robust standard errors in parentheses are clustered at the industry-state level. *** p<0.01, ** p<0.05, * p<0.1

Table 8
Industry Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	Complex Production Process	Simpler Production Process	Complex Production Process (CMIE)	Simpler Production Process (CMIE)	Complex & Imported Capital Intensive	Simpler & Not Imported Capital Intensive
Input Tariff$_{t-1}$	-0.29	-5.21	0.01	-2.68	0.19	-5.89
	(0.837)	(5.501)	(0.869)	(3.830)	(0.845)	(5.727)
Judicial Efficiency	0.65	-0.54	0.48	0.10	0.52	-0.09
	(0.564)	(0.988)	(0.602)	(0.968)	(0.645)	(1.088)
Input Tariff$_{t-1}$ * Judicial	-2.68**	2.55	-2.68**	1.48	-3.11**	1.43
Efficiency	(1.335)	(3.408)	(1.329)	(3.181)	(1.455)	(3.687)
Constant	1.26***	2.70	1.06***	1.87	1.00**	3.02*
	(0.370)	(1.649)	(0.406)	(1.187)	(0.431)	(1.731)
Observations	3,518	2,715	3,143	3,090	2,591	2,034
R-squared	0.381	0.120	0.314	0.291	0.433	0.084

Notes: Dependent variable is the log of total factor productivity (TFP) calculated using the Levinsohn and Petrin (2003) approach. Judicial efficiency measures the fraction of cases that are resolved within a year. Complexity of production is captured by the fraction of an industry's intermediate inputs that require relationship-specific investments. These data, which were originally constructed for US industries, are from Nunn (2007). They were concorded to Indian industries under the assumption that the complexity of production in a particular US industry is an accurate proxy of the complexity of production in the equivalent Indian industry. Industries that were above the sample median were designated as having a complex production process. All others were classified as simpler production process industries. Complex production process (CMIE) represents industries that had a Herfindahl index of input use below the sample median. This index was aggregated from Indian firm-level data on input use. The remaining industries were classified as having simpler production process (CMIE). The correlation between the Nunn measure and the CMIE measure is 0.58. Imported capital intensive industries are defined as those with a ratio of imported capital to sales above the median. All regressions include indicators for large and medium firms, the log of age, age squared, indicators for foreign and government ownership, and industry, state, and year effects. Robust standard errors in parentheses are clustered at the industry-state level. *** p<0.01, ** p<0.05, * p<0.1

Table 9
Alternate State Level Channels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Input Tariff$_{t-1}$	-2.49	0.35	0.42	0.85	0.49	0.03	-0.72
	(5.953)	(0.863)	(0.915)	(1.019)	(0.992)	(1.031)	(0.735)
Judicial Efficiency	0.74	0.64	0.62	0.56	0.57	0.75	
	(0.492)	(0.497)	(0.498)	(0.559)	(0.505)	(0.515)	
Input Tariff$_{t-1}$ * Judicial Efficiency	-2.82**	-2.67**	-2.58**	-2.32*	-2.47**	-3.06**	-2.48*
	(1.276)	(1.269)	(1.252)	(1.283)	(1.254)	(1.335)	(1.316)
Input Tariff$_{t-1}$ * Ln (State GDP per capita)	0.32						
	(0.597)						
Ln (State GDP per capita)	0.00						
	(0.000)						
Input Tariff$_{t-1}$ * Distance to Ports		0.05					
		(0.328)					
Input Tariff$_{t-1}$ * Flexible Labor Laws			-0.12				
			(0.279)				
Input Tariff$_{t-1}$ * Business Environment Ranking				-0.07			
				(0.056)			
Input Tariff$_{t-1}$ * Financial Development					-0.24		
					(0.527)		
Input Tariff$_{t-1}$ * Infrastructure Index						0.004	
						(0.006)	
Constant	0.77*	1.14***	1.16***	1.19***	1.17***	1.11***	1.66***
	(0.409)	(0.335)	(0.331)	(0.346)	(0.329)	(0.330)	(0.286)
State * Time Effects	No	No	No	No	No	No	Yes
Observations	6,233	6,220	6,233	6,169	6,233	6,220	6,233
R-squared	0.285	0.284	0.284	0.286	0.284	0.284	0.286

Notes: Dependent variable is the log of total factor productivity (TFP) calculated using the Levinsohn and Petrin (2003) approach. Judicial efficiency measures the percentage of cases that are resolved within a year. Distance to ports captures the distance from each state capital to the nearest port. Flexible labor laws is an indicator that is 1 for states with flexible labor laws and is obtained from Hasan et al. (2007). Business environment ranking is from Iarossi (2009) and has been reversed to be increasing in better environment. Financial development in an indicator that is 1 for states with credit per capita above the median and is obtained from Topalova and Khandelwal (2011). The infrastructure index is from the 11th Finance Commission Report (Government of India, 2000). In column (7) the level effect of judicial efficiency is dropped due to its collinearity with the state and time effects. Note that apart from State GDP per capita, all other alternate state variables are time invariant. As a result, their level effects are wiped out by the state fixed effects. All regressions include indicators for large and medium firms, the log of age, age squared, and indicators for foreign and government ownership. All regressions also include industry, state, and year effects. Robust standard errors in parentheses are clustered at the industry-state level. *** p<0.01, ** p<0.05, * p<0.1

Table 10

Selection Bias & Endogeneity of Tariffs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Matched Sample				Default Sample			
	OLS				2SLS (One-Period Difference)			
Input Tariff$_{t-1}$	0.66	-0.08	0.89	0.01	-0.34	0.12	-0.51	0.15
	(1.405)	(5.859)	(1.335)	(1.202)	(2.519)	(2.596)	(2.445)	(2.580)
Input Tariff$_{t-1}$ * Treatment	-1.27***	-1.29***	-1.26***	-1.49***				
	(0.403)	(0.344)	(0.375)	(0.462)				
Input Tariff$_{t-1}$ * Ln (State GDP per capita)		0.09						
		(0.563)						
Ln (State GDP per capita)		0.35						
		(0.550)						
Input Tariff$_{t-1}$ * Business Environment Ranking			-0.02					
			(0.046)					
Judicial Efficiency					1.45**	1.67*	1.58*	1.67**
					(0.738)	(0.863)	(0.839)	(0.850)
Input Tariff$_{t-1}$ * Judicial Efficiency					-4.47*	-4.73*	-4.53*	-4.72*
					(2.307)	(2.437)	(2.398)	(2.410)
Capital Intensity * Judicial Efficiency						-0.27		
						(0.198)		
Skill Intensity * Judicial Efficiency							-0.62	
							(0.551)	
Log of Concentration Ratio * Judicial Efficiency								-0.02
								(0.014)
Constant	0.94**	-2.41	0.94**	1.20***	-0.07	0.00	-0.04	0.01
	(0.444)	(5.289)	(0.410)	(0.333)	(0.114)	(0.134)	(0.125)	(0.133)
State * Time Effects	No	No	No	Yes	No	No	No	No
Observations	3,884	3,884	3,851	3,884	2,676	2,676	2,676	2,676
R-squared	0.289	0.289	0.29	0.291	0.035	0.040	0.035	0.041

Notes: Dependent variable is the log of total factor productivity (TFP) calculated using the Levinsohn and Petrin (2003) approach in columns (1) - (4) and the one-period difference in that TFP in columns (5) - (8). Treatment takes the value of one for firms in states at or above the sample median for judicial efficiency and is zero for firms in states with below median judicial efficiency and is the nearest neighbor for a firm in a high judicial efficiency state. The business environment ranking is from Iarossi (2009) and has been reversed to be increasing in better environment. Note that this ranking and the treatment indicator are time invariant. As a result, their level effects are wiped out by the state fixed effects. Judicial efficiency measures the fraction of cases that are resolved within a year. Columns (5) - (8) instrument the one-period difference in input tariffs using input tariffs from 1997. I use an interaction between 1997 input tariffs and judicial efficiency to instrument the first-differenced interaction between input tariffs and judicial efficiency. Columns (1) - (4) include indicators for large and medium firms, the log of age, age squared, indicators for foreign and government ownership and state and industry effects. In columns (5) - (8) the time-invariant indicators for foreign and domestic ownership as well as the state and industry effects are dropped due to the first differencing. All regressions include year effects. The standard errors in parentheses in columns (1) - (4) are bootstrapped with 100 repetitions. The robust standard errors in parentheses in columns (5) - (8) are clustered at the industry-state level. *** p<0.01, ** p<0.05, * p<0.1

Table 11
Robustness Checks

Dependent Variable	(1) TFP Index	(2) TFP OLS	(3) TFP LP	(4) TFP LP	(5) TFP LP	(6) TFP LP
			Balanced Panel			
Input Tariff$_{t-1}$	0.68	0.64	0.82		-0.29	0.62
	(0.476)	(0.429)	(0.581)		(0.847)	(2.387)
Judicial Efficiency	0.76	0.13	0.94**	0.03		
	(0.880)	(0.790)	(0.388)	(0.335)		
Input Tariff$_{t-1}$ * Judicial	-2.63**	-1.93*	-2.96***			
Efficiency	(1.255)	(1.092)	(1.056)			
Input NTB$_{t-1}$				0.90**		
				(0.342)		
Input NTB$_{t-1}$ * Judicial				-1.94*		
Efficiency				(1.157)		
Pendency Ratio					1.42	
					(0.931)	
Input Tariff$_{t-1}$ * Pendency Ratio					-1.65	
					(1.315)	
Input Tariff$_{t-1}$ * Confidence in						-0.33
State Judiciary						(0.528)
Constant	0.15	1.49***	0.91***	1.12***	0.98**	0.75
	(0.342)	(0.287)	(0.291)	(0.233)	(0.425)	(1.015)
Observations	6,233	6,233	5,382	6,233	6,233	6,182
R-squared	0.108	0.227	0.318	0.284	0.284	0.284

Notes: TFP Index takes the total factor productivity (TFP) of each firm and subtracts the TFP of the average firm within that firm's industry. TFP OLS and TFP LP refer to the TFP obtained when equation (2) is estimated using OLS and the Levinsohn and Petrin (2003) approach respectively. Judicial efficiency measures the fraction of cases that are resolved within a year. Pendency ratio is 1 minus the ratio of the number of pending cases to the number of registered cases. Confidence in state judiciary is a subjective measure of judicial quality based on the opinion of firm managers. See the notes of Table 4 for a more detailed description. Note that the level effect of confidence in state judiciary is wiped out by the state fixed effects as the measure is time invariant. All regressions include indicators for large and medium firms, the log of age, age squared, and indicators for foreign and government ownership. All regressions also include industry, state, and year effects. Robust standard errors in parentheses are clustered at the industry-state level. *** p<0.01, ** p<0.05, * p<0.1

Table 12
Sensitivity Tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Outliers Dropped	High Leverage Obs. Dropped	Influential Obs. Dropped	Maharashtra Dropped	Bottom 10% Judicial Efficiency Dropped	Top 10% Judicial Efficiency Dropped	All States Included
Input Tariff$_{t-1}$	-0.07	0.92	1.04	0.42	1.10	0.68	0.22
	(0.770)	(0.912)	(0.744)	(1.017)	(1.000)	(0.886)	(0.865)
Judicial Efficiency	0.35	0.56	0.55	0.72	0.59	1.25**	0.76*
	(0.414)	(0.610)	(0.419)	(0.526)	(0.567)	(0.561)	(0.394)
Input Tariff$_{t-1}$ * Judicial	-2.09*	-2.60*	-2.92***	-2.87**	-2.66*	-4.40***	-2.79**
Efficiency	(1.118)	(1.365)	(0.896)	(1.405)	(1.538)	(1.400)	(1.235)
Constant	1.34***	1.07***	0.96***	0.81**	0.89***	1.04***	1.09***
	(0.292)	(0.347)	(0.295)	(0.371)	(0.340)	(0.349)	(0.338)
Observations	5,883	5,600	5,870	4,078	4,948	5,310	6,341
R-squared	0.377	0.262	0.346	0.284	0.274	0.294	0.293

Notes: Dependent variable is the log of total factor productivity (TFP) calculated using the Levinsohn and Petrin (2003) approach. Judicial efficiency measures the fraction of cases that are resolved within a year. All regressions include indicators for large and medium firms, the log of age, age squared, indicators for foreign and government ownership, and industry, state, and year effects. Robust standard errors in parentheses are clustered at the industry-state level. *** p<0.01, ** p<0.05, * p<0.1