Openness and Factor Shares: Is Globalization Always Bad for Labor?*

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July 2020

Abstract

This paper studies the response of factor shares to the liberalization episode in India during the 1990's, which is characterized by large and unexpected changes in trade and foreign investment policies. Contrary to what might be expected given the reduction in the aggregate data, our empirical results reveal access to foreign capital as a new mechanism through which openness raises the labor-to-capital relative factor share. As lower tariffs on capital goods and FDI liberalization lead to inflows of foreign technology, capital's productivity per unit of expenditure improves, which in turn raises wages and the relative labor share. Consistent with this mechanism, firm TFP and the share of firms that import capital both increase in industries with the largest capital cost reductions, while the relatively larger rise of labor payments is observed predominantly for new capital importers. We identify domestic deregulation policies and reallocation to capital-intensive firms as potential determinants of the observed decline in the aggregate labor share. Finally, in a model where domestic and foreign capital are imperfect substitutes, we quantify the effect of a reduction in capital tariffs, and find that it explains a large part of the estimated increase in the labor share found in the reduced form analysis.

JEL Classification: E25, F13, F60, O24

Keywords: Labor share, trade liberalization, foreign capital, openness

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*We thank seminar and conference participants at Aarhus University, InsTED Workshop at Syracuse University, and Tinbergen Institute Conference 2018.

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1 Introduction

The secular decline in the labor share since the 1980's is a global phenomenon (Karabarbounis and Neiman (2014)), and a trend that is concurrent with large liberalization episodes worldwide. It is therefore natural to study how specific reforms, either through lower trade barriers or more open financial markets, might play a role in the determination of factor shares. Globalization – outsourcing in particular – has been brought forth as a primary suspect for the decline in the labor share in developed countries (Elsby et al., 2013). For developing countries it has been argued that globalization can lower or raise the labor share depending on the bargaining power of labor and price-to-cost margins (Ahsan and Mitra, 2014; Kamal et al., 2019). A potential factor that has not been investigated in relation to factor shares in developing countries, which are farther from the technological frontier, is their reliance on R&D intensive capital imports from developed countries.[1] In this paper we uncover a new mechanism – access to foreign capital – through which openness can have important distributional implications for factor income. We show that trade openness and FDI liberalization can in fact have positive implications for labor in a way that contrasts with the common perception in developed countries.

To analyze the impact of openness on factor shares, we investigate an important liberalization episode of a developing country, that of India in the 1990's. In 1991, India passed several major unexpected regulatory reforms in response to a balance of payments crisis that led to a severe recession and a need to borrow from agencies such as the World Bank and the IMF. The structural reforms included large reductions in import barriers, liberalization of foreign direct investment (FDI) policies, and industrial policy reforms such as reductions in the licensing requirements for capacity enhancements. A vast literature has documented numerous outcomes that can be attributed to these reforms, which we follow in the construction of plausibly exogenous policy shocks that can be split into variations in output, input, and capital tariffs, in addition to changes to the restrictiveness of FDI and licensing. Our contribution is to apply a setting that allows us to identify a causal relationship to show how improving firms' access to foreign capital raises wages and the labor share.

We find that trade reforms raised the labor share in India, contrary to what might be expected given the reduction in the aggregate data. We conduct the main empirical analysis with a panel data-set of Indian manufacturing firms obtained from the Center for Monitoring Indian Economy (CMIE) Prowess database for the period from 1989 to 1997.[2] We combine

[1]Eaton and Kortum (2001) document that the production of R&D intensive capital equipment has been concentrated in a few developed countries. We confirm that in India, 80% of imported capital during our sample period from 10 developed nations (see Appendix Table 9).

[2]This is the period when policy changes are most likely to be exogenous given the impetus for the reform

the firm level data with policy measures of tariffs and industry regulations at the 3-digit national industry classification (NIC) level, in addition to the industry-state level measures of wages and other economic measures provided by the Annual Survey of Industries (ASI). As in Raval (2019), we consider the share of income paid to labor relative to the share paid to capital in our benchmark estimation, although we show that similar patterns hold also for labor's share of value added.[3] The identification of the policy reforms' effects on factor shares is possible due to the differential exposure to liberalization depending on the industry firms operate in.

When we examine the changes in tariffs by splitting up output, input, and capital tariffs, we find that only a reduction in the capital tariff has a significant positive effect on the share of labor in value added relative to the share of capital. The observed industry-average reduction in the effective capital tariffs during the sample years raised the wage bill to capital compensation ratio by 11.5 percent. There is also a significant impact from relaxing constraints on foreign ownership, which can also be interpreted as an improvement in the access to foreign capital. Quantitatively, we find that a fully liberalized industry has an average increase in the wage-to-capital expenditure ratio equal to 16.7 percent. These results are in contrast to the studies that have examined only the import competition aspect of openness, which have found that it can exacerbate inequality (Topalova, 2010) and has detrimental impacts on manufacturing labor (Hakobyan and McLaren, 2016).

To make sense of the secular decline in the labor share, we point to some domestic policy reforms that have had the opposite effect on factor shares. Measures that are not necessarily related to openness, such as looser licensing requirements and credit expansions, have negative effects on the labor share. These results are consistent with the findings in the previous literature, in particular with Aghion et al. (2008), who find that relaxing license requirements for entry and capacity enhancements had a very large positive impact on economic growth in India, and that this effect was especially significant in states that were "less pro-worker." Additionally, the adverse impact of credit expansion on the labor share is similar to the result in Leblebicioglu and Weinberger (2020), who use a credit expansion episode in the United States that provides causal evidence showing labor share declined following state-by-state credit banking deregulation.

Prior to our empirical contribution on the firm-level responses to openness reforms, we motivate the theoretical mechanisms underlying our findings. We clarify how reforms to reduce the barriers to foreign capital can affect factor shares using a standard general equilibrium model that features a production function with constant elasticity of substitution

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after the 1991 crisis.

[3] Labor and capital payments do not necessarily sum to value added due to markups.

(CES) between labor and capital and nests a CES aggregate of domestic and imported equipment capital, which yields novel insights. In this setting, we examine a trade liberalization that is conducted through a reduction in the tariff on imported capital. The rental rate of foreign capital decreases with the tariff, which unambiguously increases labor payments relatively more than capital payments.[4] As imports become cheaper, firms increase their optimal use of foreign capital relative to domestic capital, which alters the composition of the capital stock in a way that raises the productivity of capital. The impact of lower foreign capital prices and the compositional shift are summarized by a productivity-per-cost of capital composite, which raises wages and the relative labor share as long as labor and capital are complements – which we estimate to be the case for the firms in our sample.

As a way to test our proposed mechanisms, we check alternative firm outcomes, as well as the heterogeneity in the factor share responses to policy changes. We find that the rise of labor payments relative to capital payments is observed predominantly for new capital importers, and that liberalization raises the share of firms that import capital. Moreover, firm TFP increases when capital tariffs are reduced. We also find the capital intensity and the borrowing capacity of the firm (measured by the debt-to-equity ratio) to be important determinants of the increase in the relative labor share. These characteristics point to the technology advantage of new foreign capital in driving the changes in the factor shares.

The theoretical model suggests that firms employing imported capital goods benefit from trade reform through a reduction in the price of investment and through an improved access to foreign technology, both of which can raise wages. We confirm this premise when we examine the industry-level data from ASI, based on the universe of plants: lower capital tariffs raised the average wage rate and productivity, measured with value added per worker, in India. Furthermore, we show that the rise in the relative labor share holds for this broader sample of firms. In response to FDI liberalization, there is suggestive evidence that firms become more skill-intensive. Finally, although the effects of FDI liberalization support the capital-productivity mechanism in influencing the factor shares, we also find evidence that both FDI liberalization and licensing reforms reallocate production to larger, capital intensive firms. Overall, our results indicate that policies to promote expansion of productive medium/large sized firms play a role in the aggregate reduction of the share of payments to labor relative to capital. However, the policies to promote access to foreign capital work to mitigate some of that effect.

The last part of the paper confirms that the structural channels we highlight by differen-

[4] We focus on the reduction of capital tariffs in terms of openness reforms for illustration purposes and to keep the model simple and tractable. One could extend the model to include a reduction in the barriers to foreign multinationals that bring in their technology capital and influence the factor payments.

tiating between foreign and domestic capital in production, can indeed explain a large part of the rise in the relative labor share that we identify in the empirical specification. We assess the model quantitatively by deriving an expression for the elasticity of the labor share with respect to the tariff on imported capital, which is a function of the elasticity of substitution between capital and labor. We estimate the substitution parameter with cross-sectional data on the universe of manufacturing plants for several years, and we confirm the findings from previous literature showing that it is below one (Antràs, 2004; Chirinko, 2008; Raval, 2019). Then, in an approach that likely produces a lower bound, we find that the price and the compositional effects the model captures explains approximately 50% of the increase in the relative labor share that is due to the reduction in capital tariffs.

This study fits within the strand of literature that explores the different mechanisms for the observed non-stability of factor shares, especially those that focus on the trade angle. Elsby et al. (2013) conclude that globalization – more specifically offshoring – deserves most of the blame in the United States. Also focusing on the United States, Oberfield and Raval (2019) find that the decline in the labor share originates from factors that affect technology, including automation and offshoring. For the case of developing countries, Ahsan and Mitra (2014) find that import competition – through its impact on worker bargaining power – has a negative effect on the labor share for large firms. Our paper explores a novel channel, since we concentrate on reforms that reduce the barriers to foreign capital. Furceri and Loungani (2018) and Harrison (2005) document a negative impact of capital account liberalization and trade on the labor share for panels of developed and developing countries. A separate mechanism that focuses on the growing role of capital in production is explored in Karabarbounis and Neiman (2014). They argue that firms substitute towards capital as the cost of capital decreases. Different from them, we allow for an endogenous change in the intensity use of foreign capital, which raises the productivity of capital. We also estimate the elasticity of substitution between labor and capital separately from the variation due to trade reforms.

Our paper is also related to the literature on trade liberalization and inequality – see Goldberg and Pavcnik (2007) for an early summary. In a study of regional inequality in India, Topalova (2010) finds that localities with a higher exposure to import competition experience relatively lower reductions in the poverty rate.[5] A separate literature on inequality tracks the growing gap between types of workers, or the skill premium (Attanasio et al., 2004; Parro, 2013; Burstein et al., 2013). The closest to this study is Raveh and Reshef (2016), who show that the composition of capital imports is important for explaining the skill premium

[5]This type of regional analysis has since been done in other developing *and* developed countries with a similar interpretation of the results (Autor et al., 2013; Pierce and Schott, 2016; Hummels et al., 2014; Dix-Carneiro and Kovak, 2017).

across workers. The type of inequality we study is across broader factors – labor and capital – which has different implications for inequality. The rise in the labor share we find could hypothetically be caused by a shift in the work force towards higher skilled labor, which would also raise the skill premium, as found in Kasahara et al. (2016). In fact, splitting the aggregate data by skill type, we show that wages increased by more for the skilled workers.

It is well established that trade liberalization increased productivity of Indian firms. Krishna and Mitra (1998) and Topalova and Khandelwal (2011) link this to increased competition, although the latter also highlights the importance of cheaper imported inputs. Goldberg et al. (2009) were the first to document the rise in imported inputs in India. Our findings on factor shares can be linked to productivity improvements because a rise in value added is not necessarily shared equally across factors, nor does it have to be paid out to factors – De Loecker et al. (2016) find that markups increased in response to trade reform in India. We find that the effect on factor shares acts through capital-specific tariffs, and not output and input tariffs, which have been the focus of previous work on productivity improvements. Relatedly, Bas and Berthou (2017) and Kandilov et al. (2019) look at the decision to import capital goods in India. The latter finds that investments in foreign capital increase in response to a drop in capital tariffs, which is consistent with our findings that Indian importers are the ones that raise their labor income share the most. Finally, with sector and country variation, Lian et al. (2019) argue that the global reduction in the price of capital is due to both lower trade costs and indirect productivity gains in capital production.

The remainder of the paper is organized as follows. Section 2 presents a model that illustrates how an increase in openness is a channel for varying factor income shares. In Section 3, we present the data that we use in our empirical analysis and describe the liberalization episode. The empirical specification, analysis, and results are discussed in Section 4, while in Section 5 we provide a structural interpretation of the model and estimate the elasticity of substitution between capital and labor in Indian plants. Section 6 concludes.

2 Openness and Factor Shares

In this section we consider a stylized model that motivates the relationship between factor shares, foreign capital, and openness. It shares features with the seminal papers in the literature – e.g. Oberfield and Raval (2019) and Karabarbounis and Neiman (2014) –, but is extended to differentiate between domestic and foreign capital used in production. The model contains a final good, produced with a continuum of intermediate inputs, which can be consumed or invested. We assume that the intermediate input firms combine labor with domestic and foreign capital in order to produce their product. For illustration purposes and to keep the model simple and tractable, we model foreign capital as imported goods. As the problem of the producers and the households is standard, we relegate the full theoretical set-up to the Appendix 8 and describe the new aspects of the model below.

We start off by assuming the following nested CES production function for the intermediate input producers

$$Y_t = F(K_t, N_t) = \left[\eta N_t^{\frac{\sigma-1}{\sigma}} + (1-\eta)(A^K K_t)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

where σ denotes the elasticity of substitution between total capital and labor, and η is the distribution parameter determining the labor intensity in production. For simplicity, we normalize the labor-augmenting technology to 1. Total capital, K_t, is obtained by combining foreign and domestic capital with a CES aggregator:

$$A^K K_t = \left[\alpha \left(A^f K_t^f\right)^{\frac{\gamma-1}{\gamma}} + (1-\alpha)(A^d K_t^d)^{\frac{\gamma-1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}} \tag{2}$$

where γ is the elasticity of substitution between domestic and foreign capital; α is the weight on the foreign capital in the use of total capital; and A_t^f and A_t^d are the capital augmenting technologies embodied in the foreign and domestic capital goods. This formulation allows both labor and the overall capital to be substitutes ($\sigma > 1$) or complements ($\sigma < 1$), and domestic and foreign capital to be substitutes ($\gamma > 1$) or complements ($\gamma < 1$). In Section 5 we discuss the interpretation of these parameters based on our estimates.

Combining the equilibrium conditions with the intermediate good producers' optimality conditions, we can write the ratio of labor share to capital share as[6]

$$\frac{s_{L,t}}{s_{K,t}} = \frac{W_t N_t}{R_t^f K_t^f + R_t^d K_t^d} = \Gamma \left(W_t Q_t\right)^{1-\sigma}, \tag{3}$$

where

$$Q_t = \left[\left(\frac{A_t^f}{R_t^f}\right)^{\gamma-1} + \left(\frac{1-\alpha}{\alpha}\right)^{\gamma} \left(\frac{A_t^d}{R_t^d}\right)^{\gamma-1}\right]^{\frac{1}{\gamma-1}} \tag{4}$$

is the productivity per cost index of composite capital, and the expression for Γ is given by $\Gamma = \left(\frac{\eta}{1-\eta}\right)^{\sigma} \alpha^{\frac{\gamma(1-\sigma)}{\gamma-1}}$.

In this framework the impact of trade openness on the relative labor share can be illus-

[6]Estimating the ratio of labor share to capital share allows us to identify the elasticity of substitution between total capital and labor, σ, directly. Given the importance of this parameter in interpreting the results, we choose to focus on the ratio between the labor and capital shares as opposed to just the labor share.

trated with a reduction in the rental rate of foreign capital, R^f, caused by lower tariffs on foreign capital goods.[7] To assess the effect of lower rental rate on factor shares, consider the following expression for the log of relative labor share in equation (2) with respect to the log of R^f

$$\frac{\partial ln\left(\frac{s_L}{s_k}\right)}{\partial ln(R^f)} = (1-\sigma)\left[\frac{\partial ln\,(W)}{\partial ln(Q)} + 1\right]\frac{\partial ln\,(Q)}{\partial ln(R^f)}, \tag{5}$$

where

$$\frac{\partial lnQ}{\partial lnR^f} = -Q^{1-\gamma}\left(\frac{A^f}{R^f}\right)^{\gamma-1}. \tag{6}$$

To evaluate the impact in (5), we first need to interpret the expression in (6), which shows that a reduction in the rental rate of foreign capital increases productivity per cost of capital.[8] This increase can be attributed to lower foreign capital costs, which also triggers a compositional effect. As imports become cheaper, firms increase their optimal use of foreign capital relative to domestic capital, which alters the composition of the capital stock and increases the overall efficiency of capital, shown in (2), assuming the foreign capital's productivity is higher than the one embodied in the domestic capital (i.e., $A^f > A^d$).[9] In the empirical analysis of Section 4, the impact of policy reforms on factor shares reflect both changes, and therefore are interpreted as the combined effect of lower cost and enhanced productivity.[10]

Equation (5) shows that in addition to its direct impact, changes in productivity, caused by changes in the rental rate of foreign capital, affect factor shares also through wages. An increase in the productivity per cost acts as an improvement in the overall capital augmenting technology and raises the wage rate endogenously, which can be seen from the following

[7] In Appendix 8 we show that the equilibrium foreign rental rate of capital is equal to $R^f = (1+\tau)p^f R^d$. Given this equilibrium condition, trade openness can be thought of as an exogenous shock that moves R^f through a reduction in τ.

[8] We drop the time subscripts in equation (5) and the subsequent equations, as we are evaluating the changes in the steady state.

[9] Given the CES formulation in equation (2), the relative demand for the two types of capital is given by $\frac{K^d}{K^f} = \left(\frac{1-\alpha}{\alpha}\right)^{\gamma}\left(\frac{A^d}{A^f}\right)^{\gamma-1}\left(\frac{R^f}{R^d}\right)^{\gamma}$.

[10] In the next section we report the percentages of each type of capital goods India imported between 1989-1997 (Table 2). The data show that *half* of capital imports are Machinery (except Electrical), a category that embodies a high level of technology. Moreover, using detailed trade data from the UN Comtrade, we can also show that the total value of capital imports, as well as the number of unique capital goods imported to India, increased substantially during this period. See Figure 5 in the Appendix.

expression[11]

$$\frac{\partial lnW}{\partial lnQ} = \frac{1}{\Gamma} Q^{\sigma-1} W^{\sigma-1}. \tag{7}$$

Equation (5) also shows whether the labor share increases or decreases relative to the capital share following a reduction in R^f depends on the elasticity of substitution between capital and labor. If $\sigma < 1$, that is, if labor and capital are complements (which we also estimate using the Indian data in Section 5), then a reduction in the cost of foreign capital will increase the labor share directly by increasing the productivity per cost of capital and indirectly by raising the wage rate.[12]

Foreign Direct Investment While the model we outlined mainly focuses on reductions in the tariffs, we argue that FDI liberalization can also affect factor shares through a similar mechanism of bringing in more efficient capital goods. One can extend the model to include foreign multinational firms that use their own technology capital as in McGrattan and Prescott (2009). FDI can additionally improve the domestic firms' productivity through spill-overs, as shown by a number of studies. For example, Javorcik (2004) and Blalock and Gertler (2008) find productivity spill-overs from FDI into downstream industries in Lithuania and Indonesia, respectively. Using data from the U.S., Keller and Yeaple (2009) show substantial productivity gains from horizontal FDI. Moreover, multinationals can also enhance aggregate productivity through market reallocation and between-firm selection (Alfaro and Chen (2018)). Firms' factor shares can respond to FDI through all of these mechanisms, since each of them would alter wages, cost of capital, and firms' input choices. In our empirical analysis, we highlight the channels through which FDI liberalization can facilitate the use of foreign capital, enhance capital-augmenting technology, and thereby alter the relative factor shares.

3 Data and Descriptive Analysis

3.1 Background and Data on the Liberalization Episode

Before the liberalization in the 1990's, India's economy was characterized by high tariff and non-tariff barriers on imports, as well as restrictions on foreign investment. Following the

[11] It can easily be shown that any factor that raises the wage rate will also raise output per worker, since in equilibrium we have $\frac{Y}{N} = \left(\frac{W}{\eta}\right)^{\sigma}$. Hence, in our setting a reduction in the rental rate of foreign capital will increase output per worker.

[12] The data allows us to measure the effect on real wages – a mechanism for the factor share responses – at the industry level. We do document a significant increase in Section 4.3.

standby arrangement with the IMF, which ensued the balance of payment crisis in 1991, India launched a structural adjustment program and commenced liberalizing its economy. As part of the reforms, the levels and dispersions of tariffs on imports were lowered, and the industries gradually opened up to foreign investment. The heterogeneity in the timing and the magnitude of the reforms across industries allows us to utilize the variation in the tariff measures and the FDI liberalization indicator to identify the effects of openness on firm-level factor shares. Goyal (1996) describes the reforms as "shock therapy" designed to minimize opposition. Moreover, previous papers have convincingly argued that the reforms came mostly as a surprise. For example, using data from the Annual Survey of Industry and focusing on a range of industry characteristics such as employment, wages and average factory size, Topalova and Khandelwal (2011) check the endogeneity of the changes in tariffs between 1987 and 1997 across industries. They find no correlation between tariff reductions and pre-reform (1987) industry characteristics. However, they show that in the years after 1997, tariff cuts may have been more selective to protect less efficient industries. Following their findings, we also confine our study to the pre-1997 period.[13] Still, in Section 4, we check that the policy changes are uncorrelated with firm characteristics that determine factor shares.

To construct our measures openness, we obtain the necessary information on the main policy measures, namely output tariffs and foreign investment openness indices, from Topalova and Khandelwal (2011). We aggregate the indices and output tariffs from their study to the 3-digit 1987 NIC level to construct all our measures.[14] Most importantly, we split tariff measures into output, input, and capital tariffs. Although it is common to separate tariffs as output and input tariff measures, for our purposes it also necessary to differentiate input tariffs, so that the effect on intermediate inputs and capital goods can be isolated (see also Kandilov et al. (2019)). We then make use of the 1993-1994 input-output (IO) table to produce capital and (intermediate) input tariffs, following the UN broad economic category classification of capital goods and intermediate inputs. Our construction of these tariffs follows:

$$capitaltariff_{jt} = \sum_{s} \alpha_{js} outputtariff_{st}, \tag{8}$$

[13]Some of the other papers that argue the exogeneity of the policy changes before 1997, and limit the sample to pre-1997 are Goldberg et al. (2009), and De Loecker et al. (2016).

[14]Topalova and Khandelwal (2011) use a mix of 4 to 5 digit policy measures. However, because we carry out some of our empirical analysis at the 3-digit industry level using data from the Annual Survey of Industries, we aggregate the tariff measures to the 3-digit level to be able to use the same measures consistently through out the paper.

where α_{js} is the share of capital input s (an element in the set of inputs classified as capital goods) in total costs of industry j.[15] We construct the intermediate input tariffs the same way, this time using the set of intermediate inputs. Thus, the sum of capital and input tariffs produces an input tariff measure that is more commonly found in the literature (Amiti and Konings, 2007). Notice that the *effective* capital tariffs we construct seem relatively low because the sum of the IO coefficients is smaller for capital inputs – we sum over a smaller number of inputs. This allows us to capture capital-intensity: industries that use more capital goods in production will be more exposed to the reduction in tariffs on capital goods.

Table 1 reports the average and standard deviation of three types of tariffs between 1989 and 1998. The output tariff statistics line up very closely with Topalova and Khandelwal (2011) since we take these from their study (with the very slight differences being due to the aggregation from 4-5 digit to 3 digit codes). For all three types of tariffs, the mean and standard deviations start to decrease rapidly starting in 1993, and the capital tariffs declined by more than half during this period.

[Table 1 about here.]

A better sense of the changes in tariffs on different types of capital goods is provided in Table 2, which summarizes the categories of capital imports between 1990 and 1997. The *effective* capital tariffs we construct for each industry accounts for how intensely industries employ these capital goods in their production processes. For example, consider the 55 percentage point (p.p.) reduction in the tariff on Machinery, which dropped from 76% to 21%. This change would have affected industries differently depending on their reliance on machinery. In an industry where machinery makes up 5% of firms' input costs, the effective capital tariff reduction would have been small at 2.75 p.p.s. On the other hand, in an industry where machinery makes up 50% of expenditures, the drop in effective capital tariffs would have been more substantial at 27.5 p.p.s.[16] Using this calculation, we find that industries producing tractors and motor-cycles experienced the largest declines in capital tariffs (with a 23 p.p. reduction). On the other side of the spectrum, tea and coffee processing industries experienced a negligible change that was less than 1 p.p.

To give an overview of the industries that were affected the most and the least by the changes in capital tariffs, we group the listed 120 3-digit NIC industries into 15 categories

[15] We have also constructed the capital tariffs using the share of capital input s in total value of the output (i.e., the direct input coefficients in the IO table) as weights. The correlation between the two capital tariff measures is 0.9952, and the results look very similar if we were to use the alternative weights.

[16] The same intuition can be used for inputs tariffs. It is worth noting that we differ slightly from Topalova and Khandelwal (2011) in constructing the input tariffs, who use the value of an input relative to the output value. Therefore, their input tariffs are slightly smaller.

and plot their average effective capital tariff rates at the beginning and at the end of our sample. As expected, Figure 1 shows that the capital intensive industries– such as transport equipment, communication equipment, industrial and electrical machinery– experienced larger reductions in their *effective* capital tariffs. By contrast, the relatively less capital intensive manufacturing industries–such as leather or chemical products manufacturing– were faced with smaller changes.

[Figure 1 about here.]

In Table 1, we also report a measure of FDI liberalization and a “Licensing” index, both taken from the more disaggregated data in Topalova (2010). For the FDI measure, a liberalized industry takes the value of 1 if it is in the list of industries with automatic permission for 51% foreign equity share at time t.[17] Similar to the tariff measures, we aggregate the FDI measure to the 3-digit level and obtain aggregate indices that are between 0 and 1. Before the reforms, a license was also required to establish a plant, introduce a new product and expand capacity. Through annual allotments of inputs and import licenses the government controlled the flow of inputs such as steel and fuel, as well as the licenses to purchase machinery. The “Licensing” measure aims to capture the changes in these licensing requirements. It is an indicator equal to one if the industry is subject to licensing requirements for entry and capacity enhancements, and a *reduction* in this index signals loosening of the requirements. There is large variation in both indices after the passage of the new industrial policies.

[Table 2 about here.]

3.2 Firm and Industry Data

In the following we describe the firm and industry-level data that we use in our empirical analysis, which consists of two separate data sources.

CMIE Prowess Data The data on the panel of Indian firms are collected by the Centre for Monitoring of the Indian Economy (CMIE), and made available by Prowess. The firms in the data-set account for about 70% of the organized industrial activity. In addition to the variables we need to construct the factor shares (capital stock and the total wage bill), the data also contain information on additional features, such as imports, and foreign ownership

[17] Topalova (2010) collects data on openness from *The Handbook of Indian Statistics*.

status, which allow us to analyze the heterogeneity of the impact of openness on the factor shares.

To construct the fraction of labor share to capital share ($\frac{s_L}{s_K}$), we take the ratio of total employee compensation to total payments to capital, which is the product of a firm's capital (net fixed assets) and a measure of the rental rate of capital. In constructing the rental rate, we follow Oberfield and Raval (2019) (see Section C.5 in their Online Appendix) and use the following formula:

$$R_{jt} = \left(P_{jt-1}r_t + \delta_{jt}P_{jt}\right)/(1 - tax_t), \tag{9}$$

where r denotes the real interest rate (source: Reserve Bank of India), and tax is the corporate tax rate for India (source: World Tax Database, University of Michigan).[18] The variable P_{jt} is the investment price index for industry j, constructed as a weighted average of construction and machinery deflators, where the weights are calculated based on the IO coefficients for construction and machinery in each of the 3-digit NIC industries. We use the ratio of total depreciation costs to the stock of fixed assets, each available at the industry-state level from the Annual Survey of Industries, to construct the depreciation rate (δ_{jt}).

ASI Data The micro-level *Annual Survey of Industries* (ASI) data is made available by the Indian Ministry of Statistics, contains information at the plant level for the universe of firms, and covers the liberalization period over 1988-1997. It provides comprehensive data on the industrial sector, which is mostly manufacturing plus repair services, gas and water supply and cold storage. The Survey is conducted annually, and covers all factories registered under the Factories Act of 1948, which are defined as factories employing 10 or more workers using power, and those employing 20 or more workers without using power. For each plant we know the district (within a state) it operates in, and its industry. In addition to having a much larger coverage than CMIE, another advantage of the ASI data is that it contains information on employment and labor compensation for several categories of workers.[19] The main disadvantage is that it cannot be used for panel data analysis of the reforms that were

[18] Oberfield and Raval (2019) use the external real rate of return specification of Harper et al. (1989) and define the rental rate as $R_{jt} = T_{jt}\left(P_{jt-1}r_t + \delta_{jt}P_{jt}\right)$, where T_{jt} is the effective rate of capital taxation in industry j. They calculate the effective capital taxation rate for the U.S. using asset level information (converted to industry level using capital flow tables) on depreciation deductions for tax purposes, the effective rate of the investment tax credit, and the effective corporate income tax rate. Because we do not have such detailed information for India, when calculating the rental rate of capital, we are only able to use the aggregate corporate tax rate, which varies only by year.

[19] It also has fairly detailed capital stock information, including a break-down by type of capital (structures and equipment). However, unlike the CMIE data, it does not contain information on capital imports.

staggered over time for industries because there are no plant identifiers. However, we use the plant level data to construct a panel of aggregate compensation, capital stock/depreciation, etc. at the state-industry (3 digit NIC)-year level. This allows us to construct representative measures like average wages, which is not possible with the CMIE data.[20] As we describe in Section 5.1, we use the plant level data to run cross-sectional regressions to obtain estimates of the elasticity of substitution between labor and capital. Finally, we note that all our data is reported for each fiscal year; that is, for example, year 1988 refers to the 1988-1989 fiscal year.

3.3 Factor Shares

For context, prior to our empirical results on how openness can impact firm-specific factor shares, we present some statistics on the evolution of aggregate factor shares in India during our sample period. Although we mostly use relative factor shares as the outcome in the regression specifications, in this section we also show the time series of labor and capital shares (relative to value added) to confirm they display similar patterns. We first present factor shares using aggregate data from ASI, and then confirm that the same patterns hold in the CMIE data.

Factor Shares at the Industry Level Panel (A) in Figure 2 reports the aggregate labor and capital shares (relative to value added) in the manufacturing sector based on the ASI data. We aggregate total factor compensation and value added in the manufacturing sector as a whole by aggregating observations for each state-industry per year.[21] To construct the capital share, we use the information on the stock of fixed capital (gross and net of depreciation) provided in the ASI data, and combine it with the rental rate of capital (described above) to construct capital expenditures.

Figure 2 depicts a decline in the labor share and an increase in the capital share over the 1988-1997 period. Aggregate labor share drops around 20%, while the capital share shows a secular climb that is concurrent to the labor share decline. There is slightly more variation in the capital share, partly due to the changes in the interest rate, as the real rate in India (reported by the Indian Central Bank) spikes in 1992. The level of the manufacturing labor

[20] The plant level ASI is not available for 1990-91, 1991-92, 1992-93 and 1995-96. For this reason we complement the data with aggregate data provided by ASI for all years. This aggregate data is essentially a summary of the micro data, also purchased from ASI, but is available for the full period.

[21] We have also calculated factor shares at the state-industry level, then taking an unweighted average, and do not find any different trends. A decomposition of the labor share (not reported) would show that, similar to what has been documented in other countries, the factor share trends are within-industry, i.e., the reduction in the labor share in India is due to within-industry declines.

share constructed using the ASI data varies from 36% in 1988 to 27.5% in 1997.[22]

In Panel (B) of Figure 2, we report the time series of the compensation of labor relative to capital expenditures, which we report for the manufacturing sector as a whole. Relative factor shares eliminate the markup component that exists in the labor share of value added. Consistent with the previous graph, the figure shows that the ratio of labor compensation to capital expenditures has also experienced a steady decline throughout this period.[23] We therefore conclude that the decline in the labor share is consistent with capital income growing faster than labor income, and is not merely a reflection of increases in markups or other changes that move capital and labor income equally during this time.

[Figure 2 about here.]

Factor Shares with the CMIE Firm Data To check how close the factor shares in the CMIE data track the industry level trends, we also construct the time series of factor shares using the sample of firms in the CMIE data. Panel (A) of Figure 3 shows that the aggregate labor share is below 15%, which is lower than the labor share calculated using ASI data.[24] Even more extreme than the ASI data, which do not account for firms with less than 10 workers, the CMIE data provide information on a selection of even larger firms with smaller labor shares. However, the trends found above with the aggregate data are still present, so we conclude that changes in the factor shares of firms within the selected sample represent the dynamics in the labor share observed in the economy overall. A similar picture emerges for the labor-to-capital expenditure ratios in Panel (B). The level is lower, as this selection of firms are more capital intensive, but a reduction in this ratio can be seen when comparing the pre-1992 period average with the end of the sample – a reduction of about 17% (from 0.9 to 0.75).

We emphasize that this study does not aim to explain the overall trend in the labor share – in fact we find the trade reforms mostly raised the labor share, a response that goes against the aggregate trend. Our aim is to compare the relative factor share responses of firms differentially exposed to openness reforms. To complement the firm-level results, in

[22]As a check, we have also calculated labor share using data provided in the KLEMS dataset. We observe a similar downward trend in the KLEMS labor share measure, but on average the labor share is around 10 percentage points higher than the labor share calculated using the ASI data. We relegate the description of KLEMS dataset and the time series of factor shares to the appendix.

[23]Fixing the rental rate over time, to eliminate the large fluctuations in the real interest rate in India, leads to a slightly more stable relative factor share but displays a similar pattern. The variation in the Indian interest rate does not affect our empirical results, since it is an aggregate picked up by year fixed effects.

[24]Ahsan and Mitra (2014) report very similar labor share numbers. This could point to a problem in the construction of value added, one reason we prefer our relative factor shares measure.

Section 4.3, we estimate the main specification using the industry-level ASI data in order to check how the selection of firms in CMIE affects our findings. Additionally, the aggregate estimates also reflect the reallocation across firms in response to the reforms that might negate some of the average within-firm changes. When compared to the results obtained with the CMIE data, changes in the capital tariffs have almost the same impact on aggregate relative factor shares. However, the rise in the labor share due to the FDI liberalization disappears in the ASI data, which likely speaks to the reallocation across firms negating the firm-level effects.

[Figure 3 about here.]

4 Empirical Results

In order to identify the effects of openness policies on the relative factor shares, we formulate our main empirical equation as follows:

$$\ln\left(\frac{s^L_{ijst}}{s^K_{ijst}}\right) = \alpha_i + \alpha_{st} + \beta Policy_{jt} + \epsilon_{ijst}, \tag{10}$$

where the subscripts denote firms (i), 3-digit NIC industries (j), states (s), and years (t).[25] We use $Policy_{jt}$ to describe the reform measures of interest— the three types of tariff measures and the FDI liberalization indicator—, as well as the licensing requirement indicator. Because the policy measures are constructed for each 3 digit NIC sector-year, the identification of the vector of coefficients β arises from within-sector variation in liberalization across years, as well as the differential level of the policy measures across sectors. We include a set of fixed effects, which contains the state-year interaction effects (α_{st}) to control for all aggregate shocks at the state level, and firm fixed effects (α_i) that capture the time-invariant unobservable firm characteristics. We should note that many of the firms in the Prowess database are multi-product firms, suggesting that they can be exposed to policy changes in more than one industry. However, firms in the sample are assigned to a single 3 digit-NIC industry based on the classification of it's highest-selling product.[26] Therefore, while

[25] Unlike the plant level ASI data, the state indicators provided by Prowess are based on the state where the firm headquarter is located, which might be different than the state production takes place. Nevertheless, controlling for these state-year effects is important, since they can capture shocks (e.g., finance shocks) that affect decision making at the managerial level, which can impact hiring, investment, and factor payment choices.

[26] More specifically, a firm is classified under a particular industry if more than half of its sales in a given year originates from a particular industry.

the identification of our estimates are based on the industry level variation in the policy measures, it is still important to control for the firm-fixed effects that capture firm's multi-product status, and consequently whether the firm is exposed to fluctuations in more than one industry or not.[27] Finally, in all cases we cluster standard errors at the 3-digit NIC industry level.

4.1 Main results

The results for the main specification in equation (10) are reported in Table 3. The first column includes tariffs as the only policy changes, and it provides evidence that neither the output nor the intermediate input tariffs have any significant effect on the relative factor shares. The strongest effect is estimated for the tariff on capital goods: a lower tariff on capital goods significantly increases the wage-to-capital-expenditure ratio. We can interpret this reduced form result through the lens of the theoretical analysis in Section 2 as follows. A reduction in the tariff on capital goods lowers the cost of foreign capital, and allows the firms to use more of these goods, which raise the productivity of capital per unit of expenditure. The fact that this increase in productivity leads to an increase in the fraction of income going to labor relative to capital suggests that labor and capital are complements in the data ($\sigma < 1$), which we confirm in Section 5.1.

The coefficient on capital tariffs implies that a 5 p.p. reduction in the *effective* capital tariff rate (the average reduction across industries as shown in Table 1) leads to a 11.5% increase in factor payments to labor relative to capital (2.3×5). We can illustrate the interpretation of this impact with the following example. Consider a 50 p.p. reduction in the import tariff on electrical industrial machinery.[28] This capital good makes up 3.5% of the total inputs (capital and intermediate inputs) used by the electrical appliance industry, implying a 1.75 p.p. reduction (0.035×50) in the effective capital tariff rate firms in the appliance industry face. This reduction in turn generates a 4% increase (1.75×2.3) in payments to labor relative to capital. By contrast, the leather products industry, for which electrical industrial machinery makes up only 0.04% of total inputs, experiences an effective tariff reduction of 0.02 p.p.s, which then leads to a negligible increase in the relative labor payments at 0.05%.

In column (2), we consider the impact of FDI liberalization on the relative factor shares.

[27] In the Prowess data, it is possible for a firm's industry classification to change from year to year depending on the product that it sells the most in that particular year. However, we do not observe any switches during the 8 years we are analyzing.

[28] The 3 digit NIC code for this good is 360. The tariff rate for this good was reduced by 57 p.p.s between 1990 and 1997, see Table 2.

An increase in "FDI Liberalization" signifies a *reduction* in the barriers to FDI, and can be interpreted as an improvement in the access to foreign capital. The result implies that a fully treated industry, whose FDI measure increases from 0 to 1, is expected to see a 16.7% increase in its wage-to-capital-expenditure ratio. This impact can be a result of foreign firms bringing their capital when they enter India, which then generates an increase in the capital-augmenting technology (McGrattan and Prescott (2009)). Assuming labor and capital are complements, firms respond to an improvement in the capital-augmenting technology by hiring more skilled labor, which in turn leads to higher wages and increases labor's share of total income.

The specifications in column (2) and the subsequent columns also include "Licensing", which captures a concurrent policy change during the restructuring in India. Previous literature has found that relaxing license requirements for entry and capacity enhancements had a very large positive impact on economic growth (Aghion et al., 2008), and that the effect was especially stronger in states that were "less pro-worker". In the context of factor shares, we find that the *reduction* in the licensing requirements lowered the relative share of labor. These results suggest that lowering the share of products in an industry subject to licensing requirements made it easier for firms to invest and increased the overall use of capital. Hence, this policy change contributed to the decline in the labor share observed in the aggregate data.

When we include capital tariffs along with FDI liberalization and licensing in column (3), the impacts of capital tariffs and FDI decline very slightly.[29] Using this specification, which will be our benchmark going forward, we provide a back of the envelope estimate for the impact of the removal of restrictions to foreign capital in a representative industry. A 5 percentage point decline in the effective capital tariff rates combined with a FDI liberalization of 0.45 (the average increase of the index in Table 1), implies a total increase in the relative labor share of 17.1% in this representative industry ($5 \times 2.2 + 0.45 \times 0.136 = 17.1$). To put this magnitude in context, for our CMIE sample of firms, the aggregate relative labor share declined about 17% between the pre-reform years and 1998 (Figure 3). Therefore, our findings indicate that the reduction in the relative labor share could have been much larger absent the liberalization on foreign capital.[30]

In column (4), we show that the results remain robust to including state-industry wages in the specification. In the fifth column, we add credit to GDP ratio to the specification

[29] In appendix Table 11, we show that there is a strong correlation between industries that lower capital and input tariffs, and also liberalize FDI.

[30] The typical caveats of this type of counterfactual – that all else is held constant – apply. In Subsection 4.3, we present a more aggregate analysis that captures the reallocation effects in addition to the firm-level changes in relative factor shares.

in column (3). This variable, which captures the credit conditions in each state, varies at the state-year level; therefore, we use separate firm, state, and year fixed effects, and exclude the state-year interactions. The negative coefficient, which is large but noisy, suggests that increases in total credit lowered the relative share of labor. This result suggests that improvements in the availability of credit allowed the firms in India to invest more in physical capital, and unlike the reforms related to openness, contributed to the decline in the labor share observed in India.[31] Controlling for aggregate shocks at the state level is potentially important, so in the rest of the analysis we adopt the specification in column (3) as our baseline, and present the results omitting (but implicitly controlling for) state credit.

[Table 3 about here.]

Alternative Firm Outcomes Our main outcome measure assumes that labor and capital only get paid through their factor payments, and the impact of markups on the labor-share and the capital-share cancel out. However, it is plausible that firm profits get paid fully to capital owners, increasing capital's share of total income. To address this measurement issue and to show that labor's share of value added displays similar responses to the policy changes we obtained for relative factor shares, in Table 4 we consider two alternative measures of labor share. In doing so, we lose some observations in the calculation of the alternative measures. For this reason, in column (1) we repeat the baseline specification of the previous table (column (3) in Table 3), and show that the change in the sample does not alter the results. The first alternative measure we consider, presented in column (2) of Table 4, adjusts for firm's markup in labor's share of factor payments and is calculated as $s_{it}^L = \frac{1}{\mu_{it}} \frac{W_{it}N_{it}}{W_{it}N_{it}+R_{it}K_{it}}$, where μ_{it} is the estimated firm markup.[32] The second measure is the simple fraction of labor payments to value added. Columns (2) and (3) show a statistically and economically significant increase in the labor share in response to a reduction in capital tariffs. The fourth column suggests that markups might have also increased. These results are consistent with De Loecker et al. (2016), who find that firms pass-through a part of cost reductions into markups. Still, we find that labor did benefit from trade liberalization and the changes

[31] These reforms are consistent with a relaxation of financial constraints and do not reflect the shocks to openness we explore in the theory. These results also line up with our findings in Leblebicioglu and Weinberger (2020), where we show banking deregulation across the U.S. states led to lower loan yields and improvements in the availability of credit in the U.S. and thereby contributed to the decline in the labor share.

[32] This expression for the labor share is obtained by combining the firm's first order conditions(see appendix) with the expression for aggregate output in (1). As a markup measure, we use a simple price-cost margin: $\frac{Y-WN-RK-Interm}{Y}$. The median markup is 18%. We also constructed markups using the DeLoecker and Warzynski (2012) method yielding similar results.

in firm markups did not wipe out the gain in labor's income share.[33] The results for FDI liberalization display a similar picture, and the results in Table 4 once again show that the removal of the licensing requirements hurt labor, causing its share (in both markup adjusted and unadjusted terms) in income to decline.

In the last two columns of Table 4, we report the effect of the policy reforms on alternative firm outcomes, which provide supporting evidence on the mechanisms we propose to explain the increase in the relative labor share following the openness reforms. Using a dummy equal to one if a firm imports capital in year t as the outcome measure, in column (5) we show that lower capital tariffs increased the share of firms that imported capital, which verifies the premise of increased usage of foreign capital in our theoretical framework.[34] In the next subsection we provide further evidence that these new importers saw the largest rises in the relative factor share. Finally, the last column suggests that firm TFP also increased following the reduction in capital tariffs.[35] Our theoretical model demonstrates the relative labor share and wage increases with a rise in the use of imported capital, which increases the capital productivity per unit cost. The result in the last column of Table 4 confirms that lower capital tariffs do indeed lead to higher productivity, and thereby to the labor share increase. We return to this point in Section 4.3 with the aggregate results.

[Table 4 about here.]

Robustness The benchmark specification leverages tariff reductions and the removal of the restrictions FDI and license restrictions that were staggered over time. However, there might be concerns about expected policy changes affecting factor shares before the reforms are implemented. Additionally, it might not be obvious when the policy reforms affect the outcome variable. To alleviate these concerns, we consider a long-differences specification, where we use the difference in the policy and outcome measures between the 1989-1990 fiscal year and the 1997-1998 fiscal year. Since we also take the difference in the firm outcomes over these years, we are left with a sample of firms that survive over the 8 years. For this reason, the number of firms drops to 1,053 from 3,576 firms. In Table 5 we replicate the first three columns of Table 3 using a cross-section of long-differences. The results are similar to the baseline specification. Different from the baseline specification, the licensing measure becomes noisier when we eliminate the annual variation, although the magnitude of the coefficient is similar.

[33]Columns (2) and (3) suggest that a 5 percentage point reduction in the effective capital tariff is associated with a 4 percent increase in the labor share, which is economically important.

[34]This result is also consistent with the findings in Bas and Berthou (2017) and Kandilov et al. (2019).

[35]We compute TFP using the Ackerberg et al. (2015) estimation with a gross output production function.

[Table 5 about here.]

We also run a separate analysis, which allows us to visualize the effects of the policy changes over time. For brevity, we relegate the description and the results of that analysis to the appendix (Figure 6). Like the robustness result above, that alternative specification has the downside of losing the annual variation; we interact a time-invariant measure of the (absolute value) long-difference in the policy measure for each industry with year dummies. It allows us compare relative factor shares across time for industries that experience varying treatment intensity. An important conclusion is that there is no evidence of differential pre-trends in factor shares between these types of industries. Although there is a large literature advocating the exogeneity of these reforms, especially during the limited time period we restrict our analysis to, we confirm this key identifying assumption holds also with respect to the labor share as the outcome.[36] It is also clear that over time the relative labor share increases more in industries with larger overall changes in capital tariffs and FDI liberalization.

To summarize, the results suggest that by reducing the price of imported capital, and increasing the availability of foreign capital used in production, openness in India led to an increase in the labor share relative to capital's share of income. The theoretical model in Section 2 suggests labor share can increase faster than capital's share as a result of the reduction in the price of capital, especially for firms that use foreign capital. Additionally, openness can enhance the capital-augmenting technology for firms that have an increased access to foreign capital goods, through imports or foreign investment. Since both impacts imply an increase in the productivity-per-cost of capital, they generate a higher labor share and wages. In the following subsection, we check whether these interpretations are consistent with the observed firm-level factor share changes by using firm characteristics that are salient to the described mechanisms.

4.2 Firm-Specific Mechanisms

Importers We start by showing that the reductions in tariffs increased the relative labor share mainly for firms that import capital. To that end, we create a dummy variable equal to one if the firm imports capital goods during *any* year in the span of our data, and a separate dummy variable equal to one if the firm *starts* to import after entering the dataset. The latter allows for the endogenous extensive margin response of firms starting to import capital. Almost 60% of firms import capital at some point between 1989 and 1997, a high number reflecting the fact that our data contain mostly large and medium-sized firms. About half

[36] A caveat is that we only have 3 pre-reform years to compare to the post-reform years.

of those (29%) do not import at the beginning of the sample but start to import later. We check the heterogeneous response of capital importers versus non-importers by interacting the capital importer dummies with the liberalization measures. Given the number of policy measures that we analyze, we can potentially have many interactions in each specification, so we only present the interaction terms with capital tariffs and FDI.

Columns (1) and (2) of Table 6 provide the first set of evidence that the average labor share increased relative to capital share due to firms that import capital. We find that the reductions in the capital tariffs increase the labor share more for firms that import capital ("CapT*Kimp (Ever)"), and this is especially true for the new capital importers ("CapT*Kimp (Start)" in column (2)). These results indicate that lower capital tariffs raise the relative share of income by allowing firms to use more foreign capital, which raise firm's productivity and allow them to pay higher wages to workers (as we show in the next subsection). Comparing the interactions in the first two columns, the rise in the labor share as a policy response is larger, and statistically significant, for the new capital importers. This suggests that while the mechanism can hold along the intensive margin for firms that already had access to foreign capital prior to liberalization, it strongly operates along the extensive margin, by allowing more firms to access foreign capital. The labor share response to FDI liberalization for capital importers seems to be muted, most likely because FDI reform does not directly affect the intensity with which firms use imported capital.

The fact that lower tariffs led to a higher relative labor share despite the rise in capital imports, which are presumably more expensive, suggests that reforms increased payments to labor by even more. The increase in payments to labor can be explained by productivity gains emerging from the use more efficient foreign capital, as our model suggests. Hence, taken together, our results point to access to the technology embodied in foreign capital as a channel through which openness can improve labor's share of income.

Next, we consider firms' overall "exposure" to imports. To do so, we calculate the ratio of firm's total imports (of intermediate and capital goods) relative to total sales, take the average import intensity at the firm level for all years, and interact the average with the policy measures of interest. Column (3) shows that a reduction in the capital tariff leads to a larger increase in the labor share for firms that have higher import exposure. That is, the large importers benefit more from the reduction in the rental rates of capital and the accompanying improvements in the capital-augmenting technology, and therefore increase their relative labor share.

Productive Capacity and Borrowing The specification in column (4) of Table 6 interacts the initial capital intensity of the firm with capital tariffs and the FDI liberalization indicator. To construct capital intensity, we take the ratio of fixed assets to a measure of labor that we calculate by dividing total compensation by the average wage rate.[37] The interaction term with capital tariffs is negative and significant, suggesting that the more capital intensive a firm is, the larger will be the relative increase in the labor share following tariff reductions. This is consistent with the interpretation that by making foreign capital more accessible, lower capital tariffs lead to an increase in the capital-augmenting technology, and it does so especially at higher levels of capital intensity.[38] Moreover, we find that the impact of FDI liberalization is larger for more capital intensive firms. We find similar results with the average debt to equity ratio of the firm interacted with the policy variables (column (5)). This can be a result of the fact that the firms who borrow more easily can finance more imported capital. While the sign on the interaction term with the average debt to equity ratio suggests financially less constrained firms benefit more from FDI openness, potentially because it is easier for them to adopt the foreign technology brought in by the multinationals (Alfaro et al. (2010)) or to become their suppliers (Javorcik and Spatareanu (2009)), the impact is not statistically significant.

Lastly, in column (6) of Table 6, we interact the policies with a dummy equal to one if the firm has foreign ownership. Since firms with foreign ownership tend to be technologically more advanced and are financially less constrained, they might respond differently to tariff reductions. We find that the increase in the relative labor share to lower capital tariffs is stronger for foreign-owned firms. These firms are more likely to increase their use of foreign capital, which enhances the productivity embodied in their total capital, through their existing international supply networks. Not surprisingly, further FDI liberalization within an industry does not affect a firm that is already foreign-owned. Finally, in the appendix we investigate how firm size affects the results, an analysis that can be compared to Ahsan and Mitra (2014).

[Table 6 about here.]

4.3 Industry Specific Mechanisms and Aggregate Impacts

To further illustrate the mechanisms through which openness can affect factor shares, we analyze the impact of the policy changes on outcomes at the state-industry level with the

[37]The Prowess data do not include units of labor or number of workers. Therefore, we need to construct a proxy for labor with total compensation (from Prowess) and the average wage rate (from ASI).

[38]In Table 12 included in the appendix, we repeat this specification splitting the sample between importers and non-importers. We find that the interaction term between capital tariffs and capital intensity measure is significant only for the importers, suggesting that the imported capital raises the productivity of capital for importers, and it does so especially at higher levels of capital intensity.

aggregated ASI data. The first column of Table 7 compares our baseline results to those in the ASI data. We find that a reduction in the capital tariffs leads to an increase in the relative labor share also at the state-industry level. Quantitatively, a one percentage point reduction in effective capital tariffs increases the relative labor share by 1.5%, which is slightly lower than the 2% increase we find using the firm level data. The fact that we get a similar, albeit slightly smaller, impact using aggregate data is reassuring, as it shows that the sample selection and coverage of the CMIE data are not problematic for inference.[39] Moreover, this aggregate estimate reflects the combined effect of the firm-specific changes in factor shares and the *reallocation* effects across firms following the liberalization. It is highly conceivable that liberalization policies changed the firm distribution in India in favor of more capital intensive firms. In particular, by making capital cheaper, lower tariff rates might have allowed more capital-intensive firms to enter the market and might have led the operating ones to grow faster than the labor-intensive firms. With these adjustments in the firm distribution, total payment to capital would have grown faster than the payments to labor, which would partly offset some of the increase in the relative labor share within firms, and can explain the smaller impact we obtain on the aggregate relative labor share (Figure 2). Nevertheless, we find that the 5 p.p. reduction in the effective capital tariffs experienced between 1989 and 1998 led to a 7.5% increase in the labor share relative to capital's share of total income, suggesting that the within firm adjustments were more dominant.

FDI liberalization does tell a different story with respect to reallocation; there is no impact on factor shares at the aggregate level. As FDI liberalization makes it easier for foreign firms, which are more likely to be capital-intensive, to enter an industry, it can lead to a faster increase in the total use of capital compared to labor in that industry. We still find that a reduction in the licensing requirements contributed to the decline in the labor share, although the estimates are more noisy. The aggregate reduction of the relative labor share is slightly larger than in the firm-level specification, which suggests that reallocation magnifies the reduction in the labor share due to a policy that reduces size distortions. [40]

The aggregate ASI data also allows us to look at the changes in wages and employment for different types of labor. In fact, the most prominent results we uncover with this sample is

[39] In fact, aggregating the CMIE sample, so that we are comparing the same set of firms as the benchmark, produces a very similar result to the ASI (Table 14 (last column), Appendix 7.8). Therefore, the sample selection is not driving our result.

[40] Weighted regressions (Table 14, first two columns) of the firm-level data display a slightly smaller effect, implying that small firms react the most. This is consistent with: i) response of labor share to capital tariffs is largest in "small" firms (also show in Table 13 of appendix), and ii) smaller firms are the "new capital importers". The FDI coefficient in aggregate regressions is lower, confirming that FDI deregulation seems to reallocate production to capital intensive firms. In this case reallocation again amplifies the labor share reduction in response to looser licensing requirements.

the across-the-board positive effect lower capital tariffs has on wages. Column (2) of Table 7 reports the effects on total wages for all employees: a 5 p.p. reduction in effective capital tariffs raises wages by 3%. Previous literature has found importing is associated with skill upgrading (Kasahara et al., 2016), though we find that the rise in wages is not merely driven by a change in the skill premium. When we split employment into "skilled" and "unskilled", we find that both types of labor experience a rise in wages, which is slightly higher and statistically significant for skilled workers (columns (3) and (4)).[41] Finally, consistent with Topalova (2010), we find some evidence that lower output tariffs reduce the wage rate and this is driven by the unskilled wage.

In columns (5) and (6), we confirm that the increase in the payments to labor relative to capital is not driven by changes in employment. The results in column (5) show that aggregate employment did not increase following the openness reforms. Moreover, we do not find any evidence on reallocation towards skilled labor after the reduction in capital tariffs, as shown in the specification for the fraction of skilled workers to total employment (column (6)). However, there is evidence that FDI liberalization raises skilled employment. It is likely that the worker composition does become more skill-intensive with FDI, as multinationals tend to hire more skilled workers. This likely contributes to the rise in the labor share (as we find in the baseline results in Table 3), but the general equilibrium reallocation to more capital intensive firms seems to counter-act this effect.

In column (7), we report a large rise in value added per worker at the aggregate level, which reinforces the productivity mechanism through which the relative labor share increases following the reduction in the capital tariffs. This result parallels the positive effect we found on firm-level TFP (column (6), Table 4), and supports the premise that lower tariffs increased access to foreign capital embodying a higher level of technology.

The final outcome we investigate (column (8)) is the rental rate of capital. The results mostly suggest a muted rise in response to lower capital tariffs. The compositional effect towards imported capital goods can lead to an the increase in the overall rental rate of capital if firms reallocate capital towards more of the technologically advanced capital goods that are costlier. As described in subsection 3.2, the industry-level variation in the rental rate we construct in (9) arises from the differences in the depreciation rates and investment price indexes across the 3-digit NIC industries over time. We construct the former using the detailed ASI data aggregated to the industry level, and the latter using a weighted average of construction and machinery price indexes, with the industry specific weights obtained from India's input-output tables. As such, an increase in the rental rate following lower capital

[41] We do caution however that the information on skill is limited. We define skilled employees as managers and proprietors.

tariffs can be explained by an increase in the investment price index or an increase in the depreciation costs, both of which can be attributed to an intensified use of higher quality and more expensive foreign capital. Unfortunately, we cannot directly test this proposition since we do not have the data on the types of capital goods that the firms are purchasing or using to construct quality adjusted rental rates. However, it is worth noting that the relative labor share increase we find despite a potential rise in the rental rate of capital suggests that the wage increases, which emerge as a result of the growth in the capital-augmenting productivity, dominate the changes in the factor shares. Overall, we find very strong evidence that both capital productivity (net of cost) and wages increase significantly, resulting in a higher relative labor to capital compensation ratio.

[Table 7 about here.]

5 Structural Interpretation of the Results

5.1 Elasticity of Substitution Between Capital and Labor

Interpreting the mechanisms that drive the changes in factor shares in response to openness reforms using the framework in Section 2 requires an estimate of the elasticity of substitution between capital and labor (σ). Our results showing the reductions in the capital tariffs increased the labor share relative to capital's share suggests that labor and capital are complements, that is, $\sigma < 1$. In this subsection we confirm that, consistent with most other firm-level studies (Chirinko, 2008; Barnes et al., 2008), capital and labor are indeed complements in the Indian plant-level data.

To estimate the elasticity of substitution between capital and labor, we adopt the strategy in Oberfield and Raval (2019) and utilize the *cross-sectional* variation in wages across the districts within a state.[42] We utilize the universe of plants in the ASI data (for the available years), and estimate the following specification:

$$\ln\left(\frac{s^L_{ijdst}}{s^K_{ijdst}}\right) = \alpha_{sjt} + (1-\sigma) ln\left(Wage^{ASI}_{jdst}\right) + FirmControls_{ijdst} + \eta_{ijdst}, \tag{11}$$

where i, j, d, s, t represent plants, industries, districts, states, and years respectively. Note that because we do not have plant identifiers, we cannot account for the time variation, but in one specification we pool together data for all years. State-industry-year fixed effects

[42] Oberfield and Raval (2019) identify the long-run elasticity with the variation in wages across the U.S. metro areas, estimated separately for each year.

(α_{sjt}) capture all shocks within a state-industry pair, including the various reforms that we study in this paper. Additionally, district-level variation allows us to control for the state-specific labor regulation regimes (Aghion et al., 2008).[43] When we estimate the specification for single years, fixed effects include only state-industry interactions. Firm controls above include a dummy for importers of intermediates, firm's markup, debt to equity ratio, cost of inputs, an indicator for whether the plant is operating in an urban metro area, and a dummy for exporting status.

Results are reported in Table 8, where we complement the pooled regression that includes all years pre-1997 (columns (1) and (2)) with regressions using single years of data (before and after the reforms).[44] In all cases, the coefficient on the wage rate is positive, yielding a value for the capital-labor substitution parameter that is below one. Given the results across specifications, our estimate of σ is in the range of 0.87 to 0.96.[45] We do note that the complementarity result is contrary to Karabarbounis and Neiman (2014) (KN), who find capital-labor substitution elasticity to be greater than one in the United States. To estimate the elasticity, they use cross-country variation in the price of capital over time, which they argue is due to reductions in the price of equipment goods in the 1980's. In contrast to KN, we run two separate estimations. We estimate σ at the plant-level using the variation in factor prices across districts (within a state-year), which accounts for any endogenous response of factor prices to other reforms occurring during this time.[46] Separately, we estimate the effect of the reforms on factor shares (specification 10), and interpret the results given the σ found in the previous step.

[Table 8 about here.]

[43]A separate strategy to estimate σ is to regress wages jointly with the responses to liberalization reforms using time variation in state-industry average wages. However, this estimation strategy can expose us to a potential bias in σ if wages are correlated with the error term. For example, other contemporaneous government reforms or financial changes that are state-specific can be correlated with factor prices. Note that, as we previously discussed, the trade and FDI reforms are considered to be set off as a "shock therapy", and therefore are argued to be *not* correlated with the error term.

[44]We estimate 1997-98 separately due to the differences in the structure of the data.

[45]As in Oberfield and Raval (2019), we confirm that the complementarity result holds when we eliminate structures, and use total payments to only plant and machinery (column (2), Table 8). They report an estimate of 0.7 for the U.S. manufacturing sector. Using data for 2001-2003, they estimate an average plant level estimate of 0.53 in India and calculate an *aggregate elasticity* of 1.11 for the whole manufacturing sector, where the greater heterogeneity in capital intensities account for about 70% of the overall elasticity. Our estimate for σ in column (2) is the average at the firm level (without giving higher shares to larger firms) obtained for the 1989-1998 period.

[46]Given our identification strategy for Indian plant-level data, our σ is an average of plants' substitution elasticities, whereas their estimate reflects an aggregate elasticity at the country level.

5.2 Structural Interpretation of the Empirical Results

Having obtained an estimate of the elasticity of substitution between capital and labor, we next quantify the increase in the relative labor share suggested by our model. Comparing the magnitude implied by the model to the reduced form estimates sheds light on the importance of the mechanism we describe in Section 2. To facilitate the comparison, we combine equations (5)-(7) with the relative demand for the two types of capital, and the fact that $\frac{\partial ln(R^f)}{\partial \tau} = \frac{1}{1+\tau}$ to obtain the following expression for the percentage change in the relative labor share with respect to a one percentage point change in the capital tariff rate (see Appendix 8 for the details):

$$\frac{\partial ln\left(\frac{s_L}{s_k}\right)}{\partial \tau} = -(1-\sigma)\left[\frac{s_K}{s_L}+1\right]\frac{1}{1+\frac{R^d K^d}{R^f K^f}}\frac{1}{1+\tau}. \tag{12}$$

Evaluating the above expression requires us to pick values for four terms. For σ we use a value of 0.9, which is in the middle of the range of estimates presented in Table 8. To calculate the ratio of capital-to-labor share, $\frac{s_K}{s_L}$, we utilize the aggregate ASI data on total wages and total capital expenditures, which we also use in Table 7, and take the average of the ratio across the sample years to get a value of 1.11.[47]

We evaluate the third term— payments to domestic capital as a fraction of payments to foreign capital $\left(\frac{R^d K^d}{R^f K^f}\right)$— using the following assumptions. First, we approximate the ratio of the capital stocks, $\frac{K^d}{K^f}$, with the ratio of investments.[48] We use foreign capital imports (obtained from the Prowess data, aggregated for the whole economy) as the proxy for investment in foreign capital and subtract it from total investment expenditures to obtain investment in domestic capital goods. Using the aggregated data and averaging across years results in domestic investment 3 times larger than the foreign one.[49] Second, we assume that the rental rates of domestic and foreign capital differ only by the tariff rate; that is, the price of the two types of capital are the same.[50] Note however, in reality foreign capital is likely to be more expensive, assuming India imports capital that embodies better technology than the ones produced domestically. In that respect, setting the price of the two types of capital

[47] If we use the average capital-to-labor share calculated from the Prowess data (a value of 1.22), we obtain a slightly larger increase in the relative labor share implied by our model than the one discussed below.

[48] Our approximation is based on the steady state relationship between the capital stock and the investment flow, where $K^x = \frac{I^x}{\delta^x}$, for $x = \{d, f\}$. In that case, the investment ratio equals the capital stock ratio when the depreciation rates are equal.

[49] This value decreases over time: $\frac{K^d}{K^f}$ is 4.5 in 1990, which drops to 2.5 in 1998.

[50] From the household's optimal investment decision, we have $R_t^f = R_t^d p_t^f (1+\tau)$. We are setting the relative price of foreign capital good, p^f, to 1. See Appendix 8 for the household's problem.

to be the same provides us with a lower bound for the impact implied by the model.

The fourth value we need to pick, both to calculate the ratio of the rental rates and the last term in equation (12), is the ad valorem tariff rate, τ. Table 2 shows that different tariff rates were imposed on different capital categories. To obtain an overall ad valorem capital tariff rate for each year, we take an average of the rates, using as weights the IO coefficients that show the importance of each capital category in the total use of capital for all industries. Then, we include the average across years in the calculation of the impact in (12).

The assumptions described above yield the change in the relative labor share given a percentage point change in the tariff rate on a representative capital good. By contrast, our empirical estimates show the impact of the *effective* capital tariffs, which are calculated using the share of a particular capital input s in total input costs and capture the capital-intensity of industries (see equation (8) and the pursuing description in subsection 3.1). To make these two estimates directly comparable, we scale the impact we calculate in (12) with the weight of capital in production. We construct this weight using the IO coefficients to compute the share of capital costs to total costs in every NIC industry, and then averaging across industries using the same weights as in the industry-level regression specifications (number of plants in the ASI data).[51]

Consequently, we find an increase of 0.76% in the relative labor share predicted by the model, which reflects the combined effects of lower capital import costs and the accompanying capital composition shift towards the more efficient foreign capital. The results in column (1) of Table 7 suggest an increase of 1.5% given a one percent decline in the effective capital tariffs. Hence, the model captures approximately 50% of the increase in the relative labor share uncovered in the data. As noted above, this effect can be thought of as a lower bound given our assumption on the equality of the price of the two types of capital. Moreover, a different estimate of σ can alter the change in the relative labor share predicted by the model. For example, if the substitutability between capital and labor is lower in the short-run, implying a smaller estimate of σ than our estimates, the model can explain a larger percentage of the reaction of the relative labor share to the change in the capital tariffs obtained in the reduced form estimates. Lowering σ to 0.80 (keeping all other parameters the same) would be sufficient for the model predicted impact to match the estimated one.

In short, the introduction of foreign capital, which is imperfectly substitutable with the domestic capital, to an otherwise standard model, generates a mechanism that has the potential to capture a significant part of the increase in the relative labor share given lower tariff rates on capital. The mechanism shows that in addition to a reduction in the cost of

[51] See Appendix 8.6 for the details on how the weighting of capital in production works to make the estimates comparable.

foreign capital, trade liberalization endogenously improves capital augmenting technology because firms increase their optimal use of the more productive foreign capital relative to domestic capital, which in turn increases wages. These concurrent changes unambiguously increase total payments to labor relative to total payments to capital. One can extend the model to allow for additional channels, such as an increase in the variety of capital, through which trade openness can impact the labor share. We leave the investigation of the other potential channels to future research.

5.3 Elasticity of Substitution Between Domestic and Foreign Capital

The value of the elasticity of substitution between domestic and foreign capital, γ, is not needed to quantify relative labor share's reaction predicted by the model. Nevertheless, it is worthwhile to examine it, as its value affects the reallocation from domestic to foreign capital given the changes in capital tariffs. With the CES formulation of total capital in (2), the relative demand for domestic and foreign capital is given by

$$\frac{K^d}{K^f} = \left(\frac{1-\alpha}{\alpha}\right)^{\gamma} \left(\frac{A^d}{A^f}\right)^{\gamma-1} \left(\frac{R^f}{R^d}\right)^{\gamma}. \tag{13}$$

Given the expression above, the effect of the relative price of the two types of capital on the ratio of the capital stocks can be written as

$$\frac{\partial ln\left(\frac{K^d}{K^f}\right)}{\partial ln\left(\frac{R^f}{R^d}\right)} = \gamma. \tag{14}$$

We can evaluate the numerator of the expression in (14) by taking the long difference of $ln\left(\frac{K^d}{K^f}\right)$, where the ratio of the two types of capital are quantified with their investment counterparts as described above. Similarly, we can use the difference between the average ad valorem tariff rates to evaluate the denominator. In doing so, we find a value of 1.85 for γ, which suggests that domestic and foreign capital are slightly substitutable in production. We believe this finding is an additional contribution of our paper, which can be useful for researchers that are interested in the role of capital imports in determining various economic outcomes.

6 Conclusion

Recent trends in factor shares worldwide have renewed interest in explaining the dynamics of the labor share that have potentially major implications for income inequality. In this paper we investigate the liberalization episode of India in the early 1990's, which provides a natural experiment with large and unexpected reforms through reduction in trade barriers and liberalized financial markets. We contribute to the literature with the first study on the effect of foreign capital on factor shares. The investigation of this relationship contributes to a broader literature that has explored how the role of capital in production, as well as automation and technical change, play a role in the observed non-stability of factor shares (Karabarbounis and Neiman, 2014; Oberfield and Raval, 2019; Eden and Gaggl, 2018).

When we examine the changes in tariffs, but split up output, input, and capital tariffs, we find that only a reduction in the capital tariffs has a significant positive effect on the share of labor in value added relative to the share of capital. The positive impact is driven by the response of new importers and capital-intensive firms. We also find a statistically significant increase in the wage-to-capital-expenditure ratio in response to FDI liberalization. On the other hand, the domestic policy reforms we investigate – relaxing license requirements for entry and capacity enhancements – have had the opposite effect on factor shares.

In analyzing aggregate state-industry level data, we find that the increase in the relative labor share following the openness reforms was accompanied with rising wages for both skilled and unskilled workers. Overall, our results indicate that the policies to promote imported capital improved firms' access to more sophisticated equipment, and thereby enhanced the capital-augmenting technology. Due to the complementarity between capital and labor, the increase in capital productivity raised the wage rate and contributed to a faster growth in the share of payments to labor relative to capital.

Our results stand in contrast to the literature that emphasizes how import competition (see Autor et al. (2013) in a developed country and Ahsan and Mitra (2014) in a developing one) or offshoring (Elsby et al. (2013)) have detrimental impacts on labor. In fact, the aggregate trends might have been even worse for labor if the de-regulatory reforms in India did not include trade and FDI liberalization. Given the controversy around liberalization policies worldwide, this area of research provides a fruitful avenue for future studies.

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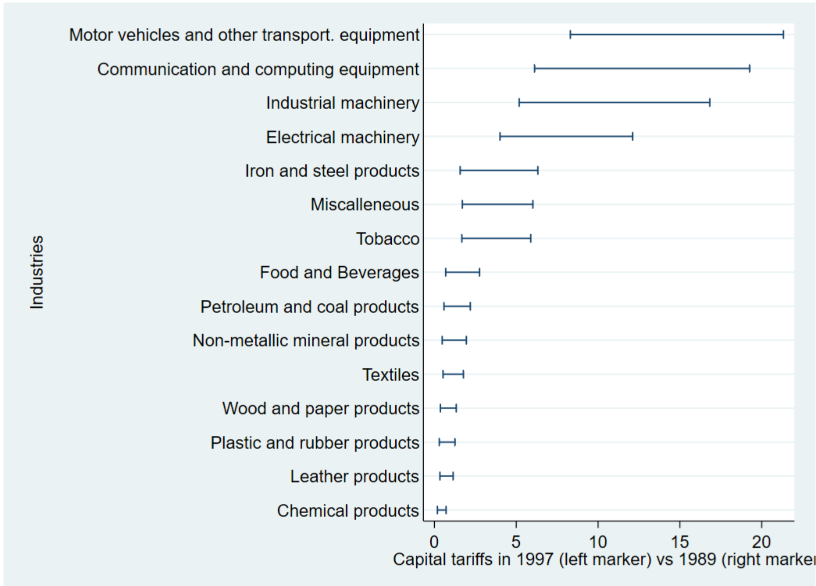
Figure 1: Capital Tariff Changes by Industry Groups

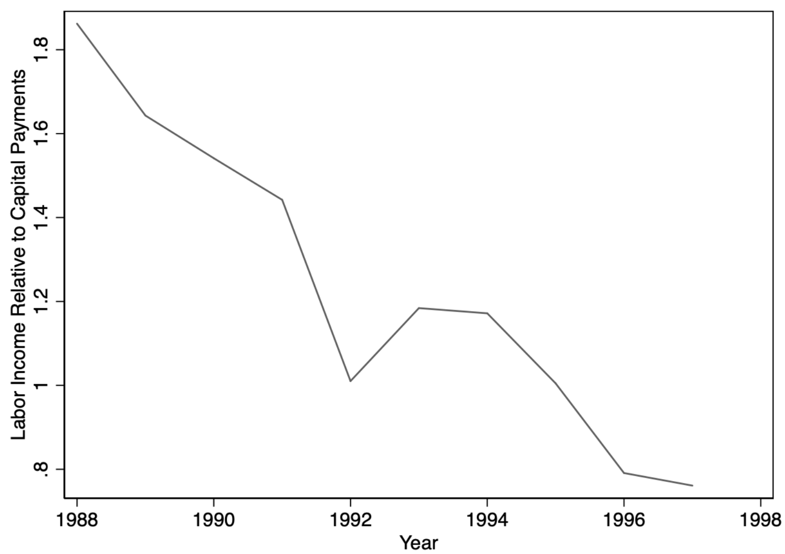


Notes: The figure plots the 1997 (on the left) and the 1989 (on the right) values of the capital tariffs for 15 industry groupings. The tariff values are the averages of the tariff rates calculated using equation (8) for the 120 3-digit NIC industries, grouped into 15 categories.

Figure 2: Factor Shares with Aggregate ASI Data

(a) Panel (A): Labor and Capital Shares

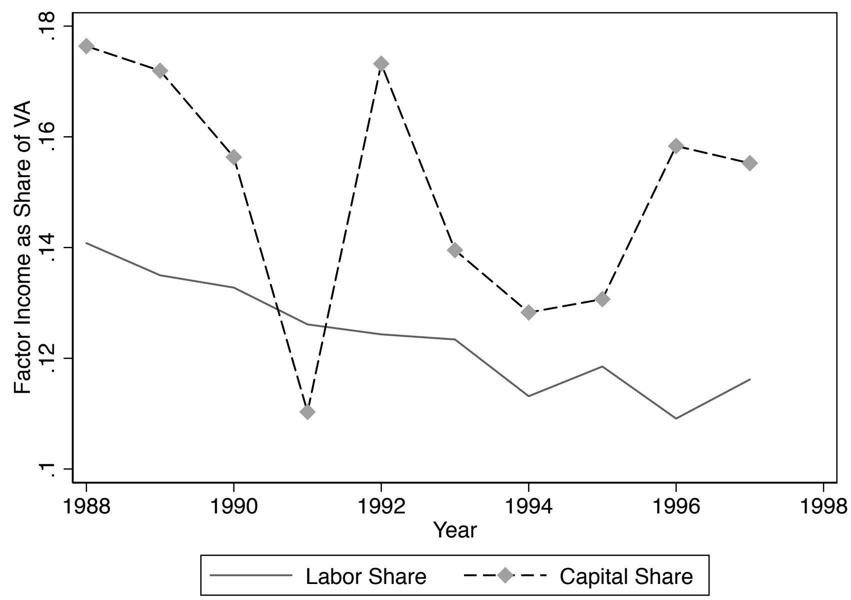
(b) Panel (B): Ratio of Labor Compensation to Capital Payments



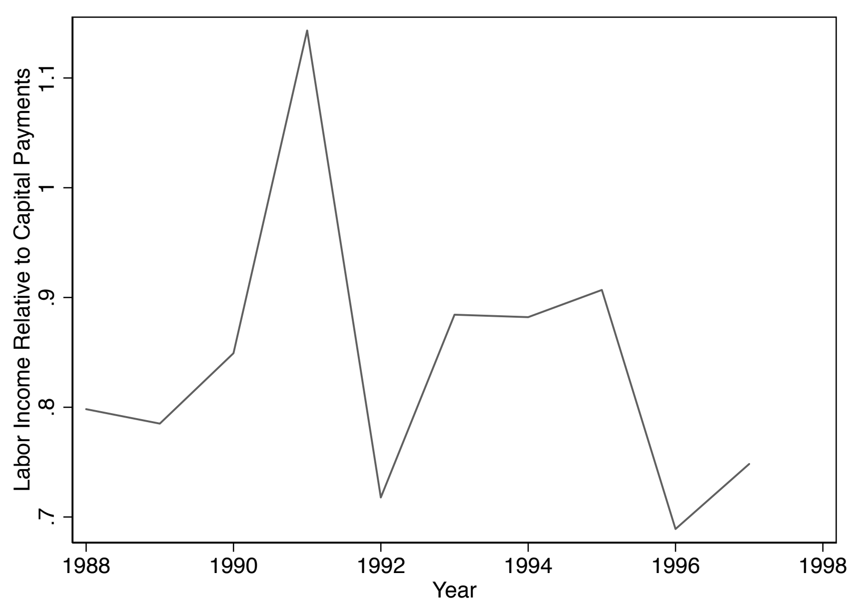
Notes: Data source is Annual Survey of Industries, which includes the Industrial sector. We construct total factor compensation in the manufacturing sector as a whole by aggregating observations for each state-industry per year. Labor compensation is reported at the industry-state level by ASI, as is the value of fixed assets. To compute capital expenditure, we multiply the value of assets by the rental rate described in (9).

Figure 3: Factor Shares with CMIE Selection of Firms

(a) Panel (A): Labor and Capital Shares



(b) Panel (B): Ratio of Labor Compensation to Capital Payments



Notes: Data source is CMIE Prowess, which includes a subset of firms within the manufacturing sector. We construct total factor compensation and value added in the manufacturing sector as a whole by aggregating observations for each firm per year. To compute capital expenditure we multiply the value of assets for each firm by the rental rate described in (9).

Table 1: Policy Variables: Averages over time

	Output Tariff	SD Output	Capital Tariff	SD Capital	Input Tariff	SD Input	FDI Liberalization	Licensing
1989	98.9	36.7	7.01	8.86	52.0	16.0	0	0.35
1990	96.4	37.8	6.90	8.77	51.7	16.0	0	0.34
1991	86.4	37.2	5.56	7.67	43.5	14.1	0	0.34
1992	88.2	36.3	5.97	8.06	44.3	16.0	0.39	0.14
1993	61.3	30.4	3.91	5.40	30.4	10.5	0.38	0.14
1994	81.4	35.7	4.97	7.05	45.1	12.5	0.39	0.12
1995	61.1	37.5	3.70	5.49	30.9	9.13	0.40	0.12
1996	47.0	28.1	2.79	3.99	24.6	6.83	0.42	0.12
1997	42.2	27.5	2.70	3.93	18.9	6.67	0.45	0.11
1998	34.2	21.4	2.10	3.04	15.9	5.45	0.45	0.081

Notes: Output tariffs as well as FDI and Licensing regulation indices are taken from Topalova and Khandelwal (2011) and Topalova (2010), and we take the simple average at the 3 digit level. Capital and input tariffs are calculated using output tariffs and the 1993-1994 input-output table following equation 8.

Table 2: Categories of Capital Goods

Capital Type	ISIC (Rev 2)	Description	Percentage of total capital imports	Real import values		Tariff rates	
				1990	1997	1990	1997
Fabricated Metal Products	381	Cutlery,hand tools,general hardware,structural metal products, furniture and fixtures primarily of metal	4.22	342	374	84.33	33.14
Machinery Except Electrical	382	Engines & turbines, agricultural machinery & equipment, metal & wood working machines, special industrial machinery & equipment except metal & wood working, office, computing & accounting machinery.	49.54	3,990	4,840	76.81	21.78
Electrical Machinery Radio,Television, & Communication Equipment	383	Electrical industrial machinery & apparatus, radio,television,communication equipment & apparatus, electrical appliances & house-ware	20.94	1,794	1,908	90.42	33.46
Transport Equipment	384	Ship building & repairing,railroad equipment, motor vehicles, motorcycles&bicycles, aircraft	16.49	1,644	1,116	65.72	30.43
Professional Goods	385	Measuring&controlling equipment, photographic & optimal goods, watches & clocks.	8.80	904	747	100	36.92

Notes: The data on imported capital good categories are from the World Bank Trade, Production and Protection database. The categories are at the 3 digit ISIC level. Average percentages of total (over the sample period from 1990 to 1997) capital goods imports are reported. Real import values are in units of millions of USD. Tariff rates are the averages of the corresponding 3 digit 1987 NIC categories.

Table 3: Relative Factor Shares and Liberalization Policies

	Labor Compensation/Capital Payments				
	(1)	(2)	(3)	(4)	(5)
Capital Tariffs	-0.023***		-0.022***	-0.019***	-0.024***
	(0.004)		(0.004)	(0.004)	(0.005)
Output Tariffs	0.000		0.000	-0.000	0.000
	(0.001)		(0.001)	(0.001)	(0.001)
Input Tariffs	-0.003		-0.002	-0.002	-0.002
	(0.003)		(0.002)	(0.002)	(0.002)
FDI Liberalization		0.167**	0.136*	0.114	0.151*
		(0.067)	(0.071)	(0.072)	(0.079)
Licensing		0.097	0.111**	0.126***	0.087
		(0.061)	(0.047)	(0.044)	(0.056)
Average Wages (ASI)				0.079**	
				(0.038)	
State Credit/GDP					-0.138
					(0.114)
Fixed Effects	Firm,State-Year	Firm,State-Year	Firm,State-Year	Firm,State-Year	Firm, State, Year
R^2	0.885	0.885	0.885	0.885	0.881
N	20024	20024	20024	18792	19865

Notes: This table displays the main results on the estimation of (10). In all cases the outcome measure is the log of labor share to capital share ratio. The first column includes only tariff policy reforms, the second column includes only FDI and licensing reforms, and the third column pools these reforms but eliminates input and output tariffs. The fourth column includes time varying state-industry average wages (from ASI), and the fifth column includes a state-level measure of credit. The outcome variable for all columns is the log of relative factor shares. We drop firms in the top and bottom 0.5% of the distribution of the relative labor share. Columns (1)-(4) include firm and state-year interacted fixed effects, plus a control for firm age. Column (5) replaces state-year fixed effects with separate state and year fixed effects. Policy variables are all aggregated to the 3-digit NIC (1987) classification. Output tariffs as well as FDI and Licensing regulation indices are taken from Topalova and Khandelwal (2011) and Topalova (2010), averaged at the 3 digit level. Capital and input tariffs are calculated using output tariffs and the 1993-1994 input-output table. Standard errors are clustered at the 3-digit NIC industry level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 4: Effect of Liberalization Policies on Alternative Labor Share Measurements and Other Outcomes

	Labor Compensation/Capital Payments	Lshare-Markup Adjusted	Lshare	Mark-up	Importer Dummy	TFP (ACF)
	(1)	(2)	(3)	(4)	(5)	(6)
Capital Tariffs	-0.022***	-0.008***	-0.007**	-0.003**	-0.005**	-0.006***
	(0.005)	(0.002)	(0.003)	(0.001)	(0.002)	(0.001)
FDI Liberalization	0.119	0.046	0.057	0.023	-0.025	-0.005
	(0.073)	(0.029)	(0.039)	(0.019)	(0.018)	(0.027)
Licensing	0.109**	0.067***	0.067**	-0.010	0.016	-0.032**
	(0.047)	(0.020)	(0.032)	(0.010)	(0.014)	(0.014)
Output Tariffs	0.000	0.000	0.000	0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Input Tariffs	-0.002	-0.000	-0.001	-0.001	-0.000	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Avg Outcome	-0.345	-1.235	-1.370	0.176		
Fixed Effects	Firm,State-Year	Firm,State-Year	Firm,State-Year	Firm,State-Year	Firm,State-Year	Firm,State-Year
R^2	0.894	0.832	0.847	0.545	0.616	0.956
N	18058	18058	18058	18058	20024	19723

Notes: This table displays the results on the estimation of (10) on alternative outcomes. Column (1) is a repeat of the baseline specification for reference. The outcome variable in the second column is the mark-up adjusted labor share as defined in the text. In the third and the fourth columns the outcome variables are the log of the labor share (compensation over value added) and the log of firm's mark-up. In column (5), the outcome is a time-varying firm dummy equal to 1 if the firm imports capital in year t (therefore the variation is across years within firms). The last column uses as an outcome the firm log TFP, estimated using the procedure outlined in Ackerberg et al. (2015) with a gross revenue production function. All columns include firm and state-year interacted fixed effects, plus a control for firm age. We drop firms in the top and bottom 0.5% of the distribution of the relative labor share, as well as any firms where the labor share of value added is not available (because of missing value added data). Policy variables are all aggregated to the 3-digit NIC (1987) classification. Output tariffs as well as FDI and Licensing regulation indices are taken from Topalova and Khandelwal (2011) and Topalova (2010), and we take the simple average at the 3 digit level. Capital tariffs are calculated using output tariffs and the 1993-1994 input-output table. Standard errors are clustered at the 3-digit NIC industry level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 5: Relative Factor Shares and Liberalization Policies: Long-differences

	Long Diff: Labor Compensation/Capital Payments		
	(1)	(2)	(3)
Δ FDI	0.280**		0.185
	(0.117)		(0.112)
Δ Lic	0.148		0.196*
	(0.121)		(0.116)
Δ CapT		-0.032***	-0.031***
		(0.008)	(0.008)
Δ IntT		-0.007*	-0.006
		(0.004)	(0.004)
Δ OutT		-0.002	-0.002
		(0.002)	(0.001)
Fixed Effects	State	State	State
R^2	0.068	0.085	0.095
N	1053	1053	1053
Average Outcome	-0.369	-0.369	-0.369

Notes: This table displays the results for a long-differences specification. The outcome and regressors are long-differences, which are the values in 1997-98 relative to 1989-90. Policy variables are all aggregated to the 3-digit NIC (1987) classification in each year before taking differences. All columns include only state fixed effects since this analysis is cross-sectional. Output tariffs as well as FDI and Licensing regulation indices are taken from Topalova and Khandelwal (2011) and Topalova (2010), averaged at the 3 digit level. Capital and input tariffs are calculated using output tariffs and the 1993-1994 input-output table. The Average Outcome row reports the (unweighted) average of (log) relative labor share reductions across industries. Standard errors are clustered at the 3-digit NIC industry level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 6: Policy and Firm Interactions

	Labor Compensation/Capital Payments					
	(1)	(2)	(3)	(4)	(5)	(6)
Capital Tariffs	-0.016*	-0.019***	-0.019***	-0.017***	-0.020***	-0.019***
	(0.008)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
FDI Liberalization	0.187**	0.150**	0.133*	0.026	0.145**	0.133*
	(0.086)	(0.075)	(0.069)	(0.085)	(0.071)	(0.070)
Licensing	0.092	0.097**	0.119***	0.145**	0.120**	0.108**
	(0.056)	(0.048)	(0.044)	(0.066)	(0.051)	(0.046)
CapT*Kimp (Ever)	-0.008					
	(0.007)					
FDI*Kimp (Ever)	-0.060					
	(0.050)					
CapT*Kimp (Start)		-0.009**				
		(0.004)				
FDI*Kimp (Start)		-0.017				
		(0.045)				
CapT*Firm Imports			-0.029**			
			(0.011)			
FDI*Firm Imports			0.008			
			(0.059)			
CapT*Kintensity				-0.009***		
				(0.002)		
FDI*Kintensity				0.118***		
				(0.020)		
CapT*Foreign					-0.015*	
					(0.008)	
FDI*Foreign					-0.094	
					(0.061)	
CapT*Debt/Equity						-0.001**
						(0.001)
FDI*Debt/Equity						0.002
						(0.003)
Fixed Effects	Firm,State-Year	Firm,State-Year	Firm,State-Year	Firm,State-Year	Firm,State-Year	Firm,State-Year
R^2	0.886	0.886	0.886	0.892	0.886	0.886
N	20024	20024	20016	17834	20024	20024

Notes: This table interacts the policy reforms with firm-specific characteristics. In the first two columns the characteristic is being a capital importer. First, captured by a dummy equal to one if a firm imports capital in any year of the sample. Second, if the firm becomes a capital importer after its first year. In the third column the firm characteristic is its import share in total capital and materials expenditures. Columns (4)-(6) include interactions of policy reforms with: capital intensity, debt to equity ratio, and a dummy for foreign ownership, as described in the text. All columns include firm and state-year interacted fixed effect. We drop firms in the top and bottom 0.5% of the distribution of the relative labor share. Unreported in the Table are interactions with input tariffs and license requirements, plus a control for firm age. Policy variables are all aggregated to the 3-digit NIC (1987) classification. Standard errors are clustered at the 3-digit NIC industry level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 7: State-Industry Level Outcome Measures

	Labor Comp./Capital Paym.	Wage	S-Wage	U-Wage	L	S/L	VA/L	R
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Capital Tariffs	-0.015***	-0.006**	-0.007***	-0.004	0.006	0.007	-0.021*	-0.001
	(0.005)	(0.002)	(0.002)	(0.003)	(0.006)	(0.024)	(0.012)	(0.001)
FDI Liberalization	0.015	0.008	-0.031	-0.003	-0.062	0.785***	0.356*	0.000
	(0.071)	(0.030)	(0.030)	(0.043)	(0.068)	(0.247)	(0.196)	(0.011)
Licensing	0.129	0.036	-0.008	0.034	0.143**	0.165	0.136	0.037***
	(0.083)	(0.034)	(0.036)	(0.038)	(0.058)	(0.253)	(0.254)	(0.012)
Output Tariffs	-0.002	0.001*	0.001	0.001**	-0.000	0.007	0.004	-0.000
	(0.002)	(0.000)	(0.000)	(0.000)	(0.001)	(0.004)	(0.004)	(0.000)
Input Tariffs	0.003	0.000	0.000	-0.000	-0.002	0.003	0.006	0.000
	(0.003)	(0.001)	(0.001)	(0.001)	(0.002)	(0.009)	(0.008)	(0.000)
Fixed Effects	Ind,State-Yr	Ind,State-Yr	Ind,State-Yr	Ind,State-Yr	Ind,State-Yr	Ind,State-Yr	Ind,State-Yr	Ind,State-Yr
R^2	0.585	0.704	0.594	0.700	0.643	0.552	0.697	0.927
N	9757	9757	9478	9719	9757	9757	9667	9757

Notes: This table displays the response of various aggregate outcomes constructed with ASI micro data that we aggregate in order to create a panel. The dependent variables vary at the 3-digit NIC (1987) industry-state-year level. Policy reforms are identical to those in the firm-level analysis. All columns include industry and state-year interacted fixed effects. The eight outcomes are: log ratio of labor to capital compensation, log wages, log skilled wages, log unskilled wages, log employment, log ratio of skilled to total employment, log rental rate, and log value added per worker. Every regression is weighted with the number of plants in the state-industry-year observation. Standard errors are clustered at the 3-digit NIC industry level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 8: Identification of σ: District Cross-Section Variation in Wages

	Labor Compensation/Capital Payments			
	(All Pre-1997)	(All Pre-1997: PM Capital)	(1989-1990)	(1997-1998)
Average District Wage (ASI)	0.054**	0.093***	0.134***	0.037*
	(0.027)	(0.035)	(0.034)	(0.022)
M Importer	-0.218***	-0.265***	-0.194***	-0.369***
	(0.015)	(0.019)	(0.022)	(0.030)
Debt/Equity	-0.070***	-0.071***	-0.064***	-0.359***
	(0.003)	(0.004)	(0.004)	(0.024)
Markup	0.000***	0.000**	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Inputs	-0.121***	-0.165***	-0.071***	-0.026***
	(0.005)	(0.009)	(0.006)	(0.004)
Urban Metro	0.197***	0.246***	0.209***	0.167***
	(0.021)	(0.027)	(0.028)	(0.025)
Exporter				-0.353***
				(0.031)
Fixed Effects	Industry-State-Year	Industry-State-Year	Industry-State	Industry-State
R^2	0.344	0.351	0.326	0.359
N	107223	100117	30796	17887

Notes: This table displays results based on specification (11). Identification of the elasticity of substitution between capital and labor is based on cross-sectional variation across districts (within each state-year). The outcome in all columns is the log of labor share to capital share ratio for a plant in the ASI data. Due to large outliers and data availability, we cut the top and bottom 5% of plants in terms of labor to capital compensation. We also keep only districts with more than 5 plants. The first column uses all years of data before 1997-98, and includes industry-state-year fixed effects. Column (2) includes all years before 1997-98 but restricts capital expenditure to plant and machinery (PM) only. For this measure, we construct the rental rate as well as net fixed capital stock without structures. In the last two columns we include only one year of data – 1989-90 and 1997-98 respectively – and include industry-state fixed effects. In addition to the reported firm controls, all columns include fixed effects for plant unit (e.g. ancillary) and whether the plant is registered. Export information and multi-unit status is only available in 1997-98. Standard errors are clustered at the district level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

7 Appendix

7.1 Factor Shares in KLEMS Data

This is the most aggregate available data that allows us to explore the labor share in India's economy as a whole, as well as in the manufacturing sector alone. The World KLEMS initiative provides the necessary data at the broad industry level (26 total industries). Figure 4 illustrates aggregate and manufacturing labor shares from 1980 to 2009. Total value added and labor share of value added is reported at the industry level by KLEMS. We use that data to construct implied labor compensation in each industry, then aggregate those to get total labor income and total value added in India.[52] We do the same for only manufacturing industries and report the labor share in manufacturing and non-manufacturing only. Finally, we also report the manufacturing share of value added.

Figure 4 suggests that the decline in the labor share is pervasive in the whole economy, although the drop is greater and starts earlier in the manufacturing sector. In the economy as a whole, the labor share is mostly constant until 1992, and then starts to drop. It drops from about 52% to 47% in 2000, then drops another couple of percentage points in the next 10 years. The non-manufacturing sector follows an almost identical pattern, which comes from the fact that manufacturing makes up only around one-sixth of the economy. In the manufacturing sector, the labor share drops from 46% to 42% before 1992, and then drops sharply to around 36% by 2000. It then drops to about 33% by 2009. Finally, the share of manufacturing in the economy is constant, hovering mostly around 16%. Given the nature of the firm data (survey of industries), and the emphasis on trade liberalization, we focus on the manufacturing sector. Although there does seem to be a negative pre-trend in the labor share, we leverage the difference-in-difference empirical strategy with various fixed effects to attempt to tease out the contributions of the liberalization policies themselves to the movements in the labor share.

[Figure 4 about here.]

7.2 Capital Import Sources and Advanced Technology Products

Table 9 lists the top countries India imports capital from. Over half of India's imports of capital come from the U.S. (20%), Japan (16%), and Germany (16%) – technologically advanced countries. In the next subsection, we also report that there was a sharp increase in the value and variety of capital imports into India after the reforms.

There is also suggestive evidence that India raised its imports of "high-tech" goods (as classified in the trade data), which supports the hypothesis that capital productivity increased following the reforms in India. Next, we present an analysis of exports by the United States that are classified as "advanced technology products" (ATP) to India versus

[52] Although the construction of the dataset does assume that labor share plus capital share equal to one, the capital share itself is constructed such that they sum to one. The labor income is actually measured in the data, so that it makes sense to use the labor share of total value added. For this reason it is not useful to measure the expenditure on labor relative to the expenditure on capital.

the rest of the world, which shows India imported a significantly larger amount of ATP products from the U.S. after the liberalization. In Section 4 we empirically investigate how this surge in capital imports, coming from the top-technology producing countries, contributed to the changes in factor shares in India, and argue that the openness reforms raised relative labor share by improving capital's productivity per unit expenditure.

We limit the analysis to U.S. exports due to the availability of detailed (HTS 10 digit code) export data provided by Schott (2008). This level of disaggregation is consistent with the classification of ATP products. Conditioning on ATP exports by the United States between 1989 and 1998, we estimate the following difference-in-difference specification:

$$\ln(X_{dt}) = \alpha_d + \alpha_t + \alpha PostLib * India_{dt} + \zeta_{dt}, \tag{15}$$

with the outcome measure being log exports by destination (d) and year (t). The coefficient of interest is on the interaction variable $PostLib*India$, a product of a dummy equal to 1 for the years post Indian-liberalization and a dummy equal to 1 for exports to India. Exports are aggregated to destination-year observations within ATP products, so we control for destination and year fixed effects. The question of interest is whether within ATP products export flows to India grew especially fast after 1993, relative to the rest of the world. Table 10 presents results for various variations of (15), each consistent with a surge of ATP exports to India after 1993.[53] The first two columns present the main specification, altering the first year of $PostLib$ from 1993 to 1994. It is clear that relative to the period before Indian liberalization, there is a large increase of U.S. exports of ATP products to India compared to other destinations. In the next column we exclude the observations from 1992 due to the large drop in exports to India during the year following the crisis. We find that our results are robust, and the recovery from the crisis is not driving the results. Finally, in the last specification we change the outcome measure to the number of high-tech products exported to each destination (where the product is a 10-digit good).

[Table 9 about here.]

[Table 10 about here.]

7.3 Increase in the variety and the volume of capital imports

Detailed trade data from the UN Comtrade allows us to report the level and variety of India's capital imports, further evidence for the compositional changes in India's capital following the liberalization. The import data is reported by the 6 digit HS codes, which we define as products. We keep only capital goods, as classified by the US Census end-use classification. Figure 5 reports the time series of total value of capital imports, as well as the number of unique capital goods imported to India as a measure of variety. As expected, the total value of capital imports drops prior to 1992, concurrent with the crisis in India. Although imports

[53] We also ran a similar specification with product-destination-year observations, and estimated the same coefficient but as an average across products. The results are consistent with a surge in exports of ATP products to India post 1993.

rebound in 1992 to 1990 levels (less than 3 billion US dollars), it is clear that the largest gains in terms of value of imports (left axis) occur between 1993 and 1995, to above 5 billion dollars. Importantly, this pattern is matched by the variety of products imported. We count a "variety" as a unique HS6 good-origin country combination, using a common definition in the literature that interprets a product from two different origins as two unique varieties (Feenstra, 1994).[54]

[Figure 5 about here.]

7.4 Correlation between the policy measures

The results in Table 3 show that the effects of FDI are slightly diminished when we include the capital tariffs as well. Therefore, we investigate the correlation of the policy implementation in Table 11. We regress FDI liberalization on the other policy variables (as well as the same controls and fixed effects) in order to explain why the effect on FDI is reduced when we include capital tariffs in the specification. In both columns, with different sets of fixed effects, there is a strong correlation between industries that lower capital and input tariffs, and also liberalize FDI. Evidently, the effect of these policies is moving the wage-to-capital-expenditure ratio in the same direction. However, it is still reassuring that in the industries with less collinearity of these policy implementations, FDI moves the wage-to-capital ratio in the expected direction. There is no evidence that the reduction in output tariffs and licensing liberalization is happening in these same industries.

[Table 11 about here.]

7.5 Robustness: Event Study Approach

We outline an event-study type of analysis that allows us to visualize the effect of reform on relative factor shares over time. The following is a further robustness check that is useful to show the lack of any pre-trends in factor shares.

The method is as follows: for each 3-digit industry, we replace the $Policy_{jt}$ measure with a *time-invariant* measure equal to the absolute value of the long-difference in the policy variable between the beginning and end of the time period. Each industry will be given this fixed "reform" measure every year. We do this separately for the three main deregulation measures. We run the following specification following the baseline from the main text:

$$\ln\left(\frac{s^L_{ijst}}{s^K_{ijst}}\right) = \sum_{t=1988}^{t=1997} \gamma_t \Delta Policy_j * year_t + \alpha_i + \alpha_{st} + \mu_{ijst}, \tag{16}$$

[54] We find a similar pattern if we count a unique variety as an HS product from any origin. When constructing the measure of variety in Figure 5, we eliminate imports from China and Germany. China is used as a proxy for Taiwan, but includes an extreme jump in the number of goods exported in 1992. German data is only available starting in 1991. Including these countries could affect the interpretation of the count across years; therefore, we do not include them in the measure. Lastly, we should point out that there exists the possibility of an upward bias in the number of variety counts during the revision years of HS codes (1992 and 1996), although we use a consistent classification. However, the qualitative interpretation is not affected if we were to eliminate the increase in the number of products in those years.

where $\Delta Policy_j$ is the time-invariant long-difference in the reform variable for each industry, and it is interacted with year dummies for each year of the sample. This allows us to plot the set of $\{\gamma_t\}$ over time, which can be interpreted as the reform's effect of the labor share in that year, relative to the effect in 1991 (the dropped year dummy). Since we take the absolute value of the long-difference, we expect γ to be positive for capital tariffs and FDI after 1991, and negative for licensing, with no clear trend before then.

Figure 6 plots the coefficients over time for each reform, with capital tariffs on the top figure, FDI reform in the middle, and licensing on the bottom. There are a couple of takeaways. First, in all cases there does not appear to be any trend in the labor share before 1991 (which is dropped, and is also the year India implements its reforms due to IMF loan requirements). Although we have cited a large literature that argues for the exogeneity of these reforms, this visualization provides a nice confirmation with respect to the labor share as the outcome. Second, there is a clear increase in the coefficients after 1991 for capital tariffs and FDI, and a reduction for licensing. This confirms the results above that found that firms raised their labor share on average in response to FDI reform and lower capital tariffs, but that they lowered the relative labor share in response to lower licensing requirements. Finally, there is also evidence that the responses grow over time, especially in the case of capital tariffs.

[Figure 6 about here.]

7.6 Subsamples: Importers and non-importers

[Table 12 about here.]

7.7 Size Interactions

Size The last characteristic we consider that can affect firm's response to openness is its size. To motivate why this characteristic is important, we refer to trade models akin to Melitz (2003), where the extensive margin plays an important role. In our context, factor shares of smaller firms might respond more to liberalization, since lower tariffs would allow the smaller firms to import capital that was already available to larger firms at higher tariffs.[55] In terms of FDI liberalization, this effect is less obvious, though again we expect initially larger firms to have a higher share of foreign investment before the liberalization. To test these predictions, we follow Ahsan and Mitra (2014) in creating three equally-sized bins: "small", "medium", and "large". Firms are assigned to these bins in the first year they appear in the data depending on their sales relative to firms within an industry-year. Columns (1)-(3) interact each of the three policy reforms with the size dummies individually. Since we interact the policy variables with "large" and "small" indicators, these interactions show the impacts relative to "medium" sized firms (whose response is represented by the non-interaction term). With respect to the reductions in capital tariffs and FDI liberalization, columns (1) and (2) make it clear that small sized firms are driving the reallocation of factor payments to labor. This suggests that trade liberalization creates opportunities to access foreign capital for smaller firms, allows them to enhance their capital-productivity and raise payments to labor, which complements the capital.

Unlike the openness reforms, the impact of the licensing reform is subdued, even reversed, for smaller firms. The specification in column (3) shows that the *decline* in the labor share following the reduction in the licence requirements is driven by medium sized firms, and to a lesser extent large firms.[56] Aghion et al. (2008) document the rise in production that is a result of productive firms being able to expand with the elimination of license requirements. Furthermore, they find this is only true in "pro-business" states, where labor is expected to be a smaller beneficiary of the rise in productivity. In summary, our results indicate that domestic policies to promote expansion of productive medium/large sized firms, which the previous literature documents has increased overall production, play a role in the within-firm reduction of the share of payments to labor relative to capital. Removing size constraints allows these firms to expand by becoming more capital intensive. However, the policies to promote foreign capital work to mitigate some of that effect.

[Table 13 about here.]

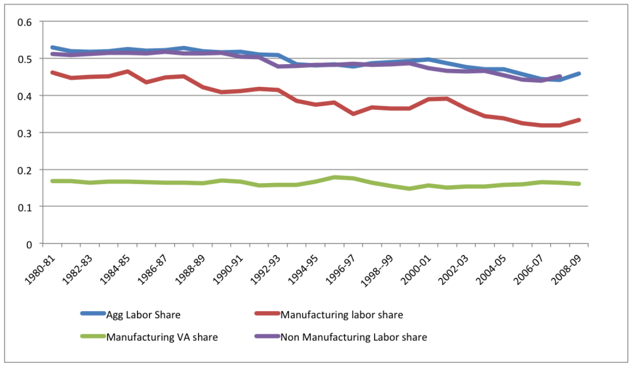
[55] Almost two-thirds of the firms in our sample eventually become importers at some point, probably due to the selection of firms in CMIE. Therefore, new importers that are labeled "small" in our sample are still relatively big firms in the context of the whole Indian economy.

[56] Although the "large" interaction coefficient is negative, notice that the sum of the "License" coefficient and this coefficient is still large and positive. Large firms contribute less to the labor share decline relative to medium firms.

7.8 Aggregate Responses to Policy with CMIE Data

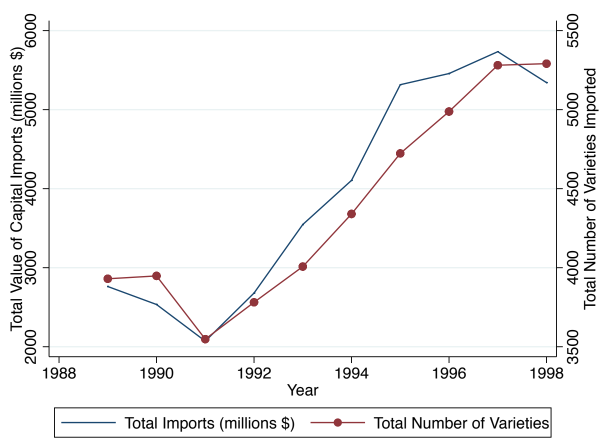
[Table 14 about here.]

Figure 4: Labor Share in India using KLEMS data: Aggregate and Manufacturing



Data source is the KLEMS World Initiative.

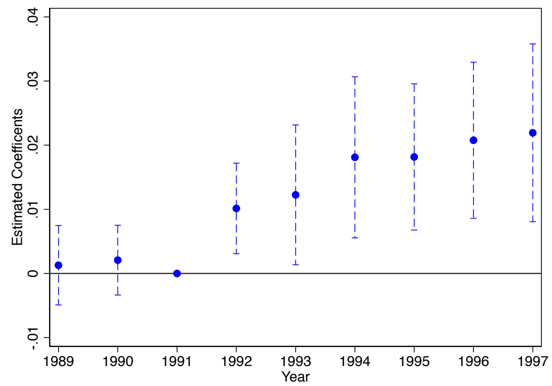
Figure 5: Capital Imports from Top Capital-Exporting Countries: Value of Imports and Number of Products



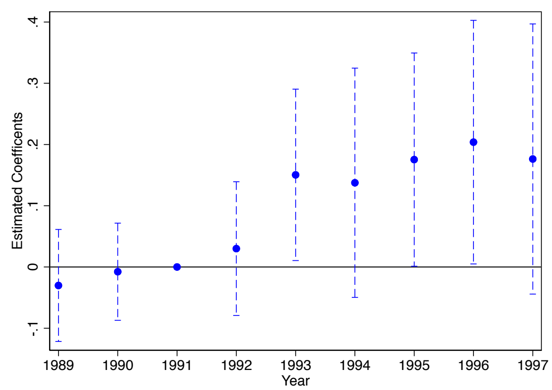
Notes: This figure displays the total value of imports and the total number of HS6 products imported by India, allowing only for capital goods from the top 10 capital-exporting countries. Trade values are in millions of US Dollars (left axis). The right axis is a measure of varieties imported. We count a "variety" as a unique HS6 good-origin country combination. To construct variety, we eliminate China and Germany. Although we attempt to use a consistent classification across years, there is a possibility for an upward bias during the revision years of 1992 and 1996. This does not appear to have a large effect on the results however. Data source for the trade data is UN Comtrade. Capital goods are classified using the end-use classification of the US Census.

Figure 6: Event Study: Long-Difference Change in Reform Measure Interacted By Year

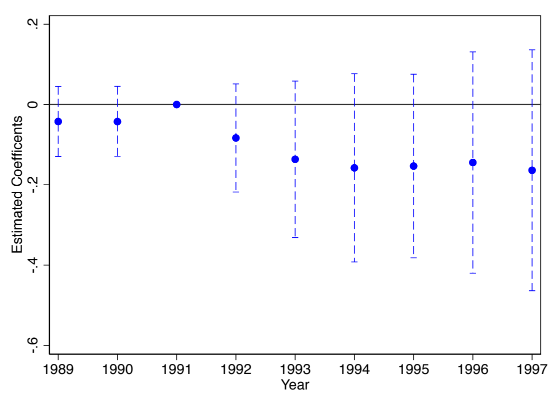
(a) Change in Capital Tariffs



(b) Change in FDI Liberalization Index



(c) Change in Licensing Index



Notes: Each figure plots the γ's estimated from specification (16). Reform measures are *time-invariant* absolute differences in the policy measures for each industry, between 1989 and 1997. Each plot includes 95% confidence intervals with standard errors clustered at the industry level.

Table 9: Trading partner share of total imported capital

Rank	Trading Partner	Imported Capital (Percent of Total)
1	U.S.	20.14
2	Japan	16.80
3	Germany	16.73
4	U.K.	6.60
5	Singapore	4.98
6	France	4.96
7	Italy	4.63
8	Switzerland	3.10
9	Korea	2.18
10	Taiwan	1.91
	All Other	17.98
	Total	100.00

Notes: The data on trading partner share of total imported capital goods are from the World Bank Trade, Production and Protection database. The percentage of total capital goods imports is an average over the sample period from 1990 to 1997.

Table 10: US exports of ATP to India Post Liberalization

	US Log Export Value			Number of High-Tech Products
	(1)	(2)	(No 1992)	(4)
India=1*Year≥1993	0.738***		0.636***	32.513***
	(0.069)		(0.073)	(1.552)
India=1*Year≥1994		0.390***		
		(0.067)		
Fixed Effects	Year, Country	Year, Country	Year, Country	Year, Country
# Observations	2003	2003	1802	2003

Notes: This table displays regression results for specification 15. In the first three columns, the outcome measure is log US exports of ATP products by destination-year. To compute this measure we condition on ATP products and aggregate product-destination-year data across all products. The last column replaces the export value with the number of HS10 products to each destination-year. The interaction variable is a product of two dummies: a dummy for the destination being India, and a dummy for years 1993 and later. In column (2) the *PostLib* dummy is for years 1994 and later. Destination and year fixed effects are included in every specification. Standard errors are clustered at the destination level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 11: Correlation of Policy Measures

	FDI Liberal.	
	(1)	(2)
Capital Tariffs	-0.012***	-0.012***
	(0.004)	(0.004)
Output Tariffs	0.001	0.001
	(0.001)	(0.001)
Input Tariffs	-0.005**	-0.004**
	(0.002)	(0.002)
Licensing	0.037	0.043
	(0.083)	(0.092)
State Credit/GDP		0.063
		(0.039)
Fixed Effects	Firm,State-Year	Firm, State, Year
R^2	0.879	0.873
N	20024	19865

Notes: All columns include firm and state-year interacted fixed effects, plus a control for firm age. Policy variables are all aggregated to the 3-digit NIC (1987) classification. Output tariffs as well as FDI and De-licensing regulation indices are taken from Topalova and Khandelwal (2011) and Topalova (2010), and we take the simple average at the 3 digit level. Capital and input tariffs are calculated using output tariffs and the 1993-1994 input-output table. Standard errors are clustered at the 3-digit NIC industry level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 12: Firm characteristics with subsamples

	Labor Compensation/Capital Payments			
	Importer	Non-Importer	Importer	Non-Importer
Capital Tariffs	-0.012***	0.001	-0.020***	-0.010
	(0.004)	(0.010)	(0.005)	(0.007)
FDI Liberalization	0.042	-0.009	0.159**	0.117
	(0.072)	(0.114)	(0.067)	(0.102)
Licensing	0.114	0.130**	0.127**	0.119*
	(0.072)	(0.065)	(0.056)	(0.062)
CapT*Kintensity	-0.019***	-0.012		
	(0.003)	(0.008)		
FDI*Kintensity	0.200***	0.243***		
	(0.026)	(0.046)		
CapT*Debt/Equity			-0.001**	0.001
			(0.001)	(0.002)
FDI*Debt/Equity			-0.000	0.010***
			(0.003)	(0.003)
Fixed Effects	Firm,State-Year	Firm,State-Year	Firm,State-Year	Firm,State-Year
R^2	0.881	0.901	0.877	0.900
N	10713	7107	12118	7897

Notes: In this table we repeat the interactions of policy reforms with firm capital intensity and debt/equity ratio (from Table 6), but separately for importers and non-importers. A firm is categorized as an importer if it imports in any of the years. All columns include firm and state-year interacted fixed effects, plus a control for firm age. Policy variables are all aggregated to the 3-digit NIC (1987) classification. Output tariffs as well as FDI and De-licensing regulation indices are taken from Topalova and Khandelwal (2011) and Topalova (2010), and we take the simple average at the 3 digit level. Capital and input tariffs are calculated using output tariffs and the 1993-1994 input-output table. Standard errors are clustered at the 3-digit NIC industry level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 13: Policy and Firm Interactions: Firm Size

	Labor Compensation/Capital Payments		
	(1)	(2)	(3)
Capital Tariffs	-0.011*	-0.020***	-0.020***
	(0.006)	(0.004)	(0.004)
FDI Liberalization	0.125*	0.074	0.146**
	(0.070)	(0.078)	(0.069)
Licensing	0.125***	0.110**	0.203***
	(0.045)	(0.048)	(0.071)
CapT*Small	-0.018**		
	(0.007)		
CapT*Large	-0.000		
	(0.005)		
FDI*Small		0.189***	
		(0.067)	
FDI*Large		0.004	
		(0.052)	
Lic*Small			-0.181***
			(0.066)
Lic*Large			-0.080
			(0.066)
Fixed Effects	Firm,State-Year	Firm,State-Year	Firm,State-Year
R^2	0.885	0.886	0.886
N	18792	20024	20024

Notes: This table interacts the policy reforms with a firm size categorical variable. Firms are split into three bins, so that the size measure equals 1, 2, or 3 for small, medium, and large firms respectively. Each of the three columns interact a separate policy measure with the size bins. All columns include firm and state-year interacted fixed effects, plus a control for firm age. Policy variables are all aggregated to the 3-digit NIC (1987) classification. Output tariffs as well as FDI and licensing regulation indices are taken from Topalova and Khandelwal (2011) and Topalova (2010), averaged at the 3 digit level. Capital and input tariffs are calculated using output tariffs and the 1993-1994 input-output table. Standard errors are clustered at the 3-digit NIC industry level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 14: Aggregate Responses to Policy with CMIE Data

	Labor Compensation/Capital Payments		
	(Firms with Sales Weight)	(Firms with VA Weight)	(State-Industry Level)
Capital Tariffs	-0.018***	-0.015**	-0.018***
	(0.006)	(0.006)	(0.005)
FDI Liberalization	0.098	0.081	0.051
	(0.086)	(0.088)	(0.080)
Delicensing	0.122*	0.119	0.223***
	(0.065)	(0.080)	(0.063)
Output Tariffs	0.001	0.000	0.001
	(0.001)	(0.001)	(0.001)
Input Tariffs	-0.003***	-0.003**	0.006*
	(0.001)	(0.001)	(0.003)
Fixed Effects	Firm,State-Year	Firm,State-Year	Industry,State-Year
R^2	0.911	0.914	0.433
N	20023	18303	6116

Notes: This table reports an "aggregate interpretation" of our baseline specification. The first two columns specify the specification in (10), but with weights. Column (1) introduces sales weights while column (2) uses value added weights. Since value added is reported as negative in some instances, those observations are dropped in column (2). In the third column we aggregate the Prowess firm data to the industry-state-year and run at the regression at this level, weighting observations with the number of firms in each state-industry-year. Standard errors are clustered at the 3-digit NIC industry level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

8 Theoretical Appendix

This appendix describes the problem of the final good and intermediate input producers, and households that give rise to the equilibrium conditions discussed in the text.

8.1 Final Good Producers

We assume that there are perfectly competitive firms that purchase intermediate inputs from a continuum of monopolistically competitive producers and combine the varieties $z \in [0, 1]$ with the following CES technology to produce the final good:

$$Y_t = \left(\int_0^1 y_t(z)^{\frac{\epsilon-1}{\epsilon}} dz \right)^{\frac{\epsilon}{\epsilon-1}}, \tag{17}$$

where $y_t(z)$ is the quantity of input z used in the production of the final good, and $\epsilon > 1$ denotes the elasticity of substitution between the inputs. The final good can be used as the consumption good or the domestic investment good. Normalizing the price of the final good to 1, and letting $p(z)$ denote the price of input variety z, the demand for z can be written as $y_t(z) = p_t(z)^{-\epsilon} Y_t$.

8.2 Intermediate Input Producers

The producer of the intermediate input variety z rents domestic ($k_t^d(z)$) and foreign capital ($k_t^f(z)$) from the households and combines them with labor $n_t(z)$ using a constant returns to scale technology to produce output, $y_t(z) = F\left(n_t(z), k_t^d(z), k_t^f(z)\right)$. Producer of input z chooses labor, each type of capital and the price of its product in order to maximize profits given by

$$\prod_t(z) = p_t(z)y_t(z) - R_t^d k_t^d(z) - R_t^f k_t^f(z) - W_t n_t(z) \tag{18}$$

subject to

$$y_t(z) = c_t(z) + x_t^d(z) = p_t(z)^{-\epsilon}\left(C_t + X_t^d\right), \tag{19}$$

where R_t^d and R_t^f are the rental rates of domestic capital and foreign capital, and W_t is the wage rate. The first order conditions yield the following demand equations for capital and labor:

$$R_t^f = \frac{1}{\mu_t} F_{fk,t}(z) p_t(z) \tag{20}$$

$$R_t^d = \frac{1}{\mu_t} F_{dk,t}(z) p_t(z) \tag{21}$$

$$W_t = \frac{1}{\mu_t} F_{n,t}(z) p_t(z), \tag{22}$$

where F_{fk}, F_{dk} and F_n denote the marginal products of foreign capital, domestic capital, and labor, and $\mu = \frac{\epsilon}{\epsilon - 1}$ is the mark-up that the firm charges over the factor prices.

8.3 Household's Problem and the Equilibrium

The representative household consumes the final consumption good, provides labor to the intermediate good producers, and accumulates domestic and foreign capital through purchases of investment goods from domestic and foreign firms. The purchases of imported capital goods are subject to a tariff, τ. The household receives dividends from the firms they own at the end of each period. Additionally, the household holds an international bond B_t that pays the world interest rate r_t. The household chooses $\{C_t, X_t^d, X_t^f, K_{t+1}^d, K_{t+1}^f, B_{t+1}, n_t(z)\}$ to maximize

$$\mathbf{U} = \sum_{t=0}^{\infty} \varphi^t U(C_t, N_t), \tag{23}$$

subject to the capital accumulation equations $K_{t+1}^f = (1-\delta)K_t^f + X_t^f$, $K_{t+1}^d = (1-\delta)K_t^d + X_t^d$, and the budget constraint

$$\begin{aligned} &C_t + X_t^d + (1+\tau)\, p^f X_t^f + B_{t+1} - (1+r_t)B_t = \\ &\int_0^1 \left(W_t n_t(z) + R_t^f k_t^f(z) + R_t^d k_t^d(z) + \prod_t(z) \right) dz + \Lambda_t, \end{aligned} \tag{24}$$

where φ denotes the discount factor; X_t^f denotes the capital good imports; Λ_t is the transfers from the intermediate good producers to the household; and aggregate labor supply and and the aggregate capital stocks are given by $N_t = \int_0^1 n_t(z)dz$, $K_t^d = \int_0^1 k_t^d(z)dz$ and $K_t^f = \int_0^1 k_t^f(z)dz$.

The equilibrium of the model is symmetric with $p_t(z) = P_t = 1$, $k_t^f(z) = K_t^f$, $k_t^d(z) = K_t^d$, $n_t(z) = N_t$, $c_t(z) = C_t$, $x_t(z) = X_t$, and $y_t(z) = Y_t = F(K_t^f, K_t^d, N_t)$.

From the household's optimality conditions we have the following expressions for the rental rates of foreign capital and domestic capital:

$$R_t^d = r_t + \delta, \tag{25}$$

$$R_t^f = (1+\tau)\, p^f R_t^d, \tag{26}$$

8.4 Obtaining equation (7) in the main text

Imposing the symmetric equilibrium conditions noted above, the firm's first order conditions in (20)-(22) can be re-written as

$$N = \eta^\sigma Y W^{-\sigma} \tag{27}$$

$$A^f K^f = [\alpha(1-\eta)]^\gamma Y^{\frac{\gamma}{\sigma}} \left(A^K K\right)^{\frac{\sigma-\gamma}{\sigma}} \left(\frac{A^f}{R^f}\right) \tag{28}$$

$$A^d K^d = [(1-\alpha)(1-\eta)]^\gamma Y^{\frac{\gamma}{\sigma}} \left(A^K K\right)^{\frac{\sigma-\gamma}{\sigma}} \left(\frac{A^d}{R^d}\right). \tag{29}$$

Substituting (28) and (29) into the aggregator in (2), we can write $A^k K$ as

$$A^K K = Y(1-\eta)^\sigma \left[\alpha^\gamma \left(\frac{A^f}{R^f}\right)^{\gamma-1} + (1-\alpha)^\gamma \left(\frac{A^d}{R^d}\right)^{\gamma-1}\right]^{\frac{\sigma}{\gamma-1}}. \tag{30}$$

We can further substitute (27) and (30) into the production function (1), which simplifies to

$$1 = (1-\eta)^\sigma \left[\alpha^\gamma \left(\frac{A^f}{R^f}\right)^{\gamma-1} + (1-\alpha)^\gamma \left(\frac{A^d}{R^d}\right)^{\gamma-1}\right]^{\frac{\sigma-1}{\gamma-1}} + \eta^\sigma W^{1-\sigma} \tag{31}$$

or

$$1 = \eta^\sigma \Gamma^{-1} Q^{\sigma-1} + \eta^\sigma W^{1-\sigma}. \tag{32}$$

In order to get $\frac{\partial lnW}{\partial lnQ}$, we can take a total differentiation of (32) and get

$$\frac{\partial W}{\partial Q} = \frac{1}{\Gamma} Q^{\sigma-2} W^\sigma. \tag{33}$$

When we multiply the above expression with $\frac{Q}{W}$, we get equation (7) in the main text.

8.5 Obtaining equation (12) in the main text

Substituting the derivatives in equations (6) and (7) into (5), we get

$$\frac{\partial ln\left(\frac{s_L}{s_k}\right)}{\partial ln(R^f)} = -(1-\sigma)\left[\frac{s_K}{s_L}+1\right]\frac{1}{1+\left(\frac{1-\alpha}{\alpha}\right)^{\gamma}\left(\frac{A^d}{A^f}\right)^{\gamma-1}\left(\frac{R^f}{R^d}\right)^{\gamma-1}}. \tag{34}$$

From the firm's optimization problem we also have

$$\frac{R^d K^d}{R^f K^f} = \left(\frac{1-\alpha}{\alpha}\right)^{\gamma}\left(\frac{A^d}{A^f}\right)^{\gamma-1}\left(\frac{R^d}{R^f}\right)^{1-\gamma}. \tag{35}$$

Combining the equations above with the fact that $\frac{\partial ln\left(R^f\right)}{\partial \tau} = \frac{1}{1+\tau}$, we obtain equation (12) in the text.

8.6 Scaling of the Capital Tariff for Quantitative Comparison

We can illustrate how the scaling works with the following simple example. Assume there are only two types of capital with ad valorem tariff rates τ_1 and τ_2, and cost shares α_1 and α_2. The effective tariff rate we use in the estimations is $T = \alpha_1\tau_1 + \alpha_2\tau_2$ (see equation 8 in the main text). If we consider a 1 percentage point (p.p.) reduction in τ_1 and τ_2, we would get a $(\alpha_1+\alpha_2)$p.p. reduction in T. To obtain a 1p.p. reduction in T, which would be directly comparable to the point-estimates reported in the reduced form estimates, we need a $\left(\frac{1}{\alpha_1+\alpha_2}\right)$p.p. decrease in τ_1 and τ_2. Since the expression in (12) above gives the percentage change in $\frac{s_L}{s_K}$ given a 1p.p. change in τ, we would multiply the predicted value with $\left(\frac{1}{\alpha_1+\alpha_2}\right)$ to obtain a value comparable to the estimated value.