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Tariffs and Firm Performance in Ethiopia

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ABSTRACT *We use data on Ethiopian manufacturing firms and commodity-level data on tariffs to examine the effects of trade liberalisation on firm performance. We distinguish the productivity gains that arise from reducing final goods tariffs from those that arise from reducing tariffs on intermediate inputs. We find no evidence that output tariff reduction improves productivity, but we find large positive effects of input tariff reductions. These are robust to alternative productivity measures, treating tariffs as endogenous, and various generalisations of the model. We conclude that policy measures designed to facilitate access to inputs produced abroad may lead to productivity gains.*

1. Introduction

Since the 1980s, most countries in Sub-Saharan Africa have moved away from inward-looking development strategies, as a reaction to the failure of previous import substitution policies. The reforms were generally undertaken within the framework of structural adjustment programmes under the auspices of the international financial institutions. Reforming trade policy, an important component of these programmes, included import liberalisation through tariff reductions and the removal of non-tariff barriers. Despite the high profile of the topic, little is known about how these reforms have impacted firm performance. In this paper we investigate this issue for Ethiopia, using matched firm-level panel data and commodity-level data on imports and tariffs. The government of Ethiopia implemented six successive custom tariff reforms between 1993 and 2003. The staggered nature of the tariff reductions over time and across industrial subsectors enables us to identify the effects of tariffs on firm performance whilst controlling for a range of unobservable determinants of productivity.¹ Our estimation sample covers all manufacturing establishments with 10 or more workers in the country and is, by the standards of African firm-level datasets, very large.²

Several hypotheses exist about how increased openness to trade impacts firm productivity. Trade liberalisation should increase competition from imported goods and may therefore ‘discipline’ domestic producers to improve their efficiency (Holmes & Schmitz, 2001; Nishimizu & Robinson, 1984). Increased competitive pressure may also lead to further exploitation of economies of scale, if the reduction in domestic firms’ market power forces them to expand output and move down the cost curve (Helpman & Krugman, 1985; Krugman, 1979). Import competition may further lead to a reallocation of resources as a result of firm turnover and dynamics. For example, if reduced protection lowers domestic prices, high cost producers are forced to exit the market which frees up resources for

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An Online Appendix is available for this article which can be accessed via the online version of this journal available at <http://dx.doi.org/10.1080/00220388.2016.1139691>

the efficient firms that survive (Roberts & Tybout, 1991; Rodrik, 1992). Increasing integration into the world economy may benefit productivity because of other mechanisms than increased competition. For example, access to cheaper and better intermediate inputs, access to global finance, and exposure to new goods and new methods of production can be sources of increased productivity (for example, Dornbush, 1992; Grossman & Helpman, 1991; Romer, 1994; Young, 1991).

Several empirical studies of the effects of trade liberalisation on firm productivity have been undertaken for developing countries in Latin America and Asia.³ Most of these indicate that lower tariffs have positive effects on firm performance.⁴ However, whether the results generalise to sub-Saharan Africa remains an open question. Indeed, there is evidence in the macro literature that the effects of trade on economic performance are context specific and depend on the quality of the investment climate and the level of economic development (Chang, Kaltani, & Loayza, 2005; DeJong & Rippol, 2006). We have found three published articles that have examined the effect of trade liberalisation on manufacturing performance based on firm-level data. The first is that by Harrison (1994), which documents a fall in price-cost margins amongst firms in Cote d'Ivoire following the 1985 trade reform. This is consistent with the hypothesis that openness to imports increases competition in the domestic market. The second is that by Mulaga and Weiss (1996), which, based on data for Malawi 1970–1991, reports mixed results as to the effect of trade reform on productivity growth. The third is that by Njikam and Cockburn (2011), which examines the relationship between effective rates of assistance (a combined measure of tariff, quotas and subsidies) and productivity growth among Cameroonian manufacturing firms. Although these studies are interesting and important, the nature of the data limits the range of questions that can be answered. Harrison (1994) and Mulaga and Weiss (1996) use data that are limited in terms of their post-reform coverage, and the samples used in these studies are fairly small.⁵ Njikam and Cockburn (2011) do not distinguish between the effects of input and output tariffs, a distinction which turns out to be important in our application.

In addition to shedding new light on the effects of trade liberalisation in Africa, our study also contributes to a thin but growing literature that disentangles the productivity gains that arise from reducing tariff on final goods from those that arise from reducing tariffs on intermediate inputs (for example, Schor, 2004; Amiti & Konings, 2007; and Topalova & Khandelwal, 2011).⁶ A common empirical result in this recent literature is that there are relatively large productivity improvements associated with reductions in input tariff – in fact, effects of input tariff reductions are quantitatively more important than the gains from reducing output tariffs. Topalova and Khandelwal (2011) argue that the gains from intermediate inputs may be particularly important for developing countries that have emerged from import substitution strategies under which firms faced significant technological constraints because of inadequate access to imported inputs. The Ethiopian case is interesting in this regard, since the country's manufacturing sector operated under a long period of protection in the two previous regimes prior to the start of the reform programme. Harrison and Rodríguez-Clare (2009) argue that differentiating the relative effects of these channels may be important from a policy perspective.

We begin our empirical analysis by documenting the reductions in output and input tariffs over the sampling period. We note that the cross-sectional standard deviation of tariff rates has decreased over time, implying greater uniformity of tariff rates across sectors. Results from OLS regressions suggest a negative relationship between input tariffs and firm-level productivity, and no strong relationship between output tariffs and productivity. These results prove robust to the inclusion of firm-level fixed effects, and they do not change much as a result of computing productivity on the basis of a different cost of capital. Furthermore, the results do not change much if we use firm-level, rather than sector-level, measures of input tariffs. We proceed by investigating if firm entry and exit patterns are associated with tariffs, and conclude that the selection effects are weak or non-existing. To investigate if the productivity effects are robust to treating tariffs as econometrically endogenous, we use a two-stage least squares approach in which the tariff change over the entire sample period is instrumented using a measure of initial tariff. We also use a dynamic panel data GMM estimator introduced by Arellano and Bond (1991). The results are somewhat weak but broadly in line with the fixed effects results. Finally, we consider fixed effects estimates of generalised specifications allowing for

heterogeneous tariff effects, depending on: a) the intensity with which firms import inputs; b) industry concentration; and, c) the tariff levels. We obtain evidence that the first of these mechanisms is important, but not the second or the third.

The rest of the paper is organised as follows. The next section describes the Ethiopian context. Section 3 presents the data and the empirical framework. Section 4 discusses the empirical results. Section 5 provides the conclusions.

2. Ethiopia's Trade Liberalisation and the Institutional Context

The Ethiopian manufacturing sector operated under long periods of protection during the twentieth century. The first development plan in the 1950s relied on an import-substituting strategy, and industrial development gained momentum after the Imperial government introduced measures such as generous tax incentives, high levels of tariff protection, and easy access to domestic credit for domestic production of manufactured goods. The military regime (known as the Derg) that came into power in 1974 nationalised all private large- and medium-scale manufacturing firms, and pursued an import-substituting strategy combined with a command economic system. The industrial development strategy sought to promote industrialisation through public investment behind high tariff walls, while at the same time stifling the private sector.⁷ As a result, industrial production contracted dramatically.

After nearly two decades of centralised economic policy a new government took over in 1991, and it has since then undertaken extensive policy reforms to transform the economy into a market oriented one. In August 1993, the Ethiopian government launched a comprehensive trade reform programme aimed at dismantling quantitative restrictions and gradually reducing the level and dispersion of tariff rates. Based on agreements with the Bretton Wood institutions, the government implemented six successive customs tariff reforms between 1993 and 2003. Table 1 shows the rounds of reforms and average tariff rates in detail. In the first round (August 1993) the maximum tariff was reduced from 230 per cent to 80 per cent. It was then gradually reduced and reached 35 per cent in the sixth reform round in 2003. The average weighted tariff rate has been reduced from 41.6 per cent to 17.5 per cent, and the number of tariff bands has fallen from 23 to 6 including the zero rate band.⁸

Other reform measures introduced alongside the trade reforms included foreign exchange market liberalisation starting with a massive devaluation in October 1992. Since then the exchange rate has been determined by a weekly auction system. Most price controls and restrictions on private investment have been lifted and a large number of public establishments have been privatised. Gebreeyesus (2013) provides an extensive review of the Ethiopian reform process in the 1990s as well as industrial policy experiments in the 2000s (see Sections 2 and 4 in Gebreeyesus, 2013).

In our regression analysis below, our initial assumption is that tariffs are exogenous to firm-level productivity. However, in general, tariffs could be endogenous. A common worry in the literature on firm-level performance and tariffs is that the policy makers may decide to adjust tariffs in response to lobbying by firms in industries with low, or falling, productivity levels. In such a case, one may find a negative correlation between tariffs and productivity, even though tariffs do not *cause* productivity.

Table 1. Tariff reforms in Ethiopia

Rounds of reforms	Year	Maximum tariff	Average tariff	Number of tariff bands
Before reform	Before 1993	230	41.6	23
1st round	August 1993	80		
2nd round	January 1996	60		
3rd round	1997	60		
4th round	January 1998	50	21.5	
5th round	December 1998	40	19.5	
6th round	January 2003	35	17.5	6

Source: Ministry of Finance and Economic Development, Government of Ethiopia (2006).

While we cannot rule out endogeneity in tariffs a priori, we are optimistic that this problem is not overly serious. The World Bank and the IMF had considerable influence over the Ethiopian trade reforms, which should reduce the worry that poorly performing sectors receive benefits in the form of slower reductions in protection. This conjecture is in tune with the findings reported by Jones, Morrissey, and Nelson (2011). Using industry-level data for a sample of four African countries (including Ethiopia), these authors ask whether the pattern of protection and tariff reform since the early 1990s can be explained by political economy mechanisms, for example, protection in response to industry lobbies. The evidence suggests that such mechanisms have played a limited role. The authors argue instead that the pattern of tariff reductions was technocratic in structure, noting that reductions in average tariffs were implemented across the board, with larger reductions for higher tariffs. This is consistent with policy reforms being guided by the World Bank, in which case it would seem plausible to argue that policy reforms were essentially exogenous. We nevertheless investigate below if our main results are robust to treating tariffs as econometrically endogenous.

3. Data and Empirical Framework

3.1 Data and Construction of Variables

We match census panel data on manufacturing firms, collected annually by the Central Statistical Agency of Ethiopia (CSA), with annual data on tariffs and imports obtained from the Ethiopian Customs Authority (ECA) for the period 1996/7 (henceforth 1997) to 2004/5 (henceforth 2005). The enterprise census covers every formal manufacturing establishment in the country with 10 or more workers.⁹ We refer to the establishments as firms rather than plants, but this distinction is not very important as the available data indicate that less than 5 per cent of the firms have more than one branch.¹⁰ There is information in the data on output, inputs (local and imported), sales (local and exported), employment, location, ownership type, and a variety of costs. Throughout the analysis, all financial variables are expressed in real terms using sector-specific deflators generated from the CSA production and sales data. Capital stock series are constructed using the perpetual inventory method. Further details on deflators and variable construction can be found in the Online Appendix.¹¹

Our measure of productivity is based on the production function, which we express as

$$Q_{ijt} = TFP_{ijt} X_{ijt} \quad (1)$$

where Q is output, TFP is total factor productivity, X is a composite index of inputs, and i, j, t are firm, sector and time subscripts, respectively. In our baseline specification, we represent Q by real value added, and assume a two-factor Cobb-Douglas function with constant returns to scale. Our productivity measure is thus defined as

$$\log TFP_{ijt} = \log Q_{ijt} - \alpha \log L_{ijt} - (1 - \alpha) \log K_{ijt} \quad (2)$$

where L denotes labour and K capital. The first-order condition for optimal labour implies $\alpha = wL/(wL + rK)$, where w is the wage rate and r is the capital rent. Our estimate of α is therefore the average cost-share of labour in the data (see for example Foster, Haltiwanger, & Syverson, 2008, 2012, for a similar approach). For our baseline model we assume $r = 0.10$ which amounts to a 10 per cent annual user cost of capital. We also consider industry specific estimates of α .

An alternative approach for estimating productivity would be to use an econometric estimator. However, it has become increasingly clear in recent years that identification of production function parameters (especially those associated with flexible inputs) by means of an econometric approach requires strong assumptions. Specific econometric procedures for estimating production function while allowing for simultaneity and attrition have been proposed by Olley and Pakes (1996), and Levinsohn and Petrin (2003); see Bond and Söderbom (2005), Akerberg, Benkard, Berry, and Pakes (2007), Gandhi, Navarro, and Rivers (2013), and Akerberg, Caves, and Frazer (2015), for a critique of these

procedures. Indeed, the debate on what is the best econometric approach for estimating production function parameters appears to be far from settled at this point. Fortunately, there is in most datasets considerable variation in the factor inputs across firms, suggesting that differences in production function parameter estimates may not lead to radically different productivity estimates. The results in Van Biesebroeck (2005a) and Syverson (2011) lend some support to the notion that productivity estimates are not overly sensitive to method. Below we complement the cost-share approach by an econometric approach, and investigate if our main results are robust.

The dataset on output tariffs and imports was constructed using unpublished commodity level data made available to us by the ECA. These data were originally organised according to the 6-digit Harmonized System (HS) code. We used concordance information from the World Bank trade website, prepared by Alessandro Nicita and Marcelo Olarreaga, to map the import and tariff information with HS codes at the 6-digit level into 4-digit international standard industrial classification (ISIC) product codes, enabling us to match our two datasets.¹² To do this, we define the 4-digit level tariff rate as the unweighted average of the values of duties to imports across the 6-digit level HS commodities within the corresponding 4-digit category. To generate industry level (4-digit level) intermediate input tariffs, we combined information in the production data from CSA and tariff data from ECA. This was a somewhat laborious task. We began by listing all the inputs used by the firms. We then assigned a HS number to each input identified in the data, enabling us to merge the input data with the customs data on input tariffs for specific products. Using the firm-level data, we then computed the total value of inputs used for each subsector (defined at the 4-digit ISIC level) and input type in the data. We aggregated input values over different inputs, within each subsector, and computed the share of a particular input in total inputs for each product within the sector. Finally, we merged the shares data with the tariff data, and, for each sector and year, computed a weighted average of the input tariff with weights based on shares calculated as described above. In the empirical analysis below, we also consider results based on a firm-level measure of input tariffs. This measure is constructed in the same way as described above, except that the input shares are computed at the level of the firm rather than at the industry level. A similar approach has been used by Lileeva and Trefler (2010).

3.2 Empirical Framework

Our empirical approach for studying the effects of trade liberalisation on firm performance is to regress our measure of firm productivity on the measures of trade openness and other control variables (see for example, Schor, 2004; Amiti & Konings, 2007; and Topalova & Khandelwal, 2011, for a similar approach). Our baseline model is thus specified as

$$TFP_{ijt} = \theta_0 + \theta_1 Tariff_{jt}^O + \theta_2 Tariff_{jt}^I + \tau_t + \alpha_{ij} + \varepsilon_{ijt} + v_{ijt} \quad (3)$$

where $Tariff_{jt}^O$ and $Tariff_{jt}^I$ denote output and input tariffs, respectively, for sector j at time t , τ_t is a time effect common to all firms, α_{ij} is a firm-level fixed effect, ε_{ijt} is a (potentially autocorrelated) productivity shock, and v_{ijt} is a serially uncorrelated measurement error in productivity. Since the tariff variables vary only across sectors and over time, and since we control for both time and firm fixed effects, a necessary condition for θ_1 and θ_2 to be identified is that there is variation across sectors in the growth rates of tariffs. Note that macroeconomic shocks common to all firms will be captured by the time dummies. This is an important aspect of the model, since the tariffs were reduced gradually and these reforms were accompanied by other broad reform activities (see Section 2).

Our first hypothesis is that a reduction in the output tariff increases firms' productivity ($\theta_1 < 0$) through increasing import competition, which in turn leads to reduction of X-inefficiency and further exploitation of economies of scale. Most empirical studies support this hypothesis. However, import competition may not always improve firm productivity, and in some circumstances it might even have the opposite effect. Traca (1997) distinguishes two conflicting effects of import competition on productivity: a direct effect that harms productivity and a pro-competitive effect that fosters it. The

negative effect on productivity arises if output contracts in response to a decline in demand for domestic goods, following increased import competition. For the pro-competitive effect to prevail, the domestic firm has to continuously invest in productivity growth.

Two opposite forces are also thought to take part in the relation between input tariff reduction and firm productivity. On the one hand, reducing import tariffs might offset some of the import competition effects thus reducing the incentive to pursue more efficient techniques. On the other hand, lower import tariffs can benefit firms by making foreign inputs more accessible and increase productivity due to a learning effect from the foreign technology embodied in the imported inputs, as well as higher quality variety of inputs. Previous empirical studies (for example, Amiti & Konings, 2007; Schor, 2004) show that the latter effect outweighs the former, thus, the overall effect of a reduction of input tariffs is to increase firm productivity. In our model this would imply a negative value of θ_2 .

4. Empirical Analysis

4.1 Descriptive Statistics

Table A.1 in the Online Appendix shows some characteristics of the formal manufacturing sector in Ethiopia, for selected years within our sampling period. The number of firms increased by 42 per cent between 1997 and 2004. Employment also grew, but relatively less so than the number of firms. In terms of employment, textiles was the leading sector in 1997, followed by food. By 2004, the order had been reversed reflecting a significant contraction in textile sector employment. The leather sector has also seen a reduction in employment over the sampling period.

Figures 1 and 2 show averages, and standard deviations, of nominal tariffs and import penetration rates over the sampling period. These averages and standard deviations are based on firm-level observations, hence tariffs and import penetration rates in sectors with a lot of firms receive a higher weight. Figure 1 confirms that average tariffs of both outputs and inputs fell gradually, and that the dispersion of tariffs across firms decreased, between 1997 and 2005. The latter finding reflects the greater uniformity of tariffs across sectors, which has been considered a good policy rule of thumb in the literature on trade reform.¹³ Figure 2 shows that there is no strong trend in the import penetration rate. An OLS regression of the import penetration ratio on output tariffs, year dummies and sector dummies, estimated at the sector level, results in an estimate of the tariff coefficient equal to -0.20 and an associated standard error of 0.12. Hence there is a negative association between output tariffs and imports, but it is not quite statistically significant.

In Table A.2 in the Online Appendix, we provide a breakdown by sector, for selected years. Output tariff rates have been declining for all industries except two. In 2005, the industries with the highest output tariff rates were garment (34%), footwear (33%) and tobacco (32%). Seven industries have 10 per cent or lower tariff rates in the same year. Input tariff rates have also been similarly reduced in most of the

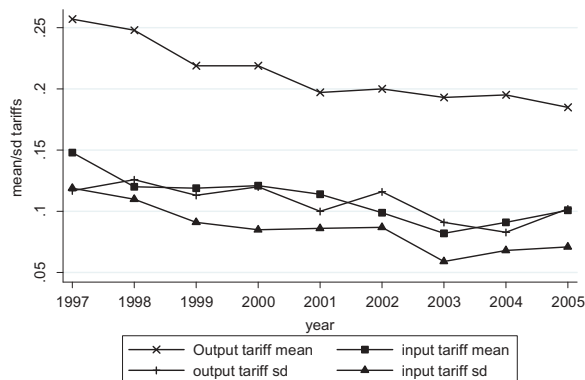


Figure 1. Trends in the mean and standard deviation of tariffs.

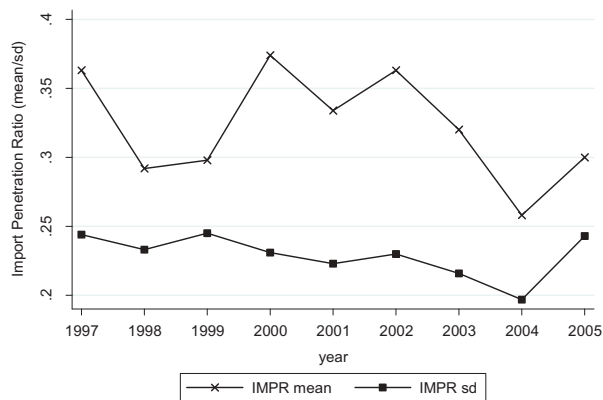


Figure 2. Trends in the mean and standard deviation of import penetration ratio.

industries. The three identified above (garment, footwear, and tobacco), and other food, are the remaining industries with higher input tariffs, 20 per cent or more, in 2005. About half of the industries enjoyed a one digit input tariff in the same year. There is variation across sectors and over time in the growth rates of tariff rates, which is necessary for it to be possible to identify the tariff effect on outcomes whilst controlling for time and firm (or, in some specifications, sector and location) fixed effects.

The trend for import penetration differs across industries too, some showing a declining trend and others an increase. Most industries use imported intermediate inputs to some extent and some are heavily dependent on these. For example in 2005, the imported input ratio of total input use was 50 per cent and above for 10 out of the 21 industries defined at the 3-digit level. Export participation of the Ethiopian manufacturing is increasing, but the majority of the industries have not yet become involved in the export market. The few industries that are significantly involved in the export market are leather, food, footwear and textiles.

4.2 Regression Analysis

4.2.1 Baseline results: tariffs and firm-level productivity. In [Table 2](#) we show our baseline regression results, with the dependent variable (TFP) defined as in Equation (2). The regressions are estimated at the level of the firm, and the standard errors are firm-level clustered throughout, thus robust to heteroskedasticity and serial correlation. The first column reports OLS results for the productivity specification without controls for firm fixed effects, but with dummies for sector, location, and time included. The output tariff is not statistically significant (the estimated coefficient even has the ‘wrong’ sign), and the input tariff is weakly significant, at the 10 per cent level. The estimated input tariff coefficient is equal to -0.62 , which, under the assumption that tariffs are exogenous, implies that a one percentage point tariff reduction results in a productivity increase of about 0.6 per cent.

Columns (2)–(7) in [Table 2](#) show results for specifications that control for firm fixed effects. As a result of adding these controls, the estimated tariff coefficients decrease. The output tariff is never close to being statistically significant in these specifications (and the estimated coefficients associated with the output tariff variable are close to zero), but the input tariff is significant at the 5 per cent level or better. In column (2), the input tariff coefficient is estimated at -0.88 , which, under the exogeneity assumption, implies that a one percentage point tariff reduction increases productivity by 0.88 per cent. In columns (3) and (4) the output and input tariffs are added separately to the model, which yields results that are similar to those in column (2). Hence, even though the two tariff measures are positively correlated, the correlation is not strong enough to result in near-collinearity problems in regressions in which both measures are included simultaneously. In column (5) we increase the user cost of capital from 10 per cent to 15 per cent, implying a lower labour coefficient and a higher capital coefficient in the equation used for computing TFP (see Equation (2)). The changes in the estimated

Table 2. Tariffs and firm-level productivity: baseline results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Output tariff	0.318 (0.324)	0.163 (0.313)	-0.020 (0.295)		0.175 (0.316)	0.142 (0.314)	0.164 (0.304)
Input tariff	-0.623 (0.377)*	-0.882 (0.416)**		-0.847 (0.397)**	-0.920 (0.418)**	-0.875 (0.421)**	-1.043 (0.351)***
Year dummies	yes	yes	yes	yes	yes	yes	yes
Sector dummies	yes	redundant	redundant	redundant	redundant	redundant	redundant
Town dummies	yes	redundant	redundant	redundant	redundant	redundant	redundant
Firm fixed effects	no	yes	yes	yes	yes	yes	yes
User cost of capital	0.10	0.10	0.10	0.10	0.15	0.10	0.10
Input tariffs	Sector level	Sector level	Sector level	Sector level	Sector level	Sector level	Firm level
Sector specific production function	no	no	no	no	no	yes	no
Observations	6208	6268	6268	6268	6268	6268	6268
Firms	1705	1738	1738	1738	1738	1738	1738

Notes: The dependent variable is log TFP defined by Equation (2). All regressions are estimated by means of OLS. For the regressions in columns (2)–(7) the within transformation is used in order to eliminate the firm fixed effects. Firm-level clustered (robust) standard errors are shown in parentheses. * denotes statistical significance at the 10 per cent level; ** significant at the 5 per cent level; *** significant at the 1 per cent level.

tariff effects are negligible: the estimated coefficients and the levels of statistical significance in column (5) are very similar to those in column (2). In column (6), we relax the restriction that factor shares are constant across sectors and instead compute factor shares separately for each 4-digit industry. This may be important if heterogeneity in technology across sectors results in differing coefficients of the factor inputs. The results change very little, however. In column (7), we replace the sector-level input tariff by our firm-level measure of the same variable.¹⁴ We find that the effects of lower input tariffs on productivity are somewhat larger (the point estimate is now -1.0), and more statistically significant (now at the 1% level), if we use the firm-level measure rather than the sector-level measure. However, since one might worry that the firm-level measure may be endogenous – for example, if firms with efficient management and higher productivity may have lower firm-level input tariffs since they are better at choosing inputs as to minimise tariff expenses than firms with inefficient management – we will use the sector-level measure in the remainder of this paper. In any case, it is reassuring that whether one uses a firm-level measure or a sector-level measure does not seem to matter very much. Finally, we estimate Cobb-Douglas production functions directly, with and without constant returns to scale imposed. The results, shown in Table A.3 in the Online Appendix, are similar to those in Table 2: the input tariff variable is statistically significant while output tariff is insignificant. Consistent with several other studies of African manufacturing, we do not reject the null hypothesis of constant returns to scale (Baptist & Teal, 2008; Söderbom & Teal, 2004).

What should we make of these results? First, we note that the absence of significant effects of output tariff reductions on firm productivity in our data is not consistent with the import discipline hypothesis and stands in contrast to most previous empirical findings (for example, Amity & Konings, 2007; Fernandes, 2007; Pavcnik, 2002). Second, the result that lower input tariffs tend to raise productivity, and that the effect appears to be quantitatively large, is more in tune with findings for other regions. For example, using a similar specification to ours, Amity and Konings (2007) report results implying that a one percentage point reduction in input tariffs in Indonesia results in a productivity gain of 0.4 per cent – that is a smaller effect than what we obtain for Ethiopia – while a one percentage point reduction in output tariffs raises productivity by just 0.07 per cent. Schor (2004) reports 0.9 per cent and 1.5 per cent productivity gains from a reduction of 10 percentage points for output and input tariffs respectively in Brazilian manufacturing. Our results thus add to a growing body of evidence indicating that cutting input tariffs can be an effective way of spurring firm-level productivity in developing

countries. Our finding that output tariffs appear unrelated to productivity should not be interpreted as saying that these tariffs are generally irrelevant. Clearly, lower tariffs on imported final goods benefit domestic consumers, for example.

4.2.2 Tariffs and firm-level entry and exit patterns. Thus far we have focused on the relationship between tariffs and the productivity of existing firms. Naturally, trade liberalisation may affect firm-level behaviour in many other ways apart from productivity. In this sub-section we ask whether there is any connection between the tariff reductions and the entry and exit decisions of firms. This question is of economic interest in and of itself. Moreover, a better understanding of these relationships sheds some light on whether our results referring to productivity effects may be driven by selection mechanisms. For example, if tariffs affect the decision to exit, while at the same time the unobservables determining the decision to exit are correlated with the unobservable drivers of productivity, our estimates of the tariff effects on productivity may be spurious due to attrition bias. Table A.4 in the Online Appendix shows OLS estimates, with and without firm fixed effects, of linear probability models of the decision to exit from the market (that is the dependent variable in these regressions is a dummy variable equal to one if the firm exits in a given period and zero otherwise). In both specifications, the tariff variables are wholly statistically insignificant. Table A.5 (see Online Appendix) shows results from regressions in which we model the number of firms (in logarithmic form) present in a particular sector at a particular point in time as a function of output and input tariffs. The tariff variables are statistically insignificant throughout. We thus find no evidence that tariffs correlate with the exit decision or net entry into a particular sector.

4.2.3 Endogenous tariffs. So far, the tariffs have been treated as econometrically exogenous. We now investigate if our results are robust to treating the tariff variables as endogenous, focusing on the relationship between tariffs and firm-level productivity. Previous studies (for example, Amity & Konings, 2007; Goldberg & Pavcnik, 2005) have instrumented for tariff changes using pre-reform tariffs. Unfortunately, we do not have information on pre-reform tariffs for Ethiopia. The first period for which we have tariff data disaggregated at the sector level is 1995, that is a couple of years into the reform process, but at least pre-sample.¹⁵ We use these data to instrument for changes in tariffs in a regression modelling the change in productivity over the entire sampling period, 1997–2005. Table 3 shows reduced form (column 1) and instrumental variables (column 2) estimates of the productivity equation thus estimated in ‘long’ differences. While the instruments are statistically strong (as

Table 3. Tariffs and firm-level productivity growth: reduced form and instrumental variables estimates

	(1) OLS (reduced form)	(2) Two-Stage Least Squares
Output tariff growth 1997–2005		1.701 (2.40)
Input tariff growth 1997–2005		–0.976 (1.191)
Output tariff in 1995	–0.675 (0.553)	
Input tariff in 1995	0.780 (0.644)	
Weak identification test:		
Kleibergen-Paap rk Wald F statistic		39.02
H ₀ : Tariff growth exogenous (p-value)		0.86
Observations (firms)	230	230

Notes: The dependent variable in both specifications is the change in log TFP over the period 1997–2005. A constant is included in both regressions. Robust standard errors are shown in parentheses.

indicated by the large Wald F statistic obtain by means of the Kleibergen-Paap test), the relationship between the productivity change and the 1995 tariffs is statistically weak. Indeed, the absolute values of the t-statistics in the reduced form specification are only marginally higher than one. In the two-stage least squares regression, neither tariff variable is statistically significant, though we note that the point estimate of the input tariff effect is very close to the fixed effects estimates shown in Table 2. Based on a formal test for exogeneity, we do not reject the null hypothesis that the tariff variables are in fact exogenous.

The estimation sample in the above two-stage least squares analysis is clearly very small (only 230 observations). To explore whether the results can be improved if we use the entire panel, we use the System Generalised Method of Moments (SYS-GMM) estimator proposed by Blundell and Bond (1998) and exploit lags of the regressors as instruments. Assuming that the error term ε_{ijt} in eq. (3) follows an AR(1) process, $\varepsilon_{ijt} = \rho\varepsilon_{ij,t-1} + u_{ijt}$, where u_{ijt} is serially uncorrelated, the model has the following dynamic (common factor) representation:

$$TFP_{ijt} = (1 - \rho)\theta_0 + \theta_1 Tariff_{jt}^O - \rho\theta_2 Tariff_{j,t-1}^O + \theta_2 Tariff_{jt}^I - \rho\theta_2 Tariff_{j,t-1}^I + \rho TFP_{ij,t-1} + \tau_1 \rho \tau_{t-1} + \{ (1 - \rho)\alpha_{ij} + u_{ijt} + v_{ijt} - \rho v_{ij,t-1} \}, \tag{4}$$

or

$$TFP_{ijt} = \pi_0 + \pi_1 Tariff_{jt}^O + \pi_2 Tariff_{j,t-1}^O + \pi_3 Tariff_{jt}^I + \pi_4 Tariff_{j,t-1}^I + \pi_5 TFP_{ij,t-1} + \tau_t^* + \{ \alpha_{ij}^* + w_{ijt} \}, \tag{5}$$

subject to the two nonlinear (common factor) restrictions $\pi_2 = -\pi_1\pi_5$ and $\pi_4 = -\pi_3\pi_5$. Notice that this specification contains a lagged dependent variable whose coefficient measures the serial correlation in the error term ε_{ijt} . The error term w_{ijt} will be serially uncorrelated in the absence of measurement errors, and first-order moving average (MA(1)) otherwise. As discussed by Blundell and Bond (2000), given estimates of the unrestricted parameters π_1, π_2, π_5 , the common factor restrictions can be imposed using a minimum distance approach which yields estimates of the parameters of interest (θ_1, θ_2, ρ).

The firm fixed effect α_{ij} can be removed by taking first differences of eq. (5), resulting in a differenced specification:

$$\Delta TFP_{ijt} = \pi_1 \Delta Tariff_{jt}^O + \pi_2 \Delta Tariff_{j,t-1}^O + \pi_3 \Delta Tariff_{jt}^I + \pi_4 \Delta Tariff_{j,t-1}^I + \pi_5 \Delta TFP_{ij,t-1} + \Delta w_{ijt}, \tag{6}$$

The SYS-GMM estimator is obtained by combining Equations (5) and (6) into a system, and using lagged levels as instruments for variables in first differences and lagged differences as instruments for variables in levels (Blundell & Bond, 1998). We initially use output and input tariffs lagged two, three and four periods as instruments for the differenced equation and differences of these variables lagged one period for the levels equation. In addition, we use TFP lagged three and four periods as instruments for the differenced equation and differenced TFP lagged two periods as instruments for the levels equation.¹⁶ Year dummies are exogenous and thus serve as their own instruments. SYS-GMM estimates are shown in Table 4, column (1). Panel (A) shows the unrestricted estimates while panel (B) shows estimates of the restricted model, obtained by means of minimum distance estimation procedure. The estimates look broadly in line with the earlier results. The estimated tariff effects shown in panel (B) are negative and somewhat larger than the fixed effects estimates reported earlier. The input tariff variable is significant at the 10 per cent level, while output tariff is statistically insignificant. The estimated serial correlation is relatively precisely estimated at 0.70, and the common factor restrictions are not rejected. However there is strong evidence from Hansen’s specification test that the unrestricted model is mis-specified, in the sense that the over identifying restrictions on the orthogonality conditions appear invalid. In view of this outcome, we gradually remove lags from the

Table 4. Dynamic specification with endogenous tariffs: system GMM and minimum distance estimates

	(1)	(2)	(3)
A. SYS-GMM estimates of unrestricted model			
Output tariff _t	-1.521 (0.808)*	-1.036 (0.690)	1.496 (1.418)
Output tariff _{t-1}	0.170 (0.650)	0.253 (0.939)	-0.885 (1.492)
Input tariff _t	-1.581 (1.000)	-1.978 (1.188)*	-5.257 (1.675)***
Input tariff _{t-1}	1.473 (0.727)**	1.989 (1.252)	5.442 (1.851)***
log TFP _{t-1}	0.687 (0.103)***	0.820 (0.122)***	0.927 (0.111)***
m1	-7.15***	-6.89***	-7.23***
m2	2.58**	2.69***	2.56**
Hansen: p-value (df)	0.000 (62)	0.000 (46)	0.330 (32)
Diff Hansen: p-value (df)	0.002 (22)	0.000 (20)	0.276 (18)
B. Minimum Distance estimates of restricted model			
θ ₁ (output tariff)	-1.296 (0.795)	-1.070 (0.685)	1.418 (1.410)
θ ₂ (input tariff)	-1.674 (0.959)*	-2.007 (1.182)*	-5.095 (1.630)***
ρ (residual autocorrelation)	0.704 (0.010)***	0.846 (0.010)***	0.918 (0.097)***
Comfac: p-value (df)	0.124 (2)	0.687 (2)	0.551 (2)
Year dummies	yes	yes	yes
Observations	4243	4243	4243
Firms	1144	1144	1144

Notes: The instruments for the specifications in panel A are as follows. Column (1): differenced equation, output and input tariffs lagged 2, 3 and 4 periods, log TFP lagged 3 and 4 periods, differenced year dummies; levels equation, differenced output and input tariffs lagged 1 period, log TFP lagged 2 periods, year dummies. Column (2): differenced equation, output and input tariffs lagged 3 and 4 periods, log TFP lagged 3 and 4 periods, differenced year dummies; levels equation, differenced output and input tariffs lagged 2 periods, log TFP lagged 2 periods, year dummies. Column (3): differenced equation, output and input tariffs lagged 4 periods, log TFP lagged 3 and 4 periods, differenced year dummies; levels equation, differenced output and input tariffs lagged 3 periods, log TFP lagged 2 periods, year dummies. Firm-level clustered (robust) standard errors are shown in parentheses. * denotes statistical significance at the 10 per cent level; ** significant at the 5 per cent level; *** significant at the 1 per cent level. The null hypothesis underlying the Comfac test is that the common factor restrictions are valid. The null hypothesis underlying the Hansen test is that the overidentifying restrictions are valid. The null hypothesis underlying the Diff Hansen test is that the moment conditions associated with the levels equation are valid.

instrument set. In column (2) we exclude t-2 lags of tariffs from the instrument set for the differenced equation, and use second lags of tariffs differenced (instead of first lags) as instruments for the levels equation. However, there is still strong evidence that the model is mis-specified.

In Table 4 column (3), we use output and input tariffs lagged four periods as instruments for the differenced equation and differences of these variables lagged three periods for the levels equation. As a result of using only such deep lags as instruments, based on the Hansen test we do not reject the null hypothesis that the orthogonality conditions are valid. Unsurprisingly, since deep lags have limited explanatory power for the instrumented regressors, the standard errors for this specification are high. Results for the restricted model (column 3, panel B) suggest a negative and significant productivity effect of input tariffs and a positive but wholly insignificant output effect. The point estimate of the input tariff coefficient is equal to -5.1, implying that a one percentage point reduction in input tariffs increases firm-level productivity by about 5 per cent. This is a much larger effect than those obtained

from the fixed effects estimator above. Of course, given a standard error of 1.63, there is considerable uncertainty as to the true effect.

We draw three main conclusions from the SYS-GMM results. First, there is a clear trade-off between on the one hand satisfying the orthogonality conditions underlying the model and on the other hand employing sufficiently informative instruments. In order for the over identifying restrictions to be accepted we need to use deep lags of the tariff variables as instruments, and the associated standard errors are therefore large. Second, the results appear to confirm earlier findings that input tariffs are a more important determinant of firm-level productivity than output tariffs. Third, as a result of controlling for endogeneity, the estimated input tariff effect becomes quantitatively larger. This suggests that, if endogeneity is indeed a problem, the fixed effects estimate of the input tariff effect tends to be biased toward zero. It may thus be appropriate to interpret the estimates obtained with fixed effects conservatively.

4.2.4 Import intensity, industry concentration and nonlinearities. The main conclusion from the analysis so far is that lower input tariffs lead to productivity improvements across firms. The effects of lower output tariffs are weaker and not statistically significant. In this section we extend the baseline model in three ways in order to better understand the mechanisms through which input tariff reduction impacts firm productivity. First, we investigate whether firms that use imported inputs relatively intensively tend to benefit more from lower input tariffs than less import dependent firms. Second, we examine whether controlling for industry concentration affects our results, and whether the tariff effects on productivity themselves vary with the degree of market concentration.¹⁷ Third, we investigate whether assuming the baseline model eq. (3) to be linear masks important nonlinear effects. Since we have obtained no strong evidence that the fixed effects estimates are biased away from zero, and given that the political process underlying the trade liberalisation was such that exogeneity appears a reasonable assumption, we continue to use the fixed effects estimator for the discussions that now follow. Industry concentration is measured by the Herfindahl concentration index, computed at the 4-digit industry level, based on sales. The share of imported inputs is computed directly from the firm-level data. These variables are added to the baseline specification along with their interactions with input and output tariffs. Potential nonlinear tariff effects are captured by adding squared terms to the model. Table 5 shows results for our extended specifications.

The most general model, containing all the interaction and squared terms, is shown in column (1). We obtain a negative and statistically significant coefficient on the interaction term between the firm's imported input share and the input tariff, suggesting that the effect of reducing input tariffs tends to be particularly strong for import intensive firms. A similar result was reported by Amiti and Konings (2007). The non-interacted input tariff coefficient is negative but the effect becomes statistically insignificant as a result of the inclusion of the interaction term with imported inputs. One interpretation of this result is that changing input tariffs has no effect on productivity for firms that do not import inputs, suggesting that spillover effects spreading from importing to non-importing firms are weak. Moreover, the coefficient on output tariffs squared is negative and significant at the 10 per cent level. Since the estimated coefficient on output tariffs in levels is positive, the results suggest that if output tariffs are already relatively low, further tariff cuts may result in lower firm-level productivity; only at high output tariff levels do reductions seem to result in higher firm-level productivity. However, these effects are imprecisely estimated, and the output tariff and its square are jointly statistically insignificant. Overall the evidence for nonlinear effects is thus weak. Finally, there is no evidence that market concentration impacts productivity: the Herfindahl index and its interactions with tariffs are statistically insignificant. This suggests that mark-up changes are not the reason we observe a significant relationship between input tariffs and productivity in our data. In column (2) we show results from a model with the market concentration interaction terms excluded, and in column (3) we consider a specification in which all nonlinear and interacted terms are excluded except the interaction between input tariff and the share of imported inputs. The evidence that reducing input tariffs is associated with higher productivity primarily for import intensive firms appears robust across these specifications.

Table 5. Import intensity, industry concentration and nonlinearities

	(1)	(2)	(3)
Output tariff	1.898 (1.206)	2.020 (1.214)*	0.136 (0.315)
Input tariff	-1.722 (0.990)*	-1.634 (0.957)*	-0.607 (0.443)
Share of imported inputs	0.227 (0.113)**	0.225 (0.114)**	0.277 (0.095)***
Herfindahl index	-0.205 (0.388)	0.058 (0.264)	0.056 (0.270)
Share of imported inputs x Output tariff	0.444 (0.497)	0.434 (0.497)	
Share of imported inputs x Input tariff	-1.819 (0.752)**	-1.798 (0.754)**	-1.609 (0.721)**
Herfindahl index x Output tariff	0.607 (1.610)		
Herfindahl index x Input tariff	1.211 (1.580)		
Output tariff squared	-3.810 (2.262)*	-3.777 (2.265)*	
Input tariff squared	2.062 (2.047)	2.662 (1.879)	
Year dummies	yes	yes	yes
Firm fixed effects	yes	yes	yes
Observations	6268	6268	6268
Firms	1738	1738	1738

Notes: All regressions are estimated by means of OLS. The within transformation is used in order to eliminate the firm fixed effects. Firm-level clustered (robust) standard errors are shown in parentheses. * denotes statistical significance at the 10 per cent level; ** significant at the 5 per cent level; *** significant at the 1 per cent level.

5. Conclusion

In this study we obtain results indicating that input tariff reductions are associated with higher firm-level productivity, implying that protecting upstream domestic producers by means of high tariffs might result in productivity losses downstream. Additional results indicate that input tariff reductions benefit primarily import intensive firms. For non-importing firms, the effect is small and not significantly different from zero, suggesting weak or no spillover effects. We find that the relationship between output tariffs and import penetration is weak (see [Figure 2](#) and the discussion in [Section 3](#)) and there is no evidence that output tariffs affect firm-level productivity. We note that the absence of a strong relationship between output tariffs and productivity should not be interpreted as indicating that output tariffs are economically unimportant more generally.

In the literature on firm performance in African manufacturing it is often argued that exports can be a source of efficiency gains (for example, Bigsten et al., 2004; Bigsten & Söderbom, 2006; Van Biesebroeck, 2005b). In the present sample, only about 5 per cent of the firms export their products, and manufacturing exports growth has generally been slow in Ethiopia (see [Table A.2](#) in the [Online Appendix](#)) despite a decade of rapid growth in GDP. Hence, Ethiopia does not presently appear to have strong enough industrial capabilities to be internationally competitive, suggesting that, at least in the short term, exporting may not be the most promising route to higher productivity. Our results highlight the importance of imports as an alternative source of productivity gains. Policy measures that result in inputs produced abroad becoming more accessible, and cheaper, would likely benefit Ethiopian firms. While input tariffs can be reduced further, they are clearly not the only policy instrument available to this end. Reducing transport costs through infrastructure investments can be

another effective way of facilitating access to foreign technology, especially for a landlocked country like Ethiopia.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. No firm-level data are available for the period before the trade reforms were initiated, thus it would not be possible to do a 'before-after' comparison of firm performance along the lines of Harrison (1994).
2. See Bigsten and Söderbom (2006) for a survey of the literature on manufacturing enterprises in Africa.
3. See Harrison and Rodríguez-Clare (2009) for a survey of the literature.
4. Notable exceptions include Jenkins (1995) for Bolivia; Ocampo (1994) for Colombia; and Weiss and Jayanthakumaran (1995) for Sri Lanka.
5. Harrison (1994) uses data on 246 large and medium sized firms, whereas Mulaga and Weiss (1996) rely on cross-section survey data for 1991–1992 that covered only the few surviving large manufacturing establishments that had been in operation since 1973.
6. The combined effect of input and output tariffs is sometimes measured as the effective rate of protection of domestic producers. Using the effective rate of protection as an explanatory variable in models of productivity would not enable the effects of input and output tariffs to be identified separately.
7. Its contribution to production and employment in medium and large scale manufacturing in 1988/89 was a mere 4 and 8 per cent respectively (Central Statistical Agency of Ethiopia, 1990).
8. The last round of reform in 2003 constitutes six tariff bands that include 0; 5; 10; 20; 30; and 35 per cent. There are 5608 tariff lines, out of which 5424 are subject to ad valorem duties, while the rest are duty free items or prohibited imports. There are no import quotas, but there are import prohibitions on health and environment grounds (Ministry of Finance and Economic Development, Government of Ethiopia, 2006). Some categories of imported goods are subject to excise tax (3%). Compared to other countries in sub-Saharan Africa, Ethiopia still has relatively high tariffs. For example, the average tariff level in sub-Saharan Africa for all goods was 11.8 per cent while for Ethiopia it was 13.0 per cent (World Bank, 2008).
9. Micro enterprises are thus not represented in the data, and whether the empirical results reported below generalise to this group of firms is very uncertain.
10. It should be noted that we only have complete information on the number of branches for 1997 and 1998.
11. The Online Appendix can be obtained here: http://www.soderbom.net/Appendix_Tariffs_Ethiopia_BGS_2015.pdf
12. There is some ambiguity in the industrial classification in some sectors (mainly machinery and vehicle assembly sectors) forcing us to discard about 200 observations in the manufacturing dataset.
13. Devarajan, Lewis, and Robinson (1990) showed that this may not be a good rule of thumb if other taxes are not set optimally.
14. We are grateful to a referee for suggesting this approach.
15. The averages presented in Table 1 (which includes information for 1993) were obtained from a report published by the Ministry of Finance and Economic Development, but the underlying disaggregated data are, as far as we can tell, not available.
16. The presence of productivity measurement errors implies that TFP lagged two periods is not a valid instrument for the differenced equation and differenced TFP lagged one period is not a valid instrument for the levels equation. These lags are thus excluded from the instrument set throughout.
17. One common concern in the literature is that it is hard to estimate the effects of tariff reforms on productivity and mark-ups separately (for example, Harrison, 1994). In particular, changes in mark-ups resulting from the trade liberalisation may show up as productivity effects unless properly controlled for. To address this concern we include a measure of market concentration in the specification. We do not have data on mark-ups.

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