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INDUSTRIAL LABOR PRODUCTIVITIES AND TARIFFS IN SOUTH AFRICA: IDENTIFICATION BASED ON MULTILATERAL LIBERALIZATION REFORM

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Industrial labor productivities and tariffs in South Africa: Identification based on multilateral liberalization reform

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Abstract

The analysis of the effect of tariffs for labor productivity faces the challenge of tariff policy endogeneity. Tariff policy is designed to promote economic development and the industrial sector tariff structure may reflect characteristics of the industries protected. We seek to identify the effect of tariffs by taking advantage of multilateral tariff liberalization using reductions in industrial sector tariffs in other world regions as instruments for sectoral tariff reductions in South Africa. The data cover 28 manufacturing sectors over the period 1988-2003. We find that tariff reductions have stimulated labor productivity when instrumented by multilateral tariffs. The OLS estimates show downward bias and supports the understanding that the government has given priority to tariff reductions in sectors with slow productivity growth.

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1. Introduction

Do tariffs affect labor productivity? We investigate this relationship using data for industrial sector development and tariffs for South Africa. The main challenge for any policy evaluation is to take into account the endogeneity of policy. Trade policy typically is part of industrial policy and the sectoral tariff rates are designed to promote sectoral policy goals. Correlations between tariffs and productivity may reflect political responses to sectoral productivity development. We take advantage of multilateral tariff reform and use industrial sector tariffs of countries in other world regions as instruments for tariff reductions in South Africa. Identification of the tariff effect is based on predictions from tariff reform elsewhere, controlling for possible direct effects of foreign tariffs on domestic productivity.

We apply the Trade and Industry Policy Studies (TIPS, 2004) industrial sector panel data for the period 1988-2003 covering 28 manufacturing industries in South Africa. The panel data allows for calculation of labor productivity and this is related to sectoral tariff rates. The tariff rates are instrumented using sectoral tariff rates for similar countries in three world regions, Latin-America, Middle-East and South Asia. Various model specifications are investigated to check the robustness of the results and reveal the dynamics of adjustment. The results consistently show that reduced industrial sector tariffs have contributed to higher labor productivities. Increased competition and international technology spillovers are possible channels of effects. Aghion et al. (2008) investigate the economic mechanisms involved in the relationship between trade and growth in South Africa based on nominal tariffs, effective protection rates, and export taxes. Their results indicate that competition may be important for total factor productivity spillover, which is consistent with the analysis of domestic competition conditions in South Africa by Aghion et al. (2006). Edwards and Lawrence (2008) offer a broader investigation of the effects of trade policy in South Africa.

The effect of trade policy for productivity and growth is a classic issue in policy evaluation and has been analyzed in an enormous literature including case studies, country time series and cross-country econometric analysis. The literature has exploited data at the plant/firm level, industrial sector level and country aggregates. The industrial sector level has the advantage of long panel data. Recent country studies with ambition of identifying causal effect of trade policy in sector data include Ferreira and Rossi (2003) and Muendler (2004) for Brazil, Fernandes (2007) and Karacaovali (2006) for Columbia, and Amiti and Konings (2007) for Indonesia. All these authors apply instruments to represent changes in tariffs, but the instruments are typically constructed from other industrial sector characteristics than productivity.[1] For example, Amiti and Konings (2007) use historical tariffs as instruments in an analysis of Indonesia. While this approach certainly represents an improvement compared to the earlier literature, there are potential endogeneity involved in using historical and sectoral characteristics to predict sectoral tariff policies. Alternative approaches are offered by Trefler (2004), Romalis (2007). Trefler studies trade policy reform in the context of the Canada – US free trade agreement. Romalis uses US tariff barriers to predict the openness of developing countries in a cross country study. We suggest using other countries sectoral tariffs to predict tariffs in South Africa and thereby avoid the dependence on internal industrial characteristics.

The dominating understanding of productivity growth in middle income countries like South Africa is ‘catching up’. This approach has historical roots in Gerschenkron’s (1962) analysis of development out of backwardness and was formalized by Nelson and Phelps (1966) as technology adoption. They assume that individual country productivity growth is determined by the gap to the world technology frontier and factors affecting the technology adoption. Caselli and Coleman (2006) offer an application of the world technology frontier in a cross-country analysis with aggregate data. Recent theoretical advances are discussed by Klenow and Rodriguez-Clare (2005) in an overview of the literature on international externalities and economic growth. Aghion and Howitt (2005) elaborate on appropriate growth frameworks and their ‘Schumpeter meets Gerschenkron’ covers catching up to the world frontier. In this context tariffs affect the international spillover of technologies. Our analysis includes the world technology frontier described

[1] A related literature addresses tariffs and productivity at the firm level (Pavcnik, 2002).

by sectoral labor productivities in the U.S.. The results indicate that the links to the world technology frontier are weak in South Africa and implies divergence.

The econometric challenges are discussed in section 2, and section 3 offers a first look at the data. The econometric analysis is presented in section 4, and section 5 gives concluding remarks.

2. Econometric challenges

Trade liberalization may or may not improve labor productivity. Trade policy is controversial because strong economic interests and ideological views are involved, but also because the effects of trade policy are unclear. Protecting industries while they are fostered and made ready for international competition has for long been the main argument for import substitution policies, the infant industry argument. Such trade policy easily ends up protecting low-productivity industries, but can also be used to stimulate high-productivity sectors. The opposite strategy attempts to promote reallocation, competition and learning from international technological spillovers in an open economy. Theoretically there are many potential linkages between trade policy and productivity. Empirical analyses have not solved the controversy as case studies always are open for interpretation and econometric studies have run into serious methodological problems of policy endogeneity. Rodrik (1995) offers a nice overview of the literature on the political economy of tariff protection, and his discussion shows how trade policy is part of industrial policy.

The endogeneity of policy in policy evaluation can be understood as an omitted variable problem. Besley and Case (2000) elaborate the biases involved in estimating policy effects. In our setting policy output is measured as labor productivity, the policy is tariffs, and a set of economic variables explain labor productivity. The tariff policy is a function of economic and political variables typically not controlled for in the estimation of labor productivity equations. Political preferences for industrial sector production and employment may influence sectoral tariffs over time. Controlling for such variables is in practice hard to do, in particular since they are themselves endogenous. For instance, if governments protect industries with high productivity growth, high sectoral tariffs will be associated with relatively high sectoral productivity growth. A simple econometric analysis assuming tariffs to affect productivity growth is likely to conclude that high tariffs do not hamper productivity growth. OLS will underestimate a negative effect of tariffs.

The relationship between industrial characteristics and trade policy has been investigated recently. Ferreira and Facchini (2005) show that more concentrated industries are more protected. Karacaovali (2006) offers a two-way analysis of tariffs and productivity for Columbia. He finds that sectors with high productivity are liberalized less. Trade liberalization is used to increase foreign exposure for low productivity industries. These studies support the understanding that the design of trade policy takes into account industrial characteristics. The endogeneity of policy is a serious challenge for policy evaluation.

The recent analyses of trade policy and productivity instrumenting trade policy represent an attempt at correcting for the endogeneity. Ferreira and Rossi (2003) discuss the endogeneity, but concludes that 'endogeneity is not a problem with respect to tariff determination' in Brazil. They base this conclusion on the observation that tariffs were reduced proportionally across industries. Muendler (2004) applies domestic and foreign price and exchange rate components as instruments. Fernandez (2003) control for endogeneity by using lagged tariff rates in Columbia. Karacaovali (2006) uses, among other variables, capital to output ratios and material prices to instrument the import ratio as determinant of tariffs in his analysis of Columbia. Amiti and Konings (2007) use former tariffs to instrument for present tariffs in a study of Indonesia. All the studies referred to above use instruments that are unlikely to be independent of productivity and therefore not well suited to identify the tariff effect.

An alternative approach is to look for tariff reform. Trefler (2004) makes use of the Canada - U.S. free trade agreement as an experiment of trade policy shift. We study a more continuous trade liberalization process and must look for exogenous background factors driving trade reform. In the broader literature of applied political economy, characteristics of the political system are typically used to instrument policies. This is hard to do properly in a disaggregated analysis of industrial sectors. If disaggregated political factors relevant at the sectoral level are observed, such as lobbying, they are themselves endogenous to sectoral productivity. Romalis (2007) use U.S. tariff barriers as instruments for the openness of developing countries. Our use of other countries' tariff liberalization as instruments shares the view that good instruments can be found abroad. Overseas tariff changes are correlated with South African ones and are expected to be uncorrelated with South African industry productivity.

South Africa is one of many countries participating in multilateral liberalization of import tariffs under the coordination of GATT and later WTO. We use the fact that the tariff phase down was the result of international negotiations and therefore harmonized across countries. It should be noticed that the tariff negotiations have affected the bound tariffs, but actual tariffs that we use have broadly followed the course set by the bound tariffs. It is an empirical question whether actual South African tariffs have followed the harmonized pattern of actual tariffs and we show that they do. As will come clear, most of the world wide tariff reductions, and also in South Africa, came during the 1990s. International shocks may have driven industry tariffs and productivity across countries and will be a concern for the validity of the instrument. We use time dummies and the sector specific international labor productivity frontier to control for general and sector specific global shocks, respectively. Change of tariffs in other world regions can affect productivity in South African industries directly via exports. We control for exports to account for this possibility. The analysis below shows that OLS underestimates the effect of tariffs, consistent with protection of industries with high productivity growth. Instrumenting, which identifies the effects of the international component of the tariff policy, leads to larger and more significant negative effects of tariffs on labor productivity growth.

3. A first look at the data

The analysis is based on the 3-digit panel data set of manufacturing industries in South Africa provided by TIPS (2004).[2] Labor productivity, y, is simply sector value added, measured in 1995 Rand, divided by number of people employed (including casual and seasonal workers) in the sector. Appendix Table 1 documents the data, and the average South Africa labor productivity in our sample is 140 000 Rand per worker. The average logarithmic growth rate of labor productivity is 4 percent.

We use applied tariffs, rather than applied and most favored nation (MFN) tariffs. As explained by Nicita and M. Olarreaga (2006), applied rates take into consideration the available data for preferential schemes.[3] Tariff data are at the level of 3-digit ISIC Rev. 2.[4] Appendix Table 2 shows the matching of the sectors. We apply sectoral tariff changes in countries in other world regions as instruments for tariff changes in South Africa and focus on similar middle income countries and look at three regions – Latin-America and Caribbean (LAC), Middle-East and North Africa (MENA) and South Asia (SA).[5]

Beyond the analysis of tariffs and labor productivity we add the world frontier labor productivity represented by industrial sectors in the U.S. Consistent with the above South African data we apply 3-digit U.S. data to calculate manufacturing sector labor productivities. The U.S. data are published by Bureau of Economic Analysis (BEA) and are classified according to SIC 87.[6] Labor productivity for the US, y*, is defined as value added in 2000 USD, and is found by deflating value added measured in millions of current USD with the corresponding price indices. These indices are 100 in 2000. The number of workers per sector is measured by the published full time and part time employees in thousands of employees. As shown in Appendix Table 1, the mean U.S.

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[2] The data are now available at: http://www.quantec.co.za/

[3] MFN rates are those granted to all WTO members to whom no preferential access is granted.

[4] The data are available at http://go.worldbank.org/EQW3W5UTP0

[5] The relevant countries in these regions with tariff data that are included in the analysis: 9 countries in LAC (Bolivia, Brazil, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Peru and Suriname), 6 countries in MENA (Algeria, Arab Rep. Egypt, Islamic Rep. Iran, Jordan, Morocco and Tunisia) and 1 country in SA (Sri Lanka).

[6] The classification has been changed over time from SIC72 to SIC87 to NAICS97. We first merge the U.S. data according to SIC87 and then merge the U.S. data with the South African data. For access to and description of the data, see: http://www.bea.gov/bea/dn2/iedguide.htm#GPO

labor productivity is 95 000 USD per worker in our sample. The average logarithmic growth rate of labor productivity in the U.S. is 2 percent, and consequently the raw data indicate catching up productivity growth in South Africa.

The development of selected sectoral tariffs in South Africa is shown in Figure 1. The sectors shown are basic chemicals, basic iron and ore, basic non-ferrous metals, motor vehicles parts and accessories, other transport equipment, and textiles. The tariffs have been reduced for almost all industrial sectors during the period studied. The size of the full period reduction varies, but is about 50% on average. Tariffs have been reduced over the whole period, but with particular sharp reductions around 1995-96, consistent with the multilateral reform promoted by the Uruguay round. The sharp reduction for 1995-96 in particular is pronounced for basic chemicals and basic metals.[7] The broad tariff policy of South Africa is analyzed by Edwards (2005).

Figure 1 about here.

The development of tariffs for the same selected industries in the three regions (LAC, SA and MENA) is also shown in Figure 1. Broadly, tariff reductions in South Africa and the three mentioned regions moved in tandem during the 1990s. Tariff developments in these regions may predict the path of South African tariffs.

The analysis addresses the relationship between tariffs and labor productivity. The development of labor productivities for the same selected industries in South Africa and the U.S. during 1988-2003 are shown in Figure 2. Overall South Africa has had positive labor productivity growth in manufacturing industries, but across industries the performance is quite heterogeneous. The diagrams broadly confirm a relationship between labor productivities in South Africa and the US. Productivity growth in South Africa has been higher in basic iron and steel, basic non-ferrous metals and motor vehicles parts and accessories, similar to the U.S. in basic chemicals and other transport

[7] Also electrical machinery, metal products, non-metallic minerals, plastic products, and other industries experienced such sharp reductions (not shown).

equipment, and below in textiles. The time paths differ, but many of the growth sectors have a take off around 1996-97.

Figure 2 about here.

Graphical observation of the raw data supports the understanding that the development of labor productivity in South Africa and the U.S. is linked and that a period of rising labor productivity has been associated with reduced tariff levels. The interaction between the three factors needs to be investigated econometrically.

4. Econometric analysis

The econometric analysis seeks to reveal any relationship between sectoral labor productivities and tariffs. Given the dataset for 28 industrial sectors during 1988-2003 we have all in all about 400 observations for South Africa. The two basic variables of the analysis are the growth rate of sectoral labor productivity $\Delta \ln y_{it}$ (sector i, year t) and tariff rate tr_{it}. The econometric specification investigates alternative dynamics of the response of labor productivity to tariffs. The adjustment process towards long run equilibrium is expected to be much longer than the observation period. In this case we are primarily able to identify the transition effect of tariff reform. This motivates estimation of the effects of tariffs on labor productivity growth. Sectoral fixed effects take into account time-invariant variation in labor productivity across sectors. Year fixed effects control for common shocks and trends over time. In the benchmark relationship we assume one-period lag of the tariff effect:

$$\Delta \ln y_{it} = \alpha_i + \alpha_t + \beta tr_{it-1} \quad (1)$$

The extension of the benchmark model includes the world technology frontier on level form and with interaction:

$$\Delta \ln y_{it} = \alpha + \beta tr_{it-1} + \gamma \ln y_{t-2}* + \delta tr_{it-1} \ln y_{t-2}* \quad (2)$$

We start out by reporting standard OLS estimates in Table 1. Column 1 is the benchmark model of growth rate effect with sectoral and year fixed effects. The coefficient is negative, but not statistically significant. As stated above we expect the OLS estimates to be biased downwards because of endogeneity of tariffs. Neither tariffs nor the frontier has a statistically significant effect when the world technology frontier is entered in the level form. In column 3 the full model (2) is estimated including the interaction term. Now both the frontier and interaction coefficients are statistically significant, but the quantitative effects are small. When year effects are left out the statistical significance disappears.

Table 1 about here.

The main econometric challenge in estimating the relationship is the endogeneity of tariffs with respect to labor productivity. To handle the endogeneity we apply a standard two stage least square method with instrument variables to predict the sectoral tariff levels. In the first stage sectoral tariffs are predicted by sectoral tariff levels in three world regions assumed to capture the multilateral liberalization that South Africa was part of. In the second stage the predicted sectoral tariffs are included as independent variables in the analysis of sectoral labor productivities.

In the first stage the one-year lagged South African sectoral tariff rates tr-1 are related to the two-year and three-year lagged sectoral tariff rates of the three regions LAC (Latin America and the Caribbean), MENA (Middle East and South Africa) and SA (South Asia). The first stage estimation also includes sector and year fixed effects. Column 1 in Table 2 shows the first stage regression for the basic model of equation (1). The sectoral tariff developments in all three regions seem to have predictive power for the sectoral tariff developments in South Africa. Columns 2 - 5 report first stage estimates of the extended models.

Table 2 about here.

Shea R-square and the F-test, reported in the second stage tables, indicate the predictive power of the instruments. Shea R-square above 0.10 and p-values of the F-test below 0.10 are generally regarded as support of predictive power.[8] We also report p-values of a Sargan test in the second stage tables. An insignificant Sargan-test, Sargan p-value above 0.10, is taken as indication of valid exclusion of the instruments from the second stage. Our Sargan-tests are generally insignificant and supports our intuition: the South African productivity level in sector i in year t is unlikely to be endogenous to the average tariff level in the corresponding sectors in these geographically distant regions in year t-2 or t-3.

The first column in Table 3 presents the second stage estimation of equation (1) and suggests a negative and, at the 5%-level, statistically significant relationship between tariffs and labor productivity growth. The estimated coefficient of -0.8 implies that 10 percent higher tariff level reduces the productivity growth about 1 percentage point. The quantitative effect is quite large and the economic interpretation is that tariff reductions stimulate the transition growth of labor productivity. The size of the effect is comparable with the analysis of Indonesia by Amiti and Konings (2007). They find that the labor productivity level increases by about 5.5% as response to 10 percentage point output tariff reduction.

The negative association between tariffs and productivity across industrial sectors is clearly more robust than in the OLS estimates. The tariff effects are in general much larger in the instrument variable estimation. First it should be noticed that bias confirms the need for instruments to control for endogenous determination of tariffs. The downward bias of the OLS estimates supports the understanding that the government has given priority to tariff reductions in sectors with slow productivity growth. The government has attempted to open up for international competition and spillovers in sectors that needed it the most. When we control for this endogeneity we increase the productivity enhancing effect of tariff reductions.

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[8] See Shea (1996) for an explanation of Shea R-square.

Table 2 about here

A basic relationship between tariffs and productivity growth using year and sector fixed effects and instrumentation of tariffs represents the core of our analysis. Two specification issues are worth pursuing: the relationship between domestic and international productivity growth and dynamics. Discussions of the methodology and alternative specifications are offered by Griffith, Redding and Van Reenen (2004), Harding and Rattsø (2009) and Rattsø and Stokke (2003).

Productivity growth in the open economy is often understood as 'catching up' to the world technology frontier and involving international productivity spillover. The barriers to growth model originated by Nelson and Phelps (1966) assumes a long run equilibrium where individual country productivity is proportional to the world technology frontier. The proportionality factor is affected by barriers such as tariffs and tariff-reduction may allow catching up to world technology. Benhabib and Spiegel (2005) have made alternative econometric tests of the relationship. This is investigated in relationships expanded to take into account the role of the world sectoral labor productivity frontier, $y_{it}*$, measured as the labor productivities in corresponding US industrial sectors. This variable takes out all global time-varying sector-specific shocks. Alternative dynamic formulations are investigated, first expanding the benchmark model with the world frontier and interaction with tariffs, then in an error-correction formulation and finally using the productivity gap as dependent variable.

Column 2 in Table 3 adds the world frontier sectoral labor productivity level. The world frontier has no independent effect on the labor productivity growth in South Africa in this specification. This is still true when we in column 3 add interaction between the tariff level and the world frontier. Our understanding of the lack of a world frontier effect is that time dummies already take care of the trend growth represented by the world frontier. Exclusion of time dummies does not provide robust and stable results. The world frontier is statistically significant when time dummies are excluded in column 4. The result is fairly consistent with other analyses of the role of the world technology frontier in South Africa. Harding and Rattsø (2009) find a weak long run relationship between the frontier represented by US industries and productivity measured by technology shocks. They conclude that the estimates reject catching up and indicate divergence. Aghion et al. (2008) find that distance to the frontier has a positive, but weak effect on total factor productivity growth. Distance to the frontier is shown to be important for total factor productivity in a panel of OECD countries by Vandenbussche et al. (2004).

Table 3 about here.

A concern with the instruments chosen is that tariffs in other world regions may affect productivity in South Africa directly via exports. We investigate the exclusion restriction of the instruments by introducing exports as a separate control variable in Table 4. The exports have no statistically significant effect on labor productivity in any of the specifications and the tariff effect is unchanged. The export channel seems not to be important for our results.

Table 4 about here.

To investigate the validity of the instruments further we have estimated the relationship between South African industrial productivity growth and the tariff rates of the three regions. The econometric formulation reported in Table 5 includes sector and year fixed effects. The effect of the productivity growth rates is investigated with 1 and 2 lags and with and without the world frontier variable. As seen from the Table, there is no statistically significant relation between sectoral productivity growth in South Africa and the tariffs used as instruments.

Table 5 about here.

Table 6 reports an alternative formulation of equation (2) as the world frontier is included on growth form. Again the world frontier has no separate effect on the productivity growth. The tariff effect is robust across the alternative model formulations, both in terms of quantitative size and statistical significance.

Table 6 about here.

To check for the robustness of the relationship we investigate alternative dynamic specifications. The error correction model separates between short and long run adjustments and excludes time dummies. The length of the time series allows for specification with lagged endogenous variable and sector fixed effects. The dependent variable is still the growth rate of sectoral labor productivity, and the full model is:

$$\Delta \ln y_{it} = \alpha_i + \alpha_1 \ln y_{it-1} + \beta_1 \Delta tr_{it-1} + \beta_2 tr_{it-2} + \gamma_1 \Delta \ln y_{it-2}* + \gamma_2 \ln y_{it-3}*$$
$$+ \gamma_2 tr_{it-2} \ln y_{it-3}*$$

We start out in the first column of Table 7 with only the tariffs on level and first difference form. The coefficient of the tariff level effect is basically the same as the results in Tables 3 and 4 above, about -0.8, and with the same statistical significance. The coefficient of the lagged endogenous variable is statistically significant at the 1% level and shows slow adjustment of labor productivity over time. The implied long run negative tariff effect on labor productivity is quite high, and our understanding is that the data sample is too short to identify the long run effect. The strong transition effect of tariffs is translated into an even stronger long run effect, but in a dataset that cannot show the true long run implications. The extension of the error correction specification to include the world frontier on level and first difference form in column 2 does not add new effects. When interaction between tariffs and frontier is added in the full error correction model, column 3 in Table 7, the world frontier emerges with statistically significant effect. The quantitative effect of the tariff rate is similar to above, and again understood as a transition effect. An increase in the world frontier labor productivity level raises the labor productivity growth in South Africa.

Table 7 about here.

An alternative specification sets the focus directly on the catching up towards the world frontier. The effect of tariffs on the productivity gap y/y* is investigated directly. In Table 8 different lags of the tariff effect on the productivity gap is shown. The results show a consistent negative effect of tariffs on the productivity gap. Higher tariffs increase the distance to the world frontier labor productivity, and 10% higher tariffs increases the gap by about 2%. Columns 1 and 2 include different lags with both sectoral and year fixed effects. Exclusion of time dummies, shown in column 3 and 4, does not change the results.[9]

Table 8 about here.

5. Conclusion

We have evaluated the effect of tariff policy on labor productivity in industrial sectors in South Africa using sectoral tariffs of other countries as instruments. The tariff liberalization in South Africa has been part of a multilateral process, and other countries' sectoral tariff developments work as good predictors of tariffs in South Africa. In this way we circumvent the methodological challenge of tariff policy endogenity in estimating the tariff effect on productivity.

The industrial sectors in South Africa have generally experienced increasing labor productivities during the period investigated, 1988-2003. Our analysis confirms that productivity growth has been linked to tariff reductions. Instrumented tariff changes are significantly related to industrial labor productivity growth. It should be noticed that the dataset covers both increases and decreases of sectoral tariffs and both improvements and setbacks in sectoral labor productivities.

[9] In Table 5 the Sargan-test is significant and it may point to invalid exclusion of the instruments from the second stage. Given our other results, a strict interpretation could be that labor productivity in the U.S. is affected by the tariff levels in these countries. We are interested in South Africa's catch up to the frontier and we interpret the results of Table 5 to be consistent with our overall findings.

The results are consistent with an understanding of tariff rates as barriers to technology adoption, but other mechanisms such as increased competition may be at work. It seems realistic to assume that domestic factors also serve as barriers to learning from abroad. It is a challenge for future research to capture such domestic barriers, but it will be hard to overcome the endogeneity of such barriers and identify the causal effects of them for spillovers and productivity.

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Table 1: First difference of log of labor productivity--OLS estimation

	1	2	3	4
	dln y	dln y	dln y	dln y
tr-1	-0.073	-0.075	-0.228	-0.119
	[0.129]	[0.129]	[0.153]	[0.119]
ln y*-2		0.008	**0.068***	0.043
		[0.021]	[0.039]	[0.033]
tr-1 x ln y*-2			**-0.169***	-0.124
			[0.092]	[0.081]
Year FE	Yes	Yes	Yes	No
Sector FE	Yes	Yes	Yes	Yes
Observations	305	305	305	305
Number of group(code sector)	28	28	28	28
R-squared	0.07	0.07	0.08	0.01
R-squared overall	0.08	0.08	0.06	0.02

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include contemporary capacity utilization as control variable.

Table 2: First stage estimation of sectoral tariffs -- corresponding to Table 3

	1	2	3	4	5
Dependent variable	tr-1	tr-1	tr-1 x ln y*-2	tr-1	tr-1 x ln y*-2
tr-2 LAC	-0.132	-0.156	-0.013	0.367***	0.044
	[0.194]	[0.194]	[0.315]	[0.130]	[0.207]
tr-2 MENA	0.120**	0.121**	-0.106	0.168***	-0.092
	[0.057]	[0.057]	[0.092]	[0.045]	[0.072]
tr-2 SA	0.131**	0.258***	0.758***	0.375***	0.717***
	[0.063]	[0.097]	[0.157]	[0.081]	[0.130]
tr-3 LAC	0.303***	0.295***	0.124	0.015	0.141*
	[0.103]	[0.103]	[0.167]	[0.052]	[0.082]
tr-3 MENA	0.007	-0.007	0.045	-0.085*	0.004
	[0.056]	[0.056]	[0.092]	[0.045]	[0.072]
tr-3 SA	-0.017	-0.112	-0.870***	-0.219**	-0.762***
	[0.073]	[0.091]	[0.148]	[0.085]	[0.135]
ln y*-2		-0.027*	0.277***	-0.041***	0.274***
		[0.016]	[0.026]	[0.014]	[0.022]
Year FE	Yes	Yes	Yes	No	No
Sector FE	Yes	Yes	Yes	Yes	Yes
Observations	305	305	305	305	305
Number of group(code sector)	28	28	28	28	28
R-squared	0.36	0.37	0.70	0.31	0.68
R-squared overall	0.56	0.62	0.57	0.67	0.64

Note: Column 1 corresponds to column 1 in Table 2, column 2 to column 2 and 3 in table 2, column 3 to column 3 in table 2 and column 4 and 5 to column 4 in table 2. tr-X means average applied tariffs among lower middle income countries in region Z, lagged X periods. The regions, defined as World Bank regions as of July 2006, are: LAC (Latin America and the Caribbean), MENA (Middle East and North Africa) and SA (South Asia). All models include contemporaneous capacity utilization.

Table 3: First difference of log of labor productivity, labor productivity level of world frontier --IV estimation

	1	2	3	4
Dependent variable	dln y	dln y	dln y	dln y
Second stage				
tr-1	**-0.840****	**-0.948****	**-0.830****	0.087
	[0.419]	[0.411]	[0.412]	[0.263]
ln y*-2		0.015	0.082	**0.158***
		[0.022]	[0.077]	[0.085]
tr-1 x ln y*-2			-0.194	**-0.458***
			[0.214]	[0.238]
Year FE	Yes	Yes	Yes	No
Sector FE	Yes	Yes	Yes	Yes
First stage tr-1:				
Shea partial R2	0.10	0.11	0.14	0.22
Partial R2	0.10	0.11	0.11	0.30
F	4.95	5.38	5.38	19.54
F, p-value	0.00	0.00	0.00	0.00
First stage tr-1 x ln y*-2:				
Shea partial R2			0.19	0.13
Partial R2			0.15	0.17
F			7.52	9.35
F, p-value			0.00	0.00
Df	6	6	6	6
df_r	260	259	259	269
Observations	305	305	305	305
Number of group(code sector)	28	28	28	28
Sargan statistics	1.85	1.65	1	3.96
Sargan P-value	0.87	0.89	0.91	0.41
F-value	4.95	5.38	2.57	3.13
Fdf1	260	259	259	269
Fdf2	6	6	6	6

Note: Instruments are as shown in table 1. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include contemporary capacity utilization as control variable. df and df_r give degrees of freedom in the F-test for the instruments' prediction power in the first stage. These numbers are the same for all first stages within the same column.

Table 4: Exclusion restriction, controlling for exports

	1	2	3	4
	dln y	dln y	dln y	dln y
tr-1	-0.863**	-0.940**	-0.844**	0.054
	[0.419]	[0.402]	[0.413]	[0.255]
ln y*-2		0.010	0.066	0.174*
		[0.022]	[0.087]	[0.096]
tr-1 x ln y*-2			-0.156	-0.495*
			[0.236]	[0.262]
ln x	0.026	0.025	0.016	-0.013
	[0.022]	[0.023]	[0.026]	[0.024]
Year FE	Yes	Yes	Yes	No
Sector FE	Yes	Yes	Yes	Yes
First stage tr-1:				
Shea partial R2	0.10	0.11	0.14	0.26
Partial R2	0.10	0.11	0.11	0.28
F	4.98	5.58	5.58	17.36
F, p-value	0.00	0.00	0.00	0.00
First stage tr-1 x ln y*-2:				
Shea partial R2			0.16	0.12
Partial R2			0.13	0.13
F			6.51	6.53
F, p-value			0.00	0.00
Observations	305	305	305	305
Number of group(code sector)	28	28	28	28
Sargan statistics	1.27	1.2	0.86	3.83
Sargan P-value	0.94	0.94	0.93	0.43
F-value	4.98	5.58	2.34	3.05
Fdf1	259	258	258	268
Fdf2	6	6	6	6

Note: Table corresponds to Table 2, but log sectoral exports, ln x, is now included as control variable. Instruments are as shown in table 1. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include contemporary capacity utilization as control variable. df and df_r give degrees of freedom in the F-test for the instruments' prediction power in the first stage. These numbers are the same for all first stages within the same column.

Table 5: Instrument validity, the effect of productivity growth for instrument tariffs

	1	2	3	4	5	6
	LAC	LAC	MENA	MENA	SA	SA
dln y-1	0.021	0.020	0.005	0.009	0.047	0.023
	[0.031]	[0.031]	[0.042]	[0.042]	[0.057]	[0.046]
ln y*-2		0.005		-0.032**		0.192***
		[0.009]		[0.013]		[0.014]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	413	413	386	386	386	386
Number of group(code sector)	28	28	28	28	28	28
R-squared	0.82	0.82	0.31	0.33	0.46	0.66

	7	8	9	10	11	12
	LAC	LAC	MENA	MENA	SA	SA
dln y-2	0.031	0.031	0.028	0.029	-0.006	-0.015
	[0.031]	[0.031]	[0.042]	[0.042]	[0.056]	[0.045]
ln y*-2		0.005		-0.032**		0.192***
		[0.009]		[0.013]		[0.014]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	413	413	386	386	386	386
Number of group(code sector)	28	28	28	28	28	28
R-squared	0.82	0.82	0.31	0.33	0.46	0.66

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is average applied tariffs among lower middle income countries in the region indicated. The regions, defined as World Bank regions as of July 2006, are: LAC (Latin America and the Caribbean), MENA (Middle East and North Africa) and SA (South Asia). All models include contemporaneous capacity utilization.

Table 6: First difference of log of labor productivity, labor productivity growth of world frontier -- IV estimation

	1	2	3
Dependent variable	dln y	dln y	dln y
Second stage			
tr-1	**-0.848****	**-0.841****	-0.140
	[0.420]	[0.418]	[0.212]
dln y*-2	-0.004	0.136	**0.593***
	[0.037]	[0.356]	[0.322]
tr-1 x dln y*-2		-0.396	**-1.704***
		[1.009]	[0.913]
Year FE	Yes	Yes	No
Sector FE	Yes	Yes	Yes
First stage tr-1			
Shea partial R2	0.10	0.10	0.29
Partial R2	0.10	0.10	0.29
F	4.93	4.93	18.09
F, p-value	0.00	0.00	0.00
First stage tr-1 x dln y*-2			
Shea partial R2		0.07	0.08
Partial R2		0.07	0.08
F		3.15	3.95
F, p-value		0.01	0.00
Df	6	6	6
df_r	259	259	269
Observations	305	305	305
Number of group(code sector)	28	28	28
Sargan statistics	1.84	1.71	4.31
Sargan P-value	0.87	0.79	0.37
F-value	4.93	3.14	3.93
Fdf1	259	259	269
Fdf2	6	6	6

Note: Instruments are as shown in table 1. All are included in second and third lag. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include contemporary capacity utilization as control variable. df and df_r give degrees of freedom in the F-test for the instruments' prediction power in the first stage. These numbers are the same for all first stages within the same column.

Table 7: First difference of log of labor productivity, error correction model -- IV estimation

	1	2	3
Dependent variable	dln y	dln y	dln y
Second stage			
ln y-1	**-0.162*** **	**-0.171*** **	**-0.250*** **
	[0.033]	[0.033]	[0.051]
dtr-1	-0.333	-0.309	0.280
	[0.387]	[0.393]	[0.485]
tr-2	**-0.746*** **	**-0.824*** **	**-0.677*** **
	[0.264]	[0.247]	[0.251]
dln y*-2		-0.001	0.038
		[0.036]	[0.040]
ln y*-3		0.016	**0.241** **
		[0.023]	[0.116]
tr-2 x ln y*-3			**-0.629** **
			[0.319]
Year FE	No	No	No
Sector FE	Yes	Yes	Yes
First stage dtr-1			
Shea partial R2	0.16	0.16	0.10
Partial R2	0.13	0.13	0.13
F	6.45	6.40	6.40
F, p-value	0.00	0.00	0.00
First stage tr-2			
Shea partial R2	0.21	0.24	0.28
Partial R2	0.17	0.19	0.19
F	8.81	10.67	10.67
F, p-value	0.00	0.00	0.00
First stage tr-2 x ln y*-1			
Shea partial R2			0.08
Partial R2			0.10
F			4.94
F, p-value			0.00
Df	6	6	6
df_r	267	265	265
Observations	304	304	304
Number of group(code sector)	28	28	28
Sargan statistics	4.78	5.05	1.48
Sargan P-value	0.31	0.28	0.69
F-value	4.98	5.35	2.38
Fdf1	267	265	265
Fdf2	6	6	6
R-squared centered	0.02	-0.01	0.05

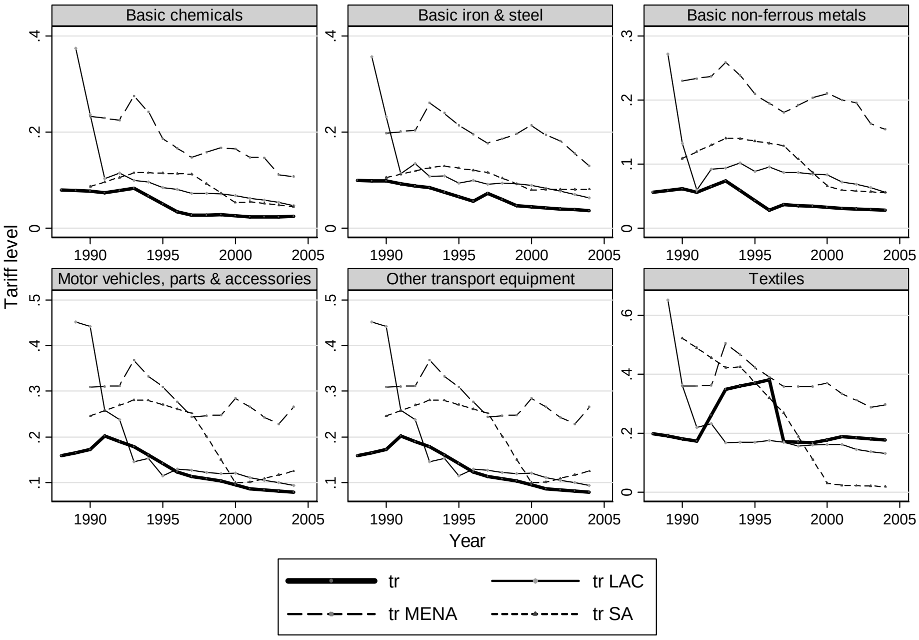
Note: Instruments are as shown in table 1. All are included in second and third lag. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include one period lagged and contemporary first differenced capacity utilization as control variables. df and df_r give degrees of freedom in the F-test for the instruments' prediction power in the first stage. These numbers are the same for all first stages within the same column.

Table 8: Relative productivity--IV estimation

	1	2	3	4
Dependent variable	y/y*	y/y*	y/y*	y/y*
Second stage				
tr-1	**-1.242*** **	0.386	**-0.771*** **	-0.006
	[0.403]	[0.783]	[0.186]	[0.378]
tr-2		**-1.881** **		**-1.030** **
		[0.743]		[0.438]
Year FE	Yes	Yes	No	No
Sector FE	Yes	Yes	Yes	Yes
First stage tr-1				
Shea partial R2	0.10	0.06	0.29	0.15
Partial R2	0.10	0.10	0.29	0.29
F	4.95	4.95	18.15	18.15
F, p-value	0.00	0.00	0.00	0.00
First stage tr-2				
Shea partial R2		0.05		0.10
Partial R2		0.10		0.20
F		4.71		11.02
F, p-value		0.00		0.00
Df	6	6	6	6
df_r	260	260	270	270
Observations	305	305	305	305
Number of group(code sector)	28	28	28	28
Sargan statistics	65.78	46.77	77.33	65.51
Sargan P-value	0.00	0.00	0.00	0.00
F-value	4.95	2.28	18.15	5.04
Fdf1	260	260	270	270
Fdf2	6	6	6	6

Note: Instruments are as shown in table 1. All are included in second and third lag. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include contemporary capacity utilization as control variable. df and df_r give degrees of freedom in the F-test for the instruments' prediction power in the first stage. These numbers are the same for all first stages within the same column.

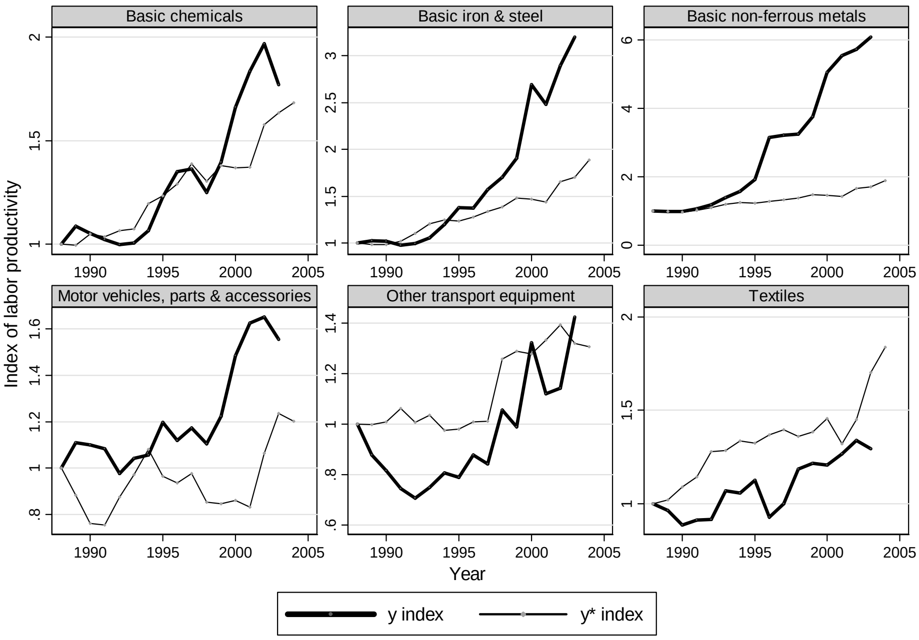
Figure 1: Tariffs in South Africa, LAC, MENA and SA



Graphs by s1

Note: tr and tr Z measure interpolated tariffs in South Africa and region Z respectively. The regional measures are simple averages of the specific sectors' tariff level in year t, across the countries in region Z.

Figure 2: Labor productivity in South Africa and US



Graphs by s1

Note: y and y* measure sectoral labor productivities in South Africa and the U.S. respectively. The indexes are scaled relative to the level of 1988.

Appendix Tables

Appendix Table 1: Descriptive Statistics

Variable	No. of observations	Mean	Std. Dev.	Min	Max
y	305	0.14	0.15	0.02	0.83
ln y	305	-2.39	0.83	-3.88	-0.19
dln y	305	0.04	0.10	-0.40	0.50
y*-2	305	0.95	1.42	0.23	12.46
ln y*-2	305	-0.34	0.59	-1.47	2.52
dln y*-2	305	0.02	0.17	-2.59	0.43
tr-1	305	0.14	0.12	0.00	0.74
tr-1 x ln y*-2	305	-0.05	0.21	-0.91	1.21
tr-2 LAC	305	0.14	0.05	0.06	0.38
tr-2 MENA	305	0.34	0.15	0.13	1.21
tr-2 SA	305	0.27	0.32	0.03	2.28
tr-3 LAC	305	0.17	0.10	0.06	0.85
tr-3 MENA	305	0.34	0.15	0.13	1.21
tr-3 SA	305	0.29	0.33	0.05	2.28
x	305	2523.38	2999.00	22.16	16090.77
ln x	305	7.16	1.27	3.10	9.69

Note: The sample corresponds to Table 2. tr-X means average applied tariffs among lower middle income countries in the particular region. The regions, defined as World Bank regions as of July 2006, are: LAC (Latin America and the Caribbean), MENA (Middle East and North Africa) and SA (South Asia). X denotes the number of lags. Scale: average tr-1 is 14%, average y is 140 000 1995 Rands per worker, average y* is 95 000 2000 USD per worker.

Appendix Table 2: Sector concordances

SA Code	SA Name	ISICRev2 Code	ISICRev2 Name	SIC87 Code	SIC87 Name
12101	Food [301-304]	311	Food products	20	Food and kindred products
12102	Beverages [305]	313	Beverages	20	Food and kindred products
12103	Tobacco [306]	314	Tobacco	21	Tobacco products
12111	Textiles [311-312]	321	Textiles	22	Textile mill products
12112	Wearing apparel [313-315]	322	Wearing apparel except footwear	23	Apparel and other textile products
12113	Leather & leather products [316]	323	Leather products	31	Leather and leather products
12114	Footwear [317]	324	Footwear except rubber or plastic	31	Leather and leather products
12121	Wood & wood products [321-322]	331	Wood products except furniture	24	Lumber and wood products
12122	Paper & paper products [323]	341	Paper and products	26	Paper and allied products
12123	Printing, publishing & recorded media [324-326]	342	Printing and publishing	27	Printing and publishing
12131	Coke & refined petroleum products [331-333]#	353	Petroleum refineries	29	Petroleum and coal products
12132	Basic chemicals [334]	351	Industrial chemicals	28	Chemicals and allied products
12133	Other chemicals & man-made fibers [335-336]	352	Other chemicals	28	Chemicals and allied products
12134	Rubber products [337]	355	Rubber products	30	Rubber and miscellaneous plastics products
12135	Plastic products [338]	356	Plastic products	30	Rubber and miscellaneous plastics products
12141	Glass & glass products [341]	362	Glass and products	32	Stone, clay, and glass products
12142	Non-metallic minerals [342]##	369	Other non-metallic mineral products	32	Stone, clay, and glass products
12151	Basic iron & steel [351]	371	Iron and steel	33	Primary metal industries
12152	Basic non-ferrous metals [352]	372	Non-ferrous metals	33	Primary metal industries
12153	Metal products excluding machinery [353-355]	381	Fabricated metal products	34	Fabricated metal products
12154	Machinery & equipment [356-359]	382	Machinery except electrical	35	Machinery, except electrical
12160	Electrical machinery [361-366]	383	Machinery electric	36	Electric and electronic equipment
12171	Television, radio & communication equipment [371-373]	383	Machinery electric	36	Electric and electronic equipment
12172	Professional & scientific equipment [374-376]	385	Professional and scientific equipment	38	Instruments and related products
12181	Motor vehicles, parts & accessories [381-383]	384	Transport equipment	37	Motor vehicles and equipment
12182	Other transport equipment [384-387]	384	Transport equipment	37	Other transportation equipment
12191	Furniture [391]	332	Furniture except metal	25	Furniture and fixtures
12193	Other industries [392]	390	Other manufactured products	39	Miscellaneous manufacturing industries

Note: Data on tariffs are classified according to ISIC Rev. 2, while BEA-data necessary for calculating labor productivity in the US was merged in according to the SIC87 classification. #Represented by 353 rather than 354, since 353 is the largest (more than ten times the output). ##Represented by 369 rather than 361 since 369 is the largest (more than six times the number of employees).