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Integration and Trade
Sector

DISCUSSION
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ABSTRACT

Using the multisector, heterogeneous-firm general equilibrium trade model of Caliendo et al. (2017), this paper carries out five exercises to understand the trade and welfare effect of trade liberalization in Latin America and the Caribbean (LAC). First, it evaluates the overall tariff reduction effect (of both MFN and preferential tariffs) on all 26 LAC countries between 1990 and 2015. Second, it evaluates the tariff reduction effect on each LAC26 country independently. Third, it examines the effect of five different LAC preferential trade agreements. Fourth, it runs a policy experiment to ascertain the effect of the least liberalized countries in the region lowering their MFN tariff to the average OECD level. Last, it analyzes the effect of a complete free trade agreement between the LAC26 countries.

JEL Codes: F12, F13, F15, F17, F60, F62

Keywords: Trade liberation, welfare, general equilibrium model, Latin America and Caribbean

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1. INTRODUCTION

We use the multisector, heterogeneous-firm general equilibrium trade model of Caliendo et al. (2017) to study the trade and welfare effect of trade liberalization in Latin America and the Caribbean (LAC).[1] One new channel this model captures is the fact that tariffs reduce firm entry relative to a free trade equilibrium, which contracts the output of the differentiated sector, raises its price index, and therefore lowers welfare, with tariff revenue only offsetting part of this effect. There are two kinds of goods in this model: finished goods and intermediate goods. Finished goods are not traded and are produced using intermediate goods from different sources, with constant elasticity of substitution (CES) technology. Finished goods can either be consumed by consumers or used as inputs to produce intermediate goods. In each intermediate goods sector, the model assumes heterogeneous firms with different productivity levels, producing their own unique variety. The materials used to produce intermediate goods are final goods and labor. Firms face entry costs, fixed operating costs, and costs of trading in all markets, which leads to selection in serving different markets. In the model, countries impose tariffs on imports, and tariff revenues are rebated to consumers as part of their income. The trade balance is assumed to be exogenous.

In this model, traded goods are subject to two types of bilateral trade frictions. First, as is conventional, there is an iceberg trade cost in the ad valorem form $\tau_{ji,s} - 1 > 0$ of shipping goods s from j to i, where $\tau_{ii,s} = 1$. Second, there is the ad valorem tariff $t_{ji,s}$, which is applied to the revenue cost of imports from j to i, where $t_{ii,s} = 0$. Unlike iceberg costs, tariffs generate revenues, which are rebated to consumers as part of their income. Therefore, this model can be used to analyze not only the effects of tariff reduction but also the effects of nontariff barrier reduction through the iceberg trade cost.

Caliendo et al. (2017) calibrate a 189-country, 15-sector quantitative version of the model, and use it to perform policy experiments to evaluate the gains (in both trade and welfare) from actual past trade liberalization and potential future gains yet to be realized. They extract data on value-added shares, the share of intermediate inputs in production, gross output, and total exports from the EORA MRIO database. The model is calibrated to the baseline year of 1990 and then solved after introducing actual tariff changes between 1990 and 2010.

2. DATA

In this paper, we apply the model to estimate the effects of trade liberalization in LAC countries between 1990 and 2015. Trade liberalization is measured by tariff reduction between 1990 and 2015. We estimate the overall effect of tariff reduction and decompose it into the effect of MFN rate reduction and the effect of preferential rate reduction. Improving on Caliendo et al. (2017), we extend the period from 2010 to 2015, but unlike these authors, we calibrate the model to the base year of 2015. Taking 2015 as the base year rather than 1990 allows us to analyze the effect of trade liberalization in the current economic environment, which has changed dramatically compared with 1990. Data on value-added shares, the share of intermediate inputs in production, gross output, and total exports for 2015 are extracted from the EORA MRIO database. The trade balance is assumed to be exogenous and to stay at the level of base year 2015. The values of all the parameters are borrowed from Caliendo et al. (2017).[2]

We obtain tariff data from the newly constructed World Bank dataset, which includes tariff information at HS 6-digit level for 1988–2015. To aggregate tariffs for the ten tradable sectors of the model, we use partner country's exports of each HS 6-digit product to the world in 2015 as weights for both the base year (2015) and the counterfactual year (1990).

[1] We only lay out the key concepts of the model here. Interested readers should refer to Caliendo et al. (2017) for more details.

[2] In the model, these parameters (elasticities of substitution and Pareto shape parameters) are time invariant. We can thus still use the same parameter values even though our base year is different from the one used in the reference paper.

Due to the difficulties of extracting specific tariff information and matching it to appropriate unit values, we only include ad valorem tariffs. Switzerland and Liechtenstein are both exceptions, in that their tariffs are specific, so we proxy them using Norway's.

In the original tariff data, Colombia's preferential tariffs for Bolivia, Colombia's for Ecuador, Peru's for Bolivia, and Peru's for Ecuador are missing for 2015. We substitute them using the preferential tariffs from 2014.

For the importing countries on which tariff data is not available at all (38 countries), we use the world average MFN tariff at the sector level. In the case of trade partners whose exports to the world are missing, we could not calculate the average tariff at the sector level (this is true of five countries and one sector in two additional countries). We replace them using the world average MFN tariff at the sector level as well.

In this paper, we focus on 26 LAC countries and several trade agreements, namely the Andean Community (AC), the Central American Common Market (CACM), CARICOM, Mercosur (MSUR), and NAFTA. Table 1 lists the countries included in each agreement.

TABLE 1. LIST OF COUNTRIES

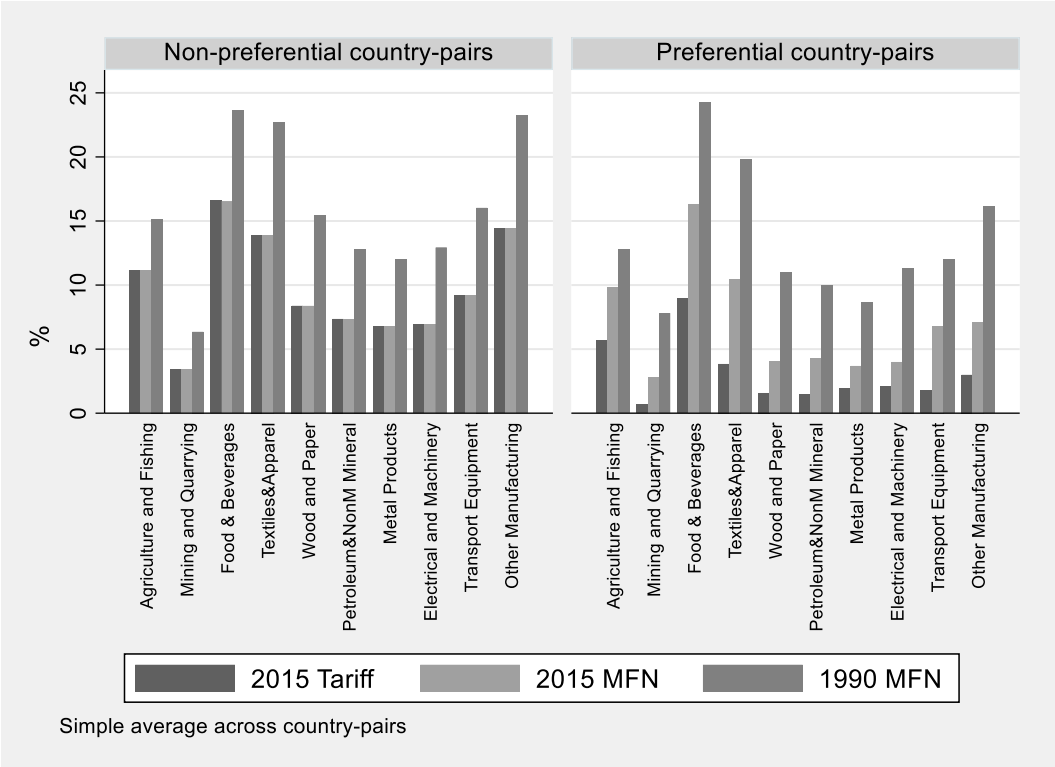
LAC26		AC	CACM	CARICOM	MSUR	NAFTA
Argentina	Guyana	Bolivia	Costa Rica	Antigua and Barbuda	Argentina	Canada
The Bahamas	Haiti	Colombia	Guatemala	Barbados	Brazil	Mexico
Barbados	Honduras	Ecuador	Honduras	Belize	Paraguay	USA
Belize	Jamaica	Peru	Nicaragua	Guyana	Uruguay	
Brazil	Mexico		El Salvador	Jamaica		
Bolivia	Nicaragua			Suriname		
Chile	Panama			Trinidad and Tobago		
Colombia	Paraguay					
Costa Rica	Peru					
Dominican Republic	Suriname					
Ecuador	Guatemala					
El Salvador	Uruguay					
Trinidad and Tobago	Venezuela					

Source: Compiled by the authors.

Unfortunately, tariff data is only available for 22 of the above 29 countries (LAC26 plus Canada, the USA, and Antigua and Barbuda) for the counterfactual year (1990). The earliest year for which tariff data is available is 1991 for Guatemala, Paraguay, and El Salvador, 1993 for Ecuador, 1994 for Honduras, 1997 for Panama, and 1999 for the Bahamas. We substitute the tariff data for these years for the 1990 tariff level for these seven countries. The 1990 tariff data generated for 28 countries is in HS1988 except for the Bahamas, whose tariff data is in HS1996. We convert the Bahamas' trade data for 2015 to HS1996 using UNCTAD concordance tables and use these as weights to aggregate tariffs from the HS 6-digit level to the sector level. For the other 28 countries, we convert 2015 trade data to HS1988 using UNCTAD concordance tables and use them as weights. Figure 1 compares different types of tariffs at the sector level. First, on average, the MFN tariff

dropped dramatically for all ten tradable sectors between 1990 and 2015. Second, preferential agreements further reduced tariffs for all sectors in 2015.

FIGURE 1. TARIFF COMPARISONS



Source: Authors' calculations based on World Bank Tariff data.

3. RESULTS

We carry out five different exercises to understand the tariff effects on economic activities and welfare. First, we evaluate the overall effect of tariff reduction between 1990 and 2015 (both MFN and preferential tariff reduction) for all countries. This scenario allows us to see how tariff changes over this period affect LAC26 countries and to decompose these effects into those that are due to reductions in MFN tariff reductions and those that are due to preferential tariffs. Second, we evaluate the effect of tariff reductions in each LAC26 country independently. Third, we evaluate the tariff reduction effect of five different preferential trade agreements (PTAs), including the AC, CACM, CARICOM, Mercosur, and NAFTA. Fourth, we run a policy experiment in which we assume that the least liberalized countries in the region (Argentina, Brazil, Paraguay, Uruguay, Bolivia, Ecuador, and Venezuela) lower their MFN tariff to the average OECD level. Last, we study the effect of a complete free trade zone between LAC countries, in other words, a scenario in which all tariffs between LAC26 countries are reduced to zero.

In each exercise, we first calibrate the model to the base year of 2015. The calibrated imports, exports, real wages, and welfare are denoted as T_{base}. Keeping all other model parameters and variables the same as the base year, we change the tariff rates to a counterfactual level and solve the model to obtain the new imports, exports, real wages, and welfare (denote as $T_{counterfactual}$). The comparison between T_{base} and $T_{counterfactual}$ reveals the effects of tariff reduction.

A. Exercise 1

In this exercise, we evaluate the overall effect of the reduction of both the MFN and preferential tariff rates on all countries between 1990 and 2015. This is referred to as the multilateral tariff reduction effect. Through the lenses of the model, we can also find out the effect of MFN reduction and preferential tariff rates separately. To do so, after calibrating the model to the base year, we set the counterfactual tariff rates to the 2015 MFN rates and the 1990 MFN rates separately, then we solve for $T_{2015MFN}$ and $T_{1990MFN}$ respectively, where T could be trade/GDP ratio, imports, exports, real wages, and welfare.

The overall multilateral tariff reduction effect is calculated as

$$g_{multilateral} = \frac{T_{base} - T_{1990MFN}}{T_{1990MFN}}.$$

The preferential tariff effect is

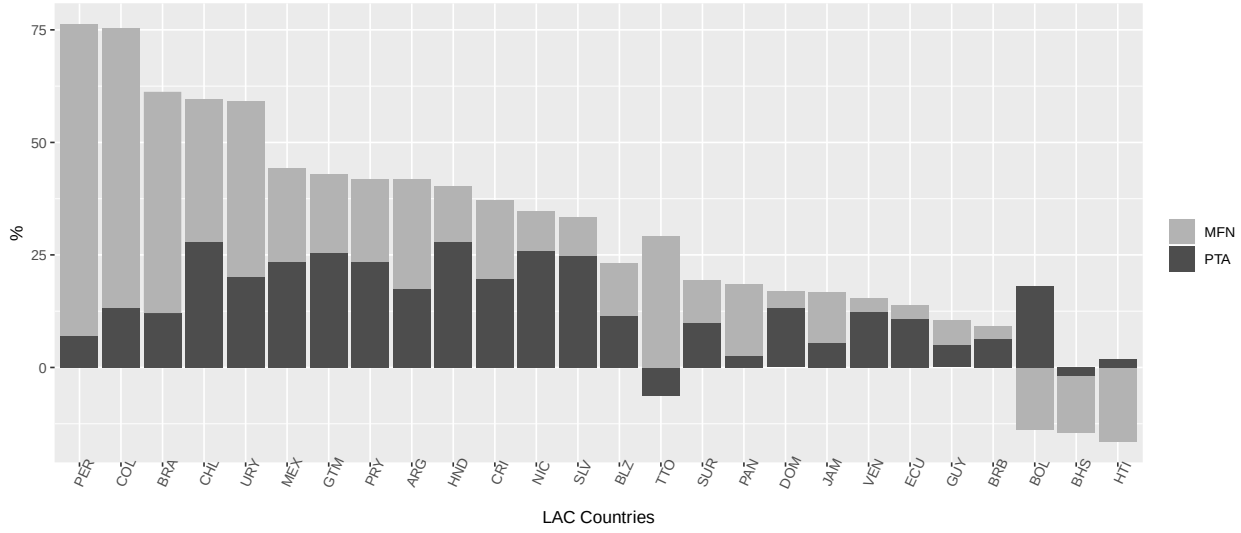
$$g_{multilateral,PTA} = \frac{T_{base} - T_{2015MFN}}{T_{1990MFN}},$$

and the MFN tariff reduction effect is

$$g_{multilateral,MFN} = \frac{T_{2015MFN} - T_{1990MFN}}{T_{1990MFN}}.$$

The following graphs show how each LAC26 country is affected by the tariff changes between 1990 and 2015. Figure 2 plots the change in trade/GDP ratio (defined as imports to GDP ratio in the model). Most LAC26 countries become more open to trade during this time period. We can also see the heterogeneity in the relative importance of MFN tariff reduction and PTA tariff reduction for each country.

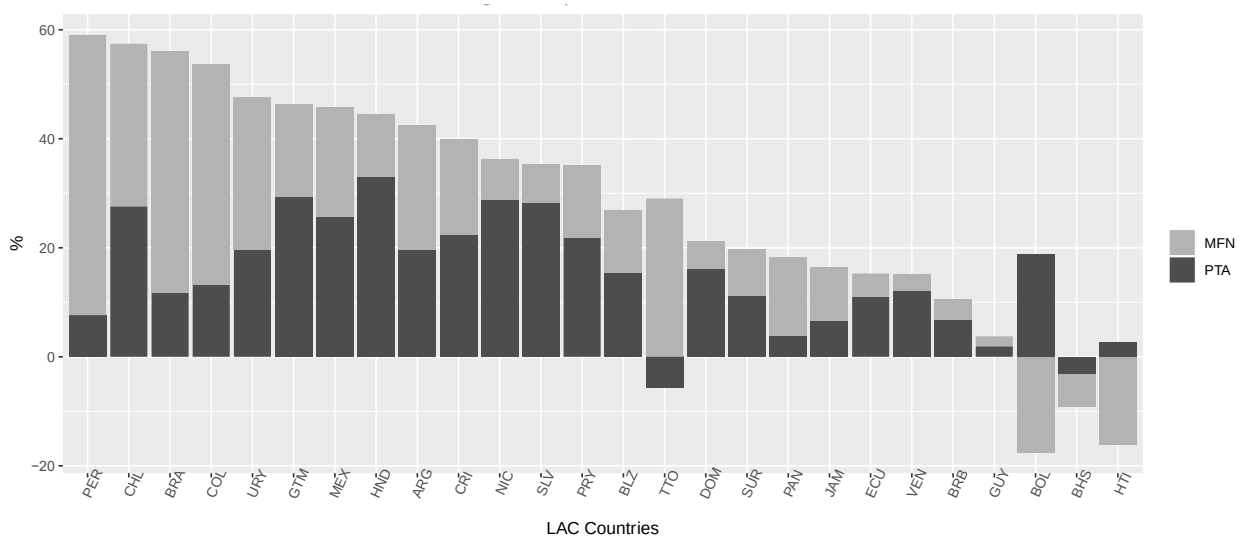
FIGURE 2. CHANGES IN IMPORTS/GDP RATIO (1990–2015)



Source: Authors' calculation based on simulation results.

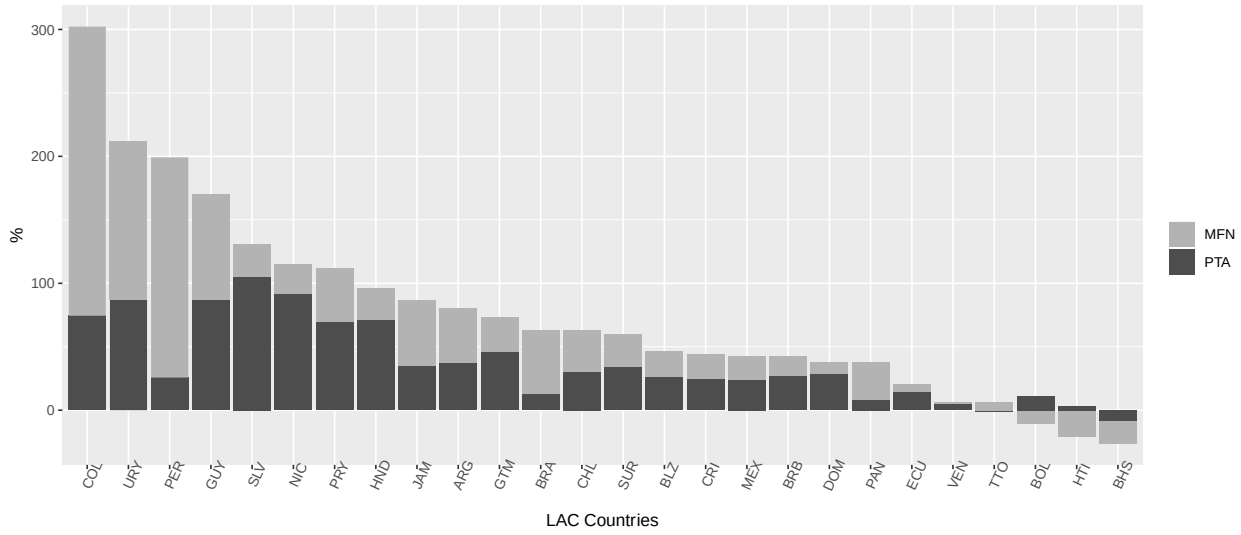
Figure 3 and 4 plot the changes in imports and exports separately. Note that the effects on exports seem to be larger than imports for most LAC26 countries.

FIGURE 3. CHANGES IN IMPORTS



Source: Authors' calculation based on simulation results.

FIGURE 4. CHANGES IN EXPORTS (1990–2015)

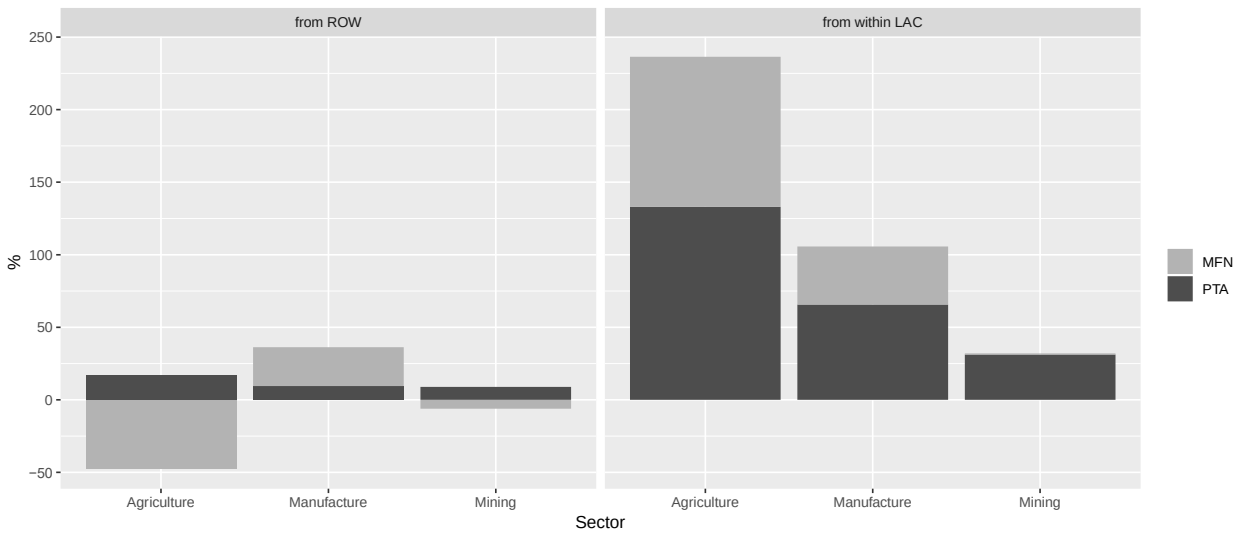


Source: Authors' calculation based on simulation results.

Taking all 26 LAC countries as a group, we look at how much trade between them and trade with the rest of the world has changed. Using the model, we can also decompose these effects into different sectors.[3] Figures 5 and 6 plot these results.

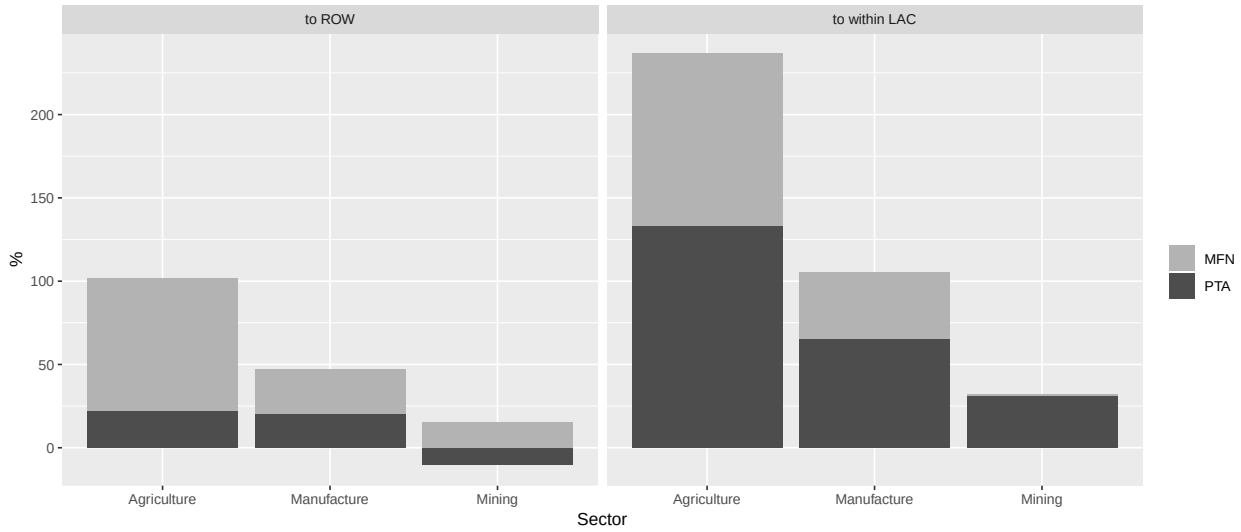
[3] For the purpose of presentation, we group the 10 tradable sectors into 3: agriculture, mining and manufacture.

FIGURE 5. CHANGES IN TOTAL LAC IMPORTS (1990–2015)



Source: Authors' calculation based on simulation results.

FIGURE 6. CHANGES IN TOTAL LAC EXPORTS

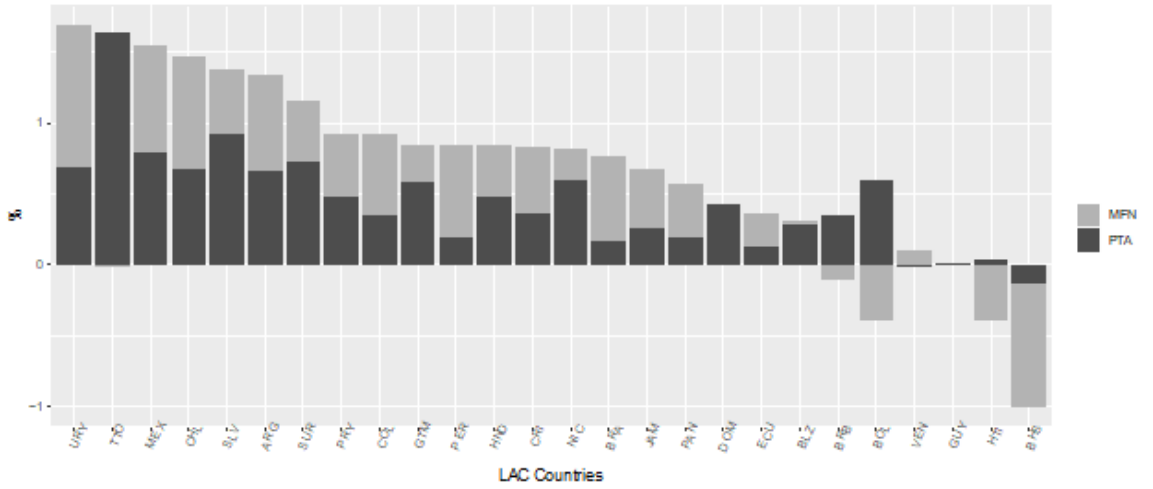


Source: Authors' calculation based on simulation results.

Over the period, LAC26 countries' exports to the rest of the world increase in all sectors, with agriculture exports doubling due to tariff reductions and manufacture exports increasing by almost 50%. Of the major changes, most of the effects come from MFN tariff reduction. The story is different for trade within LAC26 countries. First, the increases are on a much larger scale: trade in agriculture more than triples, and trade in manufactures increases by more than 100%. Second, PTAs play a much more important role in trade within LAC26 countries than in trade between LAC countries and the rest of the world.

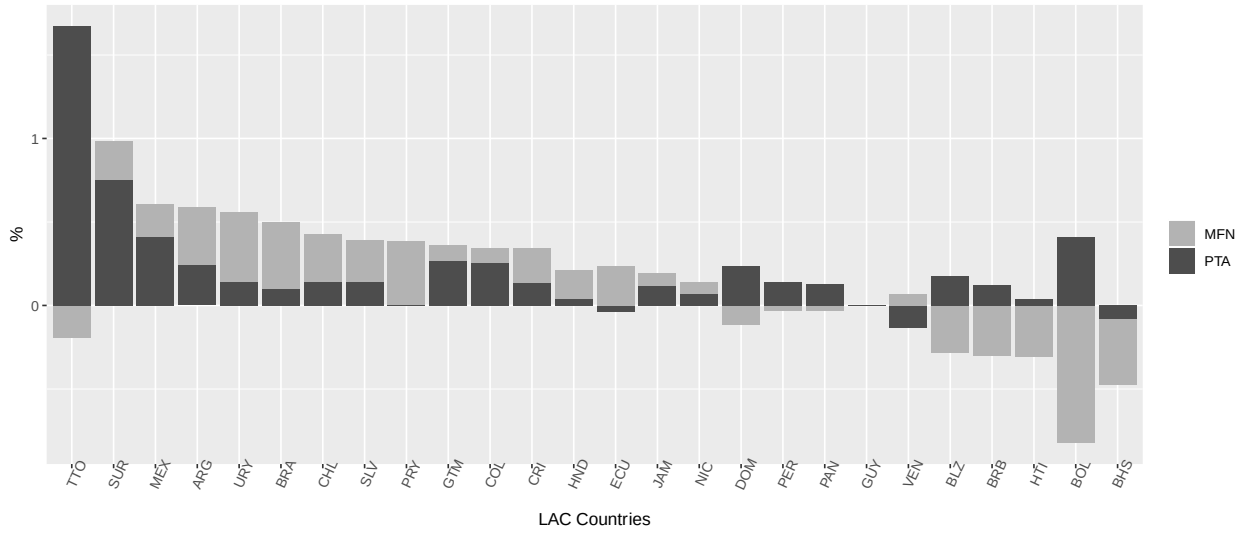
Finally, figures 7 and 8 show how tariff changes affect real wages and welfare for each LAC26 country.

FIGURE 7. CHANGES IN REAL WAGES (1990–2015)



Source: Authors' calculation based on simulation results.

FIGURE 8. CHANGES IN WELFARE (1990–2015)

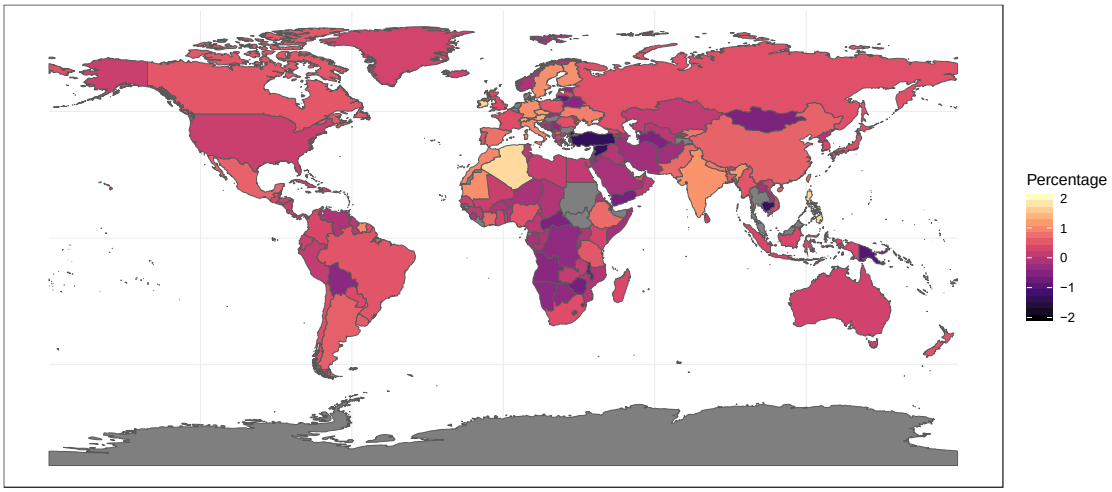


Source: Authors' calculation based on simulation results.

The effects on real wages and welfare are quite heterogeneous even within LAC26 countries. As is common in the trade literature, the welfare gains are relatively small in numbers. Still, these graphs show that various countries have benefited differently from the most recent wave of globalization.

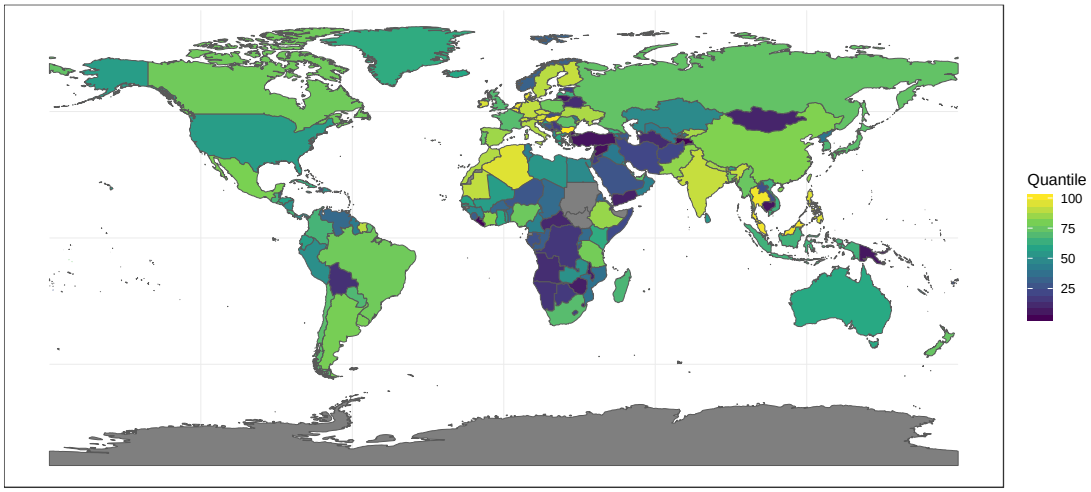
It might be more informative to compare LAC26 countries to the rest of the world. Figure 9 shows the welfare gain from multilateral tariff changes for all countries in this period, in percentages. Figure 10 shows how all countries rank in terms of welfare gain. As can be seen, most LAC countries are in lighter colors, indicating that they gain more from multilateral tariff reductions relative to the median world country.

FIGURE 9. CHANGES IN WELFARE (1990–2015)



Source: Authors' calculation based on simulation results.

FIGURE 10. CHANGES IN WELFARE (1990–2015)



Source: Authors' calculation based on simulation results.

B. Exercise 2

Next, we try to understand the effect of unilateral tariff reductions for each LAC26 country, which is referred to as the unilateral tariff reduction effect. In the first counterfactual for country *i*, we change preferential tariff rates between country *i* and its preferential trading partners to their respective MFN level in 2015 while keeping the tariffs between other country-sector pairs unchanged. The results in the first counterfactual are denoted as $T_{2015MFN,i}$. In the second counterfactual, we further change the tariffs of country *i* to their 1990 MFN level and denote the equilibrium results as $T_{1990MFN,i}$.

As in the first scenario, we calculate the overall effect of the unilateral tariff reduction as

$$g_{unilateral,i} = \frac{T_{base} - T_{1990MFN,i}}{T_{1990MFN,i}},$$

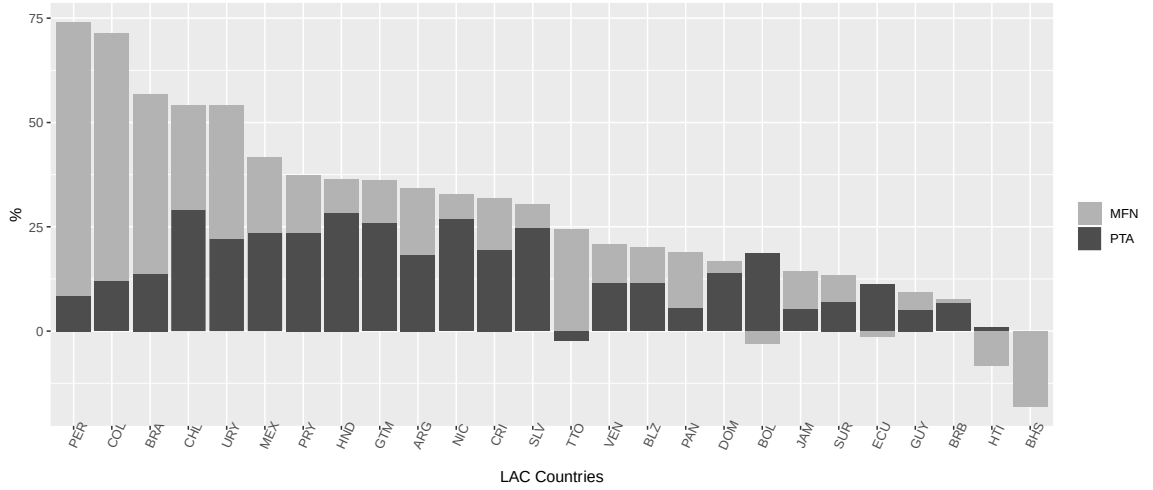
the effect of preferential tariff rates as

$$g_{unilateral,i,PTA} = \frac{T_{base} - T_{2015MFN,i}}{T_{1990MFN,i}},$$

and the effect of unilateral MFN reduction as

$$g_{unilateral,i,MFN} = \frac{T_{2015MFN,i} - T_{1990MFN,i}}{T_{1990MFN,i}}.$$

FIGURE 11. CHANGES IN IMPORTS/GDP RATIO (1990–2015)

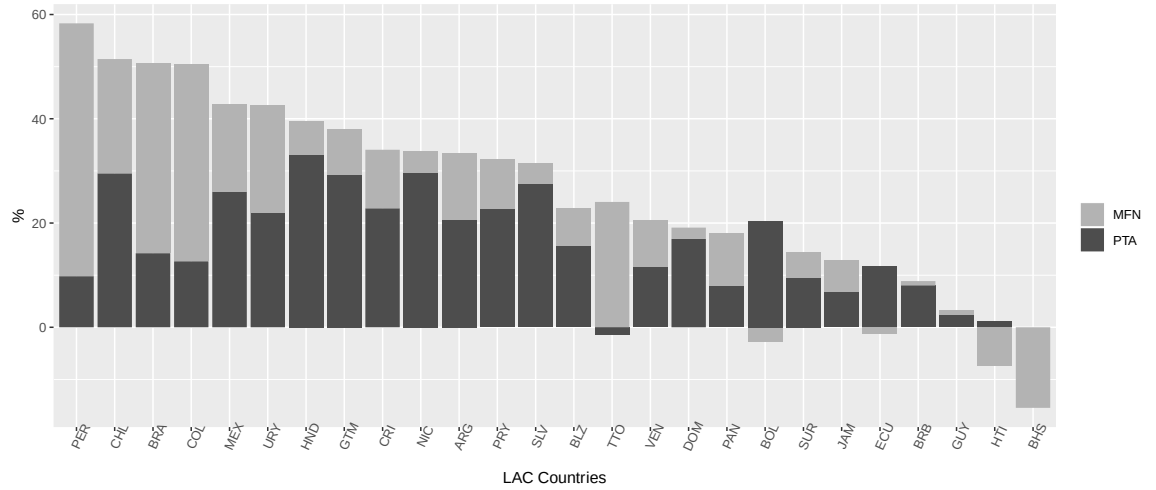


Source: Authors' calculation based on simulation results.

Figure 11 plots the trade/GDP ratio changes due to the unilateral tariff changes. In this diagram, each column for a country corresponds to the unique counterfactual in which only tariffs between this country and its preferential trade partners are changed while all other countries' tariffs are held constant.[4] Peru leads the LAC26 countries in the increase in trade/GDP ratio due to unilateral tariff changes, and most of the effect comes from the decrease in MFN rates Unilateral tariff changes lead to increased economic openness in all LAC26 countries except Haiti and the Bahamas. The effect of preferential tariff rates varies little across countries and mostly ranges between 10% and 30%. This heterogeneity mainly originates in the change in the MFN tariff level.

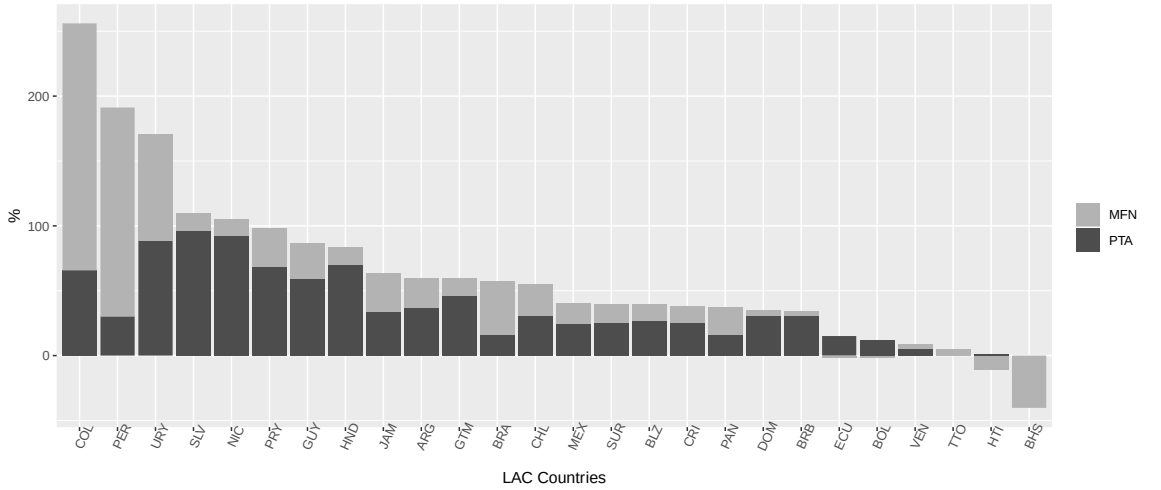
[4] The same comment applies to all diagrams shown in the second scenario.

FIGURE 12. CHANGES IN IMPORTS (1990–2015)



Source: Authors' calculation based on simulation results.

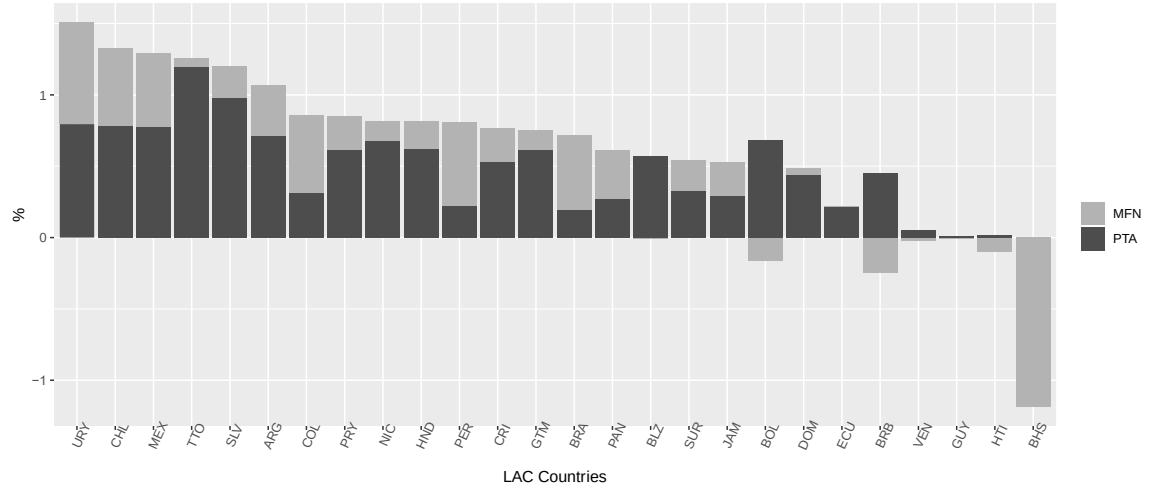
FIGURE 13. CHANGES IN EXPORTS



Source: Authors' calculation based on simulation results.

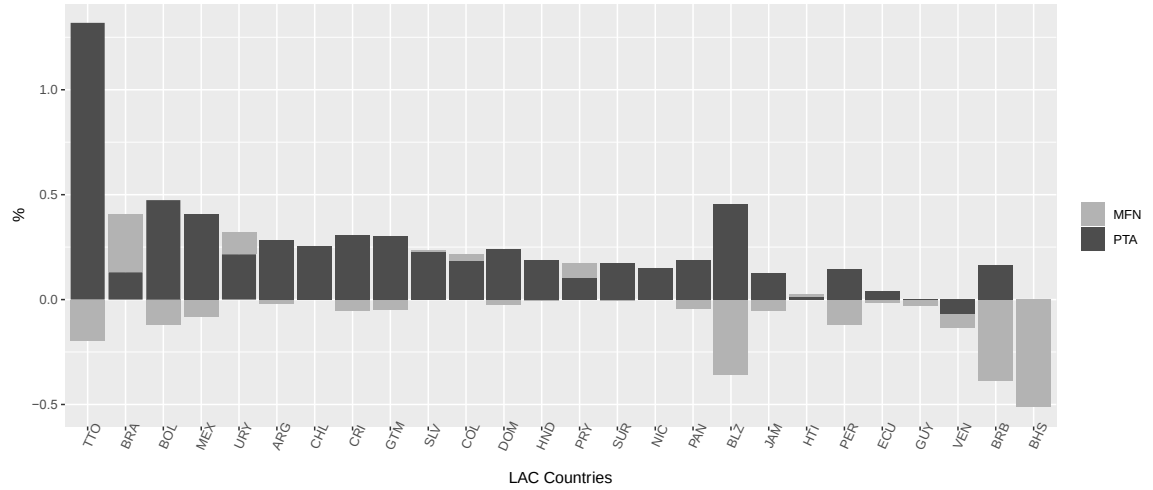
Figures 12 and 13 show that for most countries, the change in exports is more pronounced than that of imports. This observation also holds true for imports: the change in preferential rates affects imports similarly across countries (with some exceptions), but MFN tariff changes may have very different effects on imports.

FIGURE 14. CHANGES IN REAL WAGES



Source: Authors' calculation based on simulation results.

FIGURE 15. CHANGES IN WELFARE



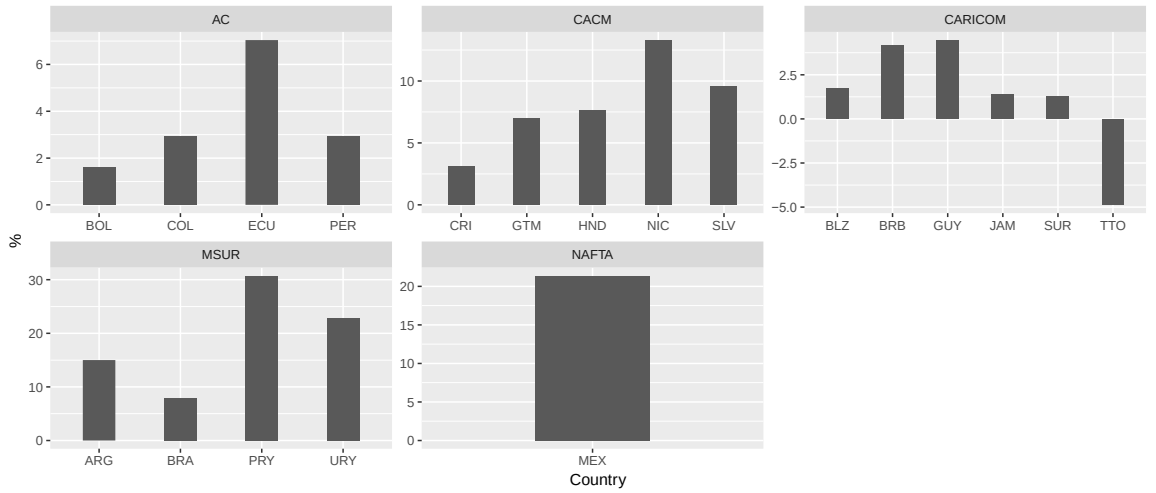
Source: Authors' calculation based on simulation results.

Figures 14 and 15 show that tariff changes have heterogeneous effects on real wages and welfare in different countries. Preferential tariffs mostly improve welfare, while unilateral MFN tariff reduction may bring negative welfare effects for some countries.

C. Exercise 3

In this exercise, we analyze the effects of five LAC PTAs, namely the Andean Community (AC), Central America Common Market (CACM), CARICOM, Mercosur (MSUR), and NAFTA. Here we only show the results for member countries who are also in the LAC26 group.

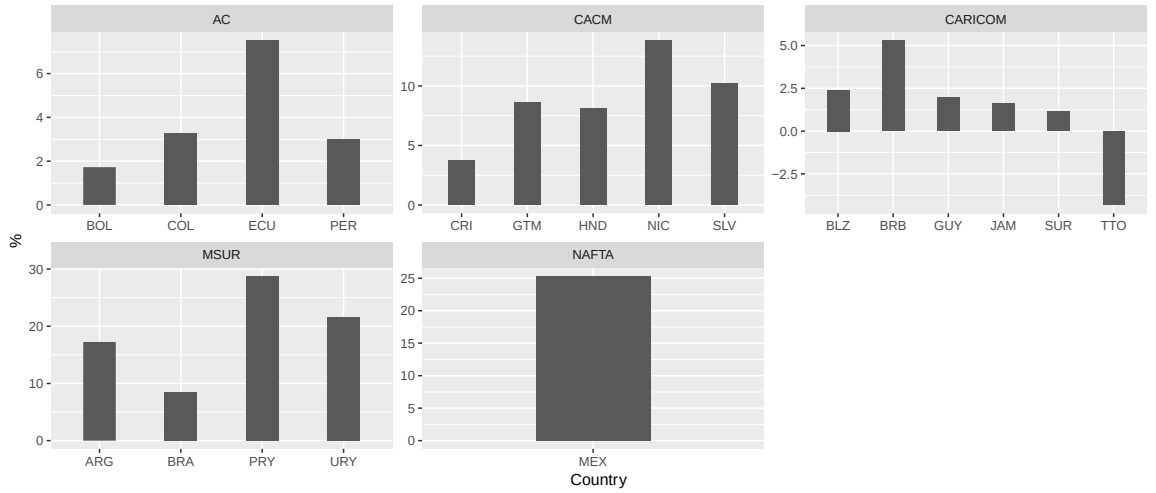
FIGURE 16. CHANGES IN TRADE/GDP RATIO, BY PTA



Source: Authors' calculation based on simulation results.

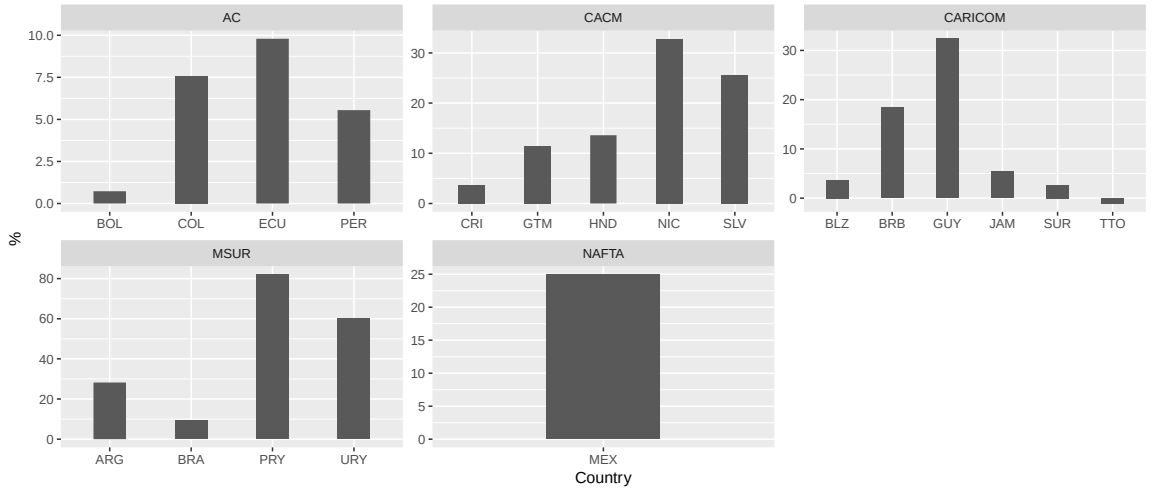
Figure 16 shows heterogeneous effects on the trade/GDP ratio both across PTAs and within member countries of a particular PTA. As we expected, NAFTA and Mercosur have the largest effect on their member countries (the only NAFTA country we examine is Mexico). With the exception of Trinidad and Tobago, all member countries become more open as a result of signing PTAs. The reason why the import/GDP ratio decreases for Trinidad and Tobago is that compared to other countries in CARICOM, Trinidad and Tobago's import tariff was already quite low. Although tariffs decreased for all countries in CARICOM, the change was much more pronounced in countries other than Trinidad and Tobago. All the same, as we will see later, Trinidad and Tobago still benefit from CARICOM in terms of real wages and welfare. As shown in figures 17 and 18, almost all countries' imports and exports increased as a result of their respective PTAs.

FIGURE 17. CHANGES IN IMPORTS, BY PTA



Source: Authors' calculation based on simulation results.

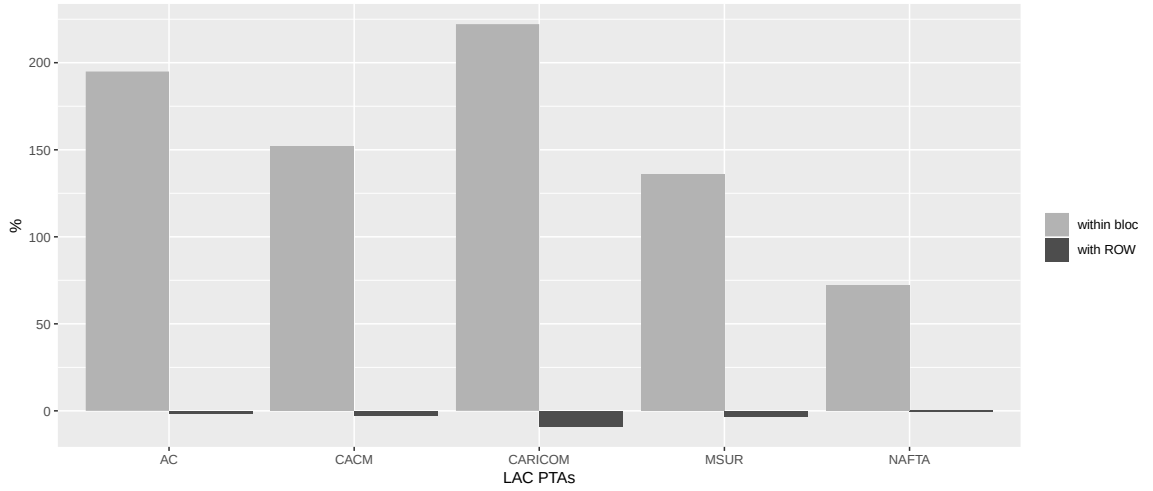
FIGURE 18. CHANGES IN EXPORTS, BY PTA



Source: Authors' calculation based on simulation results.

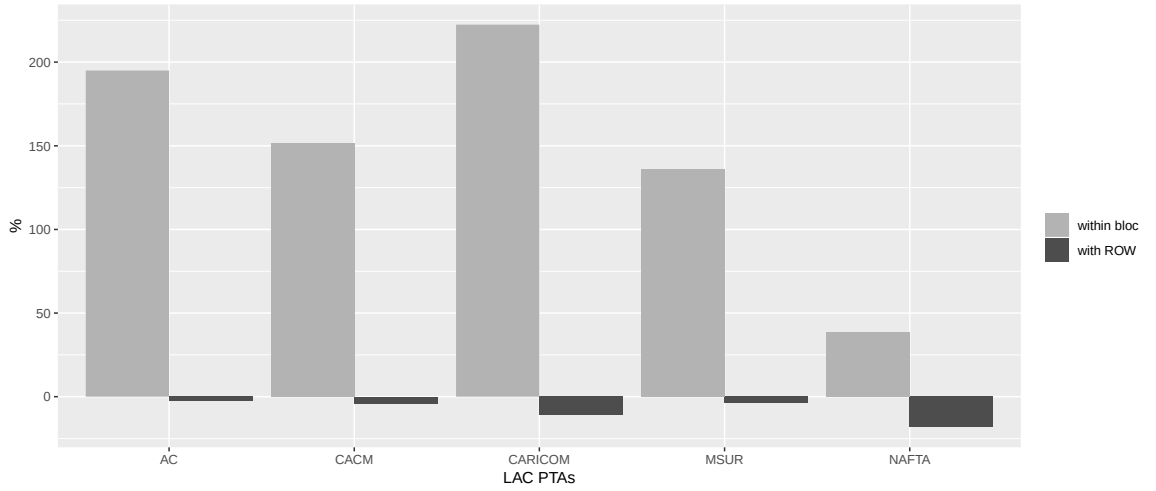
Next, we can see how these PTAs affect trade volumes with members of the same PTA (denoted as within bloc) versus other countries (denoted as ROW). Figures 19 and 20 show that PTAs have a strong effect on promoting trade between member countries. Meanwhile, compared to the vast changes in within-bloc trade, there are only inconsequential negative effects on trade with other countries. Figures 21 and 22 show the changes in real wages and welfare in each member country.

FIGURE 19. CHANGES IN MEMBERS' TOTAL IMPORTS, BY PTA



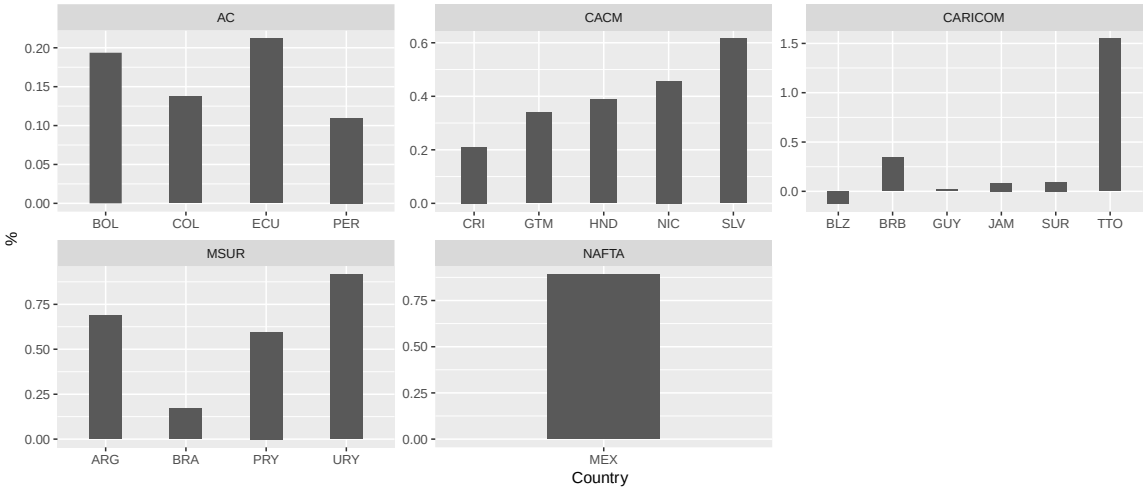
Source: Authors' calculation based on simulation results.

FIGURE 20. CHANGES IN MEMBERS' TOTAL EXPORTS, BY PTA



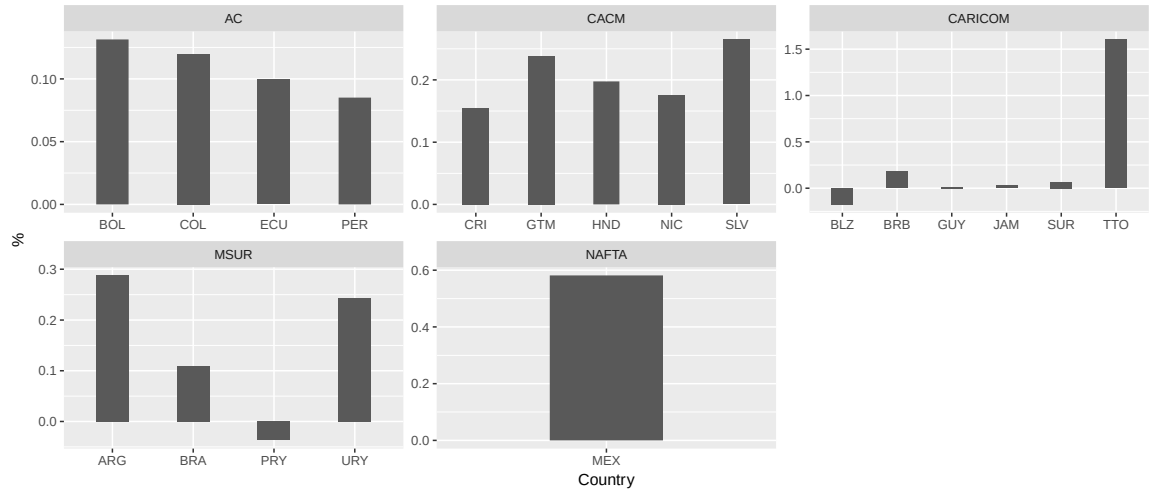
Source: Authors' calculation based on simulation results.

FIGURE 21. CHANGES IN REAL WAGES, BY PTA



Source: Authors' calculation based on simulation results.

FIGURE 22. CHANGES IN WELFARE, BY PTA

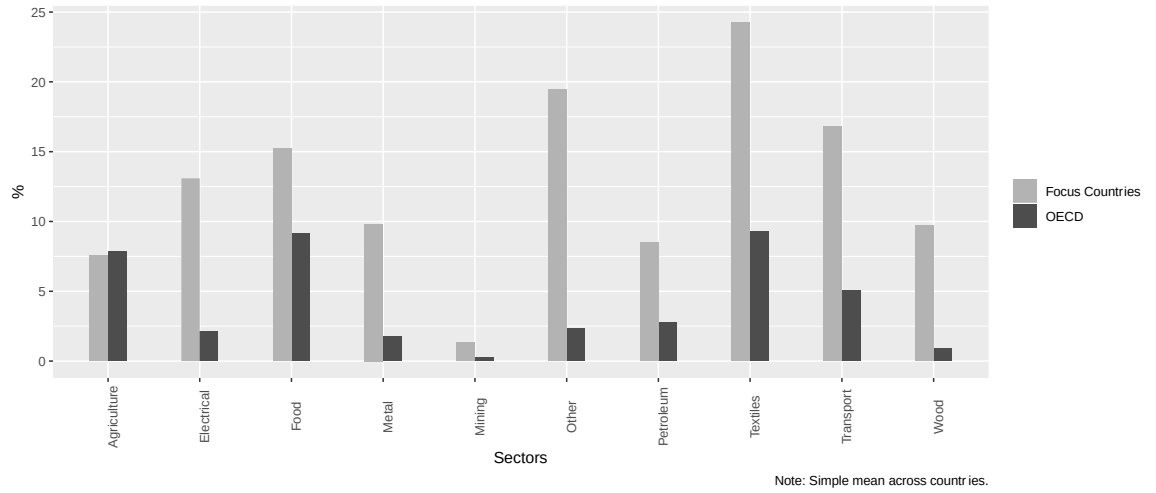


Source: Authors' calculation based on simulation results.

D. Exercise 4

We do a policy experiment in which we assume that the least liberalized countries in the region (Argentina, Brazil, Paraguay, Uruguay, Bolivia, Ecuador, and Venezuela) lower their MFN tariffs to the average OECD level.

FIGURE 23. SECTOR TARIFF COMPARISON



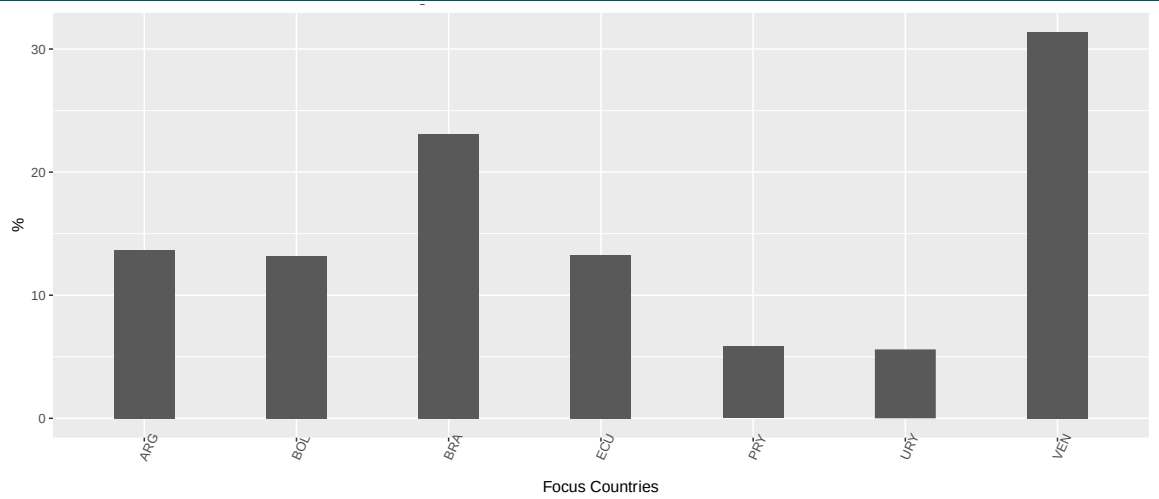
Source: Authors' calculations based on World Bank Tariff data.

Figure 23 shows the difference in MFN tariffs between our target countries and OECD countries. It shows that tariff rates are not prohibitively high in 2015—even for the least liberalized countries in the region. The mean tariffs in all sectors are below 25%. Second, except for agriculture, mean tariffs in all sectors are still quite high compared to the mean tariffs imposed by OECD countries.

In this scenario, for each of the seven countries, we run a separate counterfactual where the country goes through unilateral trade liberalization, that is, its tariff rates are reduced to the mean of OECD countries' MFN

tariff rates.[5] Here we want to focus on the effect of tariff reduction, so if in some sectors the focus country imposes a tariff that is lower than the OECD mean, we keep this original tariff level unchanged. The presentation of results here is of the same style as in scenario 2: each bar corresponds to a separate experiment where the country unilaterally lowers its tariff rate.

FIGURE 24. CHANGES IN TRADE RATIO DUE TO UNILATERAL LIBERALIZATION

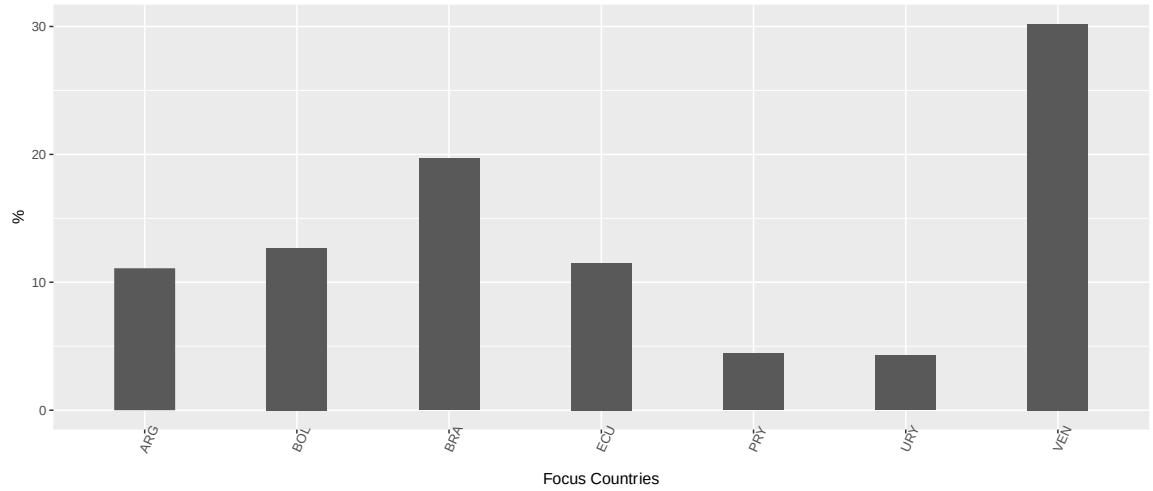


Source: Authors' calculation based on simulation results.

As shown in figure 24, all seven countries see a significant increase in the trade/GDP ratio. Venezuela sees the largest increase in trade/GDP ratio, over 30%, followed by Brazil with an increase of 23%. Because different countries' MFN tariffs start at different levels, they experience different degrees of change in the trade/GDP ratio. Also, different countries may have a comparative advantage in different sectors. Figures 25 and 26 show that all countries see an increase in imports and exports. The size of the increase is different, however.

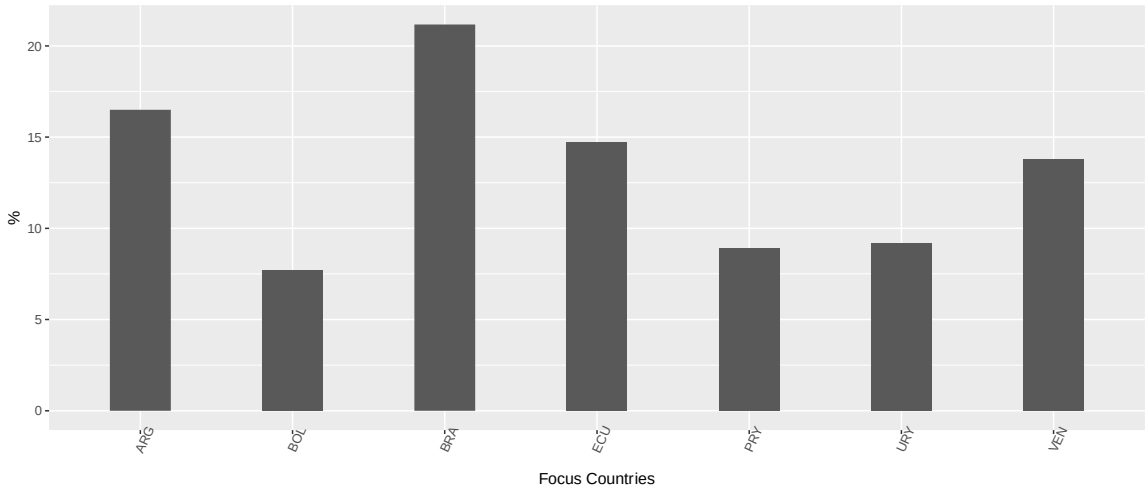
[5] For the experiment, we use the mean tariffs of OECD countries as the counterfactual tariffs, weighted by import volumes. The weighted mean and the simple mean for OECD countries are very similar.

FIGURE 25. CHANGES IN IMPORTS DUE TO UNILATERAL LIBERALIZATION



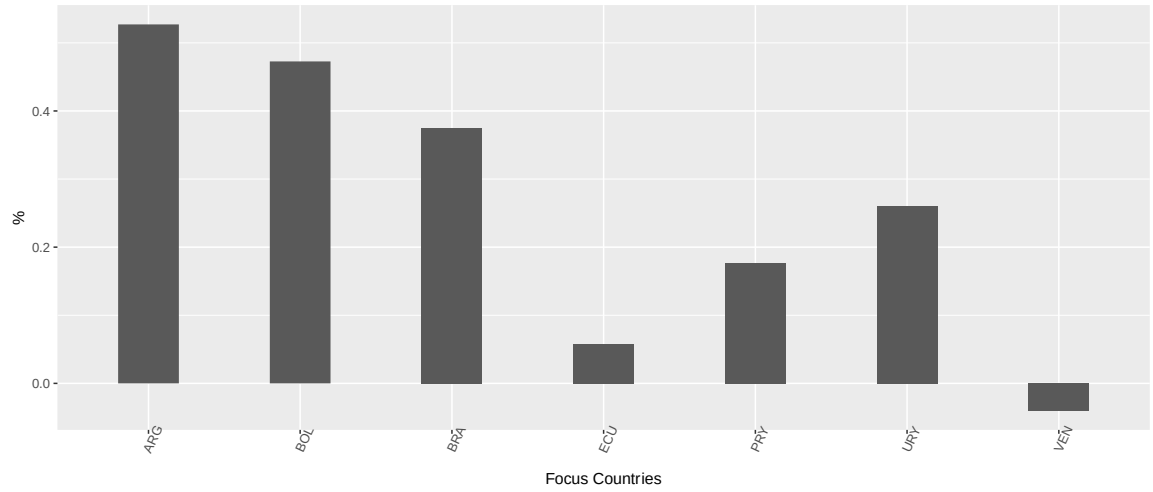
Source: Authors' calculation based on simulation results.

FIGURE 26. CHANGES IN EXPORTS DUE TO UNILATERAL LIBERALIZATION



Source: Authors' calculation based on simulation results.

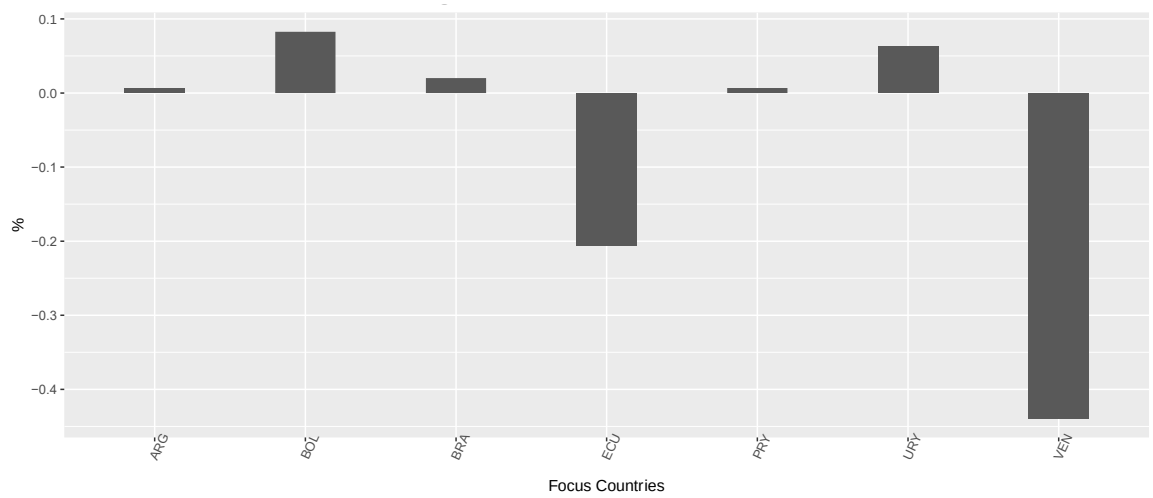
FIGURE 27. CHANGES IN REAL WAGES DUE TO UNILATERAL LIBERALIZATION



Source: Authors' calculation based on simulation results.

As shown in figure 27, real wages increase for all target countries but Venezuela. The size of the change is rather small though. The absolute values of percentage changes are all within 0.6%.

FIGURE 28. CHANGES IN WELFARE DUE TO UNILATERAL LIBERALIZATION



Source: Authors' calculation based on simulation results.

However, figure 28 shows that the welfare consequences are heterogeneous even among target countries. Argentina, Bolivia, Brazil, Paraguay, and Uruguay would experience a welfare gain ranging from 0.005% to 0.08%, while Ecuador and Venezuela would both see a welfare loss.

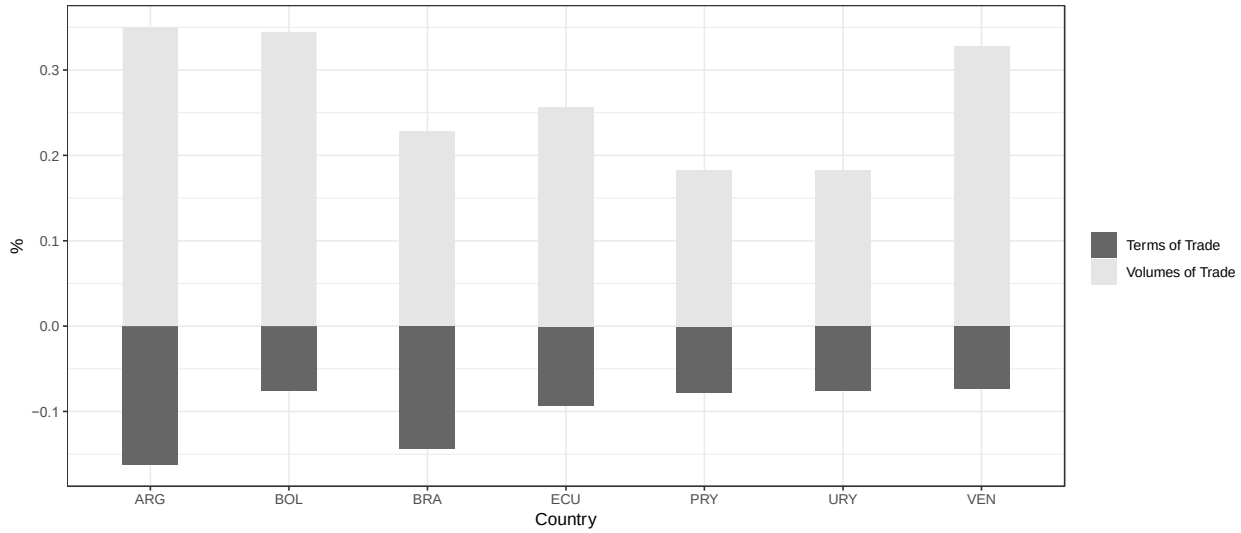
Comparing the effects on welfare and the effects on real wages can help us understand the underlying explanations for the figures. Here, welfare in country *i* is defined to be real total income, which is the sum of real wage income and tariff revenue rebates adjusted by price level.

$$W_i = \frac{w_i + T_i}{P_i} = \frac{w_i}{P_i} + \frac{T_i}{P_i}.$$

When tariffs are reduced, the price index within a country will decrease, but wages and tariff revenues will also be affected. In our exercise, the unilateral decrease in tariffs results in tariff revenue losses, which explains why the change in welfare is greater than the change in real wages.

To understand why welfare may be adversely affected, we decompose welfare change within the model into three different components: terms of trade, volumes of trade, and residual. The first two effects were calculated following the definition in Caliendo and Parro (2015).[6] Because we also have firm entry here, it should be noted that the terms-of-trade and volumes-of-trade effects calculated here are an approximation of these effects. All the same, they provide some indications as to why different countries see different welfare results. Figure 29 shows the decomposition for our target countries.

FIGURE 29. TERMS OF TRADE AND VOLUMES OF TRADE EFFECT



Source: Authors' calculation based on simulation results.

It reveals the volumes-of-trade effect to be positive for all seven countries, and the size of this effect does not vary significantly across countries. On the other hand, all countries suffer from terms-of-trade loss.

It might be puzzling at first sight that the terms-of-trade effect is negative when the tariff rate is reduced. To get some insight into this, we should note that the terms-of-trade effects from tariff changes quantifies the gains from an increase in exporter prices relative to the change in importer prices, measured at world prices (net of tariffs). In this model, this measure of terms of trade is a multilateral weighted change in export and import prices at the sectoral level, where the weights are given by bilateral exports and imports, respectively. Foreign goods are imported and used in the production of local goods. When tariffs are reduced, foreign inputs become cheaper for domestic firms, hence production costs may come down. Thanks to these lower input costs, domestic firms can charge lower prices for their products and become more competitive in the market. Of course, in the general equilibrium model, lower domestic prices mean that foreign firms can purchase inputs at a lower cost and are able to reduce their prices, too. It turns out that on average, export prices measured at world prices decrease more than import prices in our counterfactuals. The terms-of-trade effect is negative here.

[6] Specifically, we define

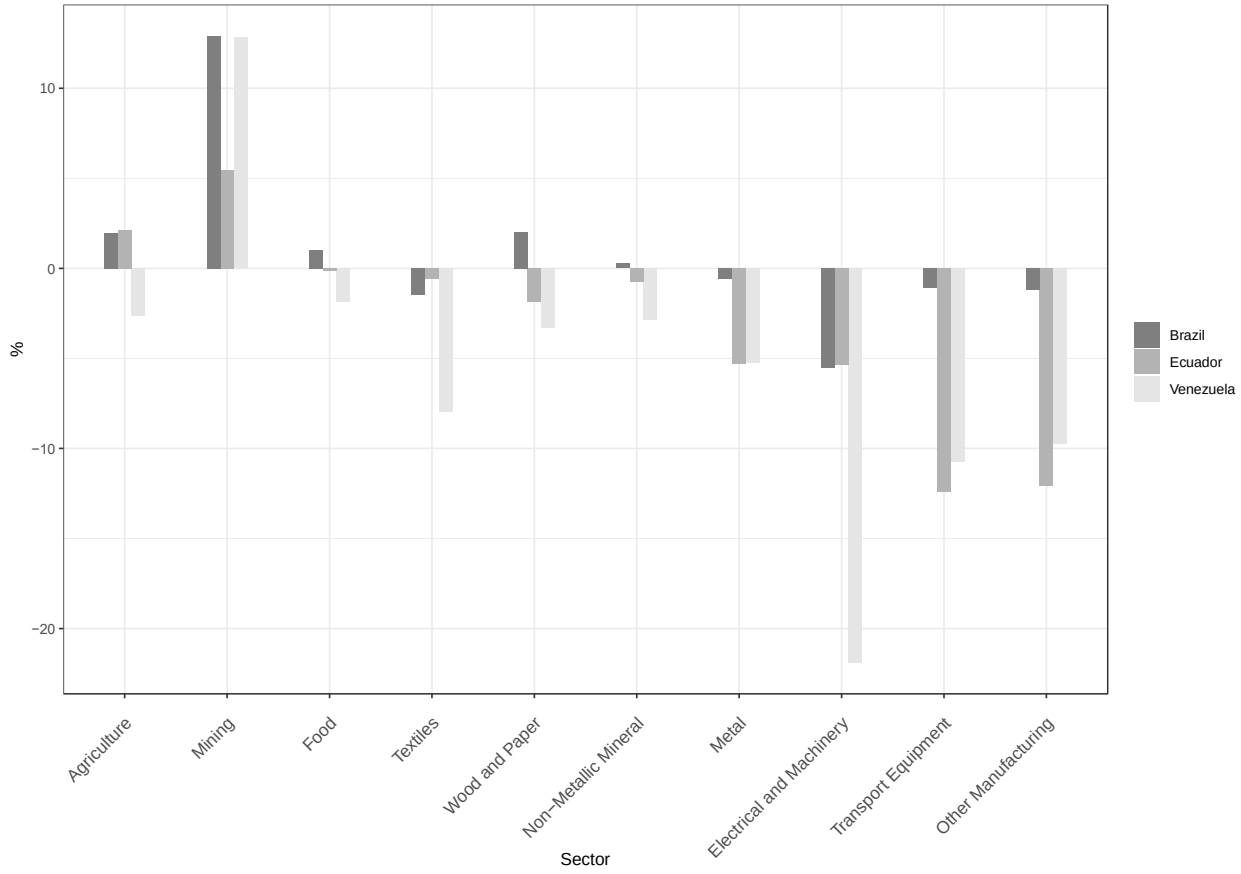
$$\mathrm{d}\ln W = \frac{1}{I_n}\sum_j\sum_i \left(E_{ni}^j\,\mathrm{d}\ln c_n^j - M_{ni}^j\,\mathrm{d}\ln c_i^j\right)$$
$$+\frac{1}{I_n}\sum_j\sum_i \tau_{ni}^j\,M_{ni}^j\left(\mathrm{d}\ln M_{ni}^j - \mathrm{d}\ln c_i^j\right) + residual.$$

The left-hand side is the percentage change in welfare, the first line on the right-hand side is the terms-of-trade effect, the second line is the volumes-of-trade effect, and the last component is the entry effect. Notation wise, I_n is the total income of country n, E_{ni}^j denotes exports from country n to country i in sector j, M_{ni}^j notes the imports of country n from country i in sector j, while c_n^j is the unit cost of producing in country n, sector j. Finally, τ_{ni}^j is the ad-valorem tariff rate.

The previous diagram shows increased volume of trade to be a significant margin where countries gain from tariff reductions, measured as import values deflated by import prices.

The final component of welfare change has to do with local firms' entry into or exit from the market. Firms react to tariff reductions in two different ways. The availability of cheaper inputs from foreign firms makes these materials cheaper for local firms, so more local firms might enter the market to take advantage of this cost reduction. However, local firms also face more competition from foreign firms and some might be driven out of the market as a consequence. One important margin that affects welfare is wages, which are closely related to the mass of firms. When more firms are operating in the market, the demand for labor is higher and firms need to pay higher wages.

FIGURE 30. CHANGES IN MASS OF LOCAL FIRMS



Source: Authors' calculation based on simulation results.

In figure 30, we compare Ecuador and Venezuela, two countries that would experience welfare loss with unilateral tariff reduction, with Brazil, which would see an increase in the mass of firms in many sectors and welfare gain. The effect on the mass of firms in nontradable sectors is negligible compared to tradable sectors, so we focus exclusively on tradable sectors. We can see that in all sectors except mining and quarrying, tariff reductions in Venezuela would result in less firms entering the market. As for Ecuador, firm entry decreases in all sectors except for the first two. In Brazil, on the other hand, more firms will enter five of the tradable sectors. In most of the sectors in which the mass of firms decreases in Brazil, an even higher percentage of firms in Ecuador and Venezuela exit the market. Firms exiting has an adverse effect on welfare because local wages decrease due to lower labor demand. This helps explain why real wages increase more in Brazil than Ecuador, and decrease in Venezuela, as we showed earlier.

Focusing exclusively on tariffs in 2015 would imply hugely underestimating Venezuela's level of protection, much of which takes the form of trade costs other than tariffs, as shown in table 2 using the ESCAP-World Bank Trade Costs Database.[7] In the agriculture sector, Venezuela's total trade costs are 430%, while its trade cost excluding tariffs are 400%. In the manufacturing sector, these figures are 323% and 289%, respectively. In both sectors, nontariff trade costs make up at least 89% of total trade costs. On average, nontariff barriers in OECD countries are 30% lower than Venezuela in the agriculture sector and 32% lower in the manufacturing sectors.

TABLE 2. TRADE COST IN 2013

	OECD average		Venezuela	
	Total trade costs	Nontariff trade costs	Total trade costs	Nontariff trade costs
Agriculture	304%	280%	430%	400%
Manufacturing	215%	197%	323%	289%

A more relevant policy experiment for Venezuela is how its welfare would change if it opened up and unilaterally reduced both tariffs and nontariff barriers. To answer this question, we run a counterfactual in which Venezuela unilaterally lowers its tariffs in each sector to OECD countries' mean MFN tariff rates. In addition, we also let Venezuela take measures to lower other trade costs by 30% in the agriculture and mining sectors, and by 32% in the eight manufacturing sectors, to bring nontariff trade barriers to a level that is comparable with OECD countries. In contrast to the above result, this more comprehensive opening-up proves to be extremely beneficial for Venezuela.

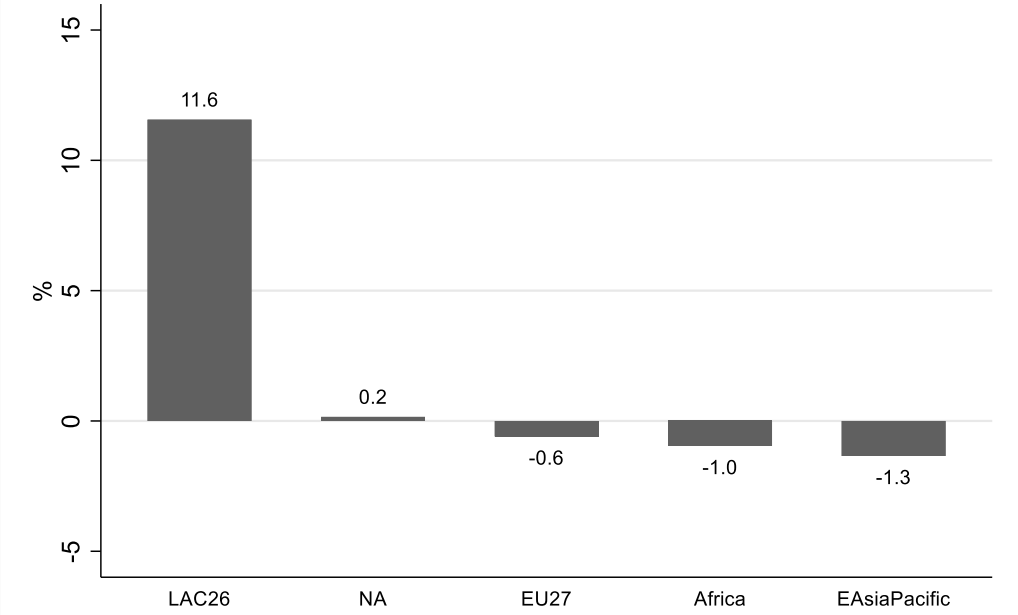
When trade costs are reduced, we expect trade volumes to increase significantly between Venezuela and other countries. The counterfactual shows exactly this: Venezuela's total imports would increase by 242.6%, and its total exports by 110.3%. This openness is accompanied by an increase in real wages and welfare. Both real wages and total welfare in Venezuela increase by 2.2%. Reducing nontariff barriers greatly reduces price indexes within the country and increases trade volumes, both of which would contribute to higher welfare, as we stated previously. Unlike tariff reduction, tariff revenue also increases in this case, further increasing welfare. As is shown here, Venezuela would benefit greatly from reducing its nontariff barriers.

E. Exercise 5

In the last exercise, we study the effect of a free trade agreement between LAC countries, in other words, the reduction of all tariffs between LAC26 countries to zero. Figure 31 plots the effect on LAC26 countries' exports to different regions. The removal of all tariffs between LAC26 countries may increase exports between them by 11.6% and exports from them to North America by 0.2%. Exports to other regions such as the EU, Africa, and East Asia are reduced slightly because of trade diversion. There is a similar effect on LAC26 countries' imports, as shown in figure 32. By definition, imports between LAC26 countries are exactly the same as exports between them. As most of the effect is on trade between these countries, figure 33 plots the changes in each country's exports to LAC26 as a bloc. Every country except Trinidad and Tobago exports more to the bloc after tariff removal. Figures 34 and 35 present the effects on real wages and welfare.

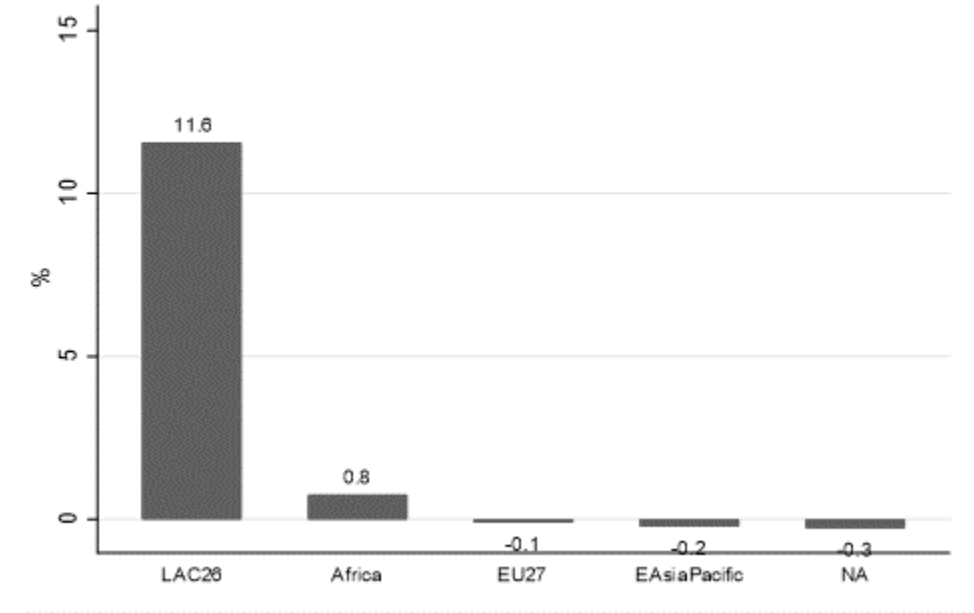
[7] https://www.unescap.org/resources/escap-world-bank-trade-cost-database. Although it is hard to measure trade costs precisely, United Nations ESCAP and the World Bank joined forces to develop a common standard methodology for calculating comprehensive international trade costs so as to provide the research and policy community with a global benchmark. Note that due to data availability issues, we use the data on 2013 for the comparison, as this is the last year on which data for Venezuela is available.

FIGURE 31. EFFECT OF LAC26 FTA ON LAC26 EXPORTS TO DIFFERENT REGIONS



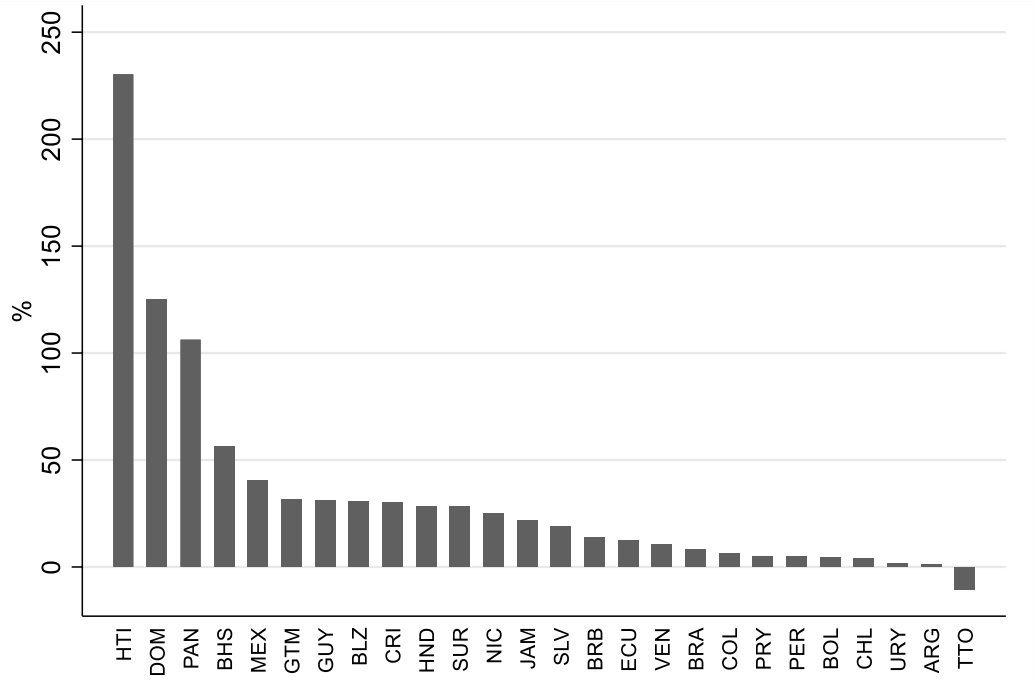
Source: Authors' calculation based on simulation results.

FIGURE 32. EFFECT OF LAC26 FTA ON LAC26 IMPORTS FROM DIFFERENT REGIONS



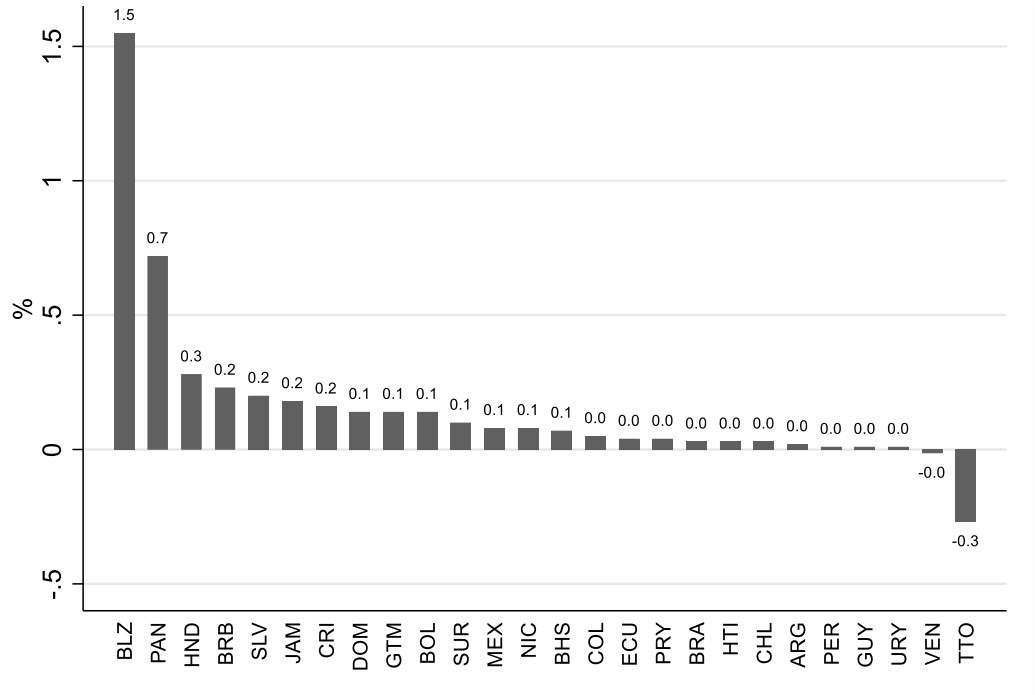
Source: Authors' calculation based on simulation results.

FIGURE 33. EFFECT OF LAC26 FTA ON INTRAREGIONAL EXPORTS, BY EXPORTER



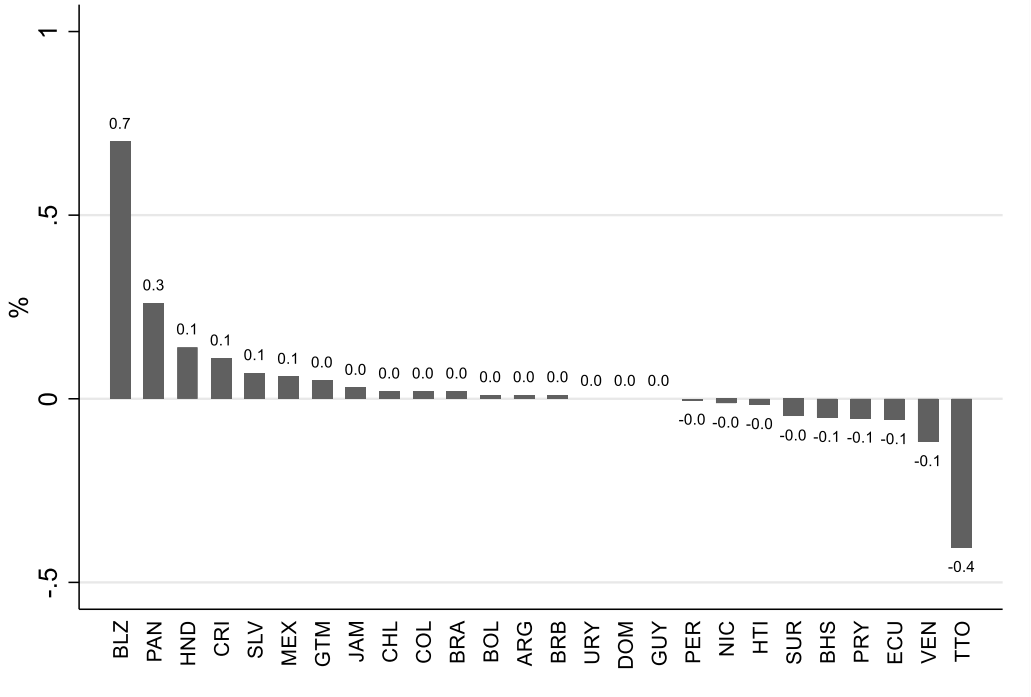
Source: Authors' calculation based on simulation results.

FIGURE 34. REAL WAGE EFFECT OF LAC26 FTA, BY COUNTRY



Source: Authors' calculation based on simulation results.

FIGURE 35. WELFARE EFFECT OF LAC26 FTA, BY COUNTRY



Source: Authors' calculation based on simulation results.

4. CONCLUSIONS

In this paper, we study the effects of tariff reductions through the lens of the model presented in Caliendo et al. (2017). First, we show that from 1990 to 2015, most Latin American countries benefited from reductions in both MFN and PTA tariff rates. During this wave of multilateral trade liberalization, imports and exports increased, and real wages and welfare increased for the majority of the Latin American countries. Second, we show that unilateral tariff changes between1990 and 2015 also had a positive impact on trade volumes, real wages, and welfare for most Latin American countries. The effect is quite heterogeneous, and PTA rates account for most of these changes. We go on to study tariff reduction as a consequence of five major regional trade agreements involving Latin American countries. Regional trade agreements greatly increased trade volumes within the bloc and brought higher real wages and welfare levels for member countries in most cases. The size of the effect depends on the specific countries and size of tariff reductions in question.

Next, we do a policy experiment to ascertain the effect of the least liberalized countries in the region (Argentina, Bolivia, Brazil, Paraguay, Uruguay, Ecuador, and Venezuela) unilaterally reducing their tariffs from 2015 levels to the mean tariff level of the OECD countries. We found that Argentina, Bolivia, Brazil, Paraguay, and Uruguay would see higher real wages and higher welfare; Ecuador would see higher real wages, but lower tariff revenues would have a negative impact on welfare; while real wages in Venezuela would drop and the country would suffer overall welfare loss. We can think of three different factors that affect total welfare: the domestic price index, tariff revenue, and labor income. The domestic price index would fall after tariff reduction, positively affecting welfare; tariff revenue would generally fall for the countries considered here, adversely affecting welfare; and labor income could move either way. There are two potential reasons for the latter effect. First, lower tariffs make foreign goods cheaper, and these goods enter the domestic production process, so domestic firms' costs are lower, and more firms would enter the market and pay higher wages. Second, a higher level of competition from foreign firms would drive some of the domestic firms out of the

market, and labor income would be lower. The overall effect on labor income depends on the relative size of the two forces.

However, if we think of the opening-up of Venezuela as involving not just tariff reduction but also other measures to facilitate trade and reduce trade costs, Venezuela stands to gain a lot from liberalization. Trade volumes would increase greatly as a result of lowering trade costs, and tariff revenue would also increase. This emphasizes the importance of nontariff measures for facilitating trade.

Last but not least, we examine the effect of a proposed free trade agreement between 26 LAC countries. The results show that trade between them will increase by 11.6%, while trade with other regions decreases minimally.

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