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ATPDEA's end:

Effects on Bolivian Real Incomes

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Abstract

We explore the implications of the ATPDEA's end or transformation into a reciprocal Free Trade Agreement (FTA) on Bolivian incomes, using a 2005 household survey. We first simulate the magnitude of the trade shock using a partial-equilibrium model, then feed the trade shock into price and quantity changes in manufacturing and agriculture, and finally feed those price and quantity changes into household incomes. We find that for those individuals who lose their jobs in the manufacturing sector, the income loss is substantial but the aggregate job loss is very small. Variations in agricultural income come almost only from trade diversion on the Colombian market for Bolivian soybean exporters who face more intense competition from the US after Colombia signs an FTA, but again the effects are very small.

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1. Introduction

Bolivia's economy has been stagnant for over fifty years. There were two growth spurts, one from the early 1960s to the late 1970s and one during the 1990s, both followed by collapses and crises that offset their achievements. Political instability, weak institutions, macroeconomic mismanagement, discouraging trade policies and taxation are among the factors usually pointed out as reasons for Bolivia's long-term stagnation.

The boom of the 1990s was the result of stabilization policies put in place in the mid-1980s and of structural policies involving trade liberalization, privatization and the decentralization of public spending. Average growth was 4.7 percent per year between 1993 and 1998, 1.2 percentage point above the average in the previous 5 years. Unemployment and self-employment rates fell in this period. Fueled by foreign direct investment (which grew from 2% of GDP in 1994 to 12% in 1998), export growth made a modest contribution to economic expansion, but it was concentrated in natural-resources and capital- and skill-intensive sectors. Hydrocarbons, construction, utilities, transport and communication were among the fastest-growing sectors. Growth was unbalanced geographically as well and fostered regional divergence rather than convergence.

Although urban poverty rates declined from 52 percent to 46 percent between 1993 and 1999, the gains were modest and short-lived. Jimenez et al. (2005) recently estimated elasticities of urban poverty to growth and found that a 1% increase in per capita income results in a 0.53% decrease in the headcount index of poverty and in a 1.6% decline in the poverty gap. With such low poverty-growth elasticities, Bolivia's economy would have to grow much faster than it did in order to generate any meaningful progress on the poverty-reduction front.

Today, Bolivia's extremely high level of persistent poverty is the worst in Latin America and transcends the country's rural-urban and regional boundaries. Although poverty is extreme in the valleys and central highlands, especially in the departments of Potosi and Chuquisaca, urban areas have the largest numbers of poor due to their high populations. The incidence of poverty is also higher among indigenous people (70%) than among non-indigenous ones (50%).

The late 1990s saw the end of Bolivia's short-lived boom. Capital flows dried out following the 1998 Russian crisis, terms of trade deteriorated and exports slumped after the Brazilian and Argentine currency devaluations in 1999 and 2001, and the 1997-2000 coca eradication program reduced coca production by 80 percent. Growth collapsed to 1.9 percent during 1999-2003, unemployment increased from 4.4 percent in 1997 to 9.2 percent in 2003 and earlier progress in poverty reduction was reversed. The population living in poverty rose from 62 percent to 65 percent.

The recovery has been slow. High prices for Bolivia's primary exports (mining, hydrocarbons and soy products) yielded a modest 3.2% growth rate between 2000 and 2006, peaking at 4.6 percent in 2006. However as pointed out by Nina and Andersen (2004), "the relatively small impacts of trade on poverty are due to the structure of labor markets and trade in Bolivia, and especially due to the fact that most poor people are concentrated in traditional agriculture and non-tradable sectors, which have only very indirect links with trade."

Bolivia is now faced with the possibility of another adverse trade shock. The trade relationship between the US and Andean countries –Bolivia, Colombia, Ecuador and Peru– is currently ruled by a unilateral trade preferences agreement known as the Andean Trade Preference and Drug Eradication Act (ATPDEA). Like all nonreciprocal preference regimes based on "soft" criteria (and unlike the GSP which is based on a "hard" income criterion), the ATPDEA is not WTO-consistent[1] and is thus likely to evolve through either

[1] FTAs are covered by Article XXIV of the GATT or by the Enabling Clause. In both cases, "substantially all trade" must be liberalized in order to make the agreement WTO-consistent, a requirement that cannot be met if the preferences are non-reciprocal. Non-reciprocal preferences granted by industrial countries to developing ones, like the GSP, must base eligibility on a verifiable and universal criterion (like the level of income). Cooperation in areas like the war on drugs (the criterion used by the US in its agreements with Andean countries) or the environment (the criterion used by the EU in the so-called "GSP-plus") is not such a criterion.

transformation into a reciprocal Free Trade Agreement (FTA) or outright elimination.

Enacted in 1991 and amended in 2002 by the ATPDEA, the original Andean Trade Preference Act (ATPA) provided duty-free treatment for a wide range of Andean exports[2] in return for cooperation in the struggle against narcotics production and traffic in the Andean region. It expired in December 2001, but in February 2002, the ATPDEA not only restored its benefits but also extended preferential (duty-free) treatment to about 700 products that were previously not eligible, including petroleum and petroleum products, certain footwear, tuna in flexible containers, and certain watches and leather products. The most significant extension of the benefits was in the apparel sector, although, as we will see later on, the rate of utilization of ATPDEA preferences in the textile & apparel sector subsequently went *down* rather than up. The ATPA, as amended, was set to expire on December 31, 2006, but an additional extension was approved by the 109th Congress until June 30, 2007, and for an additional eight months for countries forming reciprocal free-trade agreements with the US before then.[3] So far Colombia and Peru have concluded FTAs with the United States, but Bolivia and Ecuador have not, Bolivia's president having expressed a preference for the renewal of the ATPDEA rather than the signature of an FTA.

A recent study of Bolivia's Ministry of Economic Development (Bolivia 2006) argued that the expiration of the ATPDEA would only have minor and localized effects on Bolivian exports, as it would only affect clothing, leather manufacturing and the wood industry, situated mainly in La Paz and El Alto. The rest of the products exported to the USA would still enter the US market duty-free under the GSP. We revisit the issue by combining partial-equilibrium simulations of the trade shock generated by the elimination or transformation of the ATPDEA with household-survey data in order to identify price and income effects on household real incomes. The trade shock

[2] Exceptions for Bolivia are listed in section 4.1 and included, inter alia, certain textile & apparel products, footwear, and petroleum products.
[3] At the time of writing, an extension had just been reportedly passed by the US Congress for an additional eight months.

affects both the manufacturing and the agricultural sectors, but the channels of influence are different. For manufacturing, we combine our simulation results with econometrics results from a companion paper (Cadot, Molina and Sakho 2008) to get an estimate of the number of jobs created or destroyed by the trade shock in each branch of manufacturing. Given that the trade shock is very small (see the results in the companion paper), we assume that wages do not adjust (i.e. the trade shock does not trigger a renegotiation of labor contracts in the formal manufacturing sector) and the only margin of adjustment is job creation/destruction. The trade shock being either reduced market access in the US (if the ATPDEA is unilaterally repealed by the US) or trade diversion on Andean markets (if all Andean countries sign FTAs with the US) its effect is job destruction rather than creation.

We estimate predicted incomes in employed and unemployed status using a Heckman two-stage procedure which involves estimating a selection equation by probit in the first step and income equations for employed and unemployed households in the second step. We use the selection equation to calculate unemployment propensity scores, and rank employed households by decreasing order of the HH head's propensity score. Then we use our estimated number of jobs destroyed, *n*, to switch the first *n* households from "employed HH head" to "unemployed HH head" and recalculate their predicted income with the income equation.[4] The difference in predicted income from pre-switch to post-switch gives our estimate of the income loss due to the trade shock in the manufacturing sector.

For the agricultural sector, we also use a simplifying assumption. We assume that the termination of the ATPDEA would cut Bolivian export prices by the amount of the US's MFN tariff. That is, if Bolivian farmers could sell at $p^*\left(1+t^{US}\right)$ when they had duty-free access, they can sell only at the world price

[4] When the shock creates manufacturing jobs, the procedure is more complex because switching from, say, self-employment to wage employment involves a choice which must be modelled as such (that is, the "switchers" must make more money by switching than by staying in the pre-shock occupation). This is what e.g. Lara and Soloaga do for their assessment of the Doha Round's effect on Bolivian households (Lara and Soloaga (2006)). Here the switch from employed to unemployed status is involuntary, so we do not need to deal with discrete-choice issues.

p^* when they lose this preferential access, so the price decrease that they face is simply the amount of the tariff. Furthermore, we assume that the domestic price of cash crops in Bolivia is equal to their FOB price, assuming away issues of incomplete pass-through.[5] Thus, the decrease in export prices is passed on fully to domestic prices. These price changes affect households on the consumption side for products that they consume and on the production side for products that they produce. We calculate net effects using production and consumption weights calculated using Bolivia's latest household survey, the Encuesta de Hogares 2005, for each product and household in the sample.

The effect on households that lose their manufacturing jobs is sizable, but the proportion of those households is very small.[6] As will be shown later in the text, the burden of job loss falls more than proportionately on indigenous people.

In a second set of simulations, we explore the effect of ATPDEA's transformation into a full-fledged FTA with the United States. The effect on employment is now coming from both the import side (because US imports are granted tariff-free treatment) and the export side (essentially because of trade diversion on the market of other Andean countries that simultaneously sign FTAs with the US). Again, the effects are very small. Simulated US export gains on the Bolivian market are quantitatively small and their transmission to employment levels is insignificant in most econometric specifications. Simulated export losses on Andean markets are slightly larger. The transmission of the shock on poverty numbers is, however, very small.

[5] In his study on Mexico, Nicita (2004) used time series for the domestic price of several crops inside Mexico to estimate pass-through effects between border prices and domestic prices. We do not have access to such data here.

[6] The actual number is difficult to assess. As discussed in our companion paper, UNIDO reports only 50'000 manufacturing jobs in Bolivia. This figure is also used in the WTO's latest TPR, which quotes Bolivian official sources. By contrast, based on ENCOVI 2002 household survey, Lara and Soloaga (2006) estimate manufacturing employment at 13% of total employment, which currently stands at about 4 million according to the World Bank's WDI. This would mean about 500'000 jobs. Indeed, they estimate manufacturing job creation resulting from the Doha Round at about 50'000, which is of course incompatible with an initial estimate of 50'000 jobs. Given the large uncertainty about the number of manufacturing jobs, we give results in percentage rather than actual numbers.

2. Incomes, consumption and poverty in Bolivia

2.1 Stylized facts

About a third of Bolivia's population is in extreme poverty, and two thirds in poverty (Lara and Soloaga 2006). As in most low-income countries, poverty affects rural households more than urban ones, with poverty rates of 80% and 53% respectively. Poverty is also unevenly spread geographically. Of Bolivia's three ecological regions (the Altiplano, the Valley and the Plain) the poorest is the Altiplano, where farmers are isolated from world markets by difficult terrain and poor infrastructure. Poverty and remoteness translate into low use of fertilizers and low productivity, creating a vicious circle of poverty. As a result, the rate of self-consumption is highest in the Altiplano. By contrast, the share of export-oriented agriculture is highest in the Plain, which produces most of the country's output of soybeans. Poverty also affects ethnic groups differently. The indigenous population represents about 60% of the population and is generally poorer, less educated, less urbanized, and more heavily affected by unemployment.

2.2 The 2005 household survey

Household data come from the Encuesta de Hogares 2005, a household survey conducted by Bolivia's Instituto Nacional de Estadística (INE) during the months of November and December of 2005 by direct interview. The data were collected at national level, taking into account all Bolivia's nine departments, including both urban and rural areas. The survey is divided into eight sections covering socio-demographic characteristics, migration, education, employment, income, expenditures and agriculture production. The stratified sampling procedure resulted in a sample with 4,086 households, of which approximately 60% are indigenous households.

Using data from the Encuesta de Hogares 2005, we find that the average monthly income, in Bolivianos, is almost twice as large for non-indigenous households: Bol 1'975 for non-indigenous people vs. 1'018 for indigenous ones (Table 1). Average education is also higher for non-indigenous, by 22%.

Table 1
Summary Statistics

Income sources are given in Table 2. It can be seen that agricultural income looms very large, especially for the poor.

Table 2
Sources of income for Bolivian households

Consumption shares are given in Table 3. By far budgets are dominated by food, especially for the poor.

Table 3
Consumption shares of Bolivian households

Table 4 confirms that indigenous populations are more heavily impacted by unemployment, since the probability of being unemployed is 24.5% for indigenous against 21.3% for non-indigenous people. It is worth mentioning here that while these numbers are considerably higher than the national unemployed rate in Bolivia, which is around 9%, they are not directly comparable to it. The calculation of the unemployment rate takes into account the entire labor force (i.e., those searching for job and those employed in all sectors of the economy). Here, on the other hand, our analysis is restricted to households unemployed and those employed in the manufacturing sectors only.

Table 4
Status frequency (%)

3. Tracking the domestic effects of the trade shock

3.1 The approach

Our approach consists of two steps:

Step 1: The effect of the assumed shocks on Bolivian trade flows (tariff changes in all simulations) are modeled using SMART, a highly disaggregated partial-equilibrium model. The appendix describes the model's equations and how we apply them to Bolivian trade. The output of step 1 takes the form of variations in trade values. These variations are essentially due to two forces: trade creation and trade diversion, or their opposites when tariff preference margins are eliminated (as in simulation 1).

Step 2: Variations in trade values are fed into household survey data in order to obtain effects on real incomes. Real incomes are affected by so-called "first-order effects" (price changes) and "second-order effects" (induced quantity changes). In both cases, the linkage from trade to household welfare is via prices and incomes; specifically, induced changes in consumer prices, producer prices, and wages. In the simulations that follow, we restrict ourselves to first-order effects.

3.2 Policy simulation I: The end of ATPDEA

Replacing duty-free status by MFN status for Bolivian exports to the US triggers a reduction in the dollar value of Bolivian exports which we model using SMART. In a general-equilibrium setting, this would trigger a chain of resource-reallocation effects in the domestic economy which would potentially affect all wages (through Stolper-Samuelson elasticities), prices, and quantities. Here, in a partial-equilibrium setting, things are simpler. In the manufacturing sector, the trade shock affects potentially industry wages and employment. Because we do not have enough data to estimate wage pass-through equations, we restrict ourselves to employment effects.[8] In the agricultural sector, the trade shock affects income from the production of cash crops.

3.2.1 Manufacturing

In a companion paper (Cadot, Molina and Sakho (2008)), we estimated the long-run elasticity of industry-level employment to trade volumes which are used to obtain an estimate of the reduction in manufacturing employment triggered by the trade shock. As a result of the end of the ATPDEA, 0.13% of manufacturing employment is expected to be destroyed (2% in the textile and apparel sector, which is the most affected in relative terms).[9] We estimate how this small increase in unemployment affects household incomes using a two-step procedure as follows:

(i) We run a probit of unemployment on individual and household (HH) characteristics:[10]

$$\lambda_i = \text{prob}(I_i = 1 | \mathbf{z}_i) = f\left(\mathbf{z}_i \boldsymbol{\alpha} + u_i\right) \qquad (0.1)$$

where $\mathbf{z}_i$ is a vector of individual and HH characteristics including, inter alia, HH head's age, education, household composition, u_i is an error term with standard properties, and

$$I_i = \begin{cases} 1 & \text{if HH } i\text{'s head is unemployed} \\ 0 & \text{otherwise;} \end{cases} \qquad (0.2)$$

(ii) We run a switching regression of HH income on HH characteristics of the following form. Let y_{i1} be the income of HH ***i*** if the HH head is employed and

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[8] Cadot, Molina and Sakho (2008) treated the endogeneity of wages in the employment equation by using Blundell and Bond's system-GMM estimator.
[9] The very small size of our simulated effects is due to the fact that we use preference utilization rates reported by the US ITC to apply the loss of preferential status only to those exports that requested preferences in the first place. Because these utilization rates have been consistently low since 2000, the loss of preferential status is barely perceptible.
[10] Regional department controls as well as a dummy variable for urban or rural location were also used.

y_{i2} its income if he (she) is unemployed. Income in each status is determined by the following equation

$$y_{ei} = \mathbf{x}_{ei}\boldsymbol{\beta}_e + v_{ei} \tag{0.3}$$

if status is « employed » and

$$y_{ui} = \mathbf{x}_{ui}\boldsymbol{\beta}_u + v_{ui} \tag{0.4}$$

if it is « unemployed ». Even though the sample split between employed and unemployed is observed, (0.3) and (0.4) cannot be estimated simply with two separate OLS regressions. To see this, suppose that unobserved individual characteristics (say, individual talent) affect both income and other individual characteristics (say, the level of education) while being also correlated with the probability of being unemployed. In that case, there would be a selection bias, even though the status is not a choice. We correct this bias using Heckman's two-step procedure, i.e. by running (0.1), retrieving the hazard rate and using it to estimate "augmented" versions of (0.3) and (0.4).[11]

Results from the probit estimation of the selection equation are shown in Table 5.

Table 5
Probit regression results, selection equation

Although the coefficient on age squared is positive, the probability of unemployment is monotone decreasing in age. The effect of education is significant only in the square term and is –unintuitively– positive and too large to be plausible, so results should be interpreted with caution. From regression (0.1), we get propensity scores $\hat{\lambda}_i$ (estimated probabilities of being unemployed) for all household heads employed in the manufacturing sectors (for other households, this score would be meaningless); and we rank them by decreasing order of $\hat{\lambda}_i$ (from the most likely to be unemployed *among the*

[11] See Maddala (1986) for a detailed description of the estimation method.

employed ones to the least likely). Then, knowing that *n* manufacturing jobs would be destroyed, we change the status of the *n* first household heads (the ones with the highest propensity scores) from employed to unemployed, and then recalculate their predicted incomes using the estimates from the income regression.

Predicted income is

$$\hat{y}_{ei} = E\left(y_{ei} \middle| \mathbf{x}_{ei}\right) = \mathbf{x}_{ei}\hat{\boldsymbol{\beta}}_e$$

when the household head is employed and

$$\hat{y}_{ui} = E\left(y_{ui} \middle| \mathbf{x}_{ui}\right) = \mathbf{x}_{ui}\hat{\boldsymbol{\beta}}_u \,.$$

when he/she is unemployed. The percent change in predicted income for an individual who loses his/her job is then

$$\delta_i = \frac{\Delta\hat{y}_i}{\hat{y}_{ei}} = \frac{\hat{y}_{ui} - \hat{y}_{ei}}{\hat{y}_{ei}} < 0 \,. \qquad (0.5)$$

We then apply this *predicted* percent income reduction to *observed* income, household by household:

$$\left.\frac{\Delta y_i}{y_i}\right|_{simulated} = \delta_i y_i \,. \qquad (0.6)$$

Regression results for the income equation are shown in Table 6.

Table 6
Regression results, income equation

For employed people, income peaks at age 49, which is plausible. Education seems to have no effect irrespective of the status. Indigenous status (which is as self-reported by the respondents) has a negative coefficient in the equation for unemployed individuals, implying that indigenous people would have fewer “outside opportunities” for earning money once they lose their job. Outside earning opportunities being extremely diverse in the survey (including such idiosyncratic things as alimony or widowhood/orphan hood benefits) there is little direct interpretation of this.

Income simulation results are shown in Table 7, distinguishing between indigenous and non-indigenous people.

Table 7

Income changes for households employed in the manufacturing sector

The income changes are very large for the individuals concerned, especially so for indigenous people (who lose 68% of their income), but because the number of individuals losing their jobs as a result of the ATPDEA’s termination is so small (less than one hundred if the baseline manufacturing employment is taken to be 50’000), the aggregate income loss is negligible.

In order to get a feel for the distributional implications of the change, Figure 1 shows the income change by centiles of the initial income distribution.

Figure 1
Income change, manufacturing workers, ATPDEA elimination

The curve is a “smoother regression”, i.e. a series of non-parametric regressions, one per observation (i.e. per centile of the income distribution), run over samples centered around the observation in question. The curve generated is a smooth curve that can accommodate any nonlinear relationship between the variable plotted on the horizontal axis (income centiles) and that on the vertical axis (income change due to the trade shock). If it is upward-sloping, the change is regressive (more positive for richer centiles than for poorer), and vice versa. Here, it is flat, suggesting no bias either way.

3.2.2 Agriculture

In agriculture, we treated the effect of the trade shock differently. In principle, things were simpler: the trade simulation gave us variations in the quantities of exports, by crop. Since we had export values but not domestic production, we did not know how much the reduction in US import demand represented relative to Bolivia's initial production and, consequently, we could not use the share of each crop in the cash income of farm households to allocate the export cuts. Therefore we started instead from the price effect

$$\Delta p_k = \frac{-t_k^{US,MFN}}{1+t_k^{US,MFN}} < 0\,, \qquad (0.7)$$

assuming full pass-through, and calculated the first-order effect for Bolivian farm households involved in the production of cash crop *k*. The effect for household *i* was calculated as

$$\frac{\Delta y_i^a}{y_i^a} = \sum\nolimits_{k\in K} \omega_{ik} \Delta p_k \qquad (0.8)$$

where $\omega_{ik} = y_{ik} / y_i^a$ was the share of cash income from the production of crop *k* in household *i*'s total income. We also assumed that (i) only cash income was affected by the export reduction, (ii) all farmers producing cash crop *k* for export to the US would be affected (the price decrease being transmitted backward to all sales of crop *k*, domestic or foreign),[12] and (iii) farmers not producing crops exported to the US would not be affected at all. Table 8 presents the results, again broken down between indigenous and non-indigenous people. As a result of the extremely small price effects that result from the tariff shock, the effects on income are negligible.

Table 8

[12] Whether this is true or not depends on the curvature of the transformation surface between domestic and export sales. If it is flat, continued export sales to the US require equality between domestic and export prices, so the former must adjust like the latter; if it is strictly convex, price differentials can be consistent with continued export sales.

Income changes for farm households

A smoother regression similar to that of Figure 1 is shown in Figure 2. The income change is negative throughout the income distribution and again we did not find any indication of a bias against the households in the lower or higher centiles of the distribution.

Figure 2
Income change, farm households, ATPDEA elimination

3.3 Policy simulation II: Transformation into a reciprocal FTA

The transformation of the ATPDEA into a reciprocal FTA has a very small effect on the import side. Bolivia's MFN tariffs are generally low (centered around 10%) and the US represents barely 15% of its imports, with many zero-trade lines. So even assuming an infinite elasticity of US supply to Bolivia –which is what we assume– the effects are very small (we do not consider action at the extensive margin, i.e. the US does not start to export products that it currently does not export to Bolivia). Consumption effects were calculated analogously to the calculation of agricultural effects previously described in the case of termination of ATPDEA. We calculated shares of each product in the HH's expenditure basket in total HH expenditure and multiplied these shares by the price changes resulting for the tariff shock. Table 9 reports the consumption effects as a result of the FTA.

Table 9
FTA: Simulated expenditure change

Figure 3 shows the usual smoother regression. Even though the consumption effects are very small for all households the upward sloping curve indicates a bias towards the richer households. These results could be explained by the fact that as a consequence of the FTA, tobacco and articles of clothing are the product categories experiencing the largest price decreases and as shown in Table 3, the share of these products in total expenditure is higher for non-poor HHs than for poor ones.

Figure 3
Expenditure changes from FTA

Bolivia's elimination of its tariffs on US products involves very little action on the export side. Bolivia already enjoys duty-free access on the US market except for ATPDEA's exceptions, but in 2002 those were reduced compared to the ATPA vintage 1991. As a result, improvements in market access for Bolivian producers would be very limited. The only substantial effect comes from trade diversion on Andean markets. As Colombia and Peru sign FTAs with the US, the change compared to the current arrangement is that they grant tariff-free access to US products, which means added competition for Bolivian products. The only product where this trade-diversion effect is substantial is soybeans, for which Colombia is a significant outlet. Simulations reported in our companion paper suggest that Bolivia would lose about $4 million in sales of soybeans to Colombia if Colombia signed an FTA with the US. All in all, the export reduction on Andean markets represents a loss of 2.5% of Bolivia's initial exports. With an export elasticity of 3.5, this would translate into a 0.7% decrease in the price of Bolivian soybeans. Income changes for soybeans exporters due to trade diversion in soybeans on the Colombian market are incredibly small, around 0.3% for non-indigenous HHs and 0.4% for indigenous households. Consumption effects could not be calculated since data on soybeans consumption is not available. In manufacturing, there is almost no effect for the same reason: market access is unchanged.

4. Concluding remarks

Our simulation results suggest that ATPDEA's elimination or transformation into a reciprocal FTA would have virtually no effect on poverty in Bolivia. The reasons are multiple. First, there is little scope for improvements in market access from tariff reductions only, since Bolivia already enjoys tariff-free access on the US market. Second, even if there were, the rate of utilization of US preferences where they could matter (in textiles & apparel) is very low.

Third, Bolivia's preferential liberalization could have only very small effects given the limited number of products that the US exports to Bolivia and the small volumes involved. The only substantial action is trade diversion on Andean markets in soybeans but even that is limited.

As always with this kind of simulation, however, it should be kept in mind that the trade adjustments considered are at the intensive margin. One could imagine that well-designed preferences could trigger inward investment and the appearance of new export items as the African Growth and Opportunity Act (AGOA) did for East Africa. However whether this would take place depends on a whole lot of internal and external factors that lie beyond the scope of this paper.

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Appendix: Simulation equations

A.1 Elimination of US preferences

This appendix describes the equations used in our simulation exercise, which are derived from the SMART model[13]. The reader is referred to Jammes and Olarreaga (2005) for a complete description. US consumers have Dixit-Stiglitz preferences with a quasi-linear "upper-stage" (defined over goods), of the form

$$U\left(c_0, c_1, \ldots, c_n\right) = c_0 + \sum_{k=1}^{n} u\left(c_k\right) \tag{9}$$

where c_0 stands for consumption of a composite good used as numéraire and c_k for consumption of good *k* (defined at the HS6 level). The function $u(.)$ is increasing, concave and identical in all countries.

Goods themselves are composites of differentiated national "varieties". That is, each country produces a variety *i* and those varieties are combined in the "lower-level" of US preferences through a Constant Elasticity of Substitution (CES) aggregator of the type

$$c_k = \left[\sum\nolimits_j \left(c_k^j\right)^{1-\sigma}\right]^{1/(1-\sigma)}. \tag{10}$$

This formulation makes it possible to construct an aggregate price level for all varieties of good *k*:[14]

[13] The type of simulation we perform here, which does not involve a formula-based final tariff, is not programmed directly in SMART, so we replicated the equations in Stata.
[14] We omit the derivation of this price index which is somewhat tedious.

$$p_k = \left[\sum_j \left(p_k^j \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}. \tag{11}$$

This is the “price” to which US consumers will react in trade-creation effects (by contrast, trade-diversion effects will be driven by changes in the relative prices of national varieties).

Consider now a representative good. We use superscript i for Bolivia and ℓ for other exporters to the US. Let $\tilde{m} = m^i / m^\ell$ be the ratio of a US imports of the composite good from *i* and ℓ respectively, and $\tilde{p} = p^i / p^\ell$ the ratio of their landed (duty-paid) prices. The elasticity of substitution σ between the two origins of our representative good is

$$\sigma = \frac{\tilde{p}}{\tilde{m}} \frac{d\tilde{m}}{d\tilde{p}} < 0. \tag{12}$$

and the elasticity of import demand (in algebraic value, i.e. negative) is

$$\varepsilon = \frac{p}{m} \frac{dm}{dp} < 0. \tag{13}$$

where *p* is the CES aggregate of the landed prices of all of the representative good’s varieties in the importer country given by (11) and *m* is aggregate imports of all varieties of good *i*. For each variety *i*, the relationship between the producer and landed price is

$$p^i = p^{i*} \left(1 + t^i \right) \tag{14}$$

and t^i is the applied tariff, i.e. the MFN tariff reduced by the preference margin:

$$t^i = t^{MFN}\left(1-\delta^i\right). \tag{15}$$

We assume that Bolivia's export supply curve is upward sloping with supply elasticity μ^i, which means that we apply a "large-country" framework.

Trade creation

What we are looking for here is a « trade-destruction » effect rather than a trade-creation one since the experiment consists of raising US tariffs on Bolivia (from zero back to their MFN level) instead of cutting them on an preferential basis. The logic is however the same.

We have three unknowns to determine: the change in Bolivian exports to the US, dx^i (equal to dm^i), the change in the landed price of Bolivian exports on the US market, dp^i, and the change in the producer price of Bolivian exports to the US, dp^{i*}, all in terms of the tariff change dt^i. In order to have a solution we need three equations: (i) The definition of the supply elasticity,

$$\mu^i = \frac{p^{i*}}{x^i}\frac{dx^i}{dp^{i*}}, \tag{16}$$

(ii) The equation linking the exporter's producer price, the tariff, and the domestic price, given by (14) and (iii) the definition of the importer's price elasticity of import demand, given by (13). We close this simple system of equations by noting that US imports from Bolivia equal Bolivian exports to the US.

Starting from (13), differentiating totally (14), and substituting from (16) gives

$$
\begin{aligned}
dx^i &= \frac{\varepsilon x^i}{p^i} dp^i \\
dp^i &= p^{i*} dt^i + \left(1 + t^i\right) dp^{i*} \\
dp^{i*} &= \frac{p^{i*}}{\mu^i x^i} dx^i ;
\end{aligned}
\tag{17}
$$

replacing x^i by m^i, evaluating p^{i*} at unity, and combining all three equations in (17) gives

$$
dm^i \Big|_{TC} = \left(\frac{\mu^i \varepsilon}{\mu^i - \varepsilon} \right) m^i \, \frac{dt^i}{\left(1 + t^i\right)} . \tag{18}
$$

Recall that ε is in algebraic value and is thus normally negative, so trade creation is *positive* when the tariff goes *down*. Here, the US tariff on Bolivia would go *up* from zero to its MFN level upon the elimination of the ATPDEA; thus, $t^i = 0$, $\Delta t^i = t^{US,MFN}$, and the formula used in our simulation is

$$
\Delta m^{BOL \mapsto US} \Big|_{"TC"} = \left(\frac{\mu^{BOL} \varepsilon^{US}}{\mu^{BOL} - \varepsilon^{US}} \right) m^{BOL \mapsto US} \; t^{US\ MFN} \tag{19}
$$

Trade diversion

Here again, we are looking for anti-trade diversion effects since preferences are being eliminated. Observe first that using an expression similar to (16) for the rest of the world's elasticity of supply gives, after a bit of algebra,

$$\frac{d\tilde{p}}{\tilde{p}} = \frac{dt}{1+t} + \frac{1}{\mu^i}\frac{dx^i}{x^i} + \frac{1}{\mu^\ell}\frac{dx^\ell}{x^\ell}. \tag{20}$$

Using again the fact that $x \equiv m$ for both i (Bolivia) and ℓ (the rest of the world) and that, along trade diversion, $dm^\ell \equiv -dm^i$, (20) can be rewritten as

$$\frac{d\tilde{p}}{\tilde{p}} = \frac{dt}{1+t} + \left(\frac{1}{\mu^i m^i} + \frac{1}{\mu^\ell m^\ell}\right) dm^i. \tag{21}$$

Going back to the definition of the elasticity of substitution, (12), we have also

$$d\tilde{m} = \sigma \tilde{m} \frac{d\tilde{p}}{\tilde{p}}; \tag{22}$$

expanding $d\tilde{m}$ gives

$$\frac{m^\ell dm^i - m^i dm^\ell}{\left(m^\ell\right)^2} = \sigma \frac{m^i}{m^\ell}\frac{d\tilde{p}}{\tilde{p}}. \tag{23}$$

Using again the fact that $dm^\ell \equiv -dm^i$, rearranging (23) and using (21) gives then

$$
\begin{aligned}
dm^i\Big|_{TD} &= \sigma\left(\frac{m^i m^\ell}{m^i + m^\ell}\right)\frac{d\tilde{p}}{\tilde{p}} \\
&= \sigma\left(\frac{m^i m^\ell}{m^i + m^\ell}\right)\left[\frac{dt^i}{\left(1+t^i\right)} + \left(\frac{1}{\mu^i m^i} + \frac{1}{\mu^\ell m^\ell}\right)dm^i\right] \qquad (24) \\
&= \sigma\left(\frac{\psi_1}{1-\sigma\psi_1\psi_2}\right)\frac{dt^i}{\left(1+t^i\right)}
\end{aligned}
$$

where

$$\psi_1 = \frac{m^i m^\ell}{m^i + m^\ell} \qquad (25)$$

and

$$\psi_2 = \frac{1}{\mu^i m^i} + \frac{1}{\mu^\ell m^\ell}. \qquad (26)$$

For us, the relevant tariff change is from $t^i = 0$ to $t^i = t^{US,MFN}$, so

$$\frac{dt^i}{1+t^i} = t^{US,MFN}.$$

As a (plausible) simplification, consider now the case where the ROW's supply curve is flat ($\mu^{ROW} \to +\infty$). Then $\psi_2 = 1/\mu^{BOL} m^{BOL\mapsto US}$ and

$$\Delta m^{BOL\mapsto US}\Big|_{"TD"} = \sigma\left[\frac{\mu^{BOL} m^{BOL\mapsto US} m^{ROW\mapsto US}}{\mu^{BOL}\left(m^{BOL\mapsto US} + m^{ROW\mapsto US}\right) - \sigma m^{ROW\mapsto US}}\right] t^{US,MFN} \qquad (27)$$

Thus, the total change in Bolivian exports ("trade diversion" and "trade creation", keeping in mind that we are working backward on the *elimination* of preferences), is

$$\Delta m^{BOL} = \phi m^{BOL\mapsto US}\ t^{US,MFN} \qquad (28)$$

where

$$\phi = \left(\frac{\mu^{BOL} \varepsilon^{US}}{\mu^{BOL} - \varepsilon^{US}} \right) + \sigma \left[\frac{\mu^{BOL} m^{ROW \mapsto US}}{\mu^{BOL} \left(m^{BOL \mapsto US} + m^{ROW \mapsto US} \right) - \sigma m^{ROW \mapsto US}} \right]$$
$$= \mu^{BOL} \left(\frac{\varepsilon^{US}}{\mu^{BOL} - \varepsilon^{US}} + \frac{\sigma}{\mu^{BOL} \left(1 + \tilde{m}^{US} \right) - \sigma} \right) < 0. \qquad (29)$$

Note that if one makes use of the fact that $\tilde{m}^{US} = m^{BOL \mapsto US} / m^{ROW \mapsto US}$ is very small, the last expression can be simplified into

$$\phi \simeq \mu^{BOL} \left(\frac{\varepsilon^{US}}{\mu^{BOL} - \varepsilon^{US}} + \frac{\sigma}{\mu^{BOL} - \sigma} \right). \qquad (30)$$

Observe also that ϕ is always negative because both ε and σ are in algebraic form; it is also an increasing function of σ and could be, in absolute value, larger than $1/t^{US,MFN}$, in which case the displacement of Bolivian exports by other suppliers on the US market could be more than their initial value.[15] We accordingly bound these effects at the initial level of Bolivian exports.[16] Thus, the expressions used in our simulations are, for each product *k*, (29) and

$$\Delta m_k^{BOL \mapsto US} = \begin{cases} \phi_k m_k^{BOL \mapsto US} \; t_k^{US,MFN} & \text{if } \left| \phi_k \; t_k^{US,MFN} \right| \leq 1 \\ -m_k^{BOL \mapsto US} & \text{otherwise} \end{cases} \qquad (31)$$

where $m_k^{BOL \mapsto US}$ is of course the *initial* level of Bolivian exports to the US.

A.2: FTA between Bolivia and the US

Here the exercise is more standard, consisting of replacing the Bolivian tariff on US imports by duty-free treatment. Because of the size asymmetry between the US and Bolivia, we can use the small-country version of SMART and assume that the elasticity of US supply is infinite. The formula for trade creation is then

[15] In practice, given an elasticity of substitution around 5 (the value used in our benchmark scenario) this requires small values of the elasticities of supply and demand and large values of the US MFN tariff. The constraint is binding in only 3% of Bolivia's active export lines.
[16] In this we depart slightly from SMART which applies a smooth downward correction to eliminate corner solutions.

$$dm^{US\mapsto BOL}\Big|_{TC} = \varepsilon^{BOL} m^{US\mapsto BOL}\left(\frac{t^{BOL,MFN}}{1+t^{BOL,MFN}}\right) \tag{32}$$

where ε^{BOL} is the price elasticity of Bolivia's import demand, and $t^{BOL,MFN}$ is the initial Bolivian tariff on US imports that is eliminated.

The formula for trade diversion is

$$dm^{US\mapsto BOL}\Big|_{TD} = \sigma\left(\frac{m^{US\mapsto BOL} m^{ROW\mapsto BOL}}{m^{US\mapsto BOL} + m^{ROW\mapsto BOL}}\right)\left(\frac{t^{BOL,MFN}}{1+t^{BOL,MFN}}\right); \tag{33}$$

Total effects are given by:

$$\Delta m^{US} = \Delta m^{US\to BOL}\Big|_{TC} + \Delta m^{US\to BOL}\Big|_{TD}$$

$$\Delta m^{US} = \phi_k^{US\to BOL} m^{US\to BOL}\left(\frac{t^{BOL,MFN}}{1+t^{BOL,MFN}}\right) \tag{32}$$

where

$$\phi_k^{US\to BOL} = \sigma\left(\varepsilon^{BOL} + \frac{1}{1+\tilde{m}_k^{BOL}}\right) \tag{34}$$

and

$$\tilde{m}_k^{BOL} = \frac{m_k^{US\mapsto BOL}}{m_k^{ROW\mapsto BOL}}. \tag{35}$$

imposing the usual upper bound, we get

$$\Delta m_k^{US\to BOL} = \begin{cases} \phi_k^{US\to BOL} m_k^{US\to BOL}\left(\frac{t_k^{BOL,MFN}}{1+t_k^{BOL,MFN}}\right) & if \quad \phi_k^{BOL} t_k^{BOL,MFN} \le 1 \\ m_k^{US\to BOL} & otherwise \end{cases} \tag{35}$$

Tables and figures

Table 1
Summary statistics

	Total income (in Bs)			Gender dummy (male=1)	Age (years)	Education (years)	Number of children	Urban dummy (urban=1)
	Total	Unemployed	Employed					
Total								
Mean	1,463.95	782.10	1,667.44	0.82	37.90	9.97	1.68	0.96
Standard Deviation	202.03	97.07	254.94	0.03	1.02	0.35	0.11	0.01
Number of Obs.	217	61	156	217	217	217	217	217
Indigenous								
Mean	1,017.65	514.34	1,180.50	0.84	37.12	9.18	1.68	0.94
Standard Deviation	76.21	89.82	89.28	0.04	1.45	0.45	0.15	0.02
Number of Obs.	111	34	77	111	111	111	111	111
Non-indigenous								
Mean	1,974.58	1,133.51	2,202.38	0.80	38.80	10.87	1.69	0.98
Standard Deviation	405.71	163.94	498.40	0.05	1.37	0.56	0.15	0.01
Number of Obs.	106	27	79	106	106	106	106	106

Table 2
Income sources, %

	Total			Indigenous			Non-indigenous		
	Total	Poor	Non-Poor	Total	Poor	Non-Poor	Total	Poor	Non-Poor
Self employment	48.4	55.0	39.7	52.1	57.5	43.0	43.0	50.2	36.3
Farming activities	20.8	30.6	8.0	24.5	34.2	8.3	15.3	23.7	7.7
Non-farming activities	27.6	24.4	31.7	27.6	23.4	34.6	27.6	26.5	28.6
Wages	28.6	23.6	35.2	24.3	19.0	33.2	35.0	32.4	37.4
Other work related[1]	3.7	2.5	5.4	3.1	1.9	5.0	4.6	3.5	5.7
Non-work related[2]	4.9	1.8	8.9	4.8	1.9	9.7	4.9	1.5	8.1
Remittances	8.9	8.9	8.9	8.5	9.4	7.0	9.5	7.9	11.0
Other sources[3]	5.5	8.2	1.8	7.2	10.2	2.1	2.9	4.4	1.5

Notes

1 Bonus, comission, overtime, etc.

2 Retirement savings, rent, interests, dividends, etc.

3 Pensions, scholarships, copyrights, etc.

Definition of indigenous is based on head of household's own perception.

Table 3
Budget shares (%)

	Total			Indigenous			Non-indigenous		
	Total	Poor	Non-Poor	Total	Poor	Non-Poor	Total	Poor	Non-Poor
Food	66.3	71.9	58.8	68.0	72.7	60.0	63.8	70.5	57.6
Inside the home	58.2	66.6	47.1	60.9	68.0	48.9	54.3	64.0	45.1
Outside the home	8.1	5.3	11.8	7.1	4.7	11.2	9.5	6.4	12.4
Clothing	3.5	3.2	3.9	3.6	3.4	4.0	3.5	3.0	3.9
Education	5.4	4.9	6.2	5.4	5.0	6.1	5.5	4.6	6.2
Housing	8.6	7.3	10.4	7.7	6.5	9.6	10.0	8.7	11.2
Transport	3.3	2.8	3.8	3.4	3.0	4.1	3.0	2.6	3.5
Personal Goods	2.1	2.0	2.3	1.9	1.8	2.1	2.4	2.4	2.5
Health	1.5	1.5	1.7	1.4	1.4	1.5	1.7	1.6	1.9
Tobacco	0.2	0.1	0.2	0.1	0.1	0.1	0.3	0.2	0.3
Remittances	1.2	0.4	2.1	1.4	0.5	2.9	0.7	0.2	1.3
Other	7.9	5.9	10.5	7.1	5.7	9.5	9.0	6.2	11.6

Table 4
Status frequency (%)

	Employed	Unemployed
Indigenous	75.6	24.5
Non-indigenous	78.7	21.3
Total	77.0	23.0

Table 5
Probit regression results, selection equation (prob. unemployed)

Dep. variable: unemployed = 1	
Male	-1.220
	(0.346)***
Age	-0.082
	(0.056)
Age squared	0.001
	(0.001)*
Education	-0.105
	(0.125)
Education squared	0.010
	(0.006)*
Indigenous	0.420
	(0.289)
# of children	-0.103
	(0.086)
Urban	-0.617
	(0.489)
depto==2	-1.142
	(0.491)**
depto==3	-1.257
	(0.569)**
depto==4	-0.319
	(0.562)
depto==5	-0.193
	(0.618)
depto==6	-1.152
	(0.580)**
depto==7	-0.938
	(0.514)*
depto==8	-1.245
	(0.592)**
depto==9	-0.594
	(0.871)
Constant	2.578
	(1.396)*
Observations	217

Table 6
Regression results, income equation

	Employed	Unempl.
Age	0.0824	0.0245
	(0.0231)***	(0.0344)
Age squared	-0.0009	-0.0001
	(0.0003)***	(0.0004)
Education	0.0279	-0.0644
	(0.0471)	(0.0904)
Educ. squared	0.0023	0.0060
	(0.0026)	(0.0046)
Indigenous	0.0458	-0.9682
	(0.1111)	(0.2749)***
Constant	4.5705	5.3529
	(0.6249)***	(0.8871)***
Observations	217	217

Table 7
Termination of ATPDEA: Simulated income change for job-losers, manufacturing sector

		Total	Indigenous	Non-indigenous
Percent variation	δ (mean over hhs)	-55.5 (0.29)	-68.0 (0.15)	-33.4 (0.34)
Variation in money terms	δ*y (mean over hhs)	-856.64 (858.18)	-868.20 (764.17)	-836.29 (1019.67)
Aggregate variation	δ*y (sum all hhs)	-59'108	-38'201	-20'907
No. obs		*69*	*44*	*25*

Table 8

Termination of ATPDEA: Simulated income change, agriculture

		Total	Indigenous	Non-indigenous
Percent variation	δ (mean over hhs)	-2.2 (0.3)	-2.2 (0.3)	-2.1 (0.3)
Variation in money terms	δ*y (mean over hhs)	-42.03 (280.36)	-39.91 (302.42)	-47.62 (211.69)
Aggregate variation	δ*y (sum all hhs)	-55'353	-38'116	-17'238
No. obs		1317	955	362

Table 9
FTA: Simulated expenditure change

		Total	Indigenous	Non-indigenous
Percent variation	δ (mean over hhs)	-4.1 (0.03)	-4.2 (0.03)	-4.0 (0.03)
No. obs		*4047*	*2417*	*1630*

Figures

Figure 1
Income change, manufacturing workers, ATPDEA elimination

Notes:

Curve gives predicted values from "smoother" (nonparametric) regression, bandwith 0.8, on centiles of household income distribution.

Figure 2
Income change, farmers, ATPDEA elimination

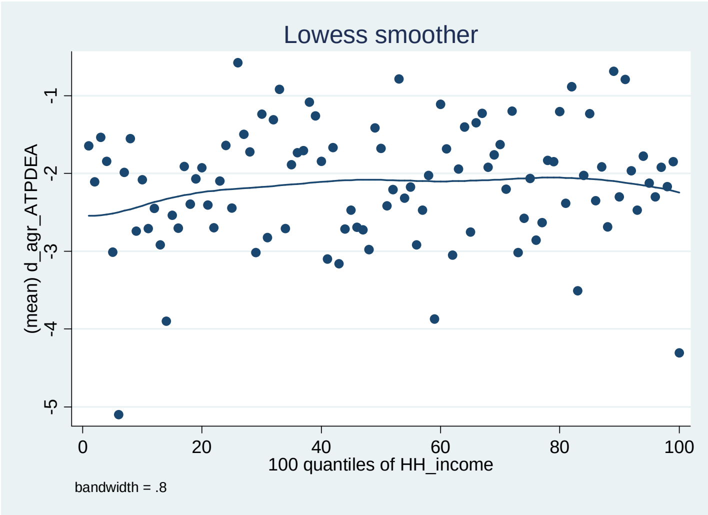

Figure 3

Expenditure change, FTA