Économie internationale 94-95 (2003), p. 155-174.

ÉCONOMIE INTERNATIONALE

TRADE LIBERALIZATION AND EMPLOYMENT IN DEVELOPING ECONOMIES OF THE AMERICAS

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Article received on August 20, 2002
Accepted on July 4, 2003

ABSTRACT. Using an applied general equilibrium model we explore the potential effect of comprehensive trade liberalization in a selection of Latin American developing economies. Over the last decade many of these economies have suffered from high levels of unemployment, and the consequences of reform on unemployment and of unemployment on the effects of reform are critical. We take the approach of utilizing alternative labor market closures, bounding the static effect of trade reform between the neoclassical, which abstracts from unemployment issues, and a surplus labor/unemployment closure. We also consider a less common specification based on the neoclassical Harris-Todaro characterization of the dual economy. Our results indicate that the presence of unemployment may significantly expand the potential net welfare benefits of trade reform in the Americas.

JEL Classification: C68; F13; J60; O54.
Keywords: Computable General Equilibrium Models; Commercial Policy; Protection; Unemployment.

RÉSUMÉ. À l'aide d'un modèle d'équilibre général calculable, cet article analyse les effets d'une libéralisation commerciale complète appliquée par certaines économies en développement de l'Amérique latine. Au cours de la décennie écoulée, nombre de ces économies ont connu un taux de chômage élevé, et les conséquences des réformes sur le chômage, tout comme celles du chômage sur les répercusions des réformes, sont sensibles. L'approche présentée ici recourt à différents bouclages du marché du travail. L'utilisation alternative d'un modèle néoclassique, qui fait abstraction du chômage, et d'un bouclage tenant compte du chômage permet d'établir des bornes à l'effet statique d'une réforme commerciale. Nous utilisons aussi une spécification plus inhabituelle fondée sur l'approche néo-classique à la Harris-Todaro de l'économie duale. Les résultats montrent que le sous-emploi peut accroître sensiblement le gain potentiel en bien-être tiré d'une réforme commerciale en Amérique.

Classification *JEL* : C68 ; F13 ; J60 ; O54.
Mots-clefs : Modèles d'équilibre général calculable ; politique commerciale ; protection ; chômage.

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Over the last decade, the developing economies of the Americas have made significant progress towards liberalizing their international trade regimes. Average tariffs in the region have fallen from over 40 percent in the mid-1980s to 12 percent in the mid-1990s (IADB, 2000). Much of the trade reform has been promoted through consolidation in the various existing regional trading arrangements: Mercosur has succeeded in establishing an "almost perfect" customs union over the last decade (Monteagudo and Watanuki, 2001) and simultaneously lowering its average external tariff dramatically, while the Andean Community has largely completed the formation of a free trade area (IADB, 2000). The progress suggests that trade reform processes have become strongly entrenched among the developing economies of the Americas, and that the import substitution model has been largely supplanted. However, there remains considerable scope for further reform. Average protection levels in the region remain high by the standard of the economies' East Asian counterparts, and by those of developed economies in the Americas.

As in other parts of the world, negotiations to expand regional trade liberalization agreements have been proliferating at a great pace in the Americas, and this appears to be the most likely modality for the majority of future trade reform. Two of the most significant are the efforts to integrate Mercosur with the European Union, and to extend NAFTA (North American Free Trade Area) to form a comprehensive Free Trade Area of the Americas (FTAA). Individual economies have also actively pursued their own agendas. Chile has been particularly diligent, pursuing agreements with Mercosur and NAFTA, in addition to adopting a strategy of seeking bilateral free-trade agreements with several economies, including South Korea, Singapore, Japan and New Zealand (Scollay and Gilbert, 2001).

In addition, trade reform continues in a multilateral and unilateral setting. Several Latin American economies (Mexico, Chile and Peru) are members of the Asia-Pacific Economic Cooperation (APEC) forum, which promotes unilateral trade liberalization among its members (a process termed 'open regionalism'), and aims for complete removal of trade barriers in developing economy members by 2020.

The brisk pace of reform in Latin America has led to an extensive literature aimed at estimating the potential effects of trade liberalization. Although much work remains to be completed, applied general equilibrium (AGE) techniques have been successfully applied to the analysis of a number of proposed arrangements using a wide variety of model specifications (on the expansion of NAFTA see, for example, Brown *et al.*, 1995 and 2000; on the FTAA see Diao and Somwaru, 2001; and on Mercosur see Flores, 1997, and Diao and Somwaru, 1999 and 2000). AGE is a particularly useful technique that provides a consistent framework of analysis for evaluating trade policy reform where the reforms are large, involve multiple sectors, or take place in the presence of other distortions that may interact with the reform process to produce unexpected outcomes. The technique is quite versatile, and the incorporation of alternative structural features and/or assumptions on the directions of economic causality (closures) can lead to numerous interesting insights on the effect of reform.

This paper is a preliminary examination of the effect of some labor market specification issues.

A number of American economies have very high unemployment levels. The most recent figures from the ILO indicate total unemployment rates of over 15 percent in Argentina and 20 percent in Colombia, for example. Many AGE models will take a long-run view and abstract from the existence of unemployment. This neoclassical approach assumes that the economy is operating on the efficiency locus, albeit at a point that is sub-optimal due to the presence of tariffs and other distortions. Changes in labor demand must be fully reflected in changes in wages. In our view this provides one bound on the effect of reform. The other bound is where the wage is fixed, and changes in demand are reflected in changes in employment (we term this a "surplus" labor closure). The "true" effect must logically fall between these extremes. Since the equilibrium data, being only a point estimate, will in general be consistent with either theoretical specification, it is important in our view to analyze both closures to gain a full picture of the potential effect of trade policy reform, and to use complementary evidence to help us to understand which outcomes are more likely. The purpose of the analysis is not to suggest that the neoclassical approach is inappropriate. Indeed, there is evidence to suggest that the actual outcome may lie closer to the neoclassical bound than the surplus. Rather, the purpose is to consider the full range of plausible results. Lora and Olivera (1998) use a similar approach with a highly aggregated general equilibrium model to examine the effect of macroeconomic shocks. Other specifications, such as a segmented labor market closure are also possible, and can provide useful insights into the effect of trade reform and complementary policy adjustments.

The remainder of this paper is organized as follows. First, we briefly discuss the trends in unemployment in the Americas, and review some of the literature that attempts to explain the phenomenon and characterize the labor market situation. Then we describe the structure of our empirical model and our simulation techniques and assumptions. We present the results of our simulations, and discussion of the policy implications. Concluding comments follow.

Unemployment and labor markets in Latin America

Duryea *et al.* (2001) cite a survey of public opinion conducted in 17 Latin American economies (the Latinobarómetro) that routinely lists labor market troubles as the main economic problem facing the region. Indeed, with few exceptions, unemployment in Latin America is at very high levels, and has been rising over the second half of the 1990s. Table 1 presents ILO unemployment rate estimates for a selection of economies (Duryea *et al.*, present similar figures and extensive analysis using household survey data).[2] A useful overview of employment trends is also provided by Lora and Márquez (1998).

2. Duryea *et al.* (2001) also present a comprehensive analysis of the unemployment breakdown by skill, age sex, location. etc.

Overall average unemployment rates in the region have risen from 9.1 percent in 1995 to 11.1 percent in 1999. The average figures disguise considerable variation across sub-regions and individual economies, however. In the Andean region (Colombia, Peru and Venezuela) the average unemployment rate has risen from 10.3 percent in 1995 to 15.4 percent in 1999. The highest rates are in Colombia (20.5 percent in 2000), but the most recent data for all three economies indicates unemployment levels of at least 10 percent.

Although increases in unemployment levels were most substantial in the Andean region, unemployment levels in the Southern Cone region (Argentina, Brazil, Chile and Uruguay) have remained consistently high over the latter half of the 1990s. The average unemployment rate in the region was 10 percent in 1995, rising to 11 percent by 1999. The highest levels are in Argentina – which has consistently sustained unemployment levels over 13 percent. Recent developments have no doubt pushed this figure considerably higher.

Mexico is one of the few economies to buck the general trend. Unemployment levels have declined from 4.7 percent in 1995 to 1.6 percent in 2000, a very low level by any standards. This unusual outcome likely reflects at least in part the extremely robust performance of the United States economy over the period. The United States experienced significant declines in unemployment levels over the period, and the geographical proximity of Mexico to North America encourages labor migration. This situation may change as the United States economy slows.

Table 1 - Annual unemployment rate for selected economies

Percent

Regions	1995	1996	1997	1998	1999	2000
Argentina	18.8	17.2	14.9	12.8	14.1	15.0
Brazil	6.1	7	7.8	9	9.6	–
Chile	4.7	5.4	5.3	7.2	8.9	8.3
Colombia	8.7	12	12.1	15	20.1	20.5
Mexico	4.7	3.7	2.6	2.3	1.7	1.6
Peru	–	7	7.7	7.8	8	7.4
Uruguay	10.2	–	–	10.1	11.3	13.6
Venezuela	10.3	11.8	11.36	11.15	14.9	–

Source: ILO Bureau of Statistics, ILOSTAT.

The causes of unemployment can be classified in terms of structural and cyclical factors. Structural factors include socio-demographic characteristics and institutional rigidities. At the most fundamental level, the cause of structural unemployment is wage rigidity. Freije (2001) discusses the underlying causes of labor market rigidity in relation to unemployment and the growth of informal employment, noting the effect of a wide variety of labor market regulations including heavy paperwork requirements, high payroll taxes, and high firing costs. Maloney and Núnez (2001) consider the effect of minimum wage regulations on wage distribution and employment. They find that the wage distribution clusters around the mini-

mum wage in both formal and informal sectors in Brazil, Chile and Colombia, and thus have evidence that the minimum wage is likely to be binding in those economies, and thus a source of unemployment. The evidence for Argentina is inconclusive.

The official unemployment figures may be somewhat misleading in that many of the statistically unemployed are in fact actively engaged in productive economic activities outside of the formal economy. There is evidence to suggest that informal labor markets are an important source of employment opportunities in the Latin American context, as in other developing economies. Though the measurement of informal activities is plagued with difficulties, several studies put the number of informal workers at between 20 and 35 percent of the urban economically active population in Latin America (Portes and Schauffler, 1993).

Measurement of informal activities in Latin America is difficult at least in part because the characterization and therefore modeling of informal markets is so complex – there is no one accepted definition. Early theories considered the informal as largely a surplus labor force in urban areas, developing from high levels of migration. These workers are viewed as peripheral and having low marginal productivity. Others have characterized the informal as being not a reflection of excess labor, but of excess regulation. The informal economy is simply a mechanism for introducing market response to an overly regulated economy. A third approach proposes the informal and formal as a series of complementary networks. For a very comprehensive overview of the informal labor market concept in the Latin American context, see Portes and Schauffler (1993). Finding ways to bring the informal sector into applied general equilibrium simulations is an important area of current research.

Irrespective of the characterization of its source, the volume of unemployment and labor market structures are clearly affected by changes in other elements of the economy. Lora and Olivera (1998) comment on the role of recent macroeconomic policy. They argue that the economic reforms aimed at consolidating macroeconomic stability have been largely successful, but have resulted in significant changes in the structure of the labor market. Among the changes they identify are a greater role for services and informal employment, an increased bias towards skilled labor, and wider wage differentials.

While understanding the causes and consequences of high unemployment in the Americas is difficult, it would also be remiss to ignore the issue when considering the impact of trade liberalization scenarios. On the one hand, it can be argued that trade liberalization issues and labor market policy issues are distinct.[3] It is true that optimal responses will require appropriate labor market policy reform (which, according to Freije (2001) has been extensive in some economies – Chile, Colombia and Peru – but not others – Venezuela and Brazil). However, this view ignores one of the principal virtues of AGE modeling – the ability to capture the second-best implications of policy shocks. The approach that we outline below is

3. Benusán and Damgaard (1999) provide a useful overview of the debate over the relationship between international trade and labor market issues.

particularly simple, consisting essentially of bounding the potential effect of trade liberalization using alternative labor market closures, but it does give us a good idea of the potential range of results and information on whether the presence of unemployment is likely to strengthen or weaken the case for liberalization. In the following section we outline the structure of our simulation model.

AN OVERVIEW OF THE MODEL

The model that we utilize in this paper is a derivative of the standard Armington trade model of a single economy, and its basic structure is thus familiar. At present the single economy models are not linked into a common system, so the experiments are conducted separately for each economy. Here we provide only a brief overview of the model (a full equation listing is available on request). Each economy under analysis is assumed to be composed of a set of competitive industries, each of which use the given endowments of factors of production (in a constant elasticity of substitution, CES, composite) along with the output of the other sectors (in a fixed-proportions composite) to produce a joint product. This joint product is composed in turn of an exportable and a domestic good, with the transformation between the two being based on a constant elasticity of transformation (CET) function.

A single representative consumer in each economy maximizes a Stone-Geary utility function subject to the economy-wide budget constraint (with quantities of investment and government purchases held constant). Having allocated expenditure across the consumption goods, a second-level optimization procedure allocates consumption of each good across domestic and imported goods in that product category. The aggregation function takes the CES form, and is invariant across different consumption activities. This "imperfect substitutes" or Armington specification of production and consumption is common in AGE models and serves the purpose of avoiding extreme changes in the equilibrium in the presence of limited factors of production. The world price of imported goods is held constant, while the world price of exported goods is derived from a constant elasticity of demand (CED) function representing the rest-of-world.

Macro-economic closure is achieved as follows. We define the numéraire of the model as the domestic producer price index. This in effect sets a "no-inflation" benchmark for the economy. The nominal exchange rate is assumed to adjust to maintain a fixed current account surplus/deficit. Since the quantities of investment and government expenditure are fixed, the government budget deficit/surplus, though not explicitly defined, is endogenous. Financing the changes in the budget is achieved very simply by lump-sum tax transfers from the representative household. Other macro-economic closure rules are of course possible and may alter the results somewhat.

The specification of factor markets is where this model diverges most from the standard model, and the specification varies depending on the simulation. Mobile factors can be classified as being fully employed (in which case the factor return is flexible), or partially

employed (in which case the factor return is fixed in one or more sectors). In a standard neoclassical labor market closure, we assume that supply of labor is fixed and the labor wage adjusts to maintain the given level of employment. This is a very common closure rule, and the results abstract from the existence of unemployment. At the opposite extreme, we can close the model by assuming that the labor wage is fixed, and changes in the level of employment are the equilibrating mechanism. This closure, which we term surplus labor, while less common, in effect defines the logical upper bound of the effect of unemployment, just as the neoclassical closure defines the lower bound. Using both rules is thus complementary, as argued above, so we implement our simulations under both these rules.

We can also take a dual approach by specifying which industries are rural and which are urban, and allowing factor migration to occur between the two in response to expected returns (the degree of mobility being controlled by a migration elasticity based on migration cost). This corresponds to an extension of the neoclassical Harris-Todaro model of a developing economy analyzed by Batra and Naqvi (1987). See Gilbert and Tower (2002) for a theoretical analysis of the implications of imperfect labor mobility in this framework. The approach is one way of modeling a segmented labor market, which in turn is one of the two contrasting views on the cause of a rural-urban wage gap.[4] Note that under the dual closure with imperfect labor mobility, labor is still classified as fully mobile between sectors within a region, the migration constraints apply only to aggregate labor movements between regions. Under all of our closures we treat land and resources as specific factors, and capital as being fully mobile and fully employed.

We should note that the empirical evidence on the segmented labor market hypothesis is inconclusive (see Freije, 2001, for extensive discussion). Moreover, it is likely that in both the segmented labor market closure and the surplus labor closure, the effect of unemployment is overstated due to the fact that we have not modeled informal labor markets. Again, this implies that the analysis presented here amounts to an upper bound. Modeling informal labor markets is an important future extension of this line of research. The model is implemented and solved in levels form using GAMS.

Base data

Both the base equilibrium and the behavioral parameters are drawn from the GTAP5 database (Dimaranan and McDougall, 2002), which has a base year of 1997. The only modification we have made is to the Armington and export elasticities of demand, which have been doubled following Anderson *et al.* (1997).[5] We have chosen eight economies with which to

4. The other is the efficient labor market hypothesis, which implies that wage differentials are a consequence of preferences reflected in human capital or job characteristics.

5. The larger the Armington elasticities, the larger will be the changes in the movement of goods (exports and imports) in response to the removal of distortions. As a consequence, the allocative efficiency gains associated with liberalization will be larger. The terms-of-trade effect will be smaller for a given change in the volume of trade. Thus, this change will tend to emphasize the effect of reform. See also the discussion of sensitivity analysis in Section 3 below.

experiment: Argentina, Brazil, Chile, Colombia, Mexico, Peru, Uruguay and Venezuela.[6] For each we have drawn an 19-sector dataset from the GTAP5 database (see the tables for the sectoral coverage).

Some summary information on the initial equilibrium is presented in TABLES 2 through 4. TABLE 2 summarizes import protection levels in the economies, TABLE 3 presents total trade and production figures, while TABLE 4 describes the sectoral pattern of exports. The data in TABLES 2 and 3 is presented primarily to provide context for the simulation results (to evaluate the significance of a percentage change in exports from a given sector, for example, we need to know the initial level of exports, similarly the GDP figures provide a basis for evaluating the relative magnitude of estimated net welfare changes).

Table 2 - Summary protection levels from the base data

Trade-weighted average percent

Regions	Average primary tariff	Average industrial tariff	Average merchandise tariff
Argentina	5.1	14.5	14.1
Brazil	5.7	15.8	14.4
Chile	11.1	11.0	11.0
Colombia	11.4	11.8	11.8
Mexico	15.4	3.8	4.4
Peru	13.1	12.6	12.7
Uruguay	4.2	12.1	11.5
Venezuela	10.8	14.2	14.0

Source: Dimaranan, B.V., McDougall, R.A., 2002. *Global Trade, Assistance, and Production: The GTAP 5 Database*. Purdue University: Center for Global Trade Analysis.

Table 3 - Summary statistics from the base data

$US1997 millions

Regions	Total exports	Total imports	GDP
Argentina	28870.0	33489.4	325973.9
Brazil	59200.7	81272.6	789679.9
Chile	19834.2	21254.5	76147.5
Colombia	15777.6	17851.4	94558.8
Mexico	115311.6	101842.1	388824.4
Peru	7883.1	9389.3	64919.7
Uruguay	4209.6	5017.6	19059.1
Venezuela	23621.2	18637.0	83737.4

Source: Dimaranan, B.V., McDougall, R.A., 2002. *Global Trade, Assistance, and Production: The GTAP 5 Database*. Purdue University: Center for Global Trade Analysis.

6. Using the GTAP5 data along with FAO estimates of the number of workers in each activity, we find that only Brazil, Colombia, Mexico and Peru have average agricultural/industrial wage patterns that are consistent with the neoclassical Harris-Todaro specification in 1997. That is, the estimated average agricultural wage is significantly lower than the estimated non-agricultural wage only in this subset of economies. Hence, this specification is only considered in relation to these four economies.

Table 4 - Value of exports by sector from the base data

US$1997 millions

	Argentina	Brazil	Chile	Colombia	Mexico	Peru	Uruguay	Venezuela
Grains	2944.2	60.3	49.1	1.3	88.3	4.0	142.0	10.7
Other crops	1775.3	5222.9	1257.9	3094.5	3174.6	497.6	106.3	132.2
Cattle and livestock	245.3	153.0	42.9	40.5	274.7	32.5	93.5	26.1
Forestry products	28.7	30.7	120.0	4.7	52.0	5.5	38.5	6.7
Fisheries	22.0	15.8	189.8	5.8	70.7	10.9	14.1	20.2
Mining and quarrying	2234.0	3325.4	2491.2	3483.8	11044.3	1193.7	5.2	11800.6
Food manufacturing	7622.6	7175.9	2792.0	925.1	2933.6	1544.0	994.7	430.7
Textiles	1548.8	3420.7	280.2	884.7	8218.6	583.7	797.0	139.7
Wood products	203.7	1570.0	773.9	30.5	2730.7	77.8	26.7	13.7
Pulp and paper products	413.8	2132.5	1040.3	230.7	790.2	20.1	72.3	165.7
Chemicals	2790.7	5214.6	1060.5	1542.3	7567.2	370.3	319.4	6364.4
Metals	1110.6	5993.0	5182.1	294.5	4053.1	1647.6	81.0	1746.9
Fabricated metal products	172.5	688.2	230.6	109.7	1827.4	32.2	8.1	210.9
Motor vehicles	2384.8	4454.2	70.2	96.1	16856.4	4.9	49.9	400.3
Other transportation equipment	124.2	793.6	28.2	14.6	215.7	10.6	5.5	59.2
Electronics	112.9	1092.1	19.5	13.6	16999.1	15.9	8.4	12.6
Other machinery	1416.7	5263.5	294.3	340.0	25293.3	54.9	106.4	208.5
Other manufactures	63.9	412.1	27.7	186.7	1592.3	173.2	9.9	37.7
Services	3328.8	7595.8	2796.8	3794.9	11409.4	1450.0	1223.8	1591.9

Source: Dimaranan, B.V., McDougall, R.A., 2002. *Global Trade, Assistance, and Production: The GTAP 5 Database*. Purdue University: Center for Global Trade Analysis.

As noted above, average tariff levels have declined significantly in the region over the last decade, but remain relatively high. Consider TABLE 2. As is typical in developing economies, in most of the economies the average industrial tariff is considerably higher than the average tariff on primary goods. The main exceptions are Chile, which has a uniform tariff structure, and Mexico, which has a tariff structure more similar to many developed economies (i.e., high protection for agriculture and relatively low protection for manufactures). By comparison the average tariff in Canada is 2.0 percent and 2.5 percent in the United States (1.2 and 2.3 in primary and 2.4 and 3.0 in industry, respectively).

Experimental design

Our experimental design is as follows. We calibrate each economy model to the initial database and set of behavioral parameters. We then close the model in a standard neoclassical fashion, and consider the effect of removal of all import tariff and export distortions. This corresponds to a free trade regime in each economy, and provides a useful benchmark analysis. We then repeat the experiment with surplus labor closure rule, which provides us with the alternative structural bound on the effect of trade liberalization. We then switch to the neoclassical Harris-Todaro specification for those economies that fit the profile (see footnote 6), and conduct the trade liberalization experiment a third time.

In addition to testing the effect of various alternative specifications (which amounts to adjusting the underlying theory of the model), the results of general equilibrium simulation exercises are known to be sensitive to the underlying behavioral parameters. AGE models are heavily dependent on external estimates of these parameters, on which there is little consensus. To work around this problem we have implemented systematic sensitivity techniques in our base simulations. Trade models are known to be particularly sensitive to the parameter values chosen for the Armington, CET and CED elasticities. Hence, our approach is to perform sensitivity analysis with the model for these three parameters. The neoclassical Harris-Todaro model is also known to be sensitive to the degree of labor mobility, so we also include the migration elasticity in the sensitivity analysis under this specification.

The most common technique for sensitivity analysis is "conditional analysis". The model is run and results generated with central parameter estimates. A parameter (or vector of parameters in the same category) that is considered particularly important is then varied in either direction to some bound, holding all other parameters constant, and the simulation results are again recorded. This approach has the advantage of simplicity, but has the problems that evaluation of the sensitivity is made on the basis of a very limited number of observed outcomes, and there is no information on potential cross-effects.

As an alternative, we utilize "unconditional analysis", in which the parameters may vary simultaneously and independently. Arndt (1996) has shown how this may be accomplished using quadratures that approximate the underlying distributions of the parameters. In this paper we utilize Monte-Carlo techniques, or repeated randomized simulations. We treat the key parameters identified above as random variables. All the model results are thus also ran-

dom variables. We assume that each of the elements of the parameter vectors in question is independently normally distributed, with mean values based on the GTAP estimates and a standard deviation of 15 percent of the mean. This implies that virtually all variation will lie within 50 percent of the mean in either direction. We then run 10000 iterations of each simulation, drawing pseudo-random parameter values from their respective distributions. Each outcome is an independent observation, and we can subsequently estimate the mean, standard deviation and standard error of each outcome variable. Thus, for each scenario and each model variable we obtain: an estimate of the expected outcome (the mean), a measure of the sensitivity of that outcome (the standard deviation), and a measure of the accuracy of our simulation procedure (the standard error).[7] As a rule of thumb, 95 percent of results will lie within two standard deviations of the mean. In order to avoid the possibility that random fluctuations could lead to misleading results when comparing alternative scenarios, we utilize the technique of "common random numbers" (CRN). This means that we choose only one set of pseudo random numbers, which is then used for each scenario.

If the mean changes sign within two standard deviations, we can assume that the result is not robust to reasonable parametric changes, and thus should not be given excessive weight in policy analysis. In the following result tables, we present the mean result, the standard deviation in brackets, and use an asterisk to denote significance to at least the 95 percent level, given the assumed parameter distributions. It is important to note that widths of the assumed probability distributions used in this technique are debatable – there is little econometric evidence and little consensus on their magnitude. Hence, although standard statistical tools are available to us, we must be careful in their interpretation. In essence, we are testing whether our results are robust to a reasonable degree of underlying parametric uncertainty, and what if any information can be obtained on the relation between given parameters and the results. While not perfect, this is an improvement on a single point observation of the outcomes.

Simulation results

The estimated net welfare effects of our trade liberalization scenario under the alternative specifications are presented in TABLE 5. The measure used in the equivalent variation in welfare, which is the change in representative household income at constant prices that is equivalent to the proposed change. The results represent the outcomes of comparative static exercises, and so should be interpreted as the annual increment to income that could be expected from reform, after all relevant adjustments have taken place.[8]

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7. The estimated standard error is given by the standard deviation divided by the square root of the number of simulations (i.e., 100 in this case). With 10000 iterations, all of our simulation estimates are highly numerically accurate.
8. The use of a single representative consumer raises some issues with respect to welfare interpretation. The use of a well-behaved aggregate social welfare function to represent aggregate consumer choices is only theoretically valid under stringent conditions (including homotheticity and equal income shares) that are rarely satisfied in any modeling exercise. In a model with unemployment, the equivalent variation welfare measure includes a pure income effect for previously unemployed workers, in addition to the usual effect for the previously employed workers.

The first column of TABLE 5 presents the results of trade reform under a standard neoclassical closure. We note that the estimated net welfare effects of reform under this common specification are rather small, ranging between a very small negative result for Argentina, Chile, Peru and Venezuela (most likely reflecting adverse terms-of-trade consequences of reform and/or the second-best implications of the remaining taxes in the system), to gains of just under $1.2 billion for Brazil. Gains (or losses) of this magnitude are consistent with typical CGE estimates. Results for Argentina, Brazil, Chile, Colombia and Peru appear to be reasonably robust to parametric changes. The results for Mexico, Uruguay and Venezuela, however, are too small to be certain even of the sign. In sum, there appear to be three robust net welfare losses (Argentina, Chile and Peru), two robust welfare gains (Brazil and Colombia), and three indeterminate cases (Mexico, Uruguay and Venezuela).

With the exception of Brazil (which has the highest industrial tariffs in the group), the results are not particularly encouraging for the benefits of completing trade reform on a unilateral basis. The results suggest that several of the developing economies of the Americas may have little interest in further trade reform, unless it is part of a multilateral or regional approach whereby they could expect some terms-of-trade improvement through export expansion into partner economies.

Table 5 - Estimated net welfare effect of unilateral trade liberalization in selected economies

$US1997 millions mean equivalent variation, standard deviation in brackets

	Neoclassical closure		Surplus labor closure		Dual closure	
	$EV	% GDP	$EV	% GDP	$EV	% GDP
Argentina	–216.6	–0.07*	1765.8	0.54*		
	(51.1)		(311.3)			
Brazil	1184.0	0.15*	4901.4	0.62*	3582.1	0.45*
	(306.0)		(684.0)		(588.3)	
Chile	–94.6	–0.12*	1228.9	1.61*		
	(20.3)		(49.8)			
Colombia	122.6	0.13*	3539.8	3.74*	2948.3	3.12*
	(44.7)		(188.2)		(167.4)	
Mexico	92.0	0.02	2932.4	0.75*	2654.5	0.68*
	(55.0)		(125.3)		(121.2)	
Peru	–84.0	–0.13*	676.4	1.04*	555.3	0.86*
	(16.4)		(52.1)		(47.8)	
Uruguay	8.3	0.04	244.3	1.28*		
	(11.7)		(19.1)			
Venezuela	–21.5	–0.03	915.6	1.09*		
	(21.1)		(80.4)			

* Significant at the 95% level.

Source: Model simulations.

It is important to note once again that we can in some ways regard these type of estimates as being "lower bounds" on the effects of liberalization. Introduction of imperfect competition, or dynamic model features will typically magnify the gains. The results are also bounds in terms of our factor market assumptions – by adopting the standard closure we have implicitly assumed away the possibility that trade could increase (or decrease) the total level of employment. The standard model assumes that the economy is operating on the efficiency locus, albeit at a point that is sub-optimal. Changes in trade policy effect the familiar movements around the economy's transformation frontier. However, the gains associated with these movements are very small. In a model with unemployment, these same efficiency gains are enjoyed when domestic prices align with world prices. However, here there is an additional effect. In the initial equilibrium, the economy is assumed to not be on the efficiency locus, as a consequence of the unemployment caused by the fixed wage. Changing the price vector can shift the allocation of resources. If more of the economies' labor resources are employed post-liberalization, the positive net effect on welfare can be substantial. If less are employed, the negative effects could be substantial. Hence, in our alternative scenario (labeled a "surplus labor" closure in TABLE 5), we expect to see much larger welfare effects, though whether these will be positive or negative is unclear.

In general, as an economy moves towards free trade, we expect the relative return to factors of production in the economy to reflect the relative abundance of those factors on world markets, as opposed to on domestic markets. In principle, we expect to see the return to rise for endowments that are relatively abundant and to fall for endowments that are relatively scarce. If the economies of Latin America are relatively labor abundant, then we might expect to see rising demand for labor reflected in increased wages in the neoclassical model. When surplus labor is present however, rising labor demand must be reflected in increased employment (i.e., if the model is closed by fixing the nominal wage).

The results in the second column of TABLE 5 support this expectation, and present a much more positive picture of the potential net welfare effect of trade liberalization in the Americas. In all cases, the estimates of net welfare changes are positive and highly significant, ranging from a gain of $244 million for Uruguay to a gain of $4.9 billion for Brazil. In several cases the estimates are larger than under the standard closure by a significant factor (see in particular Argentina, Chile, Colombia, Uruguay and Venezuela). Moreover, all of the results are robust to the same assumed parametric changes as used in the simulations discussed above (although it is true that the absolute levels of the estimated standard deviations are considerably higher, reflecting the fact that the model with unemployment is less stable than the neoclassical version). Here we must emphasize the distinction between structural sensitivity and parametric sensitivity. In the context of our results, the former is clearly more important than the latter. We might also note that even unconditional parametric sensitivity analysis as used here is in effect always conditional sensitivity analysis, being conditional on the structural choices made in designing and closing the model.

Table 6 - Estimated percentage change in employment in selected economies

Percentage change, standard deviation in brackets

	Surplus labor closure	Dual closure
Argentina	1.2*	
	(0.2)	
Brazil	1.0*	1.6*
	(0.2)	(0.1)
Chile	4.5*	
	(0.1)	
Colombia	6.9*	5.5*
	(0.3)	(0.2)
Mexico	2.3*	2.0*
	(0.1)	(0.0)
Peru	3.8*	3.1*
	(0.2)	(0.2)
Uruguay	3.4	
	(2.5)	
Venezuela	3.1*	
	(0.2)	

* Significant at the 95% level.

Source: Model simulations.

TABLE 6 presents the estimated percentage changes in the level of labor employment as a consequence of trade liberalization under this market closure assumption. The employment figures with the exception of Uruguay appear robust to parametric changes, and range from 1.0 to 6.9 percent. The estimated employment effects all lie within the bounds implied by current unemployment levels as presented in TABLE 1, which indicates that the model results are feasible.

The final column of TABLE 5 presents the results for the segmented labor market simulations applied to Brazil, Colombia, Mexico and Peru. As in the other closure in which unemployment is a feature, we observe much larger estimated increases in net welfare than in the standard closure (between $555 million for Peru and just under $3.5 billion for Brazil). These results fall between the bounds defined by the two closures examined above. Once again, the results are more sensitive in absolute terms (the standard deviations for the given underlying parametric assumptions are larger than in the standard model), but all of the results are robust changes in the parameters (i.e., they are all strongly positive). This is of course an empirical result, not a theoretical necessity. The dual economy framework used here is much more capricious than the standard model. As a rule of thumb, the model will tend to predict substantial welfare gains when the reform program involves dismantling high industrial tariffs, but the opposite may occur in cases where, for example, agricultural support alone is dismantled (depending on the ultimate balance between efficiency gains and potential employment losses).[9] Hence, the exact structure of the distortions in the model takes on

9. This result may be reversed if labor is immobile.

considerable importance in this framework – if a liberalization initiative results in a higher rate of urban unemployment by increasing the incentive to migrate beyond the capacity of urban industry to absorb labor, the result could be a substantial net welfare decline.

The changes in employment levels for this scenario are again presented in TABLE 6, in the second column. As with the surplus labor result above, these numbers represent the estimated percentage change in the total number of employed in the economy (thus the two columns can be directly compared). All estimates appear robust to parametric changes and fall within the bounds implied by the unemployment levels presented in TABLE 1 (unlike in the surplus labor closure, this constraint is directly enforced in the segmented labor market model).

The magnitude of the welfare results that we estimate are broadly consistent with the existing literature. For example, Filho (1998) estimates gains of between 0.25 and 0.32 percent of GDP for Brazil as a consequence of unilateral reform, in a neoclassical closure. Since these results are based on a 1990 database, we would expect our results (0.15 percent of GDP) to be somewhat smaller as a reflection of tariff reduction over the period 1990 to 1997. However, under the alternative labor market closures, our results are considerably higher than existing results (at 0.45 and 0.62 percent of GDP for Brazil, and even higher for other economies), suggesting an important role for labor market analysis.

While the changes in net economic welfare and overall employment are certainly important, there is also intense interest in the sectoral implications of trade reform. Information on the sectoral consequences of reform can be obtained from the changes in the trade pattern. TABLES 7a and 7b present the estimated changes in the sectoral composition of exports as a consequence of trade liberalization, under the neoclassical and surplus labor market closures, respectively. While we have not included estimated standard deviations in the tables (these are available on request), those figures that are not statistically significantly different from zero at the 95 percent level, and should thus be assigned little weight, are indicated.

The results indicate that significant changes in the trade pattern could be expected to follow from trade reform, and there does not seem to be any strong difference in the pattern over the two alternative closures, suggesting that employment effects are felt at the level of the overall economy rather than at the sectoral level.[10] While making broad generalizations from the Tables is difficult, there appears to be a general reallocation of resources towards the manufacturing sectors in Argentina, Chile, Colombia and Venezuela, and a shift towards primary production in Brazil. The results for the other economies are mixed. However, the percentage changes in these tables can be misleading and should be compared with the base export values presented in TABLE 4 to avoid drawing erroneous conclusions. Hence, for example, agricultural production in Brazil is relatively low (with the exception of the other crops category), hence the nominal increases in manufacturing output in Brazil are in fact

10. Our sectoral results for Brazil are slightly larger than the sectoral reallocations indicated in Filho (1998). This is a reflection of our parametric choices – we have used trade elasticities that are in most cases higher than those used by Filho. The implication is that we have modeled the economy as being more flexible and responsive to price signals.

Table 7a - Estimated change in exports by region/sector in selected economies liberalization scenario with "neoclassical" labor market closure

Percentage change – statistically insignificant results highlighted

	Argentina	Brazil	Chile	Colombia	Mexico	Peru	Uruguay	Venezuela
Grains	2.7*	96.6*	17.9*	35.2*	199.9*	44.5*	–9.2*	45.2*
Other crops	11.5*	114.9*	4.1*	8.8*	7.2*	3.2*	–18.8*	15.8*
Cattle and livestock	10.3*	179.7*	6.0*	–0.3	46.4*	–9.5*	110.7*	15.3*
Forestry products	31.8*	311.2*	–0.6	–16.0*	0.5	10.5*	13.6*	20.3*
Fisheries	6.0*	218.4*	3.1*	8.5*	9.8*	35.5*	–5.4	3.5
Mining and quarrying	7.4*	41.3*	9.3*	–15.7*	0.6*	11.1*	17.2*	0.7
Food manufacturing	20.0*	107.6*	7.3*	-6.0*	25.8*	24.8*	33.9*	113.3*
Textiles	50.0*	37.2*	33.2*	110.3*	6.7*	58.1*	–68.2*	69.3*
Wood products	34.6*	–7.2*	3.0*	74.9*	0.8	17.5*	42.4*	34.6*
Pulp and paper products	22.8*	0.5	5.3*	20.8*	2.2*	12.6*	31.3*	28.0*
Chemicals	23.1*	46.9*	14.3*	74.8*	3.0*	45.8*	7.3*	10.7*
Metals	33.1*	14.8*	17.9*	19.3*	4.7*	37.2*	51.4*	29.2*
Fabricated metal products	35.1*	30.7*	20.8*	48.5*	4.6*	–9.0*	42.9*	27.4*
Motor vehicles	89.6*	88.7*	93.8*	948.4*	11.9*	68.0*	269.7*	120.0*
Transportation equipment	85.5*	12.8*	24.4*	280.4*	4.6*	100.0*	74.4*	63.2*
Electronics	62.4*	64.8*	30.0*	74.1*	10.5*	25.2*	34.7*	52.5*
Other machinery	41.2*	41.2*	21.0*	79.7*	4.1*	-65.8*	44.5*	38.5*
Other manufactures	34.2*	36.7*	16.0*	121.2*	2.2*	56.7*	34.4*	8.6*
Services	27.0*	0.9	10.5*	–0.7	2.2*	33.0*	15.8*	20.3*

* Significant at the 95% Level.

Source: Model simulations.

Table 7b - Estimated change in exports by region/sector in selected economies liberalization scenario with "surplus" labor market closure

Percentage change – statistically insignificant results highlighted

	Argentina	Brazil	Chile	Colombia	Mexico	Peru	Uruguay	Venezuela
Grains	2.7*	94.4*	17.3*	26.2*	199.5*	47.6*	–8.6*	44.0*
Other crops	10.8*	113.0*	4.2*	7.3*	7.4*	4.2*	–18.6*	14.8*
Cattle and livestock	9.0*	175.4*	2.9	–13.0*	46.4*	–8.2*	108.0*	14.3*
Forestry products	30.0*	301.8*	–4.0*	–18.0*	–1.9*	6.1*	12.0*	14.6*
Fisheries	4.2*	208.3*	–2.5*	–18.6*	5.1*	22.7*	–8.0	–2.7
Mining and quarrying	6.0*	39.9*	8.7*	–19.0*	–0.5*	10.7*	15.9*	–0.2
Food manufacturing	19.7*	107.6*	8.4*	-6.2*	25.5*	24.0*	35.0*	115.9*
Textiles	51.1*	38.0*	39.7*	129.3*	7.7*	55.7*	–68.1*	76.8*
Wood products	37.4*	–6.6*	4.9*	87.4*	0.2	14.1*	48.6*	39.2*
Pulp and paper products	23.2*	1.2*	7.2*	26.2*	2.2*	11.7*	35.2*	31.5*
Chemicals	23.7*	47.6*	16.5*	80.1*	3.0*	46.5*	9.5*	11.7*
Metals	33.9*	15.9*	19.8*	28.2*	5.0*	42.1*	55.6*	32.8*
Fabricated metal products	36.8*	32.5*	25.0*	59.8*	5.5*	–6.0*	49.2*	31.0*
Motor vehicles	94.0*	92.8*	100.8*	1097.9*	13.3*	64.5*	300.4*	134.3*
Transportation equipment	91.4*	15.7*	30.6*	333.8*	6.1*	107.0*	85.9*	73.7*
Electronics	64.8*	67.2*	37.2*	90.2*	11.8*	23.1*	38.3*	58.0*
Other machinery	42.9*	42.9*	27.3*	95.8*	4.8*	-66.9*	52.1*	44.3*
Other manufactures	35.8*	37.9*	21.8*	141.3*	2.0*	53.0*	45.8*	8.6*
Services	28.2*	1.8	13.7*	6.3*	3.4*	39.7*	16.7*	23.6*

* Significant at the 95% level.

Source: Model simulations.

significantly larger than those in agriculture. Similarly, the significant estimated percentage increase in motor vehicle production in Colombia largely reflects the small initial size of the industry – it is not estimated to even come remotely close to rivaling the industry in Mexico, Brazil or Argentina.[11] In terms of employment effects, large structural changes imply the possibility of temporary adjustment costs that cannot be directly captured by a model of this type, but which may be important nonetheless.

Summary and concluding comments

What are the policy implications of these results? It seems clear that the presence of unemployment in the selected American economies dramatically increases the *potential* net welfare gain from trade liberalization, and thus makes trade liberalization, even on a unilateral basis, appear a more attractive prospect.

However, while we treat our analysis as a bounding exercise for analytical purposes, it is of course worth speculating as to which end of the spectrum of results is most likely. In this regard, the work of González-Anaya (1999), which computes output elasticities of wages and employment in thirteen Latin American economies, is interesting. The results suggest that the output elasticity of wages is smaller in the United States than in most Latin American economies (the exceptions being Brazil, Venezuela and Uruguay), while the output elasticity of employment is larger in the United States than in most Latin American economies. This implies that Latin American economies may adjust to output shocks more through wages than through employment (relative to the United States). This would in turn suggest that perhaps a response closer to that predicted by the neoclassical closure might be regarded as realistic for Brazil, Venezuela and Uruguay, where wage response is high and the employment response is low. For Argentina, Colombia, Chile, Peru, and Mexico, where both the wage and employment responses are relatively low, we have something of a conundrum. Given the presence of minimum wage laws and other sources of wage rigidity in many Latin American economies, Frieje (2001) has suggested that the response may be coming through adjustments in the informal sector, which pays wages based on marginal productivities. This is an issue towards which future modeling exercises could be usefully devoted.

Further work in this area will involve more exploration of alternative labor market specifications. In particular, we would like to examine ways of incorporating alternative specifications of informal labor markets into our model, as noted above. Another extension will be the linking of the economy-wide models into a regional economic system. This will allow a direct assessment of policy interventions on a regional and/or bilateral basis, in addition to the unilateral reform considered in this paper.

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11. We should also note that the estimated standard deviation on this particular result is very high – over 300 percent. Hence, while we might be reasonably confident of a positive effect of reform on the Colombian motor vehicle industry, the figures in TABLES 7a and 7b should be interpreted with due caution.

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