Modeling the Impact of Trade Liberalization: A Structuralist Perspective?

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Abstract:

This paper uses variants of the World Bank's Linkage model to assess how labor market specification affects the results from global trade reform. The results of the standard version of the model have been widely disseminated and discussed. The standard version has a recursive dynamic structure, no scale economies, perfect competition and market clearing for all markets including labor. This paper (using a simple comparative static version of the model) focuses on differences in labor markets alone. It reports the results from four versions of the model. The first is the standard model with uniform wages, perfect labor mobility across sectors and full employment. In succession the paper looks at three cumulative variants. The first variant introduces a wedge between agricultural and non-agricultural wages. With perfect labor mobility, the wedge implies changes in aggregate productivity as labor moves to either lower or higher productivity sectors when global trade reform is implemented. The second variant introduces partial labor mobility between agricultural and non-agricultural sectors. The third allows for fixed real wages in the urban sector, generating unemployment if labor market conditions generate demand less than supply. All three assumptions have quite different implications for the allocation of gains/losses across developing countries, although fewer impacts on the structural outcomes such as changes to agricultural output or exports.

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JEL keywords: Computable and other applied general equilibrium models, employment, unemployment, trade and labor markets, segmented labor markets

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Introduction

The World Bank has had an active program to assess the impacts of trade reforms on developing countries and poverty. A large part of this program was summarized in three major publications—Anderson and Martin 2006, Hertel and Winters 2006 and Newfarmer 2006, and key results were also reported in the World Bank's annual reports such as *Global Economic Prospects*. Anderson and Martin largely focuses on agricultural trade reform in all of its aspects as it relates to the ongoing WTO-sponsored multilateral trade negotiations under the name of the Doha Development Agenda (DDA), herein referred to as the Doha round. The Hertel and Winters report concentrates on the poverty and distributional aspects of trade reform including a large number of detailed country case studies. And Newfarmer 2006 focuses on the broader set of trade issues than either agriculture or poverty including preferential trade agreements, services, intellectual property and so forth.

While much of the underlying analysis has been partial—focusing on specific countries, sectors, and/or policies, the perhaps more widely disseminated analysis was the product of global computable general equilibrium (CGE) models—notably the World Bank's own Linkage model or the widely used Purdue-based GTAP model.[1] The strength of the global models is that they can provide a consistent global picture of the potential impacts of trade reform with the relative gains/losses across all countries and sectors.[2] Virtually all models need to make some abstractions from reality either for lack of data, solid theoretical developments and/or consensus, or simply to keep the models tractable. Most modelers will undertake sensitivity analysis of both their key parameters and specification to test the robustness of their conclusions, though the sensitivity analysis may not always find itself in the major publications or reports.

Because of these abstractions the models have been open to significant criticism, which oft-times has been critical to improving the models and the analysis. One of the more notable criticisms of this work over the past year has been the treatment of the labor markets. This has been addressed most directly by the Carnegie report[3] under the direction of Sandra Polasky and somewhat less directly by Taylor and von Arnim in a paper prepared for Oxfam.[4] Thus while most of the focus of the applied trade CGE work concentrates on scale economies, imperfect competition, product varieties and the dynamic impacts of trade reform[5], the criticism is focused on the more traditional issues of market specification and macro closure.

This paper takes a look at a narrow issue but with broad implications—the role of labor markets in assessing the impacts from trade reform. It focuses on global trade reform rather than the partial reforms that are the likely outcome of a successful Doha round. Global trade reform represents a benchmark for assessing the depth of any agreed to partial reform. The paper compares the results of the standard version of the Linkage model with three variants. The first, almost technical in nature, introduces a wedge between agricultural and non-agricultural wages. This wedge, almost always an urban premium, is persistent across space and time. Changes in trade policies therefore

1 See references below.
2 Or some aggregation thereof.
3 See Polasky 2006.
4 See Taylor and von Arnim 2006. The difference between the two is that the Carnegie report is based on a full blown CGE model calibrated to the GTAP dataset similar to the World Bank's Linkage model, whereas Taylor and von Arnim explore modeling differences with a two-sector two-region aggregate CGE.
5 For example see Francois and Martin (2007?).

introduce a productivity impact on top of efficiency gains or losses. Countries with an inherent agricultural comparative advantage will see a loss in measured productivity as employment increases in the low-paying agricultural sectors, and the reverse for countries that have a comparative advantage in manufacturing and services. Labor mobility is still assumed to be perfect in this variant (the wedge is virtually left unexplained). In the second variant, labor market segmentation is introduced that provides a natural explanation for the gap in the returns to labor. Barriers—for example institutional, informational or physical—-prevent wage equilibrium between rural and urban sectors. The third variant introduces unemployment in the urban sector. This is generated by a fixed real wage. The paper discusses the realism of these three assumptions, particularly as they may hold over the short- and long-term.

The paper begins with a brief model overview. This is followed by a more explicit description of the simulation design. The following section then discusses the key results for the four simulations, which is followed by a concluding section.

Model Overview

The Linkage model is a relatively standard computable general equilibrium (CGE) model. It has a long pedigree with its earlier incarnations in the Walras and GREEN models[6] developed at the OECD and the RUNS model developed initially at the Université Libre de Bruxelles and later extended and updated at the OECD Development Centre.[7] Linkage and its predecessors are global in scope and thus, unlike single country CGE models, have endogenous world prices. World trade must balance at the global level and this class of models also has a consistent picture of international financial flows, the counterpart to trade balances.[8] The Linkage model can be simulated in comparative static mode holding the aggregate stock of factors (and productivity) fixed or in (recursive) dynamic mode that allows for employment and population growth, capital accumulation (and changes in natural resources) and changes in technology.[9]

The earlier models were based on customized global datasets and traditional programming languages.[10] The advent of a publicly available global dataset that is updated and maintained on a periodic basis by the Global Trade Analysis Program (GTAP) at Purdue University[11] coupled with high performance simulation software[12] has greatly enhanced the ability of economic analysts to undertake analysis of a wide variety of economic issues. Whereas in earlier times database and software development may have represented 90 percent of the level of effort in CGE-based analysis, those proportions are likely reversed for most projects today.

The most recent version of the Linkage model is based on Release 6.2 of the GTAP dataset. Release 6 has a 2001 base year. The latest release has significant country coverage incorporating 80 countries accounting for over 90 percent of world GDP. The remaining countries are grouped into

6 See OECD 1990, Burniaux et al 1993 and van der Mensbrugghe 1994.
7 See Burniaux 1987 and Burniaux and van der Mensbrugghe 1994.
8 Though not necessarily endogenous.
9 The complete model specification if provided in van der Mensbrugghe 2005.
10 For example FORTRAN and C.
11 https://www.gtap.agecon.purdue.edu/
12 For example the US-based GAMS software (http://www.gams.com/) or the Australia-based GEMPACK software (http://www.monash.edu.au/policy/gempack.htm).

sixteen regional groupings.[13] Economic activity is divided into 57 sectors with relatively good detail of agricultural and energy based activities. For the purposes of the World Bank's trade work the global economy has been aggregated into 27 countries/regions—seven of which are designated as high-income using the standard World Bank income classification.[14] Of the remaining 20 developing countries/regions, 12 are identified as separate countries.[15] The 57 GTAP sectors are collapsed to 25 economic activities with a heavy emphasis on agriculture and food where protection is particularly high.

Though most of the World Bank's trade work has used the dynamic version of Linkage[16], for the purposes of this paper, the comparative static version of the model is deployed. One key reason is that the paper attempts to isolate the impact of labor market closure. While it is relatively easy to have some idea about labor market conditions in the present, it is more difficult to assess how they will evolve through 2015 or beyond. As well, it allows for a focus on key channels and closure rules. The main impact of having dynamic scenarios in the standard model is the additional growth kick from accelerated investment—largely driven by a drop in the unit cost of investment. At the global level, this additional kick has been estimated to raise the gains from full merchandise trade reform by 23 percent in 2015 relative to the baseline.[17]

Linkage in a nutshell

Typical to most CGE models production is modeled using nested CES functions designed to emulate the substitution and complementarities across inputs—goods and services, unskilled and skilled labor, capital and other factors such as land and natural resources. Linkage has some features in the production nesting that distinguishes it from many other models. First, it has three production archetypes: a) crops with substitution between intensive versus extensive production; b) livestock with substitution between range versus ranch production (i.e. land versus feed); and c) the more traditional capital versus labor substitution. Second, it has an elaborate nesting that allows for a fuller range of substitution and complementarities across inputs. Third, energy is identified as a special input that is a complement to capital in the short-term, but a substitute in the long-term.[18] The standard version of the model assumes constant-returns-to-scale technology and competitive markets for all goods and services.

A single representative household receives all factor income (less taxes). The household spends its after-tax income on goods and services, including savings, using the extended linear expenditure system (ELES).

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13 Country coverage has expanded greatly since the mid-1990s. However, three regions still have spotty representation including Sub-Saharan Africa, the Middle East and parts of Eastern Europe and Central Asia. Work is ongoing in all three regions to improve coverage.

14 The GTAP regional breakdown does not allow for a clean separation of high-income countries from developing countries. This particularly affects some countries in the Middle East—for example Kuwait and Saudi Arabia—that are designated as high-income according to World Bank definitions.

15 Full detail is available in Annex A.

16 See for example Anderson, Martin and van der Mensbrugghe 2006.

17 See van der Mensbrugghe 2006.

18 The key substitution elasticities are provided in Annex B.

Aggregate domestic absorption (household plus government and investment) is allocated to domestic goods and imported goods using the ubiquitous Armington assumption. At a first level, the aggregate Armington agent allocates aggregate absorption between domestic goods and a single imported aggregate. At a second level, imported aggregate demand is allocated across trading partners using an additional CES nest. The first-level Armington elasticities are somewhat higher than those currently used by the GTAP model, see Annex B.[19] Note that they are well below the levels typically used by Harrison, Rutherford and Tarr.[20] In an interesting twist, analysts at the Netherlands Dutch Bureau for Economic Policy Analysis (CPB), have introduced a dynamically variable Armington elasticity that rises over time.[21]

Factor markets

In the standard version of the model, aggregate labor supply is fixed. Labor is perfectly mobile across sectors and the wage rate adjusts so as to insure the equality of labor supply and demand. Typically, wages are initialized at unity and labor volumes are defined in base year remuneration levels. The price/volume split is irrelevant as long as the assumption of uniform wages holds. However, when labor markets are differentiated—for example between rural and urban—and wages are no longer uniform, then the calibration of wages is relevant to policy changes. Even if we assume perfect labor mobility, assumptions regarding the price/volume split are no longer innocuous. When an agricultural laborer moves to the city average productivity will increase, and vice versa if a non-agricultural worker moves to the farm. Hence policies that induce flows in one direction or another have an impact on average productivity. When all labor is paid the same average wage, as is the case in the default calibration, policies have no impact on average productivity.

The results described below show the impacts of assuming labor market differentiation. First, in a simulation where labor is assumed to be perfectly mobile, and then where explicit market segmentation is specified using a Harris-Todaro migration function.[22] The latter is specified for developing countries only and for unskilled workers. The simple form of the migration function has migration responding to changes in the ratio of the expected wage in urban and rural areas respectively. The expected wage is the prevailing market wage adjusted for the level of unemployment. Hence if the urban market wage increases and/or the level of unemployment declines, one would anticipate a rise in the level of rural to urban migration.

Finally, as regards the labor market, though the standard is to assume market clearing wages, in an alternative closure, we allow for semi-rigidity of the real wage that can generate unemployment. This is implemented with a minimum wage function that in the case described below is only a function of the price level.[23] The model endogenously allows for a regime switch. If market conditions are such

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19 While it has been appealing to switch to the GTAP elasticities for trade work, there are two reasons for maintaining the current values. One is for continuity and comparability with prior work. Those used in the Linkage model have been developed and sourced over time. Second, even though the GTAP elasticities have been econometrically estimated, the relative rankings of the estimates leads to some puzzling conclusions to the extent these elasticities are intended in part to reflect the relative degree of homogeneity (or lack thereof) of the underlying commodities.

20 See for example Harrison, Rutherford, Tarr and Gurgel 2004 for their discussion of the use of very high Armington elasticities.

21 See CPB 1999 and van der Mensbrugghe 2005.

22 Harris-Todaro 1970.

23 In an alternative formulation the minimum wage function also responds to the level of unemployment, i.e. unemployment would tend to put downward pressure on the minimum wage. See Agénor et al 2002.

that the prevailing market wage exceeds the minimum wage, then full employment is guaranteed.[24] In this version of the model, there is no international labor mobility.

The comparative static version of the model assumes perfect mobility of capital across sectors. This assumption comes closer to the long-run equilibrium of the dynamic version of the model. The aggregate capital stock is fixed.

Land is assumed to be perfectly mobile across agricultural sectors. There is a constant elasticity supply curve with a relatively low supply elasticity for land-constrained countries/regions. Other natural resources are sector-specific (only in fossil fuels). The supply elasticities are similarly country/region-specific.

Macro closure

Macro closure rules are critical in determining the welfare impacts of policy reforms. The standard closure rules incorporate three assumptions. First, **government expenditures and savings are fixed**. To close any potential budget gap, a lump sum tax on the single representative household is endogenous. Thus, in a free trade scenario, a reduction in tariff revenues is compensated by a rise in the direct tax on households. This closure is neutral in the sense that it does not add to (nor subtract from) any other distortions in the economy. Since there is a single representative household, it does not have any distributive consequences. Finally, it is assumed that the cost in raising the additional funds is zero. There are several alternatives to this closure rule. A first would be to alter one (or a combination) of the indirect taxes—production, sales and export. Since these are sectoral taxes, it must be decided how to allocate changes in these taxes across sectors, for example via a multiplicative or additive adjustment factor. In any case, a change in a sectoral tax, even abstracting from the costs of raising the revenues, would in most cases lead to replacing one distortion (the import tariff) with an alternative distortion that may be welfare enhancing but most likely less so than the lump sum tax. A second alternative would be to reduce government expenditures. This has occurred in a number of low income countries with limited capacity to shift tax administrative resources towards other sources of revenue. This closure rule would require adopting a broader definition of utility than in the standard Linkage model that excludes government expenditure.[25] In this case, a reduction in tariff revenues raises real private incomes and expenditures, but that is partially offset by a reduction in utility derived from public services. A third alternative is to allow for an increase in the budget deficit (or a decrease in the surplus). This also has growth and welfare impacts. On the growth side, it potentially crowds out investment. On the welfare side, it has implications for intertemporal utility.

The second closure rule relates to the **balance of savings and investment**. In the standard model private saving is determined by households (under the ELES assumption), public saving is fixed as is foreign saving.[26] Investment is then determined by the amount of available saving. A reform scenario would tend to lower (modestly) household saving as disposable income is affected by rising direct taxes. This may or may not be compensated by rising gross incomes and a substitution away

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[24] This is implemented using mixed-complementarity programming where the orthogonality condition between the difference in the market and minimum wage and unemployment holds, i.e. if unemployment is positive, the market wage must equal the minimum wage, else if unemployment is zero (or at its minimum), the market wage must be above the minimum wage.

[25] The GTAP model explicitly includes government expenditures in the utility function.

[26] These are fixed relative to the model numéraire, which is defined as the manufactured export price index of the high-income countries.

from current to future consumption. However, a second important channel would tend to raise investment. A reduction in tariffs leads to a reduction in the unit cost of investment. For the same level of savings, this would increase the volume of investment, or in other words, there would be more bang for the buck. There are, as with the public balance, a number of alternatives. In structuralist models, the level of investment is determined by planners and savings adjusts to the desired level of investment. A more neo-classical closure would be to have both savings and investment supply schedules and have a rate of interest equilibrate the two schedules. This could be combined with international financial flows, the next closure rule.

The third closure rule concerns the **balance of payments**. In the standard model, the capital balance is fixed and so therefore is the trade balance (not necessarily the gross flows however). A reduction in import tariffs increases the *ex ante* demand for imports. Export revenues need to rise to pay for the additional imports thus leading to a real exchange rate depreciation (assuming no change in market access elsewhere). If export prices are flexible (i.e. the exporting country has some degree of market power), export prices would have to fall to increase export volumes. If export prices are fixed, the price of domestic goods relative to export goods would have to fall to induce exporters to switch towards export markets.[27] An alternative would be to relax the capital account. In a variant of the Linkage model—as well as in the GTAP model—international capital flows are allowed to adjust to relative changes in the rates of return to investment, with the proviso that the net capital flow at the global level sums to zero. Clearly, this is a reasonable alternative though it does lead to welfare interpretation difficulties as eventually the income generated by foreign capital will flow back to the region of origin. These incomes are currently not accounted for in the GTAP dataset.[28] An argument (perhaps weak) for the standard Linkage closure rule on government and foreign saving is that at least they avoid the difficulties with debt sustainability.

Simulations

The purpose of this paper is to highlight the role of labor market closure in assessing the impacts of trade policy reform. Thus, rather than focus on the intricate details of a potential Doha accord or other current trade policy reform, the paper concentrates only on global trade reform where tariffs on all merchandise trade are reduced to zero.[29] In addition, export and agricultural production subsidies are removed. The paper also shows a decomposition of the gains across reforming regions and sectors. The decomposition represents a 4 x 2 matrix showing the relative weight of agricultural and food liberalization versus manufacturing and the relative weight of developed country reform versus developing country reform. The reform scenario comes off a '2005' base wherein a pre-simulation is undertaken to implement observed reforms between 2001 (the standard base year) and 2005. What this pre-simulation represents is a static equilibrium for 2001 with 2005 trade policies.[30] The main changes between 2001 and 2005 include final implementation of the Uruguay Round agreement including removal of the textile and clothing quotas[31], enlargement of the European Union (EU) to 25 countries and China's implementation of its WTO accession commitments.

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27 This is more than likely to occur in any case as the now cheaper imports put competitive pressures on domestic producers of comparable goods.

28 McKibbin's G-Cubed model is probably the most advanced in terms of modeling investment and international capital flows. See McKibbin and Wilcoxen 1992.

29 Services trade liberalization is likely to have significant structural and welfare impacts, however barriers to trade in services are poorly represented in most standard global data sets.

30 The new '2005' base year will differ for each simulation reflecting the underlying changes in assumptions and specification.

31 These have been modeled as export taxes accruing to the exporting country.

There are four sets of simulations in all. The first provides the standard (comparative static) results with Linkage—including the aforementioned decomposition. The second is similar to the first with the single exception that rural and urban wages are assumed to differ.[32] They are calibrated to an external dataset of employment split between agricultural and non-agricultural activities. Within each broad sub-sector wages are assumed to be uniform, thus inter-sectoral mobility within the broad sub-sectors has no productivity implications, but movements across broad sub-sectors does have productivity implications. In this scenario, mobility across all sectors is assumed to be perfect. There is a national wage that clears the national labor market. The sub-sectoral wage is fixed relative to the national wage. Thus if the national wage goes up by 10 percent, all sectoral wages go up by 10 percent. The persistence of the disparity in the rural and urban wages can be attributed to a number of factors, including institutional. One factor that is likely to hold in reality is the relative cost of living differentials that are not assumed in the model. This also has welfare implications that we ignore. If the wage differentials line up exactly with the cost of living differentials, a movement from the farm to the city has zero welfare implications, at least in the short-term,[33] in the absence of remittances.

The third simulation assesses the impact of a formal segmentation of the rural and urban labor markets (for unskilled workers only). This simulation uses the aforementioned Harris-Todaro migration function.[34] Note that it is essentially a one-way gauge. Rural to urban migration can be slowed or accelerated based on the ratio of expected urban to rural wages, but it cannot be reversed. This simulation assumes fixed employment in both rural and urban labor markets (separately) and total employment is fixed.

The final set of simulations introduces urban unemployment. This simulation replicates the labor market assumptions of the Carnegie study.[35] The full decomposition is also undertaken for this simulation.

Key results

The standard (comparative static) model

We first report the results for the standard model where wages are uniform across sectors. Labor is perfectly mobile across sectors and fully employed. Table 1 provides the standard real income gains from full trade reform (and removal of domestic and export subsidies). The world gain is $157 billion translating into a percent gain of 0.6. In percentage terms both high-income and developing countries reap the same gain, about 0.6 percent, though the dollar distribution is skewed towards high-income countries given their much larger baseline income.

In the comparative static framework there are some countries/regions that could stand to lose from global trade reform in aggregation—notably South Asia and parts of Sub-Saharan Africa. Dynamic gains could reverse these losses. In the standard dynamic version of Linkage, these gains accrue

[32] The term rural is used loosely in this context. It is really shorthand for agricultural labor and thus does not include off-farm rural activities.

[33] In the longer-term, a move to the city might improve opportunities for both the migrant and his or her family, beyond the immediate increase in income.

[34] These changes to the specification of labor markets are more fully detailed in Annex C.

[35] See Polaski 2006. The Carnegie study also includes a pro-productivity channel whereby sectoral productivity is linked to the share of key imports in intermediate demand.

from an acceleration in investment as capital goods become relatively cheaper. In an alternative version, where productivity is linked to the sectoral export/output ratio, the gains could be significantly higher. Other models have also demonstrated the impacts from including scale economies and imperfect competition that can also raise gains substantially.

One of the main reasons for the losses, or the attenuated gains, is due to terms of trade losses that almost all of the developing countries absorb. South Asia in particular, that has some of the highest initial tariffs, faces terms of trade losses that amount to 1 percent of the base income.

These terms of trade losses can be attributed to a combination of two factors. First is the Armington assumption, particularly in its oft-chosen functional form, i.e the constant elasticity of substitution (CES) function. Market share is gained through price reduction—though somewhat alleviated by a reduction in the tariffs of their trading partners. However, to the extent that trading partners have relatively lower tariffs, the case if your main trading partners are the OECD countries and your main exports are manufacturing, the reduction in your export prices may have to be commensurate. A higher Armington elasticity can attenuate these terms of trade impacts since they imply higher demand responsiveness. The second factor that explains the terms of trade losses (and linked to the first), is the balance of payments closure rule. As domestic import prices fall with the removal of tariffs, the *ex ante* demand for imports rises. With a fixed trade balance, the country must export more to pay for the additional desired imports. As shown in the last three columns of Table 1 most of the terms of trade adjustment falls on export prices and in fact import prices fall for almost all regions.

There are some notable exceptions to the general loss in the terms of trade and these tend to be countries/regions with well known advantages in some highly protected sectors in agriculture—for example Argentina, Brazil and Thailand.

The results from the standard dynamic version of the model are available in Annex D (Tables D-1 and D-2). They are broadly consistent with the comparative static results—though larger. The global gains are up by 0.1 percentage points and the developing country gains by 0.2 percentage points. Largely, this is the long-term impact of an acceleration in investment as the price of investment goods drops due to the removal of tariffs. There might also be structural reasons as the inefficiencies created by the trade distortions may rise overtime as resources are diverted to non-efficient uses. It appears, from Table D-1 that developing countries reap a greater portion of the global gains than in the comparative static version. This is true, but is largely an outcome of the fact that they are growing more rapidly than the high-income countries.

Table 1: Change in real income and terms of trade relative to baseline using standard model

	Real income		Terms of trade		Trade prices		
	Change relative to baseline		*Change relative to baseline*	*Change relative to baseline income*	*Change in import price relative to baseline*	*Change in export price relative to baseline*	*Change in terms of trade relative to baseline*
	$2001 mn.	Percent	$2001 mn.	Percent	Percent	Percent	Percent
World total	157,474	0.6	1,253	0.0	-0.7	-0.7	0.0
High income countries	127,898	0.6	18,151	0.1	-0.8	-0.6	0.2
Australia and New Zealand	2,259	0.7	1,954	0.6	-0.6	1.7	2.3
EU 25 plus EFTA	44,075	0.6	-2,111	0.0	-0.8	-0.9	-0.1
United States	28,790	0.3	11,867	0.1	-1.0	-0.9	0.1
Canada	3,135	0.5	493	0.1	-1.4	-1.0	0.4
Japan	31,104	0.9	4,681	0.1	-0.5	0.8	1.3
Korea and Taiwan	15,283	2.4	-670	-0.1	0.0	0.1	0.1
Hong Kong and Singapore	3,251	1.5	1,937	0.9	0.0	1.3	1.3
Low and middle income countries	29,576	0.6	-16,897	-0.3	-0.6	-1.2	-0.5
East Asia and Pacific	6,551	0.5	-1,717	-0.1	0.0	0.1	0.1
China	806	0.1	-811	-0.1	0.1	0.2	0.1
Indonesia	287	0.2	411	0.3	-0.5	0.5	1.0
Thailand	2,146	2.1	609	0.6	-0.6	0.4	1.0
Vietnam	1,023	3.4	-300	-1.0	-0.7	-2.8	-2.1
Rest of East Asia	2,289	1.6	-1,625	-1.1	0.4	0.0	-0.4
South Asia	-375	-0.1	-5,556	-1.0	-1.0	-5.7	-4.7
Bangladesh	-250	-0.6	-610	-1.4	-1.1	-7.8	-6.7
India	-562	-0.1	-4,592	-1.1	-0.8	-6.3	-5.5
Rest of South Asia	437	0.5	-354	-0.4	-1.7	-2.7	-1.0
Europe and Central Asia	5,189	1.0	-1,544	-0.3	-1.3	-1.6	-0.3
Russia	2,762	1.0	-1,550	-0.6	-1.1	-2.0	-0.9
Turkey	1,392	1.1	413	0.3	-1.2	-0.1	1.1
Rest of ECA	1,036	0.7	-406	-0.3	-1.5	-2.0	-0.5
Middle East and North Africa	5,346	0.8	-4,540	-0.6	-1.1	-2.4	-1.3
Sub Saharan Africa	749	0.3	-1,486	-0.6	-1.1	-2.2	-1.2
South Africa	807	0.9	28	0.0	-1.0	-0.8	0.2
Selected Sub Saharan Africa	197	0.4	99	0.2	-1.2	-0.5	0.7
Rest of Sub Saharan Africa	-254	-0.2	-1,612	-1.2	-1.1	-3.7	-2.6
Latin America and the Caribbean	8,321	0.5	-1,811	-0.1	-0.7	-0.8	-0.1
Argentina	1,578	0.7	500	0.2	-0.6	1.0	1.6
Brazil	4,255	1.1	2,513	0.6	-0.6	3.2	3.8
Mexico	1,371	0.2	-3,479	-0.6	-1.0	-2.7	-1.8
Rest of LAC	1,117	0.2	-1,345	-0.3	-0.6	-1.0	-0.4
Rest of the World	3,794	3.6	-243	-0.2	-0.7	-1.8	-1.1

Source: Simulations with World Bank Linkage model (comparative static version).

It is typical to breakdown the total gains and to assess the source of these gains by sector and by reforming region. This decomposition is provided in Table 2. On the left panel are the gains in dollar terms. For developing countries, roughly 50 percent of their gains come from market access in high-income countries and the remaining 50 percent from market access in their own region.

Interestingly in net they derive more of their gains from agricultural opening in developing countries ($7.7 billion) than from market access in high-income countries ($3.2 billion). This likely reflects important differences across developing countries where the net agricultural exporters benefit significantly from greater market access to the heavily protected OECD markets whereas net food importers suffer from higher world food prices.

At the global level, agriculture and food accounts for about 30 percent of the total gains. This proportion is somewhat higher for developing countries (37 percent) and a bit lower for high-income countries (27 percent).

Table 2: Decomposition of real income gains using standard model

	Allocation of gains[a] ($2001 mn)			**Decomposition of regional gain**[b] (%)		
	Developing	*High-income*	*World*	*Developing*	*High-income*	*World*
Reform by developing countries						
Agriculture and food	7,699	1,806	9,505	26	1	6
Other	6,655	42,408	49,063	22	33	31
Total	14,354	44,214	58,568	49	35	37
Reform by high-income countries						
Agriculture and food	3,226	33,233	36,460	11	26	23
Other	11,996	50,451	62,447	41	39	40
Total	15,223	83,684	98,907	51	65	63
Reform by all countries						
Agriculture and food	10,925	35,039	45,965	37	27	29
Other	18,651	92,859	111,510	63	73	71
Total	29,576	127,898	157,474	19	81	100

Note: a) The (small) interaction effects across simulations have been eliminated to assure that the decomposition adds correctly.
b) Most of the cells represent the column normalization, i.e. the percentage of the gain for each region coming from the sector/regional reform. For example, 26 percent of the gain for developing countries ($7.9 bn) of the total of $30 bn comes from own-agricultural reform. The final row shows that 19 percent of the global dollar gain accrues to developing countries and 81 percent to the high-income.

Source: Simulations with World Bank Linkage model (comparative static version).

The standard (comparative static) model with calibrated wages

The second set of results relates to the same version of the model but where a wage gap is introduced between agricultural and non-agricultural wages. The initial gap is calibrated to the volume of employment (in terms of persons) using data sourced from the OECD, the FAO and the ILO. Beyond any efficiency gains that may be had from full trade reform, the assumption of non-uniform wages—even with perfect labor mobility—has productivity consequences since workers may jump from low-productivity activities (agriculture) to high-productivity activities, or vice versa. These impacts clearly show up in the aggregate real income results. First, the global gains are considerably higher at $192 billion versus the previous $157 billion. However, the total gains now accrue almost entirely to the high-income countries ($186 billion), with a small residual for developing countries. This translates into only a 0.1 percent gain in real income for developing countries in aggregate rather than the 0.6 percent using the standard model.

One of the most dramatic changes occurs for Latin America that sees a reversal of a 0.5 percentage point gain to a loss of 0.7 percentage points. As agricultural output expands so does labor demand and thus the negative productivity impact outweighs the positive output impact. On the other hand, Europe, and to a lesser extent Japan, see a significant boost as the shedding of lower productivity agricultural labor leads to higher income gains.

The simple addition of a wedge between agricultural and non-agricultural wages therefore has some relatively big impacts on the net income gains and/or losses. This does not necessarily translate to a welfare loss in reality. One variable that is omitted from the analysis is the relative differential in the cost of living between rural and urban areas. Thus even if measured GDP rises as the output per worker increases when a low paid rural worker has a higher paying job in the city, the worker's own welfare may not change in the same proportion if the cost of living is much higher. That begs the question as to the motivation behind migration. The reasons to migrate are quite complex in reality, but certainly the anticipated dynamic benefits weigh-in significantly in the decision.

While the impacts on real income appear significant, the impacts of trade reform on many of the variables appear very similar in both simulations. For example the impacts on trade prices and the net terms of trade gains/losses are quite similar for either set of results.

The next section provides a plausible explanation for the rural/urban wage gap. However, these gaps seem to persist even over time as appears evident from looking at the implied gaps for the high-income countries where it is more difficult to assume that there are large barriers between rural and urban labor markets. As already mentioned above, the current version of the model is not able to capture the true welfare impacts of mobility as it does not adjust the change in income for any differences in the cost of living between rural and urban areas.[36] Thus even if measured GDP increases, welfare may not necessarily.

There are other reasons to assume that the results from this simulation are over-estimating the impacts, be they positive or negative. First, it assumes a certain degree of homogeneity in the labor force in the sense that a rural worker that moves to urban employment receives the average urban wage. The classification of workers into unskilled does not take into account the considerable diversity of skills. It is plausible that it is workers that are at the higher end of the skills continuum in rural areas that migrate and that they take the lowest skill jobs in urban areas, i.e. the actual productivity impact could be quite small, at least in the short term.

Finally, there are some significant data issues as regards labor remuneration and these are exacerbated countries with large pools of rural unskilled. In countries/sectors with significant informality and self-employment, labor remuneration tends to go unreported and is often recorded as profit, i.e. as capital income. This mis-reporting of labor income, to the extent it is worse in rural than in urban areas, would generate a larger wage gap than in reality.

[36] Nor for that matter does it capture the transaction costs of moving.

Table 3: Change in real income and terms of trade relative to baseline with calibrated wages

	Real income		Terms of trade		Trade prices		
	Change relative to baseline		*Change relative to baseline*	*Change relative to baseline income*	*Change in import price relative to baseline*	*Change in export price relative to baseline*	*Change in terms of trade relative to baseline*
	$2001 mn.	Percent	$2001 mn.	Percent	Percent	Percent	Percent
World total	191,815	0.7	1,135	0.0	-0.7	-0.7	0.0
High income countries	186,080	0.9	17,071	0.1	-0.7	-0.5	0.2
Australia and New Zealand	2,035	0.6	1,990	0.6	-0.6	1.7	2.3
EU 25 plus EFTA	77,934	1.1	-2,571	0.0	-0.8	-0.9	-0.1
United States	35,144	0.4	11,528	0.1	-0.9	-0.9	0.1
Canada	2,027	0.3	574	0.1	-1.4	-0.9	0.5
Japan	46,154	1.3	4,479	0.1	-0.4	0.8	1.2
Korea and Taiwan	19,456	3.1	-928	-0.1	0.0	0.0	0.0
Hong Kong and Singapore	3,330	1.5	1,998	0.9	0.1	1.4	1.3
Low and middle income countries	5,734	0.1	-15,936	-0.3	-0.6	-1.1	-0.5
East Asia and Pacific	4,818	0.3	-1,521	-0.1	0.0	0.2	0.1
China	-1,534	-0.1	-629	-0.1	0.2	0.3	0.1
Indonesia	528	0.4	457	0.3	-0.5	0.6	1.1
Thailand	1,383	1.3	679	0.7	-0.6	0.5	1.0
Vietnam	1,254	4.2	-324	-1.1	-0.6	-2.8	-2.2
Rest of East Asia	3,187	2.2	-1,705	-1.2	0.4	0.0	-0.4
South Asia	2,168	0.4	-5,614	-1.0	-0.9	-5.7	-4.7
Bangladesh	-254	-0.6	-609	-1.4	-1.0	-7.7	-6.7
India	2,203	0.5	-4,657	-1.1	-0.7	-6.3	-5.6
Rest of South Asia	219	0.2	-348	-0.4	-1.7	-2.6	-0.9
Europe and Central Asia	6,189	1.1	-1,488	-0.3	-1.3	-1.6	-0.3
Russia	3,019	1.1	-1,494	-0.6	-1.1	-1.9	-0.9
Turkey	2,067	1.6	402	0.3	-1.1	0.0	1.1
Rest of ECA	1,103	0.7	-396	-0.3	-1.5	-2.0	-0.5
Middle East and North Africa	6,259	0.9	-4,356	-0.6	-1.1	-2.3	-1.2
Sub Saharan Africa	-640	-0.2	-1,409	-0.5	-1.0	-2.1	-1.1
South Africa	330	0.4	59	0.1	-0.9	-0.7	0.2
Selected Sub Saharan Africa	-177	-0.4	107	0.2	-1.2	-0.4	0.8
Rest of Sub Saharan Africa	-794	-0.6	-1,576	-1.2	-1.0	-3.6	-2.6
Latin America and the Caribbean	-12,276	-0.7	-1,404	-0.1	-0.7	-0.6	0.0
Argentina	-54	0.0	499	0.2	-0.5	1.1	1.6
Brazil	-6,721	-1.7	2,721	0.7	-0.5	3.5	4.1
Mexico	1,028	0.2	-3,492	-0.6	-0.9	-2.7	-1.8
Rest of LAC	-6,530	-1.2	-1,131	-0.2	-0.5	-0.8	-0.3
Rest of the World	-784	-0.8	-144	-0.1	-0.6	-1.4	-0.7

Source: Simulations with World Bank Linkage model (comparative static version).

The introduction of segmented labor markets

The third set of results formalizes the wedge between agricultural and non-agricultural wages—only for developing countries.[37] For these countries we assume partial segmentation of the two labor markets with a migration gauge that is a function of the relative (expected) wages. Thus policies that tend to increase agricultural wages (relative to urban wages) would tend to reduce migration and vice versa.[38]

The most significant impact this has is to reverse (or lessen) the losses to Latin America. For the region as a whole, there is a 1 percentage point turn-around (from a loss of 0.7 percent to a gain of 0.3 percent). This pushes the overall gains for developing countries to 0.4 percent—though still below the gains when wages are assumed uniform across sectors. The relative impacts for the high-income countries (compared with the previous simulation) are marginal since labor is assumed to be perfectly mobile. Again, the role of labor market segmentation has only muted impacts on the terms of trade. The principle reason for this turnaround for developing countries—particularly the agricultural exporters, is that with segmented labor markets they no longer suffer from a loss of urban workers moving to agriculture (or more likely a deceleration in rural to urban internal migration) and the associated (potential) decline in aggregate productivity.

Figures 1a-1f provide additional insights into the role of labor market specification for a few selected structural variables. More details are available in the extended tables appended at the end of the references (Tables 7-11). The figures show a slice of the data for three countries/regions—Western Europe (essentially EU-25), Brazil and India. The first is representative of a high-income region with relatively high agricultural distortions and the absence of labor market segmentation. Brazil is representative of a developing country with a significant comparative advantage in agriculture, including abundant land. India is representative of a developing country with a large number of agricultural workers and high agricultural protection.

The largest single impact for both Brazil and India in terms of these structural indicators is the assumption of segmented labor markets. This introduces a significant rigidity in the functioning of the labor markets and limits to some extent the degree of responsiveness to changing incentives. The opening up of agricultural markets for Brazil induces a large output response that is lead by the large increase in demand for its exports. Limiting the movement of labor reduces the supply and export response. The increase in agricultural exports is cut by more than one-half, though with a lesser (percentage impact) on the aggregate supply response.

The impacts for India are more muted as the change in aggregate supply response is small in all cases. Exports respond somewhat more, with the increase in exports jumping from 45 percent to 65 percent (from a relatively low base). Since labor is less mobile in this case, there is a smaller decline in Indian agricultural output. Competition on the domestic market is roughly the same in either simulation, and thus the increased output (and surplus) is oriented towards foreign markets.

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[37] With the exceptions of Russia, the Middle East and North Africa and the Rest of the World.

[38] Note that this simulation is largely for illustrative purposes as the initial level of migration and the migration elasticity have been given plausible values but have not been validated by empirical evidence. See Table C-2 in Annex C for more details.

Table 4: Change in real income and terms of trade relative to baseline with segmented labor markets

	Real income		Terms of trade		Trade prices		
	Change relative to baseline		*Change relative to baseline*	*Change relative to baseline income*	*Change in import price relative to baseline*	*Change in export price relative to baseline*	*Change in terms of trade relative to baseline*
	$2001 mn.	Percent	$2001 mn.	Percent	Percent	Percent	Percent
World total	202,690	0.8	1,035	0.0	-0.7	-0.7	0.0
High income countries	180,632	0.9	17,075	0.1	-0.7	-0.5	0.2
Australia and New Zealand	2,084	0.6	2,049	0.6	-0.6	1.8	2.4
EU 25 plus EFTA	73,837	1.1	-2,897	0.0	-0.8	-0.9	-0.2
United States	34,383	0.4	11,953	0.1	-0.9	-0.8	0.1
Canada	1,958	0.3	609	0.1	-1.4	-0.9	0.5
Japan	45,788	1.3	4,395	0.1	-0.4	0.8	1.2
Korea and Taiwan	19,328	3.0	-966	-0.2	0.1	0.0	0.0
Hong Kong and Singapore	3,254	1.5	1,933	0.9	0.1	1.4	1.3
Low and middle income countries	22,058	0.4	-16,041	-0.3	-0.6	-1.1	-0.5
East Asia and Pacific	4,960	0.3	-1,599	-0.1	0.1	0.2	0.1
China	-1,153	-0.1	-875	-0.1	0.2	0.3	0.0
Indonesia	397	0.3	467	0.3	-0.5	0.6	1.1
Thailand	2,026	2.0	592	0.6	-0.5	0.4	0.9
Vietnam	1,093	3.7	-285	-1.0	-0.6	-2.7	-2.0
Rest of East Asia	2,598	1.8	-1,499	-1.0	0.4	0.1	-0.3
South Asia	600	0.1	-5,462	-1.0	-0.9	-5.5	-4.6
Bangladesh	-251	-0.6	-618	-1.4	-1.0	-7.7	-6.7
India	442	0.1	-4,493	-1.1	-0.7	-6.1	-5.4
Rest of South Asia	409	0.5	-352	-0.4	-1.7	-2.6	-0.9
Europe and Central Asia	5,323	1.0	-1,491	-0.3	-1.2	-1.5	-0.3
Russia	2,790	1.1	-1,568	-0.6	-1.0	-1.9	-0.9
Turkey	1,499	1.2	482	0.4	-1.1	0.2	1.3
Rest of ECA	1,034	0.7	-405	-0.3	-1.5	-2.0	-0.5
Middle East and North Africa	5,936	0.8	-4,442	-0.6	-1.0	-2.3	-1.3
Sub Saharan Africa	531	0.2	-1,413	-0.5	-1.0	-2.1	-1.1
South Africa	771	0.8	50	0.1	-0.9	-0.7	0.2
Selected Sub Saharan Africa	143	0.3	118	0.3	-1.1	-0.3	0.9
Rest of Sub Saharan Africa	-383	-0.3	-1,581	-1.2	-1.0	-3.5	-2.6
Latin America and the Caribbean	5,948	0.3	-1,568	-0.1	-0.7	-0.7	0.0
Argentina	1,547	0.6	676	0.3	-0.6	1.5	2.1
Brazil	3,568	0.9	2,614	0.6	-0.6	3.5	4.0
Mexico	1,232	0.2	-3,469	-0.6	-0.9	-2.7	-1.8
Rest of LAC	-399	-0.1	-1,390	-0.3	-0.6	-1.0	-0.4
Rest of the World	-1,240	-1.2	-65	-0.1	-0.6	-1.0	-0.3

Source: Simulations with World Bank Linkage model (comparative static version).

The most visible difference with segmented labor markets is the impact on rural factors and income. The change in agricultural value added is virtually identical for all simulations (in all regions). However, the introduction of segmented labor markets implies wage adjustment instead of quantity adjustment. In the case of Brazil, wages that had gone up by between 3 and 9 percent with perfect

labor mobility increase nearly 40 percent with segmented labor markets. On the other hand, agricultural employment that had gone up by around 30 percent with perfect mobility is virtually stagnant with segmented markets, even allowing for some movement between rural and urban markets. The net impact on India is again much lower as—to begin with—the output response is relatively muted.

As in the previous section, the plausibility of segmented labor markets needs some qualifications. First, it should reflect significant spatial and dynamic diversity. For example, Latin America is now largely urbanized and the degree of barriers to mobility is most likely limited as compared to less developed and more rural regions such as South Asia or Sub-Saharan Africa. Even in these latter regions, one would assume that migration barriers will lessen overtime as urbanization intensifies—information barriers are overcome through family and acquaintance networking, the rapid diffusion of mobile phones and other forms of electronic transmission, etc. As well, rural in our context is strictly associated with farm employment, but in many countries there exists significant off-farm rural activities that could potentially compete directly with more strictly defined urban activities.

Segmented labor markets and urban unemployment

The final simulation introduces (real) wage rigidity in the urban labor markets.[39] This creates the potential for urban unskilled unemployment with employment determined by demand conditions. Similar to labor market segmentation, initial urban unskilled unemployment is only assumed for developing countries.[40] The aggregate and terms of trade impacts are provided in Table 5.

Given the assumption that these labor market rigidities only affect developing countries, the spillover to the high-income countries is negligible. For developing countries in aggregate, the introduction of unemployment leads to an increase in the overall income gains—rising from 0.4 percent in the previous simulation, to 0.6 percent. This takes the developing country gains back to the level from using the standard model, though the distribution of the gains across developing countries is quite different. Countries that have a relative comparative advantage in manufacturing and services, such as those in Asia, see a jump in their real income gains. Unlike the very first simulation where the income gains largely result from the more efficient allocation of resources along the production possibilities frontier, the current one allows for both a more efficient allocation of resources and an increase in the employment of resources, i.e. an expansion towards the production possibility frontier.

To take the example of India, there is a greater expansion of non-agricultural output as there is virtually unlimited supply of unskilled labor and other resources[41] are re-allocated for non-agricultural uses. In the full-employment model with labor market segmentation, the real income gains for India were 0.1 percent. With under utilized labor, the real income gains jump to 0.6 percent. Brazil on the other hand sees a small relative loss from assuming under utilized labor. In its case, the real income gains drops to 0.8 percent from 0.9 percent. Despite the availability of urban labor, resources are attracted to the agricultural sectors that see a significant expansion. As well, the increase in the aggregate price index leads to a rise in nominal (urban) wages and therefore a decline in the demand for urban unskilled workers.

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39 See Annex C

40 With the same three exceptions—Russia, the Middle East and North Africa, and the Rest of the World.

41 Capital for example.

Table 5: Change in real income and terms of trade relative to baseline with segmented labor markets and urban unemployment

	Real income		Terms of trade		Trade prices		
	Change relative to baseline		*Change relative to baseline*	*Change relative to baseline income*	*Change in import price relative to baseline*	*Change in export price relative to baseline*	*Change in terms of trade relative to baseline*
	$2001 mn.	Percent	$2001 mn.	Percent	Percent	Percent	Percent
World total	212,735	0.8	1,053	0.0	-0.7	-0.7	0.0
High income countries	180,755	0.9	17,766	0.1	-0.7	-0.5	0.2
Australia and New Zealand	2,127	0.6	2,089	0.6	-0.6	1.8	2.4
EU 25 plus EFTA	73,752	1.1	-2,708	0.0	-0.8	-0.9	-0.1
United States	34,471	0.4	12,136	0.1	-0.9	-0.8	0.1
Canada	1,966	0.3	629	0.1	-1.4	-0.9	0.5
Japan	45,802	1.3	4,490	0.1	-0.4	0.8	1.2
Korea and Taiwan	19,259	3.0	-923	-0.1	0.0	0.0	0.0
Hong Kong and Singapore	3,377	1.6	2,052	0.9	0.0	1.4	1.3
Low and middle income countries	31,981	0.6	-16,713	-0.3	-0.6	-1.1	-0.5
East Asia and Pacific	10,884	0.8	-2,258	-0.2	0.1	0.1	0.0
China	2,288	0.2	-1,226	-0.1	0.2	0.2	0.0
Indonesia	796	0.6	443	0.3	-0.5	0.6	1.1
Thailand	2,693	2.6	556	0.5	-0.6	0.3	0.9
Vietnam	1,392	4.7	-314	-1.0	-0.7	-2.8	-2.1
Rest of East Asia	3,716	2.5	-1,717	-1.2	0.4	0.0	-0.4
South Asia	3,041	0.6	-5,559	-1.0	-0.9	-5.6	-4.7
Bangladesh	-180	-0.4	-618	-1.4	-1.0	-7.8	-6.7
India	2,468	0.6	-4,572	-1.1	-0.7	-6.2	-5.4
Rest of South Asia	753	0.8	-369	-0.4	-1.6	-2.6	-1.0
Europe and Central Asia	6,242	1.2	-1,516	-0.3	-1.2	-1.6	-0.3
Russia	2,811	1.1	-1,550	-0.6	-1.0	-1.9	-0.9
Turkey	2,026	1.6	457	0.4	-1.1	0.1	1.2
Rest of ECA	1,405	0.9	-423	-0.3	-1.5	-2.0	-0.5
Middle East and North Africa	5,983	0.8	-4,363	-0.6	-1.0	-2.3	-1.2
Sub Saharan Africa	1,495	0.6	-1,442	-0.5	-1.0	-2.1	-1.1
South Africa	1,170	1.3	41	0.0	-0.9	-0.7	0.2
Selected Sub Saharan Africa	274	0.6	118	0.3	-1.1	-0.3	0.8
Rest of Sub Saharan Africa	52	0.0	-1,601	-1.2	-1.0	-3.6	-2.6
Latin America and the Caribbean	5,589	0.3	-1,515	-0.1	-0.7	-0.7	0.0
Argentina	1,319	0.5	692	0.3	-0.6	1.5	2.1
Brazil	3,373	0.8	2,630	0.7	-0.6	3.5	4.1
Mexico	967	0.2	-3,457	-0.6	-1.0	-2.7	-1.8
Rest of LAC	-69	0.0	-1,380	-0.3	-0.6	-1.0	-0.4
Rest of the World	-1,254	-1.2	-60	-0.1	-0.6	-0.9	-0.3

Source: Simulations with World Bank Linkage model (comparative static version).

Table 11 shows the employment impacts in levels for all four simulations. For the first three simulations, changes to rural employment are exactly offset by changes to urban employment. The final simulation with urban unemployment shows a total expansion of 11 million employees in

developing countries with most of this occurring in the two Asian regions—not surprisingly largely due to China and India. Focusing on Brazil as a counterexample, there are a few interesting results that emerge. First, with perfect mobility and calibrated wages, full trade reform would lift agricultural employment by 3.6 million in Brazil (around 27 percent as given in Table 8). With labor market segmentation, this drops to only 81 thousand, or essentially to 0—with or without urban unemployment. Urban employment falls, by a gross amount of 145 thousand for a net fall of 62 thousand nationwide. The principle reason is that aggregate prices rise (the consumer price index for example), leading to a rise in the nominal wage (in the urban sectors) and therefore a decline in the demand for labor.[42]

Table 6: Decomposition of real income gains with segmented labor markets and urban unemployment

	Allocation of gains[a] ($2001 mn)			**Decomposition of regional gain**[b] (%)		
	Developing	*High-income*	*World*	*Developing*	*High-income*	*World*
Reform by developing countries						
Agriculture and food	12,160	-3,773	8,387	38	-2	4
Other	22,524	47,792	70,317	70	26	33
Total	34,684	44,019	78,703	108	24	37
Reform by high-income countries						
Agriculture and food	-15,529	84,111	68,582	-49	47	32
Other	12,826	52,624	65,451	40	29	31
Total	-2,703	136,735	134,032	-8	76	63
Reform by all countries						
Agriculture and food	-3,370	80,338	76,968	-11	44	36
Other	35,351	100,416	135,767	111	56	64
Total	31,981	180,755	212,735	15	85	100

Note: a) The (small) interaction effects across simulations have been eliminated to assure that the decomposition adds correctly.
b) Most of the cells represent the column normalization, i.e. the percentage of the gain for each region coming from the sector/regional reform. For example, 38 percent of the gain for developing countries ($12.2 bn) of the total of $32 bn comes from own-agricultural reform. The final row shows that 15 percent of the global dollar gain accrues to developing countries and 85 percent to the high-income.

Source: Simulations with World Bank Linkage model (comparative static version).

How does the decomposition analysis compare when implementing calibrated wages, segmented labor markets and urban unemployment? Table 6 shows this decomposition that is to be compared with Table 2, the decomposition with the standard model. First, the total gains are significantly higher, but this is largely due to the induced productivity gains for the high-income countries from shedding low productivity rural workers who find jobs in higher productivity manufacturing and services. Second, the aggregate gains for developing countries are similar at between $30 and $32 billion, but the source of the gains is very different. In total, developing countries would lose from agricultural trade reform—all of the losses incurred by the opening of agricultural markets in

[42] The formulation of wages and employment in this paper implies that the fiscal closure rule has no direct impact on these variables in which case we may be overstating the employment impacts. An alternative formulation would be to have a target for the after tax wage rate (through some bargaining mechanism, for example), that would dampen the employment response. The current formulation could hold, if for example, the lump sum tax fell mostly on rich households that derive most or all of their income from profits.

high-income countries. Higher world food prices translate into higher domestic prices (that are not offset by a reduction in tariffs). These in turn reduce demand for labor in the manufacturing and services sectors as nominal wages rise to offset the increase in food prices and a decline in output ensues. This does not happen (or is at any rate diminished) when developing countries undertake agricultural reform. In this case, any rise in the world price of food is offset (partially or in whole) by a lowering of tariffs, diminishing the impacts on domestic prices.

For the high income countries, the decomposition of the gains is little changed from the standard model with the one exception of own-agricultural reform. The latter, as mentioned above, leads to an aggregate productivity increase as low-paid agricultural workers find better paying urban jobs.

How plausible is this specification? In certain countries, perhaps quite plausible. In others, perhaps more questionable. Urban labor market institutions in most developing countries are quite complex—many involving some degree of segmentation—between formal and informal, public versus private, export processing zone versus not, domestic versus multinational, manufacturing versus services, and so forth. Fixing real wages is a simplistic device to incorporate real rigidities, but these latter are typically generated by more complex mechanisms. In most developing countries safety nets, if they exist, are for limited segments of the workforce. The alternatives are either the family safety net or some form of low-paying informal sector work. And similar to labor market segmentation, there is a dynamic component to unemployment that suggests some types of adjustment over the longer run to absorb underemployed workers. How persistent and what types of adjustment need careful study.

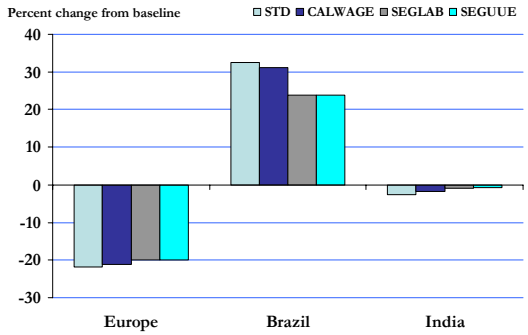
Conclusions

Most, though not all, global CGE analysis of trade reform assume across the board uniform wages, perfect labor mobility and fixed employment. Even the first assumption is not innocuous if the wage rural/urban wage gaps reflect true productivity differences and do not simply reflect data difficulties through mis-measurement of wage income or from aggregation effects. From the various tables and charts one could conclude that labor market specification matters significantly in terms of measuring the real income gains from trade reform. Two possible reactions are possible. One is that economists can provide a plausible explanation for any number and its opposite—not a very helpful form of analysis. A second is to let one's personal biases dictate the choice of specification. A free trader who believes in price-clearing will probably take the standard results, and others, with different biases might perhaps take the final specification.

There are several positive ways forward. One is to increase sensitivity analysis to get a better handle of what is robust and what is not. This paper suggests that many of the structural impacts are relatively robust to different labor market specifications, and in the end, it is probably these structural impacts that will drive the objectives of the policy makers. A long-term real income gain or loss of say 0.5 percentage points is relatively abstract compared to a 40 percent increase in agricultural output or a 100 percent increase in agricultural exports. This leads to a second point that the global analysis needs to be complemented with much more detailed institutional analysis at the country level. In other words, how labor markets actually work in both the near- and long-term, what are the detailed distributional consequences—for example for rural workers, large land owners, informal workers, formal workers, etc.—and what practical policies can be implemented that minimize both the transitional and long-term costs for those who may lose in either the short- or long-term. All four alternative simulations discussed in this paper have their drawbacks and thus the

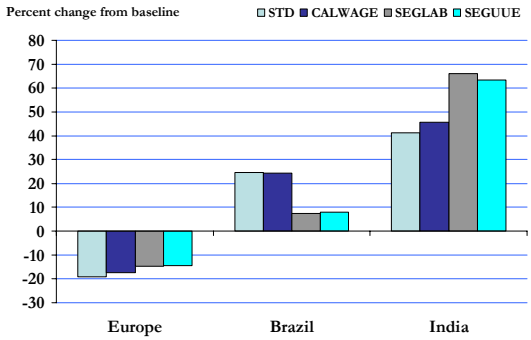
final conclusion is that much further research is needed in this area to arrive at a broader consensus on how labor markets operate with a wide enough flexibility to apply to many different situations across space and time.

Figure 1a: Change in agricultural output



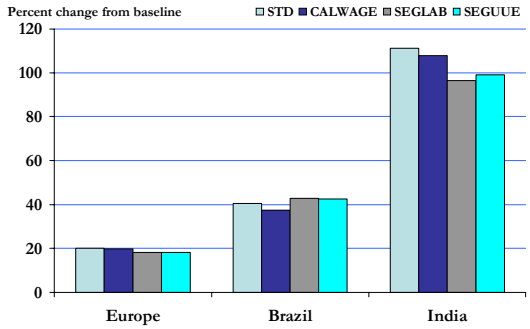
Note: Standard model (STD), standard model with calibrated wages (CALWAGE), segmented labor markets (SEGLAB) and segmented labor markets with urban unemployment (SEGUUE).
Source: Simulations with World Bank Linkage model (comparative static version).

Figure 1b: Change in agricultural exports



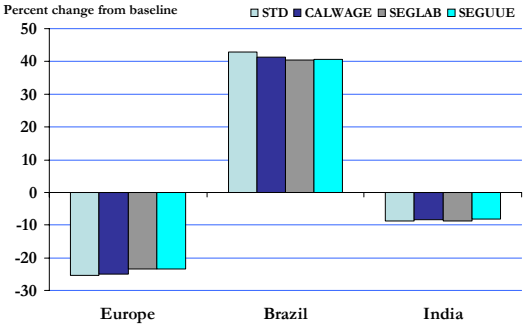
Note: Standard model (STD), standard model with calibrated wages (CALWAGE), segmented labor markets (SEGLAB) and segmented labor markets with urban unemployment (SEGUUE).
Source: Simulations with World Bank Linkage model (comparative static version).

Figure 1c: Change in agricultural imports



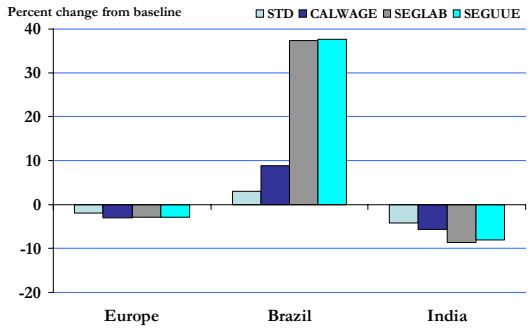
Note: Standard model (STD), standard model with calibrated wages (CALWAGE), segmented labor markets (SEGLAB) and segmented labor markets with urban unemployment (SEGUUE).
Source: Simulations with World Bank Linkage model (comparative static version).

Figure 1d: Change in agricultural value added



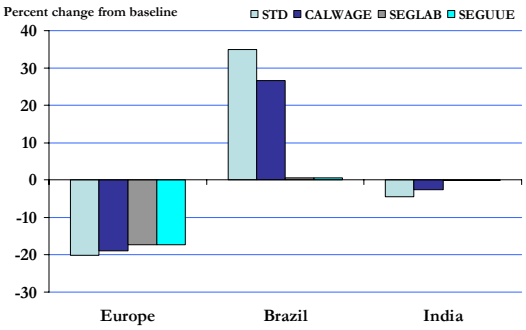
Note: Standard model (STD), standard model with calibrated wages (CALWAGE), segmented labor markets (SEGLAB) and segmented labor markets with urban unemployment (SEGUUE).
Source: Simulations with World Bank Linkage model (comparative static version).

Figure 1e: Change in agricultural unskilled wages



Note: Standard model (STD), standard model with calibrated wages (CALWAGE), segmented labor markets (SEGLAB) and segmented labor markets with urban unemployment (SEGUUE).
Source: Simulations with World Bank Linkage model (comparative static version).

Figure 1f: Change in agricultural unskilled employment



Note: Standard model (STD), standard model with calibrated wages (CALWAGE), segmented labor markets (SEGLAB) and segmented labor markets with urban unemployment (SEGUUE).
Source: Simulations with World Bank Linkage model (comparative static version).

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Additional Tables

Table 7: Change from baseline in key structural variables using standard model

	Percent change in agricultural:				Percent change in rural:		Percent change in urban:	
	Output	*Exports*	*Imports*	*Value added*	*Wage*	*Employ-ment*	*Wage*	*Employ-ment*
World total	-2.7	27.6	27.7	-4.2	-4.3	-0.1	-1.8	0.0
High income countries	-13.3	-7.7	23.1	-18.0	0.6	-17.6	-2.6	0.4
Australia and New Zealand	17.4	13.1	24.3	22.2	3.0	17.4	3.0	-1.2
EU 25 plus EFTA	-21.8	-19.1	20.2	-25.4	-1.9	-20.1	-1.9	0.7
United States	-3.8	-22.1	30.5	-11.1	-4.7	-6.9	-4.7	0.1
Canada	18.2	59.2	2.7	21.7	-0.5	21.3	-0.5	-0.3
Japan	-23.3	26.6	29.2	-25.8	0.8	-25.0	0.8	0.4
Korea and Taiwan	-17.0	185.7	44.9	-33.3	2.5	-31.6	2.5	1.3
Hong Kong and Singapore	2.8	8.7	3.6	4.3	2.8	0.7	2.8	0.0
Developing countries	3.5	70.8	36.0	3.0	1.9	0.1	0.5	0.0
East Asia and Pacific	1.2	67.4	32.1	4.0	3.5	0.2	3.4	-0.1
China	1.0	117.2	29.3	4.2	3.1	0.7	3.1	-0.2
Indonesia	-2.0	4.1	22.9	0.0	2.9	-2.4	2.9	0.6
Thailand	14.2	41.0	51.6	17.7	8.0	7.5	8.0	-1.7
Vietnam	3.5	43.4	71.0	5.9	10.4	-3.1	10.4	0.8
Rest of East Asia	-3.4	37.2	37.8	-3.5	2.8	-4.9	2.8	0.9
South Asia	-1.7	55.0	68.0	-7.3	-3.8	-3.5	-3.9	1.3
Bangladesh	0.9	165.2	-2.7	-6.8	-7.4	0.1	-7.4	0.0
India	-2.6	41.2	111.0	-8.7	-4.2	-4.4	-4.2	1.9
Rest of South Asia	0.8	73.9	51.2	0.2	-0.8	1.3	-0.8	-0.4
Europe and Central Asia	0.0	66.6	47.9	-2.5	-1.1	-1.3	-0.3	0.3
Russia	-5.3	46.0	22.7	-5.0	-1.2	-3.4	-1.2	0.3
Turkey	-3.8	20.9	101.6	-6.8	0.3	-7.3	0.3	1.8
Rest of ECA	1.6	104.3	56.0	0.8	0.1	0.7	0.1	-0.3
Middle East and North Africa	-2.0	44.7	11.2	-3.7	-1.9	-1.9	-1.9	0.4
Sub Saharan Africa	4.8	41.9	43.3	3.7	0.4	2.8	0.8	-1.7
South Africa	7.1	40.6	47.7	7.6	0.2	7.4	0.2	-0.3
Selected Sub Saharan Africa	4.1	16.5	56.5	5.7	2.7	2.8	2.7	-1.7
Rest of Sub Saharan Africa	4.5	54.9	38.3	2.3	-0.8	2.8	-0.8	-1.9
Latin America and the Caribbean	15.9	79.2	49.0	16.4	2.7	9.4	1.1	-1.5
Argentina	19.1	57.3	29.4	24.4	1.2	21.4	1.2	-1.7
Brazil	32.6	24.5	40.5	42.9	3.0	34.9	3.0	-1.3
Mexico	-0.9	63.4	69.0	-9.5	-6.6	-2.9	-6.6	1.8
Rest of LAC	23.1	135.7	37.1	25.2	1.5	20.4	1.5	-2.8
Rest of the World	28.7	475.4	37.4	27.4	4.2	19.2	4.2	-2.7

Source: Simulations with World Bank Linkage model (comparative static version).

Table 8: Change from baseline in key structural variables using with calibrated wages

	Percent change in agricultural:				Percent change in rural:		Percent change in urban:	
	Output	*Exports*	*Imports*	*Value added*	*Wage*	*Employ-ment*	*Wage*	*Employ-ment*
World total	-2.7	27.4	27.5	-4.2	-4.4	0.0	-1.8	0.0
High income countries	-12.9	-6.8	22.9	-17.7	0.9	-17.5	-3.4	1.3
Australia and New Zealand	17.3	13.2	24.4	22.3	3.3	17.1	3.3	-1.4
EU 25 plus EFTA	-21.1	-17.5	19.8	-25.0	-3.0	-18.8	-3.0	1.9
United States	-3.7	-21.9	29.9	-10.9	-4.8	-6.5	-4.8	0.2
Canada	18.0	59.1	2.6	21.7	-0.1	20.8	-0.1	-0.7
Japan	-23.0	28.8	31.0	-25.7	-0.2	-24.2	-0.2	1.4
Korea and Taiwan	-16.2	193.1	44.9	-32.9	0.6	-30.0	0.6	3.3
Hong Kong and Singapore	2.8	8.6	3.6	4.4	2.9	0.7	2.9	0.0
Developing countries	3.2	69.3	35.8	2.9	1.6	0.4	0.9	-0.5
East Asia and Pacific	1.2	68.0	31.9	4.1	3.6	0.1	3.5	-0.2
China	0.8	115.5	28.9	4.2	3.5	0.3	3.5	-0.6
Indonesia	-0.4	15.2	23.5	1.5	2.7	-0.9	2.7	0.9
Thailand	12.0	36.6	52.0	16.1	11.3	3.0	11.3	-4.4
Vietnam	4.6	46.7	71.0	6.9	8.7	-0.9	8.7	2.6
Rest of East Asia	-2.2	41.7	37.5	-2.7	1.3	-3.0	1.3	2.6
South Asia	-1.2	57.7	66.7	-6.9	-5.2	-1.8	-5.1	2.6
Bangladesh	0.9	166.3	-2.6	-6.8	-7.3	0.0	-7.3	-0.1
India	-1.8	45.7	107.8	-8.3	-5.7	-2.6	-5.7	3.5
Rest of South Asia	0.5	73.0	51.4	0.1	-0.2	0.6	-0.2	-1.0
Europe and Central Asia	0.1	68.1	47.6	-2.3	-0.2	-2.0	-0.4	0.5
Russia	-5.2	46.1	22.7	-4.9	-1.2	-3.2	-1.2	0.5
Turkey	-2.9	24.6	100.2	-6.0	-0.7	-5.6	-0.7	2.9
Rest of ECA	1.6	104.3	55.8	0.9	0.0	0.8	0.0	-0.2
Middle East and North Africa	-1.6	47.5	11.4	-3.4	-2.1	-1.3	-2.1	0.7
Sub Saharan Africa	3.8	39.5	43.2	3.3	1.4	1.4	1.7	-2.7
South Africa	6.8	40.3	47.0	7.4	1.2	6.3	1.2	-1.4
Selected Sub Saharan Africa	2.9	14.0	56.6	5.0	4.0	0.8	4.0	-3.2
Rest of Sub Saharan Africa	3.5	51.7	38.4	1.9	0.1	1.5	0.1	-2.8
Latin America and the Caribbean	14.5	75.9	48.9	15.4	-2.5	14.4	4.5	-4.8
Argentina	18.2	55.6	28.8	23.8	2.5	19.4	2.5	-3.2
Brazil	31.1	24.4	37.6	41.3	8.8	26.6	8.8	-6.8
Mexico	-1.1	62.9	69.1	-9.4	-6.1	-3.3	-6.1	1.3
Rest of LAC	20.6	128.2	38.0	23.3	5.1	14.8	5.1	-6.2
Rest of the World	21.6	435.2	38.0	22.9	14.3	6.0	14.3	-12.7

Source: Simulations with World Bank Linkage model (comparative static version).

Table 9: Change from baseline in key structural variables with segmented labor markets

	Percent change in agricultural:				Percent change in rural:		Percent change in urban:	
	Output	*Exports*	*Imports*	*Value added*	*Wage*	*Employ-ment*	*Wage*	*Employ-ment*
World total	-2.8	26.3	26.4	-3.7	-3.6	-0.2	-2.0	0.2
High income countries	-12.1	-4.0	21.5	-16.5	1.0	-16.5	-3.3	1.2
Australia and New Zealand	18.4	15.4	24.4	23.5	3.4	18.0	3.4	-1.5
EU 25 plus EFTA	-20.0	-14.8	18.4	-23.5	-2.9	-17.4	-2.9	1.7
United States	-2.8	-19.0	28.0	-9.8	-4.8	-5.4	-4.8	0.2
Canada	19.6	62.7	2.2	23.7	-0.1	22.6	-0.1	-0.8
Japan	-22.8	31.7	28.0	-25.4	-0.2	-23.9	-0.2	1.4
Korea and Taiwan	-16.1	201.3	45.0	-32.7	0.6	-29.8	0.6	3.2
Hong Kong and Singapore	3.5	10.5	3.6	5.3	2.9	1.3	2.9	0.0
Developing countries	2.7	63.6	35.3	3.0	2.2	0.1	0.3	-0.1
East Asia and Pacific	1.2	68.4	30.7	4.8	4.4	0.0	3.3	0.0
China	0.8	112.3	27.8	5.0	4.5	0.0	2.9	-0.1
Indonesia	-0.6	14.8	21.8	1.4	1.6	-0.1	3.6	0.1
Thailand	10.4	32.3	54.4	15.6	14.1	0.2	6.2	-0.2
Vietnam	5.1	51.1	69.4	7.7	8.5	-0.1	11.1	0.2
Rest of East Asia	-0.5	54.6	34.8	-1.5	-0.8	-0.1	3.6	0.1
South Asia	-0.5	70.9	62.1	-7.2	-7.3	-0.1	-2.6	0.2
Bangladesh	0.9	172.1	-1.9	-6.8	-7.2	0.0	-7.3	0.0
India	-0.9	66.2	96.5	-8.7	-8.6	-0.2	-2.3	0.3
Rest of South Asia	0.4	72.6	53.3	0.4	0.8	0.0	-1.2	-0.1
Europe and Central Asia	0.6	77.0	43.9	-1.1	-0.2	-0.7	-0.2	0.2
Russia	-4.6	53.1	20.5	-4.2	-1.2	-2.6	-1.2	0.4
Turkey	-0.1	45.2	89.4	-3.9	-3.8	-0.2	2.1	0.1
Rest of ECA	1.6	105.2	53.6	1.8	2.0	-0.1	-0.5	0.0
Middle East and North Africa	-1.4	49.8	10.6	-3.0	-2.0	-1.1	-2.0	0.6
Sub Saharan Africa	3.1	36.2	44.6	4.1	3.6	0.1	-0.9	-0.1
South Africa	4.4	33.2	46.6	7.2	7.2	0.2	-0.1	0.0
Selected Sub Saharan Africa	2.7	12.0	58.6	6.2	6.0	0.0	0.9	-0.2
Rest of Sub Saharan Africa	2.9	48.9	40.0	2.7	2.4	0.1	-2.7	-0.1
Latin America and the Caribbean	10.3	56.4	52.0	13.9	10.2	0.5	-1.0	-0.2
Argentina	9.6	34.6	42.0	20.6	19.6	0.6	-1.5	-0.1
Brazil	23.8	7.5	43.0	40.5	37.4	0.6	1.0	-0.2
Mexico	0.5	81.1	63.8	-9.0	-9.2	0.2	-4.6	-0.1
Rest of LAC	13.2	94.8	46.5	20.4	18.3	0.5	-2.0	-0.2
Rest of the World	24.2	483.9	40.5	25.7	16.0	6.6	16.0	-14.1

Source: Simulations with World Bank Linkage model (comparative static version).

Table 10: Change from baseline in key structural variables with segmented labor markets and urban unemployment

	Percent change in agricultural:				Percent change in rural:		Percent change in urban:	
	Output	*Exports*	*Imports*	*Value added*	*Wage*	*Employ-ment*	*Wage*	*Employ-ment*
World total	-2.7	26.4	26.5	-3.5	-3.4	-0.2	-2.8	1.0
High income countries	-12.0	-3.6	21.4	-16.4	1.0	-16.3	-3.3	1.2
Australia and New Zealand	18.6	16.2	24.2	23.8	3.4	18.3	3.4	-1.5
EU 25 plus EFTA	-19.9	-14.5	18.3	-23.4	-2.9	-17.3	-2.9	1.7
United States	-2.7	-18.7	27.8	-9.7	-4.8	-5.3	-4.8	0.2
Canada	19.8	63.3	2.2	24.0	-0.1	23.0	-0.1	-0.8
Japan	-22.8	32.3	28.4	-25.4	-0.2	-23.9	-0.2	1.4
Korea and Taiwan	-15.9	200.6	44.3	-32.4	0.6	-29.6	0.6	3.2
Hong Kong and Singapore	3.7	11.0	3.6	5.5	2.9	1.4	2.9	0.0
Developing countries	2.7	63.4	35.6	3.3	2.5	0.1	-0.7	0.9
East Asia and Pacific	1.3	67.5	31.4	5.1	4.7	0.0	1.9	1.4
China	0.9	113.3	28.5	5.3	4.8	0.0	1.9	1.0
Indonesia	-0.5	13.9	21.9	1.7	1.9	0.0	1.9	1.6
Thailand	10.5	31.7	55.7	15.9	14.5	0.2	2.4	3.2
Vietnam	5.4	50.0	71.8	8.4	9.1	0.0	7.7	3.5
Rest of East Asia	-0.4	52.5	35.8	-1.1	-0.4	-0.1	0.7	3.2
South Asia	-0.4	69.1	63.4	-6.8	-6.8	-0.1	-4.4	1.9
Bangladesh	1.0	174.6	-2.2	-6.5	-7.0	0.0	-7.7	0.4
India	-0.8	63.3	98.9	-8.2	-8.1	-0.2	-4.3	2.3
Rest of South Asia	0.5	72.4	53.6	0.8	1.2	0.1	-2.6	1.3
Europe and Central Asia	0.7	76.3	44.2	-0.7	0.0	-0.7	-0.8	0.8
Russia	-4.5	54.1	20.3	-4.1	-1.2	-2.5	-1.2	0.4
Turkey	0.0	44.1	90.4	-3.7	-3.6	-0.2	0.8	1.4
Rest of ECA	1.8	104.4	54.2	2.3	2.4	-0.1	-1.4	0.8
Middle East and North Africa	-1.2	52.3	10.6	-2.8	-1.9	-0.9	-1.9	0.5
Sub Saharan Africa	3.1	35.5	44.7	4.3	3.8	0.1	-2.2	1.3
South Africa	4.5	32.8	47.2	7.5	7.4	0.2	-1.0	0.9
Selected Sub Saharan Africa	2.8	11.6	58.9	6.5	6.3	0.1	-0.1	0.9
Rest of Sub Saharan Africa	2.9	47.9	40.0	2.9	2.6	0.1	-4.3	1.4
Latin America and the Caribbean	10.3	56.7	52.0	14.0	10.3	0.5	-0.9	-0.3
Argentina	9.8	35.1	41.6	20.8	19.6	0.8	-1.2	-0.4
Brazil	23.9	8.0	42.7	40.6	37.6	0.6	1.1	-0.3
Mexico	0.5	81.4	63.7	-9.0	-9.2	0.2	-3.9	-0.6
Rest of LAC	13.2	94.9	46.5	20.6	18.4	0.5	-2.2	0.0
Rest of the World	24.2	484.2	40.6	25.9	16.1	6.7	16.1	-14.2

Source: Simulations with World Bank Linkage model (comparative static version).

Table 11: Change in employment under various assumptions (in thousands)

	Standard model	Calibrated wages	Segmented labor	Segmented labor + urban unemployment		
		Rural		Rural	Urban	Total
World total	-789	445	-2,682	-2,494	13,513	11,019
High income countries	-1,550	-4,233	-3,974	-3,944	3,944	0
Australia and New Zealand	91	104	110	111	-111	0
EU 25 plus EFTA	-1,048	-2,701	-2,504	-2,487	2,487	0
United States	-61	-208	-172	-169	169	0
Canada	39	83	91	92	-92	0
Japan	-194	-628	-621	-620	620	0
Korea and Taiwan	-377	-884	-878	-871	871	0
Hong Kong and Singapore	0	0	0	0	0	0
Developing countries	760	4,678	1,293	1,449	9,569	11,019
East Asia and Pacific	446	732	152	182	4,491	4,673
China	1,073	1,460	186	206	2,245	2,450
Indonesia	-483	-433	-25	-21	775	753
Thailand	419	548	29	32	399	431
Vietnam	-249	-253	-15	-13	343	330
Rest of East Asia	-313	-590	-23	-21	730	708
South Asia	-5,541	-6,301	-480	-446	4,731	4,285
Bangladesh	13	18	1	4	122	126
India	-5,802	-6,623	-504	-480	4,221	3,741
Rest of South Asia	248	304	24	31	387	418
Europe and Central Asia	-437	-700	-252	-246	986	740
Russia	-181	-260	-213	-206	206	0
Turkey	-424	-576	-23	-25	276	251
Rest of ECA	167	136	-16	-15	504	489
Middle East and North Africa	-277	-398	-319	-274	274	0
Sub Saharan Africa	3,105	2,696	126	148	1,310	1,458
South Africa	45	170	5	5	112	117
Selected Sub Saharan Africa	688	442	25	27	121	148
Rest of Sub Saharan Africa	2,371	2,085	97	116	1,078	1,194
Latin America and the Caribbean	2,496	6,993	225	236	-373	-137
Argentina	177	309	10	12	-37	-25
Brazil	823	3,610	81	82	-145	-62
Mexico	-409	-342	17	16	-171	-155
Rest of LAC	1,905	3,416	117	125	-20	105
Rest of the World	969	1,656	1,840	1,850	-1,850	0

Source: Simulations with World Bank Linkage model (comparative static version).

Annex A: Regional and Sector Composition

The underlying database of the Linkage model used in this analysis is Release 6.2 of the GTAP dataset. The 96 countries/regions of GTAP have been aggregated into 27 countries/regions and the mapping is detailed in Table A-1.[43] The 57 activities of GTAP have been aggregated into 25 activities.

Table A-1: Regional composition

1	**anz**	**Australia and New Zealand** Australia (aus), New Zealand (nzl)
2	**eur**	**EU 25 plus EFTA** Austria (aut), Belgium (bel), Denmark (dnk), Finland (fin), France (fra), Germany (deu), United Kingdom (gbr), Greece (grc), Ireland (irl), Italy (ita), Luxembourg (lux), Netherlands (nld), Portugal (prt), Spain (esp), Sweden (swe), Switzerland (che), Rest of EFTA (xef), Rest of Europe (xer), Cyprus (cyp), Czech Republic (cze), Hungary (hun), Malta (mlt), Poland (pol), Slovakia (svk), Slovenia (svn), Estonia (est), Latvia (lva), Lithuania (ltu)
3	**usa**	**United States**
4	**can**	**Canada**
5	**jpn**	**Japan**
6	**hya**	**Korea and Taiwan** Korea (kor), Taiwan (twn)
7	**hyc**	**Hong Kong and Singapore** Hong Kong (hkg), Singapore (sgp)
8	**arg**	**Argentina**
9	**bgd**	**Bangladesh**
10	**bra**	**Brazil**
11	**chn**	**China**
12	**ind**	**India**
13	**idn**	**Indonesia**
14	**tha**	**Thailand**
15	**vnm**	**Vietnam**
16	**rus**	**Russia**
17	**mex**	**Mexico**
18	**zaf**	**South Africa**
19	**tur**	**Turkey**
20	**xsa**	**Rest of South Asia** Pakistan (pak), Sri Lanka (lka), Rest of South Asia (xsa)
21	**xea**	**Rest of East Asia** Cambodia (khm), Malaysia (mys), Philippines (phl)
22	**rlc**	**Rest of LAC** Bolivia (bol), Colombia (col), Ecuador (ecu), Peru (per), Venezuela (ven), Chile (chl), Paraguay (pry), Uruguay (ury), Rest of South America (xsm), Central America (xca), Rest of Free Trade Area of Americas (xfa), Rest of the Caribbean (xcb)
23	**xec**	**Rest of ECA** Albania (alb), Bulgaria (bgr), Croatia (hrv), Romania (rom), Rest of Former Soviet Union (xsu)
24	**mna**	**Middle East and North Africa** Iran (irn), Rest of Middle East (xme), Egypt (egy), Morocco (mar), Tunisia (tun), Rest of North Africa (xnf)
25	**sss**	**Selected Sub Saharan African countries** Botswana (bwa), Malawi (mwi), Mauritius (mus), Mozambique (moz), Tanzania (tza), Zambia (zmb), Zimbabwe (zwe), Madagascar (mdg), Senegal (sen), Uganda (uga)
26	**xss**	**Rest of Sub Saharan Africa** Rest of South African Customs Union (xsc), Rest of Southern African Development Community (xsd), Nigeria (nga), Rest of Sub-Saharan Africa (xss)
27	**row**	**Rest of the World** Rest of Oceania (xoc), Rest of East Asia (xea), Rest of Southeast Asia (xse), Rest of North America (xna)

[43] The original GTAP country/region is in parenthesis.

Table A-2: Composition of activities

1	**ric**	**Rice**
		Paddy rice (pdr), Processed rice (pcr)
2	**wht**	**Wheat**
3	**gro**	**Other grains**
4	**osd**	**Oil seeds**
5	**sug**	**Sugar**
		Sugar cane and sugar beet (c_b), Sugar (sgr)
6	**pfb**	**Plant-based fibers**
7	**v_f**	**Vegetables and fruits**
8	**ocr**	**Other crops**
9	**lvs**	**Livestock**
		Bovine cattle, sheep and goats, horses (ctl), Animal products n.e.s. (oap), Raw milk (rmk), Wool, silk-worm cocoons (wol)
10	**onr**	**Other natural resources**
		Forestry (frs), Minerals n.e.s. (omn)
11	**ffl**	**Fossil fuels**
		Coal (coa), Oil (oil), Gas (gas), Petroleum, coal products (p_c)
12	**pmt**	**Processed meats**
		Bovine cattle, sheep and goat, horse meat products (cmt), Meat products n.e.s. (omt)
13	**vol**	**Vegetable oils and fats**
14	**mil**	**Dairy products**
15	**ofd**	**Other food, beverages and tobacco**
		Fishing (fsh), Food products n.e.s. (ofd), Beverages and tobacco products (b_t)
16	**tex**	**Textile**
17	**wap**	**Wearing apparel**
18	**lea**	**Leather**
19	**crp**	**Chemicals rubber and plastics**
20	**i_s**	**Iron and steel**
21	**mvh**	**Motor vehicles and parts**
22	**cgd**	**Capital goods**
		Transport equipment n.e.s. (otn), Electronic equipment (ele), Machinery and equipment n.e.s. (ome)
23	**omf**	**Other manufacturing**
		Wood products (lum), Paper products, publishing (ppp), Mineral products n.e.s. (nmm), Metals n.e.s. (nfm), Metal products (fmp), Manufactures n.e.s. (omf)
24	**cns**	**Construction**
25	**svc**	**Utilities and services**

Annex B: Key model parameters and assumptions

Most of the elasticities in the LINKAGE model have a long vintage, in some cases going back to the late 1980s. Many have been gleaned from the literature using econometric estimates when available. Others can be attributed to guess-estimates.

Production elasticities are provided in Table B-1. Production is based on a series of nested CES functions with different CES nests for crop and livestock sectors, compared to manufacturing and services. In the dynamic version of the model, the production elasticities are differentiated between installed or *Old* capital and capital installed at the beginning of the year—so-called *New* capital. New capital has more flexibility in general than old capital. For the comparative static exercises, the *New* elasticities are imposed reflecting the long-term equilibrium nature of the results. Note that in this version of the model, unskilled and skilled labor are assumed to be substitutes. In alternative versions, skilled labor is a (near-) complement with capital. The skill+capital bundle is then a substitute for unskilled labor.

Table B-1: Production elasticities		
	Old	New
Elasticity across inputs (excl. sector-specific and energy inputs)	0.0	0.0
Elasticity between value added (including energy) and other inputs	0.0	0.0
Elasticity between capital+energy bundle and labor	0.12	1.0
Elasticity across labor inputs	0.5	0.5
Elasticity between capital and energy	0.0	0.8
Elasticity between capital and sector specific factors	0.0	0.0
Elasticity across fuel inputs	0.25	2.0
Elasticity between agricultural chemicals and land-capital input (crop sectors)	0.5	0.5
Elasticity between feed and land (livestock sectors)	0.5	0.5
Elasticity across agricultural chemicals (crop sectors)	0.5	0.5
Elasticity across feed in livestock (livestock sectors)	0.5	0.5

The trade elasticities are divided into four sets. There are two sets of import elasticities—or the so-called Armington elasticities. The top-level Armington elasticity reflects the degree of substitution between domestically produced goods and aggregate imports. The second-level Armington elasticity describes the degree of substitution of imports across region of origin. The next two set of trade elasticities reflect the degree of transformation of domestic production across domestic and export markets. Similar to imports, this transformation is implemented in a two-nested structure.

Table B-2: Trade elasticities

Top-level Armington elasticity	
Rice[a]	4.5
Wheat	5.9
Other grains	4.9
Oil seeds	4.8
Sugar	5.9
Plant-based fibers	3.9
Vegetables and fruits	3.9
Other crops	3.9
Livestock	3.9
Other natural resources	2.8
Fossil fuels	4.9
Processed meats	3.9
Vegetable oils and fats	3.9
Dairy products	3.9
Other food, beverages and tobacco	3.9
Textile	3.9
Wearing apparel	3.9
Leather	4.9
Chemicals rubber and plastics	3.9
Iron and steel	3.9
Motor vehicles and parts	4.9
Capital goods	3.9
Other manufacturing	3.9
Construction	1.5
Utilities and services	2.1
Substitution across imports by region of origin	Twice top-level Armington elasticity
Elasticity of transformation of domestic production by region of destination	Infinity

Note: a. Rice in Japan has an elasticity of 1.5 at both top and second levels.

Land supply is defined by an overall upward sloping supply function for aggregate land. The latter is allocated across sectors using a constant elasticity of transformation (CET) function. Land constrained countries have a relatively low land supply elasticity. The fossil fuel supply elasticity reflects the level of flexibility of supplying oil and gas. The highest supply elasticities are in the resource rich countries.

Table B-3: Factor supply elasticities

Land and sector specific factors		
Transformation of land in agriculture	Infinity	
	Land supply elasticity	*Fossil fuel supply elasticity*
Australia and New Zealand	1.00	1.50
EU 25 plus EFTA	0.25	1.50
United States	1.00	1.00
Canada	1.00	1.50
Japan	0.25	1.00
Korea and Taiwan	0.25	1.00
Hong Kong and Singapore	0.25	1.00
Argentina	1.00	1.50
Bangladesh	1.00	1.00
Brazil	1.00	1.50
China	0.25	1.50
India	1.00	1.50
Indonesia	1.00	2.00
Thailand	1.00	1.50
Vietnam	1.00	2.00
Russia	1.00	2.00
Mexico	1.00	2.00
South Africa	1.00	1.50
Turkey	1.00	1.50
Rest of South Asia	1.00	1.50
Rest of East Asia	1.00	1.50
Rest of LAC	1.00	2.00
Rest of ECA	1.00	1.50
Middle East and North Africa	0.25	4.00
Selected Sub Saharan African countries	1.00	1.50
Rest of Sub Saharan Africa	1.00	2.50
Rest of the World	1.00	2.50
Labor	See Annex C	
Capital		
Installed capital (disinvestment elasticity)	Perfectly mobile across sectors, fixed in aggregate	

The income elasticities are sourced from the GTAP dataset and aggregated using consumption shares. These are used to calibrate the extended linear expenditure system (ELES). Since this system rather rapidly converges towards a Cobb-Douglas function over time, the parameters of the ELES are re-calibrated between periods so as to reflect base year income elasticities.

Table B-4: Household income elasticities

	Australia & New Zealand	EU 25 plus EFTA	United States	Canada	Japan	Korea and Taiwan	Hong Kong & Singapore
Rice	0.06	0.08	0.00	0.02	0.00	0.17	0.03
Wheat	0.06	0.23	0.00	0.02	0.00	0.18	0.02
Other grains	0.07	0.18	0.00	0.02	0.00	0.16	0.03
Oil seeds	0.07	0.08	0.00	0.02	0.00	0.17	0.02
Sugar	0.30	0.28	0.20	0.25	0.17	0.39	0.24
Plant-based fibers	0.43	0.57	0.36	0.42	0.33	0.55	0.57
Vegetables and fruits	0.06	0.08	0.00	0.02	0.00	0.17	0.03
Other crops	0.06	0.03	0.00	0.02	0.00	0.18	0.01
Livestock	0.27	0.36	0.19	0.24	0.15	0.39	0.32
Other natural res.	0.55	0.55	0.47	0.54	0.44	0.64	0.74
Fossil fuels	0.70	0.72	0.62	0.74	0.62	0.76	0.87
Processed meats	0.27	0.28	0.19	0.24	0.15	0.38	0.30
Vegetable oils & fats	0.30	0.28	0.20	0.25	0.17	0.37	0.32
Dairy products	0.27	0.27	0.19	0.24	0.15	0.40	0.30
Oth. food, bev & tob	0.27	0.29	0.20	0.25	0.17	0.38	0.31
Textile	0.43	0.45	0.36	0.42	0.33	0.54	0.58
Wearing apparel	0.43	0.43	0.36	0.42	0.33	0.53	0.56
Leather	0.43	0.44	0.36	0.42	0.33	0.53	0.58
Chem. & plastics	0.54	0.55	0.47	0.54	0.44	0.62	0.67
Iron and steel	0.55	0.55	0.47	0.54	0.44	0.64	0.65
Autos & parts	0.54	0.54	0.47	0.54	0.44	0.61	0.53
Capital goods	0.57	0.57	0.50	0.56	0.44	0.63	0.68
Other manufacturing	0.54	0.54	0.47	0.54	0.44	0.62	0.68
Construction	0.95	1.00	0.87	1.01	0.92	1.00	1.31
Utilities and services	1.23	1.31	1.17	1.25	1.26	1.26	1.38

	Argentina	Bangladesh	Brazil	China	India	Indonesia	Thailand
Rice	0.26	0.41	0.52	0.33	0.34	0.48	0.52
Wheat	0.26	0.41	0.52	0.33	0.34	0.48	0.52
Other grains	0.26	0.41	0.52	0.33	0.34	0.48	0.52
Oil seeds	0.26	0.41	0.52	0.33	0.34	0.48	0.52
Sugar	0.44	0.78	0.70	0.36	0.52	0.83	0.76
Plant-based fibers	0.58	1.06	0.79	1.05	1.10	1.02	0.90
Vegetables and fruits	0.26	0.41	0.52	0.33	0.34	0.48	0.52
Other crops	0.26	0.41	0.52	0.33	0.34	0.48	0.52
Livestock	0.46	1.42	0.77	1.29	1.42	1.18	0.94
Other natural res.	0.67	1.43	0.86	1.31	1.46	1.21	1.00
Fossil fuels	0.79	1.46	0.92	1.34	1.49	1.23	1.04
Processed meats	0.46	1.42	0.77	1.29	1.45	1.19	0.94
Vegetable oils & fats	0.45	0.80	0.70	0.81	0.66	0.83	0.76
Dairy products	0.46	1.42	0.77	1.29	1.45	1.19	0.94
Oth. food, bev & tob	0.45	1.17	0.70	0.90	0.85	0.87	0.79
Textile	0.58	1.06	0.79	1.05	1.10	1.02	0.90
Wearing apparel	0.58	1.06	0.79	1.05	1.10	1.02	0.90

Leather	0.58	1.06	0.79	1.05	1.10	1.02	0.90
Chem. & plastics	0.67	1.43	0.86	1.31	1.46	1.21	1.00
Iron and steel	0.67	1.43	0.86	1.31	1.46	1.21	1.00
Autos & parts	0.67	1.43	0.86	1.31	1.46	1.21	1.00
Capital goods	0.67	1.44	0.86	1.31	1.47	1.21	1.00
Other manufacturing	0.67	1.43	0.86	1.31	1.46	1.21	1.00
Construction	0.99	1.48	1.02	1.37	1.52	1.26	1.10
Utilities and services	1.21	1.22	1.15	1.16	1.20	1.10	1.12

	Vietnam	Russia	Mexico	South Africa	Turkey	Rest of South Asia	Rest of East Asia
Rice	0.41	0.57	0.38	0.55	0.54	0.45	0.54
Wheat	0.41	0.57	0.38	0.55	0.54	0.43	0.48
Other grains	0.41	0.57	0.38	0.55	0.54	0.43	0.49
Oil seeds	0.41	0.57	0.38	0.55	0.54	0.42	0.52
Sugar	0.64	0.78	0.54	0.74	0.78	0.66	0.82
Plant-based fibers	0.98	0.90	0.72	0.84	0.89	1.11	0.93
Vegetables and fruits	0.41	0.57	0.38	0.55	0.54	0.47	0.54
Other crops	0.41	0.57	0.38	0.55	0.54	0.43	0.52
Livestock	1.24	0.92	0.61	0.83	0.88	1.39	1.07
Other natural res.	1.25	0.99	0.82	0.91	0.97	1.40	1.09
Fossil fuels	1.27	1.08	0.94	0.97	1.03	1.42	1.11
Processed meats	1.24	0.92	0.61	0.83	0.88	1.33	1.08
Vegetable oils & fats	0.71	0.79	0.59	0.74	0.78	0.78	0.86
Dairy products	1.24	0.92	0.61	0.83	0.88	1.37	1.05
Oth. food, bev & tob	0.78	0.80	0.59	0.75	0.80	0.99	0.89
Textile	0.98	0.90	0.72	0.84	0.89	1.11	0.97
Wearing apparel	0.98	0.90	0.72	0.84	0.89	1.11	0.97
Leather	0.98	0.90	0.72	0.84	0.89	1.11	0.97
Chem. & plastics	1.25	0.99	0.82	0.91	0.97	1.38	1.08
Iron and steel	1.25	0.99	0.82	0.91	0.97	1.39	1.05
Autos & parts	1.25	0.99	0.82	0.91	0.97	1.38	1.06
Capital goods	1.25	0.99	0.82	0.92	0.97	1.41	1.07
Other manufacturing	1.25	0.99	0.82	0.91	0.97	1.38	1.07
Construction	1.30	1.11	1.15	1.07	1.12	1.45	1.20
Utilities and services	1.05	1.15	1.26	1.14	1.16	1.22	1.15

	Rest of LAC	Rest of ECA	Mid. East & North Africa	Selected SSA countries	Rest of Sub Saharan Africa	Rest of the World
Rice	0.53	0.49	0.52	0.37	0.31	0.56
Wheat	0.49	0.53	0.58	0.39	0.31	0.57
Other grains	0.52	0.53	0.58	0.37	0.31	0.58
Oil seeds	0.45	0.49	0.54	0.40	0.31	0.56
Sugar	0.72	0.77	0.79	0.60	0.66	0.76
Plant-based fibers	0.82	0.95	0.84	0.90	1.01	0.84
Vegetables and fruits	0.52	0.51	0.54	0.39	0.31	0.57
Other crops	0.53	0.52	0.58	0.34	0.31	0.54
Livestock	0.72	0.97	0.86	1.54	1.47	1.04

Other natural res.	0.92	1.11	0.94	1.66	1.51	1.04
Fossil fuels	0.99	1.11	0.97	1.53	1.53	1.09
Processed meats	0.79	0.99	0.80	1.49	1.50	0.97
Vegetable oils & fats	0.69	0.79	0.74	0.78	0.69	0.79
Dairy products	0.75	0.96	0.85	1.52	1.50	0.88
Oth. food, bev & tob	0.69	0.82	0.76	0.86	0.75	0.83
Textile	0.82	0.94	0.82	1.03	1.01	0.93
Wearing apparel	0.81	0.92	0.85	1.14	1.01	0.93
Leather	0.79	0.90	0.85	1.14	1.00	0.94
Chem. & plastics	0.88	1.01	0.95	1.76	1.49	1.02
Iron and steel	0.82	1.09	0.92	1.94	1.51	1.06
Autos & parts	0.85	1.01	0.92	1.22	1.42	1.02
Capital goods	0.90	0.99	0.93	1.33	1.49	0.99
Other manufacturing	0.89	1.01	0.91	1.40	1.49	1.02
Construction	1.10	1.12	1.17	1.36	1.56	1.11
Utilities and services	1.20	1.17	1.23	1.21	1.19	1.11

There is a global trade and transport service sector that sources supply across regions based on a CES function. In most simulations productivity is fixed. In one alternative, with a productivity externality, sectoral productivity responds to sectoral openness as defined by the export to output ratio. Only a fraction of total sectoral productivity is affected by changes to openness.

Table 5: Miscellaneous elasticities

Substitution elasticity across suppliers for international trade and transport services	1	
Elasticity of trade-sensitive portion of productivity with respect to openness[a]	1 in manufacturing	0.5 in agriculture
Share of sectoral productivity sensitive to openness	40% in all sectors	

Note: a) 0.25 in agriculture for Japan, Korea and Taiwan and China. Not used in comparative static version of the model.

Annex C: Labor market modeling

This annex describes summarily the different labor market configurations for unskilled labor. The standard version of the model has a fixed labor supply and market clearing wages. Wages are assumed uniform across all markets. Equation (C-1) is the derived demand for labor by sector. It depends on the sectoral wage, *W*, other prices (prices of other inputs and output), and the volume of output, *X*. Equation (C-2) determines the market clearing wage such that aggregate labor demand is equated with (exogenous) supply. Equation (C-3) equates the sectoral wage rate to the market clearing national wage rate.

(C-1) $L_i^d = f(W_i, P, X_i)$

(C-2) $L^s = \sum_i L_i^d$

(C-3) $W_i = W^n$

In the second alternative, equations (C-1) and (C-2) hold like in the preceding framework, but equation (C-3) is replaced with:

(C-3') $W_i = \varphi_i W^n$

In this formulation, the sectoral wage relative to the market clearing national wage is fixed, i.e. they change at the same rate. In actual terms we work with only two sectoral wage rates—the rural and urban wage rate. These are calibrated to external assumptions on agricultural and total employment and the GTAP-based labor remuneration for agriculture and non-agriculture.

Table C-1 provides an example. It shows remuneration for unskilled workers in Canada in the base year. Total remuneration is $250 billion dollars, of which, $3.9 billion accrues to agricultural unskilled workers and the remaining to urban unskilled workers. In the standard model, and in the absence of an estimate of the number of workers, wages are set to 1 across the board and the volume of labor is equated to its initial remuneration (top panel). If one had an estimate of total employment, in the case below 11.7 million, than one could calibrate the initial national wage, which turns out to be $21,300 per year. In the absence of sectoral information, the calibrated national wage is assumed to hold across all sectors from which we can derive an estimate of sectoral employment. The employment share of course lines up exactly with the remuneration shares (mid panel). The model results would be identical in either case as the results are invariant to the calibration of the price/volume split as long as uniform wages are being assumed.

Using data from the ILO and FAO we have an estimate of the number of agricultural workers—402,000 in the case of Canada. This implies an annual wage of $9,700 for unskilled agricultural workers and $21,700 for unskilled non-agricultural workers, i.e. there is a fairly significant wage gap. The model results with sector-specific wages, even assuming a national labor market, will differ from those assuming uniform wages.

With the Harris-Todaro specification, the two labor markets are formally segmented so that labor markets clear in each region—rural and urban. Total labor is still fixed nationally, but is endogenous for each sub-sector.

Table C-1: Wage calibration under different assumptions

	Units	*Rural*	*Urban*	*Total*
Calibrated labor market with uniform and unitary wages				
Wage	Index	1.0	1.0	1.0
Volume	$ mn	3,902	245,885	249,788
Remuneration	$ mn	3,902	245,885	249,788
Calibrated labor market with uniform and non-unitary wages				
Wage	$ '000 per year	21.3	21.3	21.3
Volume	'000	183	11,526	11,709
Remuneration	$ mn	3,902	245,885	249,788
Calibrated labor market with sector specific wages calibrated to employment estimate				
Wage	$ '000 per year	9.7	21.7	21.3
Volume	'000	402	11,307	11,709
Remuneration	$ mn	3,902	245,885	249,788

Equation (C-4) determines the level of rural to urban migration. It is a function of the (expected) wage in urban (non-agricultural) sectors relative to the (expected) farm wage. (Within each of the two sub-sectors wages are assumed to be uniform.) In the first variant, the unemployment rate is set to zero so that the expected wage is equal to the actual wage. Equation (C-2) is replaced with the equilibrium condition for the segmented labor market, equations (C-2r) and (C-2u). The first equates agricultural labor demand with the initial rural labor supply adjusted for out-migration. The second equates non-agricultural labor demand with the initial urban labor supply adjusted for in-migration. Finally, equations (C-3r) and (C-3u) set the sectoral wages. They are equal to the market clearing wage in their respective segments.

$$\text{(C-4)} \quad Migr = \chi \left[\frac{(1-UE_{Urb})W_{Urb}}{(1-UE_{Rur})W_{Rur}} \right]^{\omega}$$

$$\text{(C-2r)} \quad L^{s}_{Rur,0} - Migr = \sum_{i \in Rur} L^{d}_{i}$$

$$\text{(C-2u)} \quad L^{s}_{Urb,0} + Migr = \sum_{i \in Urb} L^{d}_{i}$$

$$\text{(C-3r)} \quad W_i = W_{Rur} \quad \text{for} \quad i \in Rur$$

$$\text{(C-3u)} \quad W_i = W_{Urb} \quad \text{for} \quad i \in Urb$$

The final adjustment to the standard model is the addition of less than full employment. This is modeled using a minimum wage function and with endogenous regime switch using mixed

complementarity programming (MCP). Since unemployment is only assumed in the urban sector, only the equations related to that segment are reported here.[44] First, equation (C-5) determines the minimum wage. The minimum wage responds positively to the price level and negatively to the rate of unemployment. Depending on the elasticities, a number of specific assumptions can be implemented. For the results reported in this paper, the minimum wage is invariant to the rate of unemployment (ν is set to 0). With ρ equal to 0, the minimum wage is fixed in nominal terms. With ρ equal to 1, the minimum wage is fully indexed to the (national) CPI. This is the assumption for the results reported in this paper. Equation (C-6) defines the rate of unemployment. It is equal to total (urban) labor supply less total urban labor demand over total labor supply and it must be positive. The key to the MCP implementation is equation (C-2u') that replaces (C-2u) above. The latter represented the equilibrium condition for the clearing of the urban labor market. The new relation, known as an orthogonality condition, replaces the market equilibrium relation. Either of two regimes must hold. In the first, unemployment is at its minimum (often 0) in which case the prevalent urban wage is at or above the minimum wage, i.e. market clearing holds. In the second, the unemployment rate is positive (or greater than the minimum level) in which case the prevalent urban wage must equal the minimum wage.

$$\text{(C-5)} \quad WMin_{Urb} = \mu_{Urb} CPI^{\rho_{Urb}} \left(1 - UE_{Urb}\right)^{\nu_{Urb}}$$

$$\text{(C-6)} \quad UE_{Urb} = \frac{L^{s}_{Urb,0} + Migr - \sum_{i \in Urb} L^{d}_{i}}{L^{s}_{Urb,0} + Migr} \geq 0$$

$$\text{(C-2u')} \quad (W_{Urb} - WMin_{Urb}).(UE_{Urb} - UEMin_{Urb}) = 0$$

Table C-2 provides the initial labor market conditions for the developing countries/regions for this paper. Labor market segmentation and other distortions only hold for unskilled workers. The markets for skilled workers are assumed to be fully mobile and to have wage-clearing equilibrium. Column 1 has the rate of rural to urban migration as a share of the rural population. It has been set at 2 percent for most of the countries regions, with 1 percent for low-income Sub-Saharan Africa. For Russia, the Middle East and North Africa and Rest of the World, labor markets are assumed to have full flexibility and employment. The migration elasticity is set at 1 in all regions save for low-income Sub-Saharan Africa where the elasticity is set at 0.75. The urban unskilled unemployment rate was calibrated to the same rates as in the Carnegie study.[45]

[44] The equations are identical for the rural sector but the initial minimum wage is set low enough that a regime shift towards unemployment is highly unlikely.

[45] See Polasky 2006, Table 2.3.

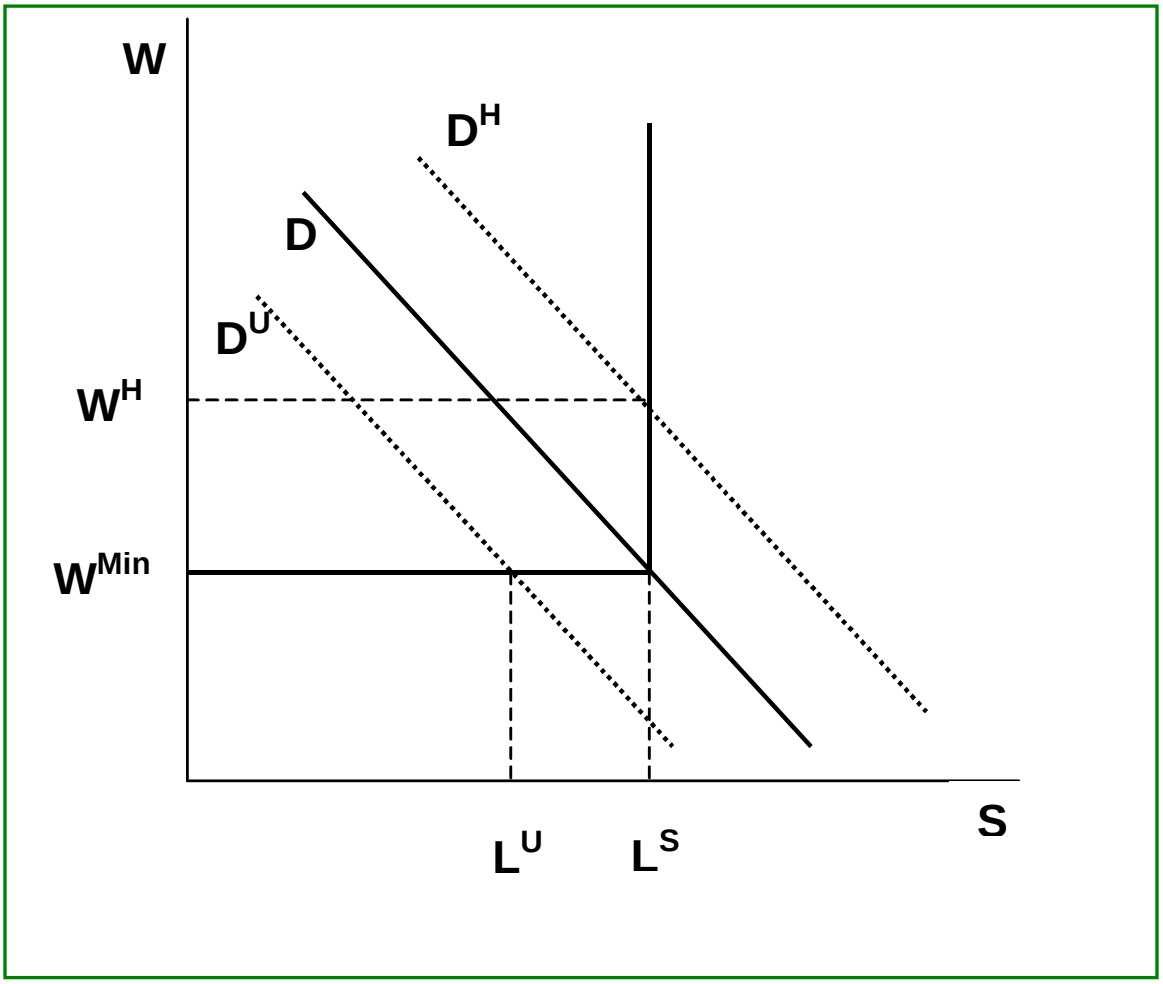
Table C-2: Initial labor market assumptions for developing countries/regions[a]

	Rate of Migration[b]	*Migration elasticity*	*Rate of urban unemployment*
Argentina	2.0	1.00	16.4
Bangladesh	2.0	1.00	27.0
Brazil	2.0	1.00	8.6
China	2.0	1.00	3.6
India	2.0	1.00	9.2
Indonesia	2.0	1.00	8.0
Thailand	2.0	1.00	5.5
Vietnam	2.0	1.00	3.1
Russia	0.0	0.00	0.0
Mexico	2.0	1.00	1.7
South Africa	2.0	1.00	21.4
Turkey	2.0	1.00	10.6
Rest of South Asia	2.0	1.00	9.3
Rest of East Asia	2.0	1.00	5.5
Rest of LAC	2.0	1.00	10.5
Rest of ECA	2.0	1.00	10.0
Middle East and North Africa	0.0	0.00	0.0
Selected Sub Saharan African countries	1.0	0.75	10.0
Rest of Sub Saharan Africa	1.0	0.75	16.9
Rest of the World	0.0	0.00	0.0

Note: a) These values hold for only unskilled workers. Full flexibility is assumed for the skilled labor market.
b) Initial rate of migration as a share of rural work force.

The specification of the regime shifting is illustrated in Figure C-1. If labor demand is high (the curve D^H) the prevailing wage will be W^H that is above the minimum wage. If labor demand is low (the curve D^U), the minimum wage puts an effective floor on the wage rate and demand will be less than supply (a vertical supply line). The number of unemployed will be the difference between L^S and L^U. The implementation of the orthogonality condition allows for endogenous regime shifting.

Figure C-1: Labor market specification with unemployment and endogenous regime shifting



Annex D: Tables with standard Linkage dynamic results

Table D-1: Change in real income and terms of trade relative to baseline using standard model

	Real income		Terms of trade		Trade prices		
	Change relative to baseline		*Change relative to baseline*	*Change relative to baseline income*	*Change in import price relative to baseline*	*Change in export price relative to baseline*	*Change in terms of trade relative to baseline*
	$2001 mn.	Percent	$2001 mn.	Percent	Percent	Percent	Percent
World total	291,827	0.7	1,767	0.0	-1.1	-1.0	0.0
High income countries	207,775	0.7	37,338	0.1	-1.1	-0.4	0.6
Australia and New Zealand	5,811	1.1	3,367	0.6	-0.8	1.5	2.3
EU 25 plus EFTA	56,792	0.6	1,143	0.0	-1.2	-0.8	0.4
United States	50,145	0.4	21,771	0.2	-1.4	-0.3	1.1
Canada	5,263	0.6	1,478	0.2	-1.6	-1.0	0.6
Japan	43,860	1.0	7,490	0.2	-0.8	0.7	1.5
Korea and Taiwan	34,755	3.0	-3,221	-0.3	-0.1	-1.4	-1.3
Hong Kong and Singapore	11,148	2.6	5,310	1.2	0.3	2.3	2.0
Low and middle income countries	84,052	0.8	-35,571	-0.3	-1.0	-1.4	-0.4
East Asia and Pacific	19,305	0.6	-12,394	-0.4	-0.3	-0.3	0.1
China	6,000	0.2	-9,923	-0.4	-0.3	-0.1	0.1
Indonesia	1,399	0.5	329	0.1	-0.6	0.3	0.9
Thailand	7,047	3.4	897	0.4	-1.1	0.0	1.1
Vietnam	3,959	6.0	113	0.2	-1.8	-1.7	0.1
Rest of East Asia	900	0.3	-3,810	-1.3	0.5	-0.1	-0.6
South Asia	4,987	0.4	-11,386	-0.9	-1.3	-5.9	-4.6
Bangladesh	-69	-0.1	-1,201	-1.3	-1.3	-7.2	-6.0
India	3,219	0.3	-9,239	-1.0	-1.5	-6.7	-5.2
Rest of South Asia	1,837	1.0	-946	-0.5	-1.3	-2.5	-1.2
Europe and Central Asia	9,543	0.9	-2,084	-0.2	-1.9	-1.7	0.1
Russia	4,457	1.0	-1,480	-0.3	-1.7	-1.8	-0.1
Turkey	3,587	1.4	692	0.3	-1.9	-0.3	1.6
Rest of ECA	1,498	0.5	-1,296	-0.5	-2.0	-2.4	-0.4
Middle East and North Africa	16,564	1.3	-6,484	-0.5	-1.8	-2.4	-0.7
Sub Saharan Africa	5,251	1.2	-1,856	-0.4	-2.0	-2.5	-0.5
South Africa	1,493	1.0	100	0.1	-1.3	-0.7	0.6
Selected Sub Saharan Africa	916	1.1	157	0.2	-2.0	-1.1	0.9
Rest of Sub Saharan Africa	2,843	1.3	-2,113	-1.0	-2.3	-3.9	-1.6
Latin America and the Caribbean	19,095	0.7	-805	0.0	-1.2	-1.3	-0.1
Argentina	3,860	1.0	962	0.3	-1.4	0.6	2.0
Brazil	9,063	1.4	4,290	0.7	-1.0	2.4	3.4
Mexico	-46	0.0	-4,088	-0.5	-1.4	-2.7	-1.3
Rest of LAC	6,218	0.7	-1,969	-0.2	-1.1	-2.2	-1.1
Rest of the World	9,306	4.3	-561	-0.3	-1.9	-2.3	-0.3

Source: Simulations with World Bank Linkage model (standard dynamic version).

Table D-2: Decomposition of real income gains using standard model

	Allocation of gains ($2001 mn)			**Decomposition of regional gain**[a] (%)		
	Developing	*High-income*	*World*	*Developing*	*High-income*	*World*
Reform by developing countries						
Agriculture and food	15,583	3,955	19,539	19	2	7
Other	36,910	73,885	110,795	44	36	38
Total	52,493	77,840	130,334	62	37	45
Reform by high-income countries						
Agriculture and food	9,764	65,681	75,445	12	32	26
Other	21,795	64,254	86,048	26	31	29
Total	31,558	129,935	161,493	38	63	55
Reform by all countries						
Agriculture and food	25,347	69,636	94,984	30	34	33
Other	58,705	138,139	196,843	70	66	67
Total	84,052	207,775	291,827	29	71	100

Note: a) Most of the cells represent the column normalization, i.e. the percentage of the gain for each region coming from the sector/regional reform. For example, 26 percent of the gain for developing countries ($7.9 bn) of the total of $30 bn comes from own-agricultural reform. The final row shows that 19 percent of the global dollar gain accrues to developing countries and 81 percent to the high-income.

Source: Simulations with World Bank Linkage model (standard dynamic version).