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World Bank CGE Macroeconomics and the Doha Debate

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Abstract

We propose a two-region SAM with trade and aid flows tied together in a social accounting matrix and a model structure heavy on CES-aggregates as a tabletop representation of the World Bank's LINKAGE model. Our goal is to critique standard approaches to measuring "welfare gains" from the Doha Development Agenda. The Bank's simulation models are based on the 1950s elasticities approach to the balance of payments. Under their preferred macroeconomic closure, the results are biased due to an interaction between the government's accounts and LINKAGE's "Armington" specification of foreign trade under imperfect competition. They also tend to overstate "welfare gains" and exaggerate price responsiveness with the values of Armington elasticities that the Bank usually employs.

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Introduction

As of this writing, the World Trade Organization's 149 members still seem to be engaged in the 9th world round of multilateral trade negotiations, the first after the WTO's creation in 1994. In December 2005 the nations' trade representatives hurried to Hong Kong, where the 6th Ministerial Conference was supposed to pave the way—at least two-thirds—towards an agreement. While the 5th Ministerial Conference in Cancun in 2003 unmistakably failed, Hong Kong did not—but fell far short of what the trade and development community considers a success. Over the course of 2006 and on into 2007, negotiations continued in an effort to avoid failure, which will happen if an agreement has not been found before President Bush's "fast track" negotiating power expires.

At this point, the manifold negotiating positions can be briefly summarized in three major blocks, representing the trade interests that fuel the debate: First, the developed world under the umbrella of the OECD aims to maintain its traditionally high protection for agricultural production while demanding improved market access in developing countries for manufacturing and services exports. Secondly, large developing countries such as India, Brazil¹ and Argentina hope to reach an agreement that allows protection as well as development policies in exactly those sectors, while demanding substantial reductions in developed countries' agricultural tariffs and subsidies, which would set free their comparative advantage. Thirdly, the poorest countries, often with small economies heavily dependent on aid as well as few primary commodity exports, feel the need to defend not only preferential trade agreements but furthermore require policy space to promote exports and economic diversification, while demanding special protection against increased import competition.²

¹ In 2004, India and Brazil joined the United States, the EU and Australia to form the core negotiating group of the Five Interested Parties (FIPs).

² The Special Safeguard Mechanism as well as the Special and Differential Treatment-clause were implemented to serve these goals. However, extending the "Green Room"-table to include India and Brazil might very well provide a disservice to the Least Developed Countries, whose interests as net food importers are often opposite those of developing countries' agricultural

Amidst this politically and historically fraught debate economists wield a powerful technical weapon in the form of global computable general equilibrium (CGE) models. The numbers they produce often dominate the public discourse about the effects of trade liberalization. In this paper we provide a review and critique of their standard building blocks. We focus on the ubiquitous Armington trade specification as it is applied in the World Bank's LINKAGE model and publications associated with Purdue's Global Trade Analysis Project (GTAP).³ We underline our analysis with a stylized two-region model tied together in a Social Accounting Matrix (SAM).

SAMs ultimately are constructed around Keynes's (1936) identification of national income with national output. CGE models based upon them thereby become intrinsically macroeconomic, despite their (at times) extreme elaboration of microeconomic detail. As far as we know, no one heretofore has worked out the macro repercussions of the Armington specification. As will be seen, it carries with it surprisingly strong implications about how a CGE macro model must function.

The paper is organized as follows. First, we set out the accounting framework and data the model is based upon. Second comes an overview of the analytics. In the following paragraphs, we discuss the many possibilities and problems presented by a CGE trade model. The former relate to causality assumptions, which in their abundance cover fairly wide swaths of macroeconomic theory; the latter include an upward bias in simulated welfare outcomes due to tariff reduction from (1) the interaction of the government deficit and the Armington apparatus for determining prices of traded goods and (2) the magnitude of the trade elasticities that the World Bank typically adopts. In a third section, we outline the differences and similarities between our version and "standard" models, both to motivate our simulation strategy and highlight limitations of the Bank's approach. Finally, we discuss simulation results and conclude.

exporters. For fairly comprehensive overviews of the Doha issues and negotiations, see <http://www.ictsd.org/> or http://www.fao.org/trade/policy_en.asp.

³ LINKAGE, see www.worldbank.org and follow Data & Research > Prospects > Products > Global Models. GTAP, see <http://www.gtap.agecon.purdue.edu/>

An Armington-Godley SAM

In this section we present the SAM and data. The main features are the Armington trade specification and a treatment of international linkages due to Godley (1996). Before jumping into rows and columns, a word is in order about the former.⁴ Paul Armington (1969) wrote his influential article about "A Theory of Demand for Products Distinguished by Place of Production" at the IMF, where empirical work on trade at the country level relied on the assumption of imperfect substitutability between domestic products and imports (and foreign products and exports), providing import and export functions dependent on relative prices and incomes. The applications, however, were limited to a single country. Armington's formulation pushed this approach in the direction of global trade models.⁵

Assuming that any type of good has distinctive features due to its place of origin solves the problem of trade flow determination in multilateral models. If "manufactures" from China enter the utility function of U.S. consumers parallel to domestic or European manufactures and all of these are imperfect substitutes because of national product differentiation, then consumers will not exclusively demand any single type—for example the cheapest—of manufacture. Thus, Armington avoids complete specialization so that global trade in a multilateral setting becomes easy to model. An important simplification is that, usually, "the standard model specification adds up Armington demand across domestic agents and the Armington decomposition between domestic and aggregate import demand ... at the national level, not at the individual agent level."⁶

Looking at a SAM clarifies the approach.

Figure 1 here

Figure 1 shows a symbolic one-country one-sector flow matrix of an open economy with Armington trade, which is helpful to consider before discussing a two country version with its own

⁴ We discuss the technical details of the Armington specification in more detail below, which will lead as well into a critique. Here we rather stick to the concept and its advantages.

⁵ See Blejer et.al. (1995) for a summary from an IMF perspective.

⁶ Van der Mensbrugghe (2005), footnote 20.

accounting complications. Figure 1 satisfies the usual restrictions of double entry bookkeeping. First, corresponding row sums and column sums are equal, so that "agents" satisfy their budget constraints reading down the columns. For example, the government's expenditure in column 4 cannot exceed its income in row E. Second, entries along rows are valued at the same price. Third, row entries variously comprise decompositions of demand, sources of incomes, flows of funds, or balances between one column and another. Fourth, columns represent cost decompositions, budget constraints, or transmission of flows from one row to another.

In Figure 1 specifically, Rows A through F present demand decompositions, uses of production and sources of incomes, followed in G through I by the flows-of-funds accounts of households, the government, and the foreign "sector," respectively.

Columns 1 and 2 and the balancing rows A and B show how Armington-style accounting deviates from standard SAM bookkeeping. The key innovation is that there is a value ZA of "composite supply" with an "Armington" supply price Z and volume aggregate A . Column 2 contains the cost components of ZA , including the values of domestic output (price P and volume X) and tariff-ridden non-intermediate imports $e(1+t)Z'M_A$ with e as the exchange rate, t as the tariff rate, Z' the foreign supply price, and M_A import volume. In row B, real supply A is used to satisfy intermediate, private consumption, government, export, and investment demands, all valued at price Z . Row A is a balancing account for PX , and column 1 shows its cost decomposition into payments to labor and capital, and foreign- and domestic-sourced intermediate inputs $[a_f e(1+t)Z' + aZ]X$ with t as the tariff on the imports. As a source of supply, domestic output X is demoted to an accounting artifact, whereas the mysteriously created real composite commodity A along row B is what everybody spends money on.

The remainder of the SAM is business as usual. Households spend their income on consumption (B3), pay lump-sum taxes (E3) and save a portion (G3). Savings, in turn, are used to finance investment (G6) and buy government bonds (G7). The government, on the other hand, supports at least a part of its expenditure (B4) by negative government savings (H4), which are funded by treasury bond sales (H7, the flip side of G7) and a foreign aid inflow. As this SAM is macroeconomically rudimentary at best—there is no financial market with different assets and

their potentially different returns—a current account deficit is offset by an exactly equal amount of capital (or aid) inflow in the government's flows of funds. Aid is financed by foreign savings, the two items offsetting each other in the foreign flows-of-funds row I.⁷

Such an obviously crude treatment of international financial markets and the resulting capital account is not very compelling, but, following the World Bank's LINKAGE, *trade* rules the world economy, rather than *money*. As discussed below, the Bank's modeling approach is a reprise of the open economy macroeconomics of the 1950s, in particular the elasticities approach to the balance of payments.

Figure 2 here

Next we include the other region into the accounting. In order to keep the number of rows and columns at a minimum we assume away the government and investment. See Figure 2 for the SAM. Without the government, the private sector is the only agent that can borrow in order to finance a current account deficit. Accordingly, the poor region's (economy-wide) savings in cell D3 would be negative and balanced by an equal capital inflow in D5, which in turn is equal to the foreign deficit. While this is a considerable simplification—together with the rest of government we dispensed with tariffs and other policy instruments—our purpose here is to clarify the accounting links between the two regions, basically following Wynne Godley (1996).

As above, the top part of the table shows supply- and income rows (A – D), followed by the international rows (E – G). From left to right, the table presents the developing region in columns 1 – 6 and the developed region in 7 – 12. As before, rows A and B and columns 1 and 2 tell the Armington story, here without factor disaggregation and imported intermediates.

The following, international rows E – G illustrate bilateral trade accounting à la Godley. Whereas in Figure 1 with its single region, exports ZE and “foreign saving” S_F in column 5

⁷ Note that we use the symbol $e\Delta'$ to denote the current account/aid-flows, which will become more reasonable below, where Δ' is the current account of the developed region, which then is converted to domestic home country currency via the exchange rate e .

balance with imports in row F, in Figure 2 these quantities are transferred from one region to another through the “conversion column” (between columns 6 and 7) that separates the two.

For example exports ZE of the poor country in cell B4 are a use of supply. From there, they are “flipped” with a sign change down to the international row F, and subsequently converted to foreign currency⁸ in cell F8. In column 8 they combine with foreign domestic output $P'X'$ to make up composite supply $Z'A'$.

With two regions, one’s imports are the other’s exports, so that row E are the developing country’s imports, but the rich country’s exports; and vice versa for row F. Export-import accounting then produces the current account, which given macroeconomic balance has to be equal to aid or capital flows, which cross the border in row G. The developed country features positive savings⁹ in cell D9, offset by the capital outflow Δ' , which is first carried into the international accounts (G11) and after conversion reappears as the deficit-balancing inflow in D5. Current and capital accounts of a region’s balance of payments do not appear anywhere in the SAM, but when wealth accounts are incorporated they can be recovered in their usual form because of the matrix’s bookkeeping consistency.¹⁰

Figure 3 here

Lastly, we take a look at the data.¹¹ We extend the symbolic 2-region, 1-sector SAM of the previous paragraphs to a numerical, 2-region, 2-sector SAM, see Figure 3. As we will see,

⁸ In more complete accounting, as in our simulated model discussed below, the trade flows are not merely currency converted, but furthermore marked-up by tariffs and disaggregated into intra- and extra-regional exports and imports.

⁹ Excess savings nowadays seem to originate in the periphery, but as our developing region describes Sub-Saharan Africa we might be correct in setting up this rather traditional scenario.

¹⁰ For the details, see Taylor (2004), Chapter Ten.

¹¹ The source of our data is GTAP 5, which neither fully incorporates the Uruguay Round implementation period nor deals in any way with preferential trade agreements (as GTAP 6 does). The most recent version is a more precise and detailed data set, and all recent CGE-estimates of welfare gains from liberalization make use of it, but we argue that using GTAP 5 does not put limits to our results. We provide a critique of the models’ theoretical foundations, and do not want to participate in a discussion about the precise magnitude—0.5% or 1.3% of GDP—of welfare estimates. GTAP 5 serves our purposes as a base year data set that depicts trade between a rich and a poor region, with strongly differing economic structures and

disaggregating production into an agricultural and an industrial good emphasizes structural differences between the two regions. The upper part, rows A through O show Sub-Saharan Africa (SSA) and the lower part (A' – O') the rest of the world (ROW), our proxy for the developed world. The first four rows and columns in each part take up the Armington business described in detail above, followed by the various agents' accounts, here inclusive of an investment column as well as the government and its treasury bills, balancing the flows of funds between private and public hands. With a government present, policy instruments such as tariff revenues, subsidies and taxes appear at the right spots. In row F (and F'), output subsidies and, presumably, tariffs on intermediates add to a negative number. Tariffs on Armington imports are accounted for in F3 and F4 and their ROW-counterparts. The data can be readily understood, based on a combination of the SAMs in Figure 1 and Figure 2. Substituting numbers for symbols, however, reveals a couple of simplifying assumptions: (1) All government expenditures are on services, which—in this aggregation—are subsumed into the industrial sector, (2) all investment occurs in the industrial sector and (3) *all* African imported intermediates originate in ROW, an assumption justified by the high extra-regional industrial import percentage.

Another important point is that imports and exports in fact are separated into intra- and extra-regional quantities, a distinction especially important for Africa for the reasons just mentioned. Notice, however, that such detail does not fit well with publishing conventions, meaning trade flows are disaggregated in a bilateral trade matrix between the two regions *but not shown here*—so that ROW's export total vastly exceeds SSA's import total. In other words, the international rows are not mere Godley-flips, but a portion of ROW's (and SSA's) exports are rerouted back into the region's imports.

Having slowly built an accounting framework, from Armington to Godley to the numbers, we can take a preliminary assessment of what these data tell us. The most obvious difference is the relative size of the economies, as the SAM entries for the rest of the world (ROW) are

characteristics—a point we highlight further below. We used GTAP 5 because it was available in the public domain. Changes were made only to average applied tariff rates, based on recent World Bank publications that make use of the GTAP 6 dataset. See World Bank Working Paper 3616, Anderson et. al. (2005), Table 1.

overwhelmingly larger than those for Sub-Saharan Africa (SSA). A few more distinctive features are a roughly ten-fold per-capita income advantage in ROW compared to SSA, an agricultural consumption share of African consumers twice as high as that in the North and high extra-regional industrial import shares in the South, exemplifying a dependent economy. See Figure 4 for a summary. These data stylize trade between a large, developed region with an affluent population and a smaller, underdeveloped, and poor region.

In the next section, we introduce behavioral functions and discuss the most important implications of such a model structure.

The Model

We discuss a one-sector set-up from the developing country's perspective, to economize on cluttering subscripts and emphasize intuition—no important result depends on a higher level of disaggregation. The model builds on the combined SAMs of Figure 1 and 2.¹² The arguments to follow depend heavily on constant returns to scale so that price determination as in equations (1)–(3) below is independent of outputs.

Two regional sets of three prices have to be determined: the “price of value-added” (or GDP deflator) following factor costs, the price of domestic product, and the price of composite supply. The poor region's value-added price Q is a constant elasticity of substitution (CES) aggregate of the wage and profit rate, and is dual to a CES production function for real value-added V .¹³ The domestic output price P follows from the cost decomposition along the column 1 in Figure 2. The price of composite supply, or, equivalently, the Armington price Z is another CES-aggregate, in this case of the domestic price and the import price $e(1+t)Z'$ —the tariff-ridden foreign Armington price Z' expressed in terms of domestic currency.

$$Q = (\alpha w^{1-\sigma} + \beta r^{1-\sigma})^{\frac{1}{1-\sigma}} \quad (1)$$

¹² We abstract from export and output subsidies. We bring these policy instruments back into the picture in the simulation analysis.

¹³ We do not model the production side explicitly. As shown below, product is determined from the demand side—which in turn follows from the dual CES-price function.

$$P = aZ + a_f e(1+t)Z' + Q \frac{V}{X} \quad (2)$$

$$Z = (\chi P^{1-\theta} + \delta [e(1+t)Z']^{1-\theta})^{\frac{1}{1-\theta}} \quad (3)$$

Analogously to the cost-production duality for value-added, equation 3 implies that domestic supply A —the composite of domestic product and imports—is "produced" by a CES production function. The underlying rationale is that (say) foreign and domestic cars are distinct products but can be aggregated into a national "car pool." Stanford (1992) gives careful consideration to the plausibility of the Armington specifications. On the surface, they appear to provide a fairly simple, operational model structure for trade. However, the national product differentiation integral to the Armington specifications ignores the fact that characteristics of products are increasingly determined by firms, not countries. A Toyota manufactured in Japan is identical to the same model made in the US, and the Toyota Group itself decides how much international trade to undertake.

In other words, much international trade is intra-firm, for which the Armington setup is beside the point. Besides these problems, and maybe more importantly, the introduction of the Armington price provides a partial solution to the well-known price over-determination problem in an open economy model: Domestic prices cannot both be determined from the cost side and at the same time be simply "marked-up" from world prices by a tariff factor. In a micro- or trade model without a macro exchange rate the Armington price brings the necessary flexibility between domestic and import prices in an otherwise over-determined system.¹⁴

The domestic price P creates less controversy. It represents a simple decomposition of the domestic price into material input costs, valued at their respective prices P and $e(1+\tau)Z'$, and the price of value-added. The last term on the right hand side in equation 2 asks for a scaling

¹⁴ The Armington solution to the over-determination problem is only partial for reasons that can only be sketched here. After substituting through equations such as (1)-(3) domestic and foreign supply prices Z and Z' emerge as complicated CES "power means" of one another and prices of domestic inputs. For reasons discussed below, if the international trade balance is fixed exogenously there must be a vehicle for price-induced real income transfers between the regions. If there is no explicit endogenous exchange rate to effect the transfers, some domestic input price(s) must be free to vary (thereby shifting Z and Z') to permit an equilibrium to exist.

factor to relate real value-added and domestic product. Given the Leontief assumption that inputs are proportional to output, we have the ratio of real value-added V to domestic output X as

$$\frac{V}{X} = \nu = 1 - a - a_f e(1+t) \quad (4)$$

which will prove useful in the following paragraphs, deriving factor and product demands.

This "Johansen" quantity equation, following Leif Johansen's (1960) pioneering contribution, emphasizes the extent to which prices are "bound." Suppose the model has only two sets of prices, for domestic goods price and value-added. Then P in (2) could move only with and against parameters and the value added components—which implies that domestic prices largely follow factor prices, an assumption to which classical economists and Keynes were no strangers. In any reasonable model, or even the real world, factor prices move only slowly and so consequently do goods prices. Looked at from this perspective, the main purpose of the Armington construct is, first, to solve the over-determination problem of domestic and international prices and, secondly, to guarantee neoclassical price flexibility in a model otherwise "naturally" suited for rather price-rigid analysis. The quantity adjustment prevalent in a world with rigid prices does not fit the world view of the World Bank.

On the demand side, intermediates—both domestic and imported—are non-competitive and thus are determined by fixed coefficient demand functions. Factor-output ratios, on the other hand, and demand shares for domestic product and imports in Armington composite supply are governed by Shephard's Lemma which determines conditional demand functions as the partial derivatives of the cost function with respect to the factor prices: Labor demand shows an inverse relationship to the wage rate, and, making use of the scaling ratio ν , becomes

$$\frac{\partial Q}{\partial w} = \frac{L}{V} = \alpha \left(\frac{Q}{w} \right)^\sigma \Rightarrow \frac{L}{X} = \alpha \nu \left(\frac{Q}{w} \right)^\sigma \quad (5)$$

and analogously for capital. The labor share follows immediately as

$$\frac{wL}{QV} = \alpha w^{1-\sigma} Q^{\sigma-1} \quad (6)$$

The derivatives of (3) with respect to the domestic price and the import price give the respective demand ratios

$$\frac{\partial Z}{\partial P} = \frac{X}{A} = \chi \left(\frac{Z}{P} \right)^{\theta} \quad (7)$$

$$\frac{\partial Z}{\partial e \tau Z'} = \frac{E'}{A} = \delta \left(\frac{Z}{e(1+t)Z'} \right)^{\theta} \quad (8)$$

Consumption demand in the multi-sector setting is determined by a linear expenditure system (LES), in which demand above a subsistence basket rises with income according to the size of Engel elasticities. In our one-sector example, consumption along the household columns in the SAM is

$$ZC = QV - ZT - S_P \quad (9)$$

With government expenditure fixed in nominal terms and investment either predetermined or savings-driven, we arrive at the material balance

$$A = \left(1 - a \chi \left(\frac{Z}{P} \right)^{\theta} \right)^{-1} D_{fin} \quad (10)$$

where $D_{fin} = (C + G + I + E)$ is real final demand and the term in brackets is the Leontief inverse augmented by equation (6) in order to substitute for X .

We set savings—in World Bank models often treated as "just another good" and certainly not influenced by differential savings rates—in Kaldorian fashion as the sum of savings out of profit and wage income

$$S_P = S_r - (S_r - S_w) \alpha Q^{\sigma-1} W^{1-\sigma} \quad (11)$$

so that $\partial S_P / \partial W < 0$ with $\sigma < 1$.

Finally, the World Bank attaches huge importance to its policy metric of choice: "welfare gains" as quantified by "little triangle" calculations of how reducing (say) a tariff will shift the economy toward a Pareto optimal allocation. While "increasing welfare" is a precious goal of many economists (and even trade negotiators) it might be helpful to recall what it means in the context of a micro/trade-driven computable model—namely nothing but a standard calculation of changes in expenditure, given utility, at pre- and post-reform prices.

Note that changes in real spending apart from those induced by prices movements do *not* figure in the standard calculations.¹⁵ In the following two sections we show, first, how these estimated welfare changes are biased by macroeconomic “income effects” in Armington-type CGE solutions and, secondly, why the World Bank reports *only* such welfare measures.

The "Armington Effect"

The model we suggest in the previous section is in its structure not very different from our computer-based model, which features three different sectors, intra- and extra-regional trade and a couple of more policy instruments. Nor is it very different from the World Bank's LINKAGE-model—and just how such a model behaves is seen best in computer simulations. These simulations are discussed at length below, but before proceeding to the opaque world of a hundred and something equations (not to mention those completely inscrutable nests of roughly 50.000 equations in LINKAGE), we focus on a—to our knowledge— previously unnoted phenomenon we call the “Armington effect.”

The story contrasts income and substitution effects. If the fiscal deficit is assumed to be fixed, then a tariff reduction must be offset by higher income taxes which will induce a drop in consumption. Consumption should increase, on the other hand, because import prices fall. The Armington assumption, however, forces the pass-through of tariffs into supply prices to be less than 100%. Cutting tariffs thereby *reduces* consumption, a thoroughly non-intuitive result.¹⁶ As it turns out, the consumption crunch is lower (and welfare gains higher), the higher the Armington elasticity of substitution.

To show this, let's consider a still further simplified one-country Armington economy. We assume that no intermediate inputs are required, so that $QV = PX$. Households do not save,

¹⁵ The World Bank usually reports the more conservative welfare measure, Equivalent Variation, which compares expenditures at pre-reform prices. Consumer- and producer-surplus “triangles” in the standard diagram fall in between Equivalent and Compensating Variation. In the simulations discussed below, we chose to report the average of Equivalent and Compensating Variation.

¹⁶ With 100% price pass-through, these two effects will offset one another. There will still be a switch toward imported goods in the consumption basket due to substitution effects which lead to standard little triangle welfare improvements.

investment is equal to zero, and as usual the governments deficit is balanced by the foreign aid inflow $e\Delta'$. The Armington effect becomes apparent in the consumption response to tariff changes. Consider the consumption column in Figure 1—with $S_P = 0$, $ZC = PX - ZT$, or equivalently in real terms

$$C = \frac{P}{Z} X - T \quad (12)$$

where consumption increases with a rise in the relative price ratio P/Z induced by falling composite supply prices and decreases with a rise in taxes. Let's think through the latter effect first: Suppose for a moment that—as in LINKAGE-style models—the government is not only willing but moreover able to control its deficit such that a loss of tariff revenue is counteracted by an equal increase in lump-sum taxes T . From row E with fixed nominal spending and (negative) saving, we have $\partial T / \partial t = -eZ'E' / Z$.

How do relative price changes affect consumption? The Armington price Z falls with trade liberalization, whereas the assumption $QV = PX$ renders P stable so long as factor prices do not change. Consequently, (P/Z) rises and spurs consumption—but just by how much? The change in the composite supply price following tariff changes is

$$\frac{\partial Z}{\partial t} = -\frac{\partial eZ'}{Z^2} \left[\frac{Z}{e(1+t)Z'} \right]^\theta. \quad (13)$$

The total effect on C above therefore depends on the relative size of the tax and price change effects. With some manipulation one can show that the tax increase (in absolute terms) and following consumption drop are always greater than the rise in the price ratio and following consumption increase:

$$\left| \frac{eZ'E'}{Z} \right| > \frac{\partial eZ'}{Z^2} \left[\frac{Z}{e\tau Z'} \right]^\theta PX$$

or

$$E' > \delta \frac{PX}{ZA} E'. \quad (14)$$

The left hand—consumption reducing—side is always greater than the right hand—consumption increasing—side. A higher value of the elasticity θ means that the consumption shortfall is less.

In a more complete model output subsidy removal has the opposite impact, as discussed in more detail below. With more than 45.000 equations and a slew of policy instruments generating income effects that can operate on consumption levels in either direction, the Armington trade specification opens the floodgates to biases of unpredictable size and direction! With reciprocal liberalization in other regions, larger trade elasticities increase export demand, which, in combination with the consumption inducing domestic price changes can outweigh the negative tax effects.

These complications depend crucially on the specific Armington price equation. Our simulations confirm the Armington bias built into the interaction of liberalization and fiscal policies. They show a strongly positive correlation between the size of the Armington elasticity and the welfare gains (at least in the developing region). See Figure 5.

Balance and Closures

Macroeconomic balance is the sum of the internal private balance, the public balance, and the foreign balance. In the identity below discrepancies between investment and savings or government spending and revenue are offset by the external balance between exports and imports, the latter nominal aggregate ZM here as the sum of intermediate and Armington imports valued at domestic supply prices.

$$[ZI - S] + [ZG - Y_G] + [ZE - ZM] = 0 \quad (15)$$

How is this balance achieved? A plethora of causality assumptions and combinations exists, even within the set of few equations above. We focus our analysis on two such closures, one we call the Bank's closure and the other an Absorption closure. The former replicates the key assumptions the World Bank usually employs, amongst them savings-driven investment, balanced trade, fixed (or full) employment and adept fiscal programming which guarantees a balanced budget. The latter stands as our Keynesian response to that; besides the age-old

income adjustment in the balance of payments the absorption closure features pre-determined investment, an endogeneous government deficit and the possibility of varying employment levels. We discuss both in a bit more detail.

The Bank's closure works along the lines of the hoary elasticities approach to the balance of payments (as extended by fiscal effects discussed above and illustrated below). The government deficit, the current account, and employment levels are exogenous. Simulation results under these assumptions do not allow one to draw conclusions about the likely future behavior of these variables. They are set in stone at their base year levels, so that any—however drastic—changes affect neither the public and foreign deficits nor the (un)employment rate.

Consistent with neoclassical theory, adjustment is mainly carried out by variation of prices. As will be seen, however, the price changes often dance to macro- and not microeconomic tunes. Besides goods prices, factor prices and the exchange rate shift so that the aforementioned constraints are satisfied. If the government deficit is predetermined, the government is not able to finance expenditure by increased borrowing. Tariff and subsidy rates are simulation parameters and prices adjust endogenously, hence the only variable that can adjust in the government balance is the household consumption tax. In the private balance, investment adjusts to savings and, lastly, the exchange rate adjusts so that the current account stays constant. With regard to factor markets, full employment rules. In the Bank's closure the totals of employed labor and capital in the two economies are assumed to be constant. At the sectoral level, however, labor-capital ratios can (and must) shift in any new solution.

First, recall the government's balances. As discussed in detail above, with fixed nominal spending and a constant deficit the government's budget constraint cannot budge. Consequently, revenue along the row has to be constant as well. As tariffs come as a policy instrument, taxes have to be endogenous.

$$\overline{ZG} + \overline{S_G} = \overline{Y_G} = \overline{ZT} + e\overline{tZ'E'} \quad (16)$$

In the government's flows of funds

$$\overline{S_G} + \overline{B} + e\overline{\Delta'} = 0 \quad (17)$$

the foreign capital inflow $e\Delta'$ finances the current account deficit, and in that sense is determined by trade flows. The only adjusting variable able to satisfy this accounting constraint is the amount of treasury bonds sold to households. The government finances its deficit by a combination of foreign aid (on which it doesn't have an influence) and domestic debt.

Household's income is equal to value added, its budget constraint the sum of expenditures along the column and its flows of funds are

$$S_P - ZI - B = 0 \quad (18)$$

where households happily buy bonds B up to the amounts the government requires them to, and channel the remainder of their savings into investment. Thus, higher government debt crowds out private ZI . As ZT is endogenous and increases post-tariff liberalization, consumption decreases, subject to the Armington effect described above.

In the foreign balance the exchange rate is endogenous. Recall that the World Bank's model does not feature an explicit exchange rate. The endogenous "real exchange rate" referred to in that context are the plenty of Armington and domestic prices moving against one another to guarantee balanced trade. Note that under this assumption the base year data determines the current account between two countries; no policy, not even unilateral liberalization policies can change the relative level of trade flows. Note furthermore that the higher the trade elasticities, the smaller the devaluation in the "real exchange rate" necessary to maintain that balance! High trade elasticities serve multiple purposes: Decreasing negative fiscal effects, increasing welfare gains, and reducing the required revaluation of e with its possibly hefty repercussions on economic performance.

Finally, with constant employment L the labor-wage relationship from (5) above becomes

$$\frac{w}{Q} = \alpha \nu \left(\frac{\bar{L}}{X} \right)^{-\frac{1}{\sigma}} \quad (19)$$

so that the real wage adjusts in order to clear the labor market.

Theoretically, the Bank's closure firmly rests on neoclassical microeconomics. Price adjustment prevails and ensures a smooth functioning of the economy, supported by the constancy of various macroeconomic indicators. However, this fairly standard story is heavily

influenced by the fiscal Armington effects discussed above. If trade elasticities are not unreasonably high and counteract the negative tax effect, with otherwise flexible prices and fixed quantities (such as the level of employment) changes in the fiscal accounts and their feedback into consumption are in fact the strongest quantity changes and thus drive simulation results. In turn, the underlying assumption is the constant deficit—a normative proposition with scant theoretical or empirical backing. Looking at the "Armington closure" from this perspective should raise some doubt about the validity of the World Bank's arguments in the Doha debate.

Our (Keynesian) absorption closure presents the natural antithesis to the Bank's closure. In all macroeconomic balances, causality assumptions are reversed: The fiscal deficit is endogenous. Fixing the exchange rate leaves the current account as an adjusting variable. It permits macroeconomic "absorption" of shifting import and export quantities, instead of an "elastic" adjustment of trade flows to international prices. In the private balance, investment is predetermined by investors' long-term expectations and animal spirits rather than by available savings that are automatically channeled into capital formation. Lastly, in this exercise we abandon full employment. Employment levels of labor are variable, and the wage rate is fixed. As in the Bank's closure, workers can freely move from sector to sector, but may end up under- or over-employed. Demand changes can have an impact on available jobs.

Let's consider again the government balance. Fixed nominal spending and an endogenous deficit enter the budget constraint, as taxes are a function of income QV and tariffs remain a policy instrument.

$$ZG + S_G = Y_G = ZT(QV) + eZ'E' \quad (20)$$

The government deficit adjusts to finance expenditure and absorbs the revenue reduction when tariffs are cut. Government borrowing moves up and down in any functioning economy, even when it is hypothetically constrained by IMF conditionalities or Maastricht accords. Letting it play its proper role in a model simulation is simple common sense.

The governments' flows of funds is

$$S_G + B + e\Delta' = 0 \quad (21)$$

where S_G now follows from the expenditure column. Otherwise, as above, the government finances that deficit by aid and bonds sold.

For the private sector that implies B is given in the flows of funds, and, in Keynesian fashion, nominal investment is predetermined. Savings then adjust to finance that investment, physical as well as portfolio,

$$S_p - \overline{ZI} - B = 0 \quad . \quad (22)$$

Note that the overwhelming impact of tax increases in the Bank's closure disappears. However, fiscal effects are still important: Tariff removal increases the budget deficit and, through the multiplier and in combination with relative price changes induces a consumption (and import) splurge, the latter unconstrained if the foreign deficit is allowed to vary. The (debt-financed) demand increase triggers positive employment changes. Prices change little, as they are bound by the fixed macro-prices w , r and e . We discuss below in more detail how subsidy removal has Keynesian effects. First, however, we move on to discuss differences and similarities between our model and LINKAGE, and how we bring the equations above to work.

A Similar Computable Model with a Different Simulation Strategy

In this Part we present an alternative to the World Bank in the form of a table-top two-region and three-sector CGE model which represents sub-Saharan Africa and the Rest of the World. With this model we show that when other (and arguably more plausible) assumptions about trade liberalization are made, its predicted outcomes are radically different.

Our model stylizes the CGE approach to trade and is capable of providing policy insights with regard to the Doha process. To allow for a critique of the LINKAGE framework, the model is based on broadly the same assumptions and theoretical constructs. Furthermore, in order to contrast the World Bank's model with alternatives, we change some of those assumptions.

First, we provide a detailed comparison of our model with that of the World Bank by juxtaposing excerpts from the Bank's latest technical reference document¹⁷ with brief sketches of our set-up. We also explain how the closure assumptions differ.

"The Linkage Model is a global dynamic computable general equilibrium model (CGE) with a 2001 base year. [...] A recursive framework is used to drive dynamics, with savings-led investment and productivity. The model incorporates adjustment costs in capital markets and trade-responsive endogenous productivity."

First of all, our model is static, and computes once-off effects of liberalization and other perturbations to the data built into the base-year SAM. The Bank's model is also essentially static, but it is run over a number of periods ("years") to generate a simulacrum of dynamic change. For example, tariffs are usually phased out over several years to leave room for adjustments in domestic policies as well as agents' behavior.

More importantly, the World Bank adopts the assumption that an increasing export/output ratio (say, in response to liberalization with the positive export response that is built into Bank models) raises a sector's labor productivity according to a pre-set elasticity. This idea is as old as trade theory: When autarchy breaks down in a Ricardian world in which comparative advantage determines trade patterns, the resulting specialization has positive productivity effects. In the classic example, Portugal and England increase output of wine and cloth for given factors and technology, as each concentrates on the good it can produce more cheaply. While most economists agree that such things can happen, it is by no means undisputed that there are positive linkages to growth and welfare. In its Doha models, the Bank's treatment of this issue is mechanical and ad hoc, so we chose not to pursue it.

"It features three production archetypes—crops, livestock, and other—a full range of tax instruments, price markups, multiple labor skills, vintage capital, and energy as an input combined with capital ... and incorporates 87 countries/regions, and 57 sectors" (vdM, p.1).

¹⁷ See the abstract in van der Mensbrugghe (2005), hereafter vdM.

The size of the Bank's model is on the order of 50,000 equations, which is impressive but not helpful in understanding and explaining the core working mechanisms. Heavy simplification implies that we aggregate sectors, factors and regions: We use three sectors (agriculture, manufactures and services), not 57, two factors (labor and capital), not five, and two regions (Sub-Saharan Africa and the rest of the world) instead of 87 as in LINKAGE. As discussed above with regard to the SAMs, our choice of regions stylizes trade between a large, rich and a smaller, poor region and directly addresses the Doha process with its focus on development concerns as well as the pivotal areas of negotiations, agriculture vs. non-agricultural market access (NAMA).

There are certainly important benefits from higher dimensionality. A global reduction in rice tariffs has a very different impact on Japan than Switzerland. Our model cannot address this issue, as rice prices and production are subsumed in the broad agricultural sector and, moreover, Japan and Switzerland appear to be the same country. Similarly, the ROW region comprises countries such as Indonesia and France. The Indonesian agricultural sector enters importantly into GDP and employment, whereas the most prominent aspect of France's agriculture (leaving aside the 350 cheeses¹⁸ and sundry other products that please the palates of trade negotiators which neither LINKAGE nor our model can consider) is the high level of protection it enjoys under Europe's Common Agricultural Policy.

"Trade is modeled using nested Armington and production transformation structures to determine bilateral trade flows".

The Armington trade specification has been discussed in detail above and is mentioned here for the sake of completeness: Trade is separated into non-competitive intermediate imports and imperfectly competitive final imports, the former determined by fixed coefficients Leontief demand functions and the latter by relative prices, coming from the derivative of the Armington price function with respect to the price of the imported component of composite supply.

¹⁸ The count according to Google seems to have risen since Charles deGaulle's famous question in Newsweek in 1962: "How can anyone govern a nation that has two hundred and forty-six different kinds of cheese?"

"In its standard version, it is a neo-classical model with both factor and goods market clearing.... Closure is identified with two variables—government savings and foreign capital flows. Both are assumed fixed in any given time period. In the case of the former, direct taxes adjust to meet the fiscal target. In the case of the latter, the real exchange rate adjusts to match the balance of payments constraint" (vdM, p. 51).

This "real exchange rate" appears to be, looked at more closely, anything but real. LINKAGE does not include exchange rate variables per se, and "exchange rate changes" are a metaphor for thousands of individual price adjustments which are impossible to think through in detail. Our specification incorporates the exchange rate explicitly. The Bank's hidden and our visible exchange rates are supposed to accommodate changes in trade flows such that the current account remains constant. How realistic is that? The underlying assumption is that any other forces potentially driving the exchange rate—such as political factors, institutions, and capital flows—do not play a role. The prevailing current account and exchange rate between the USA and China are but one example where this is clearly not the case. Our closure rules, discussed in the next section, allow for a more complete analysis.

Furthermore, there is no space whatsoever for unemployment in the standard version of the Bank's model. Bank models can address issues of employment (or shifts in the trade balance) but usually the modeling department chooses not to do so.

Contrary to the World Bank, we report and compare simulation results with and without a full-employment assumption. Not only employment, but also the current account and the government balance are important indicators of macroeconomic performance. The World Bank freezes these three major variables out of the analysis and focuses almost exclusively on welfare measures. Thus, our simulation strategy encompasses both the Neoclassical and the Keynesian configuration described in the previous section.

A few more details should be mentioned: All of the government's expenditure is assumed to go to the services sector. Investment demand is only for industrial goods. Intermediate imports are assumed to be exclusively intra-regional in the developed world, but exclusively extra-regional in SSA. The data appear to allow for such a simplification, as, first, the overwhelming

part of imports to SSA comes from outside the region and, secondly, it is likely that intermediates such as industrial goods and machinery have to be imported from the northern hemisphere.

The World Bank usually contrasts a model's results under complete liberalization with some "likely" Doha scenario which would take into account political realities, the current state of the negotiations, and the principles underlying them. The developing world would presumably allow more non-agricultural market access for firms from the North, and the developed world would lower agricultural protection by removing subsidies for agro-exporters as well as tariffs on imports. Thus, we compare Full Liberalization with such a Likely Doha outcome, while exploring the models working by discussing a variety of simulations with a single tariff or subsidy removal.

Sensitivity analysis is another important dimension of a complete model description. CGE models are fed a banquet of parameters that at best come from econometric analysis, but often from prior belief and (more or less) educated judgments on the part of the modeler. It is indispensable to investigate the effects of changes of parameters on results and the model's policy recommendations. Parameter values derived from a mixture of econometrics—itsself often not to trusted—and a modeler's considered opinions could quickly render conclusions irrelevant if they are not robust to "reasonable" changes.

The most important—and controversial—parameters in LINKAGE/GTAP-style trade models are the Armington elasticities. The World Bank has been criticized for using elasticity values that are "too high." Higher elasticities improve the responsiveness of trade flows to price changes, which in turn requires less adjustment in other macroeconomic variables. We will focus on Armington elasticity values.¹⁹

Limiting the analysis to "only" three liberalization scenarios, two closure rules and, say, three different regimes of trade elasticities already gives a wide range of combinations to discuss. The difference between our and the World Bank's modeling strategies becomes obvious. Instead of including scores of regions and sectors we attempt to describe broad patterns of results from different theoretical perspectives.

¹⁹ We also examined different degrees of factor substitutability, but found little effect on the overall results.

Results

In this section we delve into the various simulations and explain how different configurations affect results. Maybe the key result is that causality assumptions determine simulation outcomes. In order to get a feel for the model before radically removing tariffs and assuming more or less likely Doha scenarios we carefully examine several single tariff reductions under different closure assumptions.

Removing Agricultural Tariffs in the Developing Region

The baseline configuration features trade elasticities of a lower average magnitude with stronger econometric support than the ones commonly used in LINKAGE or GTAP. Completely removing, in a first exercise, the external agricultural tariff in the developing region—the tariff SSA applies to agricultural imports from ROW—and applying the Bank's closure rules has small, negative effects on welfare in SSA.

That the effects are small is not surprising in light of the fact that SSA's GDP is around 1.1% of ROW's. A change in just one tariff in a small open economy has effects on that economy, but triggers close to zero response in the larger partner.

In any scenario prices and quantities must be considered separately. Given the functional relationships among tariffs, prices, and wage and profit rates, we can trace a chain of causation in the results: a tariff decrease lowers the agricultural sector supply price Z in the Armington cost function and the output price P in the cost decomposition of domestic output in SSA. Real value added V decreases slightly and factor returns fall, which in turn pull the value-added price Q and the overall price level down.

Why does real value added decline? The change in relative prices due to the tariff decrease increases SSA demand for agricultural imports. In this particular simulation, real imports rise by more than 14%, whereas the average change in trade flows hovers at about 1%.²⁰

²⁰ Except for the outlier—agricultural imports from ROW to SSA—SSA exports increase by 1% and other imports decrease by roughly 1%, as the relative import price of agricultural product

Consumer households substitute Iowa maize for the local product in their mealy-meal, so that domestic agriculture faces an adverse shift in demand. Real output in SSA agriculture declines by about one percentage point, because the adverse demand shock is not neutralized by a positive shift in export demand. As we will see in other simulations this problem disappears with higher trade elasticities. In the present case, relative price changes induce demand shifts that translate into negative GDP growth.

The contraction of value added is a consequence of the core fiscal adjustment (noted repeatedly above) in the Bank's closure. The SSA government is constrained to borrow constant amounts from the private sector and ROW but receives less tariff revenue due to liberalization. Its only possible recourse in a LINKAGE world is to raise taxes on household income to balance its flow of funds—but raising taxes crowds out private consumption. Two effects contribute to a decrease in welfare: the decline in value-added tightens the private sector budget constraint and consequently diminished consumption levels are further stifled by increased taxes. The welfare losses are small—a third of a percentage point—and other macroeconomic performance indicators—employment, current account, fiscal deficit—are constant by assumption.

Removing Manufacturing Tariffs in the Developing Region

Tracing through a similar exercise exemplifies how adjustment works in the absorption closure. This time we look at the effects of removing SSA's tariff on industrial imports. Again, trade elasticities are assumed to be "normal."

Macro causality now runs along Keynesian lines, with quantities instead of prices bearing the weight of adjustment. The wage, profit, and exchange rates are fixed and the current account and government deficit are endogenous. As before, we analyze price and quantity changes. The former are essentially the same—as to be expected since we did not change the model structure. The industrial supply price Z decreases in response to the tariff removal. Factor prices are exogenous, so that the price of value-added Q cannot change. The difference with the previous

improves. Furthermore, the change in agricultural imports is approximately inversely proportional to the change in the tariff, which was 16.5% on exports from ROW to SSA.

story is that domestic output is not forced to contract if the export response lacks strength. In fact, because the foreign deficit is free to rise, neither exports nor GDP need move to balance an import surge.

The simulation results are clear: the current account worsens tremendously with rising imports resulting from the shift in the relative prices of domestic and foreign manufactures. In order to satisfy its flow of funds constraint and match the loss in tariff revenue, the government (now free to borrow more from the private sector while holding income taxes constant) increases its deficit spending.

Manufactures from the developed world are important inputs into the Sub-Saharan economy. The fall in input costs therefore increases output, at least in the agricultural and service sectors. Demand for manufactures themselves shifts towards foreign products, and real domestic output in the industrial sector contracts. Still, the overall effects on economic activity are positive. Because the government does not raise taxes, real output and value-added growth lead to an increase in consumption. SSA enjoys welfare increases, here about 1.3% of GDP. Employment is proportional to value-added, so that expansion in this exercise leads to higher demand for labor and the utilization of capital.

Sadly, the picture is not as rosy as might appear from the last few lines.²¹ Welfare increases make sense only if other macroeconomic indicators are held constant by assumption. Looking at the jumps in both foreign and public deficits,²² one can identify the risks faced by this developing economy. Chronic indebtedness, debt crises, capital flight, and political instability are only some of the problems it would confront in the not too distant future.

How the Government's "Fiscal Responsibility" Drives Simulation Outcomes

As seen in these two examples, closure assumption have a huge impact on results, especially around the government deficit. Before getting into details of the complete liberalization

²¹ The following points suggest that if the economy is not artificially held at full employment, a CGE model is probably better suited to analyze the short term than the long term questions.

²² In this simulation, the external gap more than doubles, the public deficit increases by 60%.

it is helpful to disentangle the effects of full output subsidy removal on one hand and full tariff removal on the other—as the former presents a decrease in public expenditure and the latter a dwindling of government revenues. Let's exemplify this by looking at the Bank's closure.

The output subsidy makes up a large part of the total expenditures of the government, and saving those costs translates into lower taxes on households because the fiscal deficit and government consumption are fixed. *Ceteris paribus*, lower taxes increase disposable income and thereby consumption, which leads to potentially hefty increases in welfare. Tariff liberalization, on the contrary, decreases fiscal revenue instead of expenditure and forces the government to raise taxes, which crowd out consumption and reduce welfare. These are macro effects. Nevertheless, they go a long way toward determining the characteristics of the Bank's microeconomically oriented closure. Evidently, welfare consequences of full liberalization in the Bank's closure depend not only on trade elasticities, but also on the initial height of tariffs (for government revenue) and subsidies (for government expenditures). Generously interpreted, the welfare result following subsidy removal could be interpreted as an efficiency gain, in the sense that producers employ resources in the most productive way instead of being misled by "wrong" price signals from the subsidies. Less generously, and probably more realistically, one could interpret the welfare increase as the model's inability to capture the socio-economic adjustment costs that come with such a policy change.

To summarize, full output subsidy removal in the Bank's closure has strongly positive welfare effects for the reasons just discussed. "Money" freed from the government's intervening, visible hand stimulates demand and real output increases. Import growth is strong, but high exports balance the current account due to a robust devaluation of the SSA currency.

Radical tariff elimination, on the other hand, triggers only small price changes. Composite supply increases due to the growth in trade, but domestic output decreases across the board. As import prices fall, demand for foreign product rises relative to domestic product; the consumption crunch following the rise in taxes consequently depresses domestic real output.

Full Liberalization and the Armington Elasticity in the Bank's Closure

Having sorted these things out, we can return to the initial question: What effects does full liberalization have in the Bank's closure? The leftmost bars in Figure 5 show the welfare results with reasonable elasticities in both SSA and ROW, the dashed line indicates the average Armington elasticity. SSA loses slightly more than half a percentage point of GDP, ROW gains circa 3%. If our base year data had featured higher subsidy and lower tariff rates, Sub-Saharan Africa could have very well shown higher—i.e. positive—welfare gains. ROW's welfare gains are due to the fact that subsidies were high.

Note how crucial the size of the Armington trade elasticities is. The simulations discussed thus far were all based on "normal" elasticities, meaning they average around 1.5—a reasonable mid-point of a range supported by empirical research. It is obvious that a policy conclusion to the effect that "SSA should not liberalize because simulations show a negative welfare change of a third of a percentage point" is meaningless because such a small change could be bigger in magnitude and/or have a different sign depending on the complex interaction of all parameters, base-year data, and functional and closure related assumptions. However, Figure 5 clearly shows the positive relationship in such a model between the magnitude of Armington elasticities and welfare effects in the small, dependent region.

Full Liberalization under the Absorption Closure

Let's look at liberalization under the absorption closure, with results for Sub-Saharan Africa summarized in Figure 6. As above, it helps to analyze subsidy and tariff liberalization separately. Removing all subsidies in this rather Keynesian economy has interesting effects. Subsidy elimination triggers a heavy contraction of demand as the government saves the funds it previously spent on subsidies to reduce its deficit. Taxes are not endogenous to close the government's accounts as in the Bank's closure. With government spending on services fixed and negative public savings decreasing in magnitude—subsidies don't need to be financed any longer—government income increases with double-digit growth rates in both regions. Using the same expression as before, the "money" freed up from subsidies is transferred to lower public

debt instead of to consumers in the form of lower taxes. Thus, subsidy removal suppresses demand, and with falling demand imports as well as exports decrease. Consequently, unemployment rises and welfare decreases.

On the positive side, the foreign deficit is relatively stable and the public deficit is cut in half in SSA and almost eliminated in the developed world. Where would such an economy be headed? IMF adjustment programs often prescribe contractionary policies to induce trust and increase foreign capital inflow. In the best case, this might happen; in the worst case, unemployment and income losses spur political unrest and severely impede development.

Radical tariff reform has opposite results. The current account and public deficits deteriorate, but employment, output, and welfare improve. The key to understanding these results is the same as in other closures and liberalization scenarios; it is the interaction between government revenue and deficit on the one side and the various demand responses (consumption, imports, and exports) on the other. Here, the government loses a source of revenue—tariffs—but still has to finance subsidies and other expenditures. With the deficit the adjusting variable, taxes do not increase and so do not crowd out consumption. Moreover, lower import prices increase demand for foreign product and lower costs for inputs; consequently trade and domestic production expand. Value added rises with output, and employment, consumption, and welfare follow.

However, if the willingness or ability to substitute imports for domestic product is moderate, the export response of an economically small region like SSA cannot be strong enough to counteract the import surge from ROW. Thus, the current account deficit increases.

Combined, liberalization of tariffs and subsidies brings about the worst of both, at least for the developing region: Foreign and public deficit rise, and consumption, output and employment fall. The benefits from lower import prices are too low relative to the contraction due to subsidy removal, but, on the other hand, the deficit lowering effects of the latter are not high enough to improve the public balances. As subsidies play a more important role in ROW, the deficit decreases. Still, global real output diminishes.

A "likely" Doha outcome

In our Likely Doha scenario,²³ we see the same principles at work as in the examples discussed so far. Let's begin our analysis again with the Bank's closure, where deficits and employment are fixed. Lowering the agricultural subsidy reduces fiscal outlays, which get transferred to consumers through lower taxes. Hence, ROW's consumers experience an income increase and welfare gains. In SSA, the lower tariff rate decreases import prices for manufactures, what boosts imports in that sector and thereby increases total supply. The export response is tame, because ROW did not further improve its non-agricultural market access, so that domestic output decreases in the industrial sector. However, the fall in output in the agricultural sector abroad leads to an increase in export demand for agricultural product. The drop in tariff revenue, moreover, is not steep enough to strangle consumption completely—despite a fall in nominal consumption spending, welfare rises.

As seen before, simulations under the absorption assumptions have opposite results: tariff removal is beneficial, as the increase in the deficit allows consumers to go on a spending spree, whereas subsidy removal has negative effects on output, employment and welfare because of the contractionary policy of the government. Consequently, our likely Doha scenario produces moderate welfare gains in SSA and small losses in the developed world.²⁴

It is important to realize how very sensitive all these simulation results are not only to the specific liberalization scenario and the base-year data set, but moreover to the assumptions made about which economic agents change their behavior and in what regard post-reform.

²³ Our Doha scenario reflects, even though somewhat crudely, the state of the negotiations at the beginning of 2006. It features a full removal of export subsidies and elimination of agricultural output subsidies in ROW and industrial tariffs in SSA. The extent of this liberalization is certainly stylized, but it gives us a blueprint to discuss the interests of the involved parties.

²⁴ Kraev (2005) presents an analysis of the effects of trade liberalization on GDP. Even though the model details differ, his methodology as well as aim are compatible with ours: Endogenizing output, employment, and current account in a CGE-framework allows to estimate future risks or past losses due to trade liberalization. The results presented in Kraev (2005) and here are not easily comparable. Government savings and foreign exchange inflows are fixed throughout scenarios, and either current account or employment (output) vary—which does not match either of our closure regimes. However, Kraev's research is consistent with the analysis presented here in the sense that as soon as one endogenizes current account and employment, trade liberalization induces macroeconomic volatility—with mostly negative impacts on developing regions.

Unsurprisingly, the Bank's closure shows results where macroeconomic performance is overall more stable. Unsurprising, because most indicators policy makers pay attention to are held constant. Still, welfare depends on the specific simulation scenarios, and it is in fact rather straightforward to see negative welfare changes due to a consumption crowding-out.

Equally unsurprisingly, the Keynesian closure shows relatively volatile macro-behavior. Employment, output, current account, and public deficit changes have strong spillover effects onto economic activity. The multiplier effect from a higher government deficit and income gains from import adjustments have positive welfare effects, but, as discussed above, they pose great risks for an increasingly vulnerable economy.

Conclusions

What is the World Bank's model supposed to do? A World Bank modeler, or a faithful neoclassical theorist, might answer that LINKAGE is supposed to show distributional changes, mainly of factor returns and sectoral output ratios. What industry in what country contracts or expands, post-liberalization? Such a question lends itself to the beautifully simple body of microeconomic theory. Trade-offs left and right, marginal pricing and substitution abound. As relative prices change, fully informed, homogenous and rational agents adjust behavior such that each individuals' utility is maximized and resources are fully employed. Moreover, the theorist might argue that "in the long run" or "on average" or "in such an equilibrium" trade is balanced and the government will not run a deficit, justifying the constancy of these indicators. She might say that a trade— and therefore micro—model is ill-suited to analyze macroeconomic variables such as the current account and unemployment. In fact, the key to understand LINKAGE's limitations is that no effort is spared to maintain its appearance as a micro-model, whereas we would argue that it implicitly does macro. The focus on welfare measures as the single variable indicating success or failure further underlines this wrong emphasis.

We might answer the question what LINKAGE is supposed to do with the assertion that it serves a purpose, providing arguments for powerful political interests behind the free-trade agenda. A list of points support such a conclusion: (1) The specific closure commonly chosen for

LINKAGE limits macroeconomic risks of trade liberalization by holding employment, current account and the public deficit constant; (2) The Armington trade specification increases welfare gains "behind the scenes," where (3) as well the exchange rate is hidden, so that effects of devaluation cannot be openly analyzed. Our final conclusion has to be that developing countries would be ill-advised to follow the radical recommendations of the World Bank's liberalization strategy insofar as it rests on results from the LINKAGE model.

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Figures

		1	2	3	4	5	6	7	8	9
		Costs	Armington	Priv	Gov	Foreign	Inv	Bonds	CA	
A	Domestic Supply	-PX	PX							0
B	Composite Supply	aZX		ZC	ZG	ZE	ZI			ZA
C		wL								
D	Factor Income	rK								QV
E	Government Income	a _e teZ'X	teZ'M _A	ZT						Y _G
F	Foreign Income	a _e eZ'X	eZ'M _A							Y _F
G	FoF-Private			S _P			-ZI	-B		0
H	FoF-Gov				S _G			B	eΔ'	0
I	FoF-Foreign					S _F			-eΔ'	0
J		0	ZA	QV	Y _G	Y _F	0	0	0	

Figure 1

		1	2	3	4	5	6		7	8	9	10	11	12
		Costs	Arm	Priv	Exp	For	SUM	XR	Costs	Arm	Priv	Exp	For	SUM
A	Output	-PX	PX				0		-P'X'	P'X'				0
B	Supply	aZX		ZC	ZE		ZA		a'Z'X'		Z'C'	Z'E'		Z'A'
C	Income	QV					QV		Q'V'					Q'V'
D	FoF			S		eΔ'	0				S'		-Δ'	0
E	Foreign		eZ'E'					-e ←					-Z'E'	
F					-ZE			→ -1/e		(Z/e)E				
G						-eΔ'		-e ←					Δ'	
H	SUM	0	ZA	QV	0	0			0	Z'A'	Q'V'	0	0	

Figure 2

SSA	Costs		Armington								SUM
	Agr	Ind	Agr	Ind	Priv	Gov	Exp	Inv	Bonds	Aid	
Dom(Agr)	-129.6		129.6								0
Dom(Ind)		-517.5		517.5							0
Arm(Agr)	35.8	7.3			78.8		14.3				136.2
Arm(Ind)	29.0	197.8			152.6	53.8	65.2	59.2			557.6
Factor-Inc.	60.6	279.0									339.6
Gov-Inc.	-2.8	-6.6	1.7	8.6	41.3						42.2
FoF:Priv					66.8			-59.2	-7.6		0
FoF:Gov						-11.6			7.6	4.1	0
Imp(Agr)	2.4	0.7	4.9								8.0
Imp(Ind)	4.6	39.3		31.5							75.4
Exp(Agr)							-14.3				-14.3
Exp(Ind)							-65.2				-65.2
CA										-4.1	
SUM	0	0	136.2	557.6	339.5	42.2	0	0	0	0	
ROW	Agr	Ind	Agr	Ind	Priv	Gov	Exp	Inv	Bonds	Aid	SUM
Dom(Agr)	-4728.2		4728.2								0
Dom(Ind)		-48771.7		48771.7							0
Arm(Agr)	1419.5	516.4			2585.3		538.6				5059.8
Arm(Ind)	1070.5	18852.9			15196.0	4291.9	5645.0	6461.0			51517.3
Factor-Inc.	2042.7	27439.8									29482.5
Gov-Inc.	-117.5	-1192.9	51.0	315.4	4489.4						3545.4
FoF:Priv					7211.8			-6461.0	-750.6		0
FoF:Gov						-746.6			750.6	-4.1	0
E(Agr)							-538.6				-538.6
E(Ind)							-5645.0				-5645.0
M(Agr)	206.9	92.9	280.6								580.4
M(Ind)	106.1	3062.6		2430.6							5599.3
CA										4.1	
SUM	0	0	5059.8	51517.7	29482.5	3545.3	0	0	0	0	

Figure 3

Sub-Saharan Africa							
Macro Balance							
Investment	Savings	Gov-Sp	Gov-Y	Exports	Imports		
59.2	-66.8	+53.8	-42.2	+79.47	-83.53	(-0.05)	
Ratio to GDP							
Investment	Savings	Gov-Sp	Gov-Y	Exports	Imports	CA	Def
17%	20%	16%	12%	23%	25%	1%	3%
Statistics							
Per Capita Income		Agricultural Cons.-Share		Industrial Import Shares			
\$470		34%		Extra-regional 90%		Fixed intermediates (extra) 52%	

“Rest of the World”							
Macro Balance							
Investment	Savings	Gov-Sp	Gov-Y	Exports	Imports		
6461	-7211.8	+4291.9	-3545.4	+6,183.9	-6,179.8	(-0.25)	
Ratio to GDP							
Investment	Savings	Gov-Sp	Gov-Y	Exports	Imports	CA	Def
22%	24%	15%	12%	21%	21%	0%	0%
Statistics							
Per Capita Income		Agricultural Cons.-Share		Industrial Import Share			
\$5150		14.5%		Intra-regional 99%		Fixed intermediates (intra) 53%	

Figure 4

Figure 5

Welfare Changes relative to GDP: Full Liberalization in the Bank's Closure with different Armington Elasticities

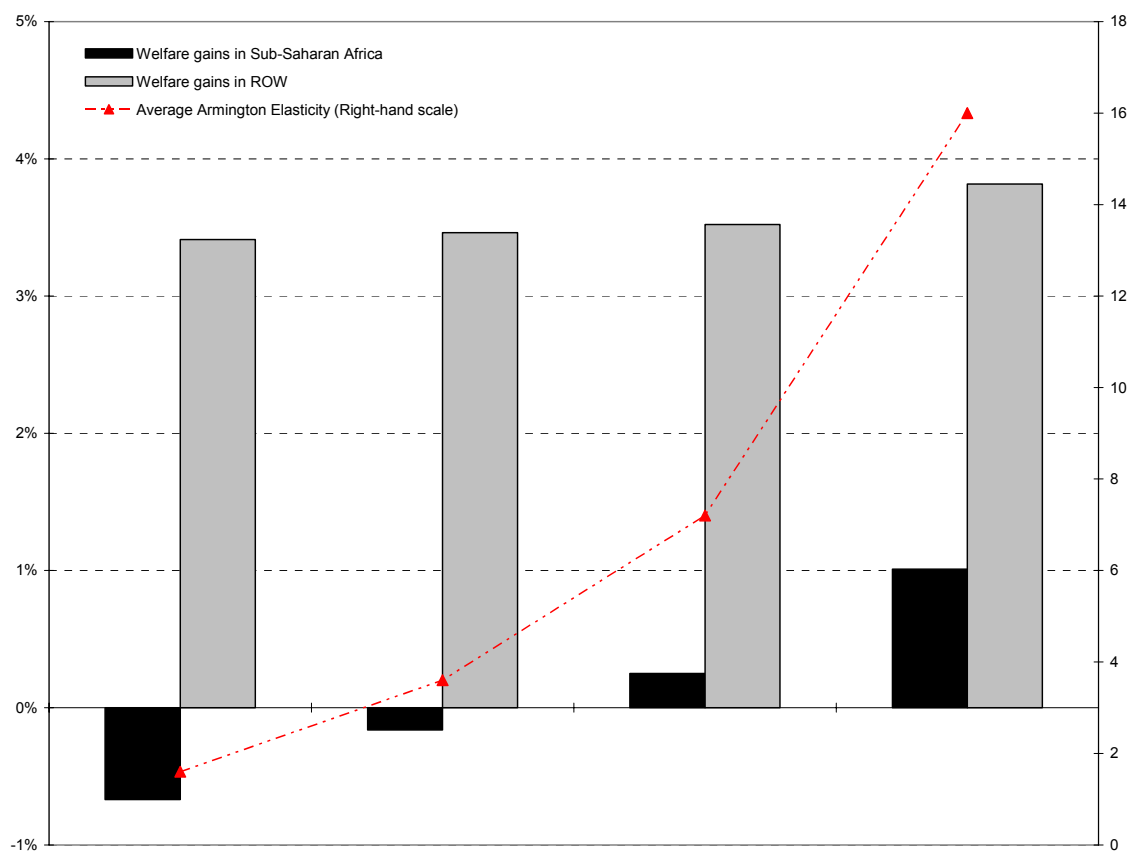


Figure 6**Selected Indicators for Sub-Saharan Macro Performance relative to GDP Absorption****Closure**