Estimating GDP effects of trade liberalisation on developing countries

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Summary

The present project aims to estimate GDP losses caused by trade deficits due to trade liberalisation. Recent econometric studies suggest that while trade liberalisation in poor countries led to an increased growth of both exports and imports, it has caused import growth to systematically outpace export growth (by 1.4 percentage points each year in a sample of 17 Least Developed Countries, and by an even larger margin in a different sample of 22 developing countries).

Note that the effect we are studying, namely, import growth exceeding export growth, is not transient, but rather worsens with time, as the difference in export and import growth rates accumulates. Therefore it cannot be fixed by a one-time financing inflow, but rather either by ever-increasing external finance (unrealistic), or by an ongoing depreciation of the real exchange rate.

This discrepancy can be expected to cause a worsening of the trade balance, and at the same time a decrease in net demand for domestically produced goods and services, causing a decrease of domestic income (GDP). The allocation of impacts between GDP and the balance of payments in each country and year would depend on private demand and government policy, as well as on the respective country's ability to raise additional external finance for the increase in trade deficit.

The present project aimed to quantify the implications of the econometric studies by using their regression coefficients in a simple macroeconomic model, which was solved for a sample of 32 LDCs and low income countries, once for each year where data was available.

The results suggest that over the countries in the sample, trade liberalisation has resulted in additional balance of between 4% and 29% aggregate demand loss (assuming balance of payments unaffected). Converting to constant 2000 US dollars, this sums up to 896 bn USD of aggregate demand losses over a 20-year period.

To assess the importance of real exchange rate depreciation in the adjustment to the trade balance deficit, we also conducted sensitivity analysis with respect to real exchange rate changes. The mitigating effect of real exchange rate adjustment never exceeded 25% of the overall impact, and was typically around 10% of the overall impact. That suggests that exchange rate changes alone are not a sufficient adjustment instrument to address trade liberalisation-caused balance of payments problems.

The sectors likely to have been most strongly affected by this GDP loss are manufacturing (a sector with most high value-added potential) and the informal service sector (typically containing a large share of the poor). The short-term damage to demand for local manufacturing products is further likely to have led to decreased investment in manufacturing capacity, undermining prospects for future growth.

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Introduction

This project aims to estimate GDP losses due to aggregate demand deficiencies arising from trade deficits due to trade liberalisation. As recent studies [Santos-Paulino 2002a,b, 2003, Santos-Paulino and Thirlwall 2004], [Unctad 2004, pp.203-204] show, trade liberalisation in poor countries led to an increase in exports, and to an even higher increase in propensity to import. This led to a worsening of the trade balance, and at the same time a decrease in net demand for domestically produced goods and services, which likely caused a decrease of domestic income (GDP).

The allocation of impacts between GDP and the balance of payments in each country and year depended on private demand and government policy, as well as on the respective country's ability to raise additional external finance for the increase in trade deficit.

The sectors likely to have been most strongly affected are manufacturing (a sector with most high value-added potential) and the informal service sector (typically containing a large share of the poor). The short-term damage to demand for local manufacturing products is further likely to have led to decreased investment in manufacturing capacity, undermining prospects for future growth.

The studies cited above quantify the changes in exports and imports due to lowering of tariffs and removal of quantitative restrictions. First, we use their regression coefficients to estimate the counterfactual balance of payments, for each country and year, that would be expected to happen had trade liberalisation not taken place, using historical GDP figures. However, this counterfactual represents an extreme assumption, namely that trade liberalisation had affected the balance of payments, with no impacts on GDP. In reality, especially the poorer countries would likely have difficulties finding extra financing for the increased balance of payments gap (especially once the reforms have been completed). Therefore, most of the impacts of deficient demand caused by trade liberalisation were likely to have been on GDP.

Thus as the next step, we use the results of Santos-Paulino to construct counterfactual estimates of GDP levels that could have been sustained from the demand side with historical levels of external financing, had trade liberalisation not taken place. For this, we use a simple injections-leakages model that could be regarded as a structuralist counterpart of the neoclassical '123' model [Devarajan et al. 1993].

Thus, we construct two 'extreme' counterfactuals, one allocating all impacts to the balance of payments and leaving GDP intact, the other allocating all impacts to GDP and leaving the balance of payments intact. In reality, some combination of the two is likely to have happened, with both balance of payments and GDP benefits somewhere in the range spanned out by our two estimates.

The following section explains why we think this particular impact of trade liberalisation is worth modeling and is among the more important aspects of trade liberalisation in poorer countries. Then, Section 2 discusses our choice of method, first in general terms, and then in more detail. Following that, Sections 3 and 4 present the data used and the definition of the counterfactuals to be modeled. Section 5 presents the results of the simulations, and Section 6 concludes.

A reader less interested in technical details might want to read Sections 1 and 2.1-2.3 for a discussion of our focus and broad method, and then proceed directly to Sections 5 and 6 for the results.

1 Chosen aspect of trade liberalisation

1.1 Chosen aspect of trade liberalisation: GDP loss from adverse trade balance effects of trade liberalisation

The aspect of trade liberalisation that we focus upon is adverse demand-side effects on GDP because of import growth exceeding export growth as an effect of trade liberalisation. Although in a typical trade liberalisation package, both import and export restrictions are removed, typically growth in import demand exceeds growth in export earnings [Santos-Paulino and Thirlwall 2004, Santos-Paulino 2003], thus leading to a net decrease in overall demand for domestically produced goods and services. This in turn leads to lower income for domestic producers, lower GDP and hence lower import demand; thus balance of payments is maintained, but at a lower level of GDP. The impact on GDP is strengthened by the multiplier effects.

It is sometimes argued that this is only a temporary phenomenon, to be remedied by one-off external financing, but it is not clear why it should be so (there is certainly no reason to be found in general equilibrium theory, as discussed in Section 2.2). If trade liberalisation leads to an increase in import demand that exceeds the corresponding increase in exports, the result will be either a *persistent* increase in trade deficit or a *permanent* reduction in GDP. If, as the regressions in [Santos-Paulino and Thirlwall 2004, Santos-Paulino 2003] suggest, trade liberalisation actually affects the *rates of growth* of exports and imports in an asymmetrical manner (increasing the yearly rate of growth of exports by 0.5% and of imports by 1.9% for a sample of 17 least-developed countries (LDCs) in Santos-Paulino [2003]), then the gap, though small at first, will actually be widening with every year, as long as that relationship holds.

Thus, there is no reason to expect the effect to be temporary, and a gap in growth rates of 1.4% between exports and imports, when cumulated over several years, is likely to produce results of noticeable magnitude. This is the effect that we will be aiming to quantify; however, this is not the only important aspect of a typical trade liberalisation package. Therefore, before proceeding to discuss modeling approaches, we discuss its relationship to the other important components. Of these, there are two broad groups, one to do with financial liberalisation and capital account dynamics, the other with supply-side effects. Let us discuss each in turn.

1.2 Other effects I: Financial liberalisation and foreign exchange inflows

Trade liberalisation has historically often been accompanied by liberalisation of the capital account, that is removal of restrictions on the movement of capital into and out of the country. Many countries that liberalised their trade as part of an International Monetary Fund-inspired structural adjustment package, have additionally been rewarded with increased concessional inflows, at least for a while (Ghana in the late 1980s is a prominent example of the latter).

As increased external inflows can compensate for aggregate demand deficiency caused by a worsening balance of payments position (in particular, it has been argued that more liberalised countries receive more external finance), one might be tempted to think that the latter is not a major problem and does not deserve the attention we are about to give it.

We would argue that this is not the case. As discussed in the previous section, there is no reason to assume the balance of payments gap due to trade liberalisation will go away after a year or two, thus such a compensating foreign exchange inflow would need to be sustained from year to year. This rules out the possibility of using grants for the purpose, as the grant flows are notoriously volatile. However, any form of sustained foreign borrowing, be it concessional or private, will lead to debt buildup and thus even greater balance of payments problems in the future (Ghana being again the case in point). The remaining option is foreign direct investment, which is generally quite low for poorer countries.

Financial liberalisation is an important subject in itself. It has often led to inflows of speculative capital, driving up exchange rates, thus further worsening the current account ('Dutch Disease'). In countries with comparatively well developed banking systems, particularly in Asia and Latin America,

the credit inflows have also often resulted in boom-bust credit cycles.

The impact of financial liberalisation has been quite different across developing countries, depending among other things on the depth of the domestic financial sector and its importance in the economy. The present inquiry focuses on LDCs and countries of sub-Saharan Africa, where banking systems are comparatively shallow and private capital inflows comparatively modest. Therefore, most of the action on the capital account was due to donor decisions. Thus, even if it was true for those countries that countries that liberalised further also experienced higher capital inflows, these two components are conceptually distinct and deserve to be considered separately. If external inflows are a function of donor policy, they should be treated as policy variables and not endogenized.

1.3 Other effects II: Supply-side effects

Another important facet of trade liberalisation are its supply-side effects, that is effects on the stock of productive capital and the structure of production. These can be roughly divided into quantitative (amount of new investment) and qualitative (technological innovation, improved productivity, etc.).

The effects of trade liberalisation on investment will have profound effects on the productive capacity of the economy in the future. Unfortunately, investment is notoriously hard to model, even in industrialised countries with their comparative data abundance, and even more so in developing countries.

In the absence of robust regressions, one has to rely on case studies and qualitative stories. These, however, also contradict each other. On the one hand, one has the promise of increased efficiency in import-competing industries and new investment in exportable goods due to improved incentives; on the other hand, a number of studies indicate that investment is hit quite hard by a number of components of a typical liberalisation package, from decreased aggregate demand to high interest rates and increased competition from cheap imports. The qualitative effects such as technological innovation are even harder to assess.

Summing up, in this paper we focus on adverse GDP effects of balance of payment deficits caused by trade liberalisation, under conditions of scarce access to foreign exchange. While capital account developments and supply-side effects are also extremely important, the former are conceptually distinct from trade policy in the case of poorer countries; and the latter are somewhat contested and lack robust quantification. Thus while our results will not be comprehensive, they will give a picture of an important component of trade liberalisation impacts for those countries and time periods where scarce access to foreign exchange is a valid assumption.

2 Choice of method

2.1 Computable general equilibrium models, neoclassical and otherwise

To quantitatively address our question, we need a widely accepted methodology that allows us to combine individual behavioral equations with comprehensive economy-wide accounting.

The methodology most often used for this purpose are computable general equilibrium models (CGEs). A CGE takes the data on a given economy's money and product flows, combines these with a priori assumptions on causal mechanisms in that economy and gives one the implications thereof. If the causal structure we assume (also known as choice of closure) is a good description of the economy at hand, the model output will be credible. A CGE does not itself allow us to verify the assumptions that went into it, but it does allow us to quantify their implications.

The use of CGEs for policy analysis is controversial because there is no consensus on the appropriate assumptions to make. Thus, for example, the model by Sahn et al. [1996] cited in the 2004 UN Conference on Trade and Development (Unctad) LDC report was harshly criticised by de Maio et al. [1999] as using assumptions that were not appropriate to the economies being modeled.

The mainstream thinking on impacts of trade policy is deeply influenced by the Heckscher-Ohlin international trade model, whose key assumptions are automatic full employment, frictionless relocation of productive capacity between exports and nontraded goods (albeit subject to diminishing returns), and balanced trade (no trade deficits). Under such conditions, it is easy to demonstrate that increased trade will have net beneficial impacts for all involved.

This line of argument is continued by Walrasian/neoclassical CGE models, which no longer necessarily assume balanced trade, but still rely for their conclusions on automatic full employment and frictionless relocation of productive capacity between sectors. The simplest of such models is the '123' model by Devarajan et al. [1993]. Its name stands for 'one country, two sectors (nontraded and exported) and three goods (exports, imports and nontraded goods)'. Its simplicity allows it to be calibrated using only national accounts data and a couple of key elasticities, and it was for a while much promoted by the World Bank as an entry-level CGE model for use by the developing countries.

Unfortunately, '123' is a typical Walrasian model in that it assumes automatic full employment throughout. The importance of that one assumption in determining the behaviour of the model can not be overemphasized. For example, in a Walrasian model an increase in export production will only be possible by relocating some labour from the nontraded goods production, thus an increase in exports must be associated with a *decrease* in nontraded goods production. On the other hand, if production of nontraded goods were demand-driven, with variable utilization of productive capacity, then increased income from exports would translate into higher demand for consumption and investment goods, in particular nontraded ones, leading to an *increase* in nontraded goods production.

Thus, before using a model for drawing policy conclusions, it is crucial to decide whether it shall include the full employment assumption.

2.2 Short-term vs. long-term?

The usual neoclassical argument regarding the full employment assumption is that it can be expected to prevail in the 'long term', once the short-term shocks have been adjusted to. However, this statement is in conflict with persistent evidence of chronic unemployment in many developing countries, and (perhaps a little more surprisingly) also in conflict with general equilibrium theory. If one goes back to read the general equilibrium classics such as Arrow [1974], one sees that full employment is only guaranteed if there are functioning futures markets for *all* commodities *contingent on all possible future states of the world* (so that it is, for example, possible to have a contract to buy a loaf of bread tomorrow, but only if it rains); since the majority of such markets are neither existing nor even feasible, there is absolutely nothing about the 'long-term' that guarantees full employment of either labour or capital [Kraev 2003].

The justification of full employment as a 'long-term' property is even less defensible if the CGE model in question is expanded to include accumulation of capital and financial stocks and then resolved on a yearly basis - how can the long term obtain over a year's time?

In reality, developing countries are continually subjected to shocks, both external and internal, such as changes in price of their exports or in government policy. This, together with evidence of persistent unemployment and underemployment, leads us to conclude that an adequate CGE model of a developing country must allow for variable utilization of productive capacity.

In fact, once the full employment (or rather, fixed output) assumption is no longer built in, our model (presented in the next section) can be used to *test* it – and the data suggests, once again, that it does not hold, even after taking into account exchange rate response (Appendix B).

2.3 A simple variable-output model

We will estimate the costs of trade liberalisation by solving a very simple computable general equilibrium model[2] built along structuralist lines, for each country and each year where data is available. The model will have a variable-output closure (injections/leakages equilibrium) formulation following Godley and Cripps [1983] and Berg and Taylor [2000]

We take essentially the same accounting framework that the '123' model uses (one country, two sectors, three goods), but modify its closure to allow for variable capacity utilization. Another simplification we make is doing all accounting in dollars, thus allowing us to sidestep domestic inflation issues. This does not introduce a theoretical weakness, since in '123', as in all Walrasian models, the nominal aggregate price level is tacked on top of the model and does not affect the real-side variables (this is, in fact, the exact approach chosen by Devarajan and Lewis [1990]).

The details are written out in Appendix A, but the basic story of the model is simple enough. Namely, suppose that tariffs change relative prices of exports and imports compared to the domestic goods, which changes export and import volumes. That leads to an imbalance in the balance of payments due to a higher increase in the demand for imports than in export revenue. This translates into a lower overall demand for domestic goods, and as a large part of any economy is demand-driven, that leads to a decrease in GDP. As a result, import demand also declines, bringing balance of payments back into balance.

The crucial points of that story are the choice of variable-output (or quantity-clearing) closure, that is, taking the main adjusting variables to be (nontraded) output on the income side and consumption or investment on the expenditure side; and an external financing constraint, that prevents unlimited borrowing to cover the trade balance deficits. The first of these we have discussed in the previous section; the second we elaborate upon in Section 2.4.2. Our model is in fact a variant of two-gap models (reviewed in Taylor [1994]), with the trade account as the 'binding gap'.

An additional choice we make is to calibrate the model and conduct experiments separately for each year rather than simulate the same model across several years. This allows us to omit from the model equations many factors, such as world prices, that differ between years and matter for model behaviour, but are unaffected by our counterfactual experiments. We can thus obtain a particularly lightweight model formulation that would not be useful for addressing some other issues such as debt accumulation, but is perfectly adequate for our question, namely negative effects of liberalisation-caused balance of payments deficits on GDP.

A neoclassical/Walrasian model would seek to avoid quantity effects (such as GDP decreases) altogether by adjusting relative prices, notably the real exchange rate. However, all Walrasian models assume automatic full employment, and thus are fundamentally unable to represent the very recessionary impacts that we are trying to estimate. Also, the role of real exchange rate as the clearing variable for the balance of payments is not supported by data (at the very least, one has to include portfolio balance considerations; and [Taylor 2004, ch.10] argues that even this will not work). Thus, we feel that allowing for variable capacity utilization is more important than endogenizing (in an unrealistic manner) the real exchange rate. The issue is discussed in more detail in Section 2.4.6.

Summing up, while more sophisticated models would be possible, even using the same data, our choice of approach is caused by two factors: firstly, the model used must be so simple as to be transparent, so that the debate can focus on the policy implications rather than on the model details. Secondly, its equations must not a priori preclude impacts of changes in tariff rates on real GDP, which means that traditional Walrasian/neoclassical formulations are not useful. Thus, our minimal demand-driven model appears to be the best solution for the task at hand.

The following section discusses and justifies in some more detail some of the specific modeling choices we make.

[2]Since our closure is quantity- rather than price-clearing, one might argue that it is not a "proper", meaning Walrasian, CGE. We believe that this is a purely linguistic issue, and the approach can be called a quantitative analytical framework instead if it doesn't fit the reader's idea of what a CGE should be.

2.4 Specific modeling choices

This section begins the more technical part of the paper. The less technically inclined reader might want to skip directly to Section 5, Results.

2.4.1 High aggregation level

The model stays at the macro level, with the same sectoral/product structure as the '123' model, namely 2 sectors (nontraded and export) and 3 goods (imports, nontraded goods and exports). The advantage of that is that we need little beyond the standard national account and balance of payments data to calibrate the model. As that data is available for most countries and most years, we can achieve broad coverage.

The disadvantage of staying at this level of disaggregation is that it does not capture the sectoral and distributional impacts of trade liberalisation. As rough sectoral output data is also broadly available, it would be conceivable to include some sectoral structure in the future; however, for pragmatic reasons we restrict ourselves to capturing purely macro impacts at present.

2.4.2 Foreign exchange inflows are constant across different scenarios

While liberalisation programmes in the countries that we are looking at (LDCs, low income and sub-Saharan Africa countries) have often been associated with extra capital inflows, the two are conceptually separate phenomena, and it makes sense to consider them separately, especially as concessional inflows are a function of deliberate donor policy, not spontaneous private sector dynamics.

The precise question our model is answering is 'How large a GDP level could have been sustained from the demand side, given historical lending flows, if the balance of payments impacts of trade liberalisation had not happened?'. Thus, this assumption is not necessarily indicative of a foreign exchange strangulation, but rather of the particular counterfactual that we are constructing.

In addition, we construct a complementary counterfactual, namely assuming the GDP was unaffected and computing the pure balance of payments impacts. In reality, the impacts would likely have been a combination of the two.

2.4.3 Constant government deficit across scenarios

As a result of trade liberalisation, revenues from export and import tariffs are likely to fall; as a result of the adverse GDP impact, revenue from taxes such as VAT and income tax is also likely to fall. Thus, in addition to the GDP impact, our framework computes the reduction in government revenues that will translate either into increased deficit or reduced government spending.

In the current version of the model, we assume that spending is adjusted in line with revenues so as to keep deficit constant. This is not unrealistic: most countries liberalised their trade as a part of an IMF package, the performance conditions of which were likely to include constraints on government deficit, so that spending will have to be reduced in line with revenues.

However, this is not as critical to the model formulation as the foreign exchange constraint. Since ours is a flow-only framework, if the government runs a deficit, it will have to borrow from the private sector, correspondingly reducing its demand. Thus, given the balance of payments constraint, government deficit only determines the allocation of absorption between government and the private sector; we could just as easily assume that the government fixes its *spending* and interpret the reduction in revenues as an increase in government deficit rather than as a decrease in spending; the GDP impacts wouldn't be affected.

2.4.4 Only compare history in a year to counterfactual in the same year

In real life, changes in government deficit in a year result in changes in government debt and therefore interest payments the following years (though a large part of these deficits in LDCs are closed by

budgetary grants which do not lead to debt accumulation). However, we do not keep track of that, because we construct a separate model for each year. The reason is that it allows us to control for exogenous influences, for example on exports and imports that change from one year to the next, such as international commodity prices or world GDP. While this limits the applicability of our framework to some problems, such as debt dynamics, it does not invalidate its use for the purpose at hand, as exports and imports tend to react quite quickly to relative prices ([Santos-Paulino and Thirlwall 2004], compare Table 1). On the positive side, it massively simplifies the model formulation, allowing us to get by with very few variables.

2.4.5 All accounting is done in dollars

We do all accounting in dollars to avoid dealing with domestic inflation issues. This is not to suggest that these are unimportant, but rather that they are not at the focus of our inquiry. While neoclassical CGE models usually do the accounting in domestic currency, upon closer inspection their equation for the aggregate price level ($PY = MV$) separates out cleanly from the real side of the models, so that in that respect their treatment is not very different from ours.

2.4.6 Neglect impacts of counterfactual on the real exchange rate

This approximation is perhaps the weakest of the present framework, though not as weak as would appear on first sight.

As we are doing our accounting in dollars, we do not have a nominal exchange rate in the model. However, this choice of accounting does not abolish the fact that the real exchange rate is both quite variable and an important determinant of the balance of payments. Why does it not play a more prominent role in model closure?

Firstly, as we only compare model behaviour to history in the same year, we are automatically correcting for any changes in the real exchange rate that are not caused by our counterfactual experiment (more v less trade liberalisation), for example due to changes in world prices. Thus the only thing that could use a better representation are changes in the real exchange rate specifically due to the differing degree of trade liberalisation that we simulate.

Unfortunately, there is no widely accepted theory of exchange-rate behaviour in a CGE context [Taylor 2004]. Walrasian models tend to let it adjust freely so as to clear the balance of payments; however, this hypothesis is not supported by observation. Ultimately, while ignoring exchange-rate reaction to choice of counterfactual is admittedly a weakness, we believe it is not a worse approximation of reality than forcing it to clear the balance of payments; and our approach has the advantage of allowing for variable output, a crucial feature not present in Walrasian models.

As a step towards overcoming that weakness, we conduct sensitivity analysis of the results with respect to the real exchange rate, with results shown in Appendix B.

Summing up, while our treatment of the real exchange rate does not include the effect of the counterfactual (no trade liberalisation) on real exchange rate, it does account for all other effects, such as changes in world prices, and sensitivity simulations show that historically observed changes in the real exchange rates following liberalisation would not change our results by much more than 10%.

3 Data

This section describes the data we use for our model. These consist of standard national accounting data, behavioural parameters, data on export and import tariffs, and overall timing of trade liberalisation. Let us discuss each in turn.

3.1 Selection of countries in the sample

The initial criterion for the selection of countries in our sample is the requirement that the inflows of private capital be relatively small compared to concessional finance. That allows us to regard external funding as an exogenous (policy) variable and thus frees us from having to represent the complex interactions between external inflows and credit, interest rates, and exchange rates, such as the boom-bust cycles observed, for example, in many Latin American countries.

To achieve this, we restrict ourselves to all countries that are either low income countries according to data in the World Bank 2003 World Development Indicators, or least developed countries according to the Unctad 2004 LDC report [Unctad 2004], or are situated in sub-Saharan Africa. This gives us a total initial sample of 70 countries. The actual model is solved only for those countries in this initial sample for which we could obtain data on timing of trade liberalisation (see Section 3.5), a total of 32 countries. The specific countries are Bangladesh, Benin, Bhutan, Botswana, Burkina Faso, Cambodia, Cameroon, Cape Verde, Ethiopia, the Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, India, Indonesia, Kenya, Lao PDR, Madagascar, Malawi, Mali, Mauritania, Nepal, Nicaragua, Pakistan, Senegal, South Africa, Sudan, Tanzania, Togo, Uganda, Republic of Yemen, and Zambia.

3.2 National accounts

The national accounts data will be taken from the World Development Indicators (WDI) database by the World Bank. This part of the data has the highest availability and quality. While far from perfect, it is quite sufficient for our purposes, which are after all rather rough estimates.

For comparability, all time series (exports, imports, GDP, etc.) are converted to constant 2000 US dollars, and used to compile a series of mini-social accounting matrices (mini-SAMs), one for each country for each year, used in calibrating the model (see Appendix A for details).

3.3 Behavioural parameters

The most crucial bit of information we need to specify our model are behavioural parameters, specifically determinants of export and import behaviour. As the general equilibrium methodology does not by itself allow validation of behavioural parameters, we have to use pre-existing research on the issue. The paper we will be using is Santos-Paulino [2003] (cited in [Unctad 2004]), which applies the methods of [Santos-Paulino 2002b,a, Santos-Paulino and Thirlwall 2004] to a new sample, consisting of 17 LDCs.

Among the results of Santos-Paulino [2003] there are regressions of the growth rates of exports and imports on their traditional determinants, namely the real exchange rate, growth in income (world income for exports, local income for imports), one-year lags of the dependent variable to test for the speed of adjustment, the effective rate of duties (on exports and imports, respectively; computed as the ratio of duties actually collected to actual exports and imports respectively), and the non-tariff trade liberalisation dummy. We reproduce the results that we will be using in Table 1.

The innovative aspect of these regressions is the use of a dummy variable to proxy non-tariff trade liberalisation. For a given country, that dummy variable is zero until a certain year, 'initial year of trade liberalisation' for that country, and one after that. Despite the simplicity of that representation, Table 1 shows that trade liberalisation thus measured is statistically significant both by itself and in interaction with the other independent variables. Thus for example, the liberalisation (shift) coefficient for exports ($\tilde{a}_0$) being equal to 0.5 shows that trade liberalisation increases the growth rate of exports by half a percentage point.

Let us briefly examine the coefficients in Table 1. Firstly, the lagged growth rate of the dependent variable is not significant for either exports or imports. This means that long-run elasticities are not significantly different from the respective short-run elasticities (at least to the extent that they can be measured by a regression such as this) and that it is reasonable to assume that adjustments take place within one year. That supports our using an equilibrium model on a one-year time scale. How

Table 1: Determinants of export and import growth (Source: Santos-Paulino [2003], Tables 2 and 5)

Explanatory variables	Dependent variable: export growth	Coeff. name	Dependent variable: import growth	Coeff. name
Real exchange rate growth, *px* resp. *pm*	-0.03 (3.33)**	a_1	-0.11 (4.82)**	b_1
Income growth (world *wy* resp. local *y*)	1.72 (5.02)**	a_2	1.63 (5.99)**	b_2
Lagged growth rate of the dependent variable	0.07 (0.92)		0.13(1.50)	
Effective duty rate	-0.19 (2.12)*	a_3	-0.12 (2.09)*	b_3
Liberalisation (shift), *lib*	0.50 (5.15)**	$\tilde{a}_0$	1.87 (5.94)**	$\tilde{b}_0$
Aid growth as share of GDP, *aid*			0.29 (4.29)**	b_4
Slope dummy $wy \times lib$ resp. $y \times lib$	0.15 (5.05)**	$\tilde{a}_2$	0.21 (6.05)**	$\tilde{b}_2$
Slope dummy $px \times lib$ resp. $pm \times lib$	-0.02 (2.94)*	$\tilde{a}_1$	-0.12 (6.41)**	$\tilde{b}_1$
Slope dummy $aid \times lib$			0.53 (4.44)**	$\tilde{b}_4$

we translate these regression coefficients into model parameters is discussed in Section A.2.

Another interesting result in Table 1 is that liberalisation dummy results in an increased yearly growth rate of half a percentage point for exports, and almost two percentage points for imports. While not huge on the face of it, this discrepancy in additional growth rates will happen *every year* after liberalisation and can be expected to cumulate to substantial imbalances over a decade or two[3].

These coefficients were estimated on a sample of 17 LDCs; one could thus ask whether we are justified in applying them to a larger sample of countries. However, Santos-Paulino and Thirlwall [2004] applied the same regression to a more diverse sample of 22 developing countries, and came up with a much stronger effect of the liberalisation dummy (a discrepancy between export and import growth rates of eight percentage points), so we are keeping our estimates conservative if we use the LDC estimates for our sample.

3.4 Tariff rates

We use the IMF's government finance statistics data on actual government revenue from export/import tariffs, and compute effective export/import tariff rates as the ratio of that revenue to the total value of exports/imports.

While using effective, rather than applied and/or bound tariff rates, has its problems Irwin [1998], in our case we choose it for compatibility, as the work by Santos-Paulino and co-authors also used effective rates.

The data on actual government revenue on international trade is for some countries/years only available as the sum of export and import tariff revenue, and not available at all for some country/year combinations. If only the total tariff revenue is given, but not broken down into import/export components, we will pretend that all of it comes from import duties, as countries are at least as likely to subsidise, as to tax, their exports.

[3]As one of our reviewers rightly remarked, growth rates of different macroeconomic aggregates cannot differ from each other for indefinite periods of time; however, we feel justified in using the coefficients over the same time period that the regression dataset had, namely 1970 to 2001.

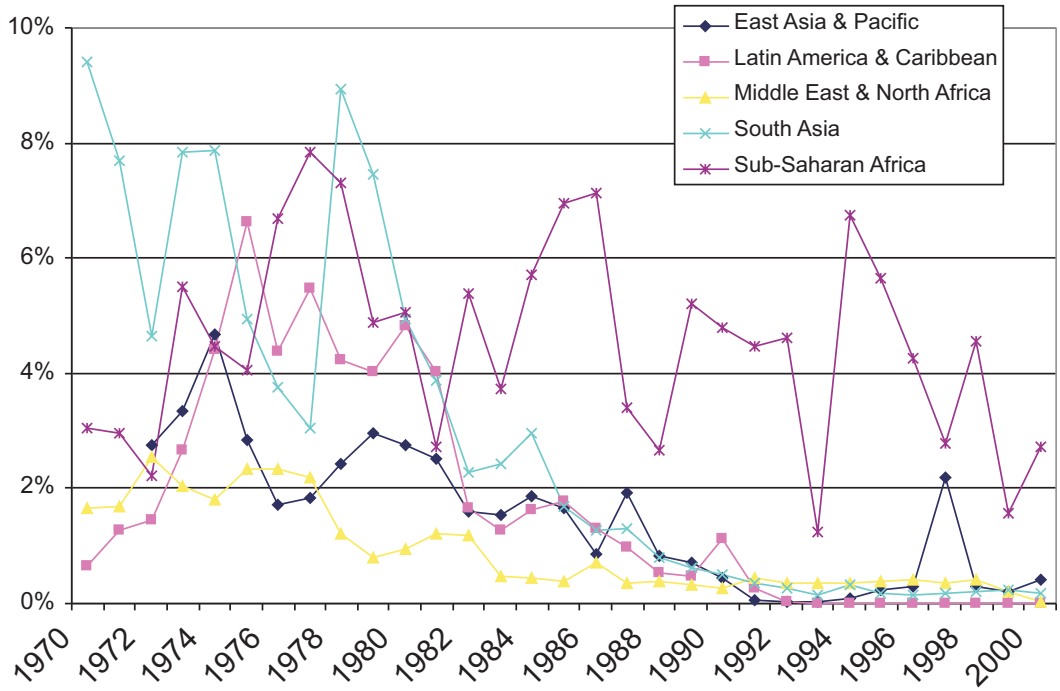

Figure 1: Average effective export tariff rates of low and middle income countries

If for a certain country/year combination no tariff data at all is available, we proceed as follows: first, we compute average tariff rates for all countries in our initial sample (consisting of LDCs, sub-Saharan Africa countries and lower income countries), sorted by geographical region. Then, for countries for which no tariff rate data at all is available, we use the regional average values. If tariff rate data for a country is available for some, but not for all years, we rescale the regional tariff rate curve (regarded as a function of time) to fit the available values using least-squares, and use the thus rescaled rates in place of the missing values.

As a result of this approach, the output of our exercise should be treated with caution for each individual country in the sample, but will be representative on the regional and aggregate levels.

The time series for effective tariff rates on exports and imports for low and middle income countries, grouped by geographical region, are presented in Figures 1 and 2. What these figures tell us is that the impact of trade liberalisation probably won't be glimpsed from the time paths of the tariffs alone. Effective import tariffs tend to meander between about 7% and 17% and do not show a great propensity to decrease over time, except for a dip in the late 1990s. In fact, in the 1980s effective import rates tend to go up, probably reflecting the replacement of quantitative restrictions by tariffs. Export tariffs hardly ever exceed 7% and are virtually eliminated by the 1990s, except in sub-Saharan Africa; but even there they tend to stay below 5% and show a slight downwards trend.

All in all, if we want to assess the impacts of trade liberalisation on the balance of trade and on aggregate demand, we can expect the main impacts to come from the other aspects of trade liberalisation, proxied in our case by the liberalisation dummy variable and its associated slope dummies, as described in Table 1. To apply these, we need to know when liberalisation began in a given country, and data on that is discussed in the next section.

3.5 'First year' of liberalisation

A key piece of information necessary for using the results in Table 1 is the initial year of trade liberalisation in each country. While clearly this is not a very well defined concept, and it would be more realistic to specify time *periods* during which the bulk of trade liberalisation happened (as

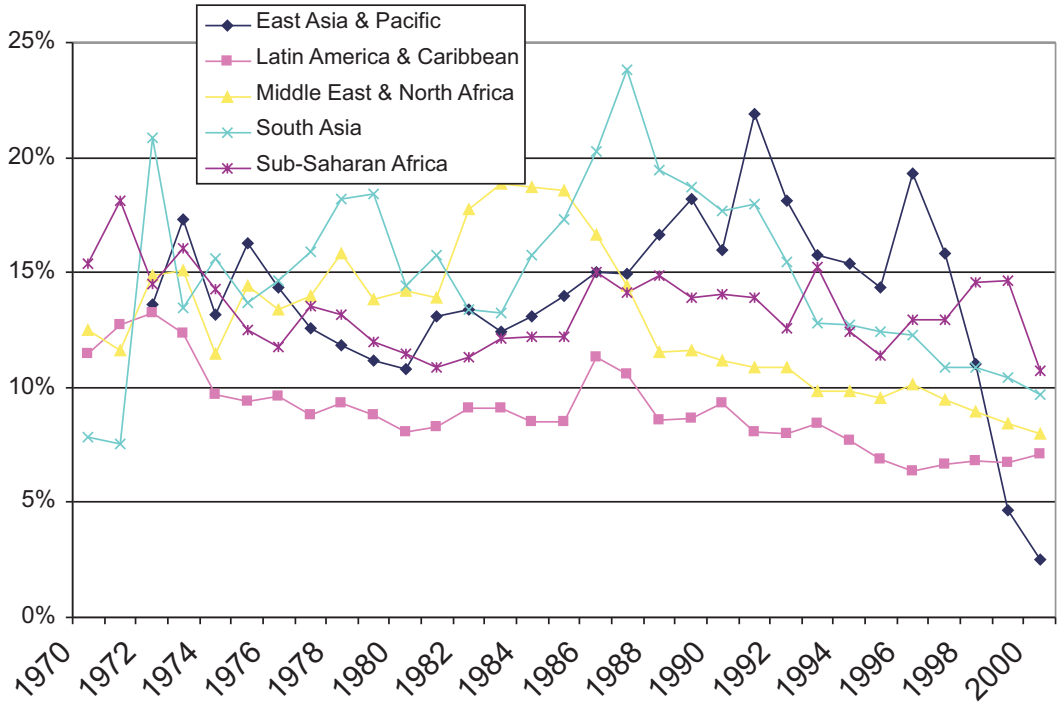

Figure 2: Average effective import tariff rates of low and middle income countries

[Unctad 2004] does, for example), it proves surprisingly hard to find comprehensive datasets on either measure[4].

To define the 'first year' of liberalisation, we used the following data sources: firstly, the Unctad 2004 LDC report Unctad [2004], Chapter 5, Table 37, contains data on trade liberalisation timing for 27 LDCs. For countries not contained in that dataset, we used the initial liberalisation years from Santos-Paulino and Thirlwall [2004]; for countries not contained in that sample either, we used the initial year of liberalisation from the Sachs-Warner index [Sachs and Warner 1995]. While that last index has been widely criticized, some of the criticisms (such as classifying east Asian economies as open, Unctad [1997]) have little bearing on the present study. Among these datasets, we are able to obtain the 'initial year' of liberalisation for 32 out of 70 countries of our initial sample. It is these 32 countries that we will be working with. The distribution of when the first year of liberalisation was for each country is shown in Figure 3. For example, the bar corresponding to the period 1995-1999 having the value of 6 means that 6 countries have begun to liberalise in that period (in this case, those were Lao PDR, Bhutan, Ethiopia, Cape Verde, Maldives and the Solomon Islands).

It would be interesting to augment this data by using the IMF Trade Restrictiveness Index, but as the latter is only available from the 1990s onwards and not available on a yearly basis, we do not use it at this point.

4 Counterfactual Construction

After model formulation, the second touchy question faced by any 'policy impacts' study is the choice of the counterfactual, that is, of the hypothetical 'other' policy that we compare the actual policies to.

Our counterfactual answers the question: 'What if trade liberalisation had not happened?' To do this, we assume that the tariffs are frozen at their average levels for that country between 1975 and

[4]The author would be grateful if a reader could point out such datasets, beyond those mentioned immediately below

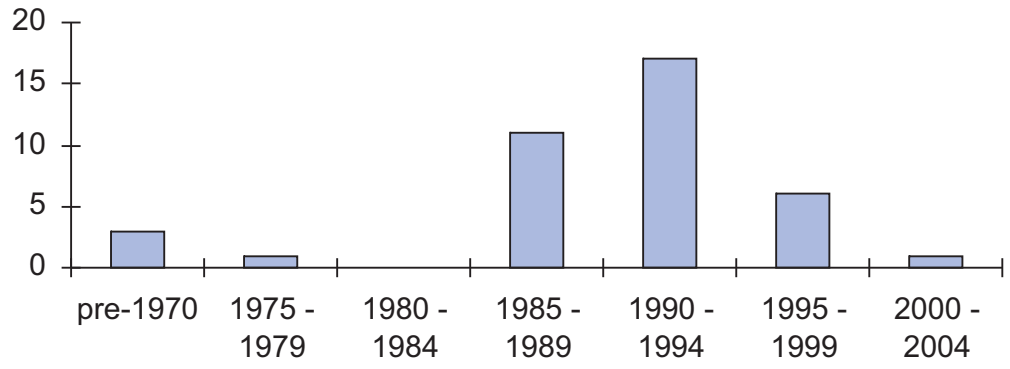

Figure 3: Number of countries from our sample beginning to liberalise

1980[5], and that the liberalisation dummy is zero for all years, all countries. This gives us 'what-if' export and import functions for any given year, most likely resulting in a lower trade deficit given historical GDP levels.

Given the counterfactual, we simulate two closures: firstly, we assume that the GDP is unaffected by the counterfactual and look at the balance of payments impact; secondly, we assume that the balance of payments is fixed (due to external financing constraints) and see what GDP levels that would imply. An important additional output in the latter case is the impact on government revenue, not only from the import and export duties, but also from internal taxes due to the change in GDP.

Remember that our base (observed, historical) case is one where liberalisation has already happened, and thus presumably led to the negative GDP effects that we are describing. Simulating the pure GDP impact shows us the extra income that would have been compatible with the present values of the trade deficit, had trade liberalisation not occurred. Simulating the pure balance of payments impact shows us how much better our trade balance could have been, given our present GDP, had liberalisation not occurred.

5 Results

Presentation of datasets with a lot of points, such as ours, is always somewhat tricky, and the impact of a study can depend greatly on whether the data is presented in a compelling fashion. We choose to group our model output by five-year periods and by geographical region; the results are presented in Tables 2, 3, 4 and 5.

The first two tables show the results of the variable-output closure, that is of assuming the balance of payments was unaffected and GDP was the adjusting variable. Table 2 shows the total GDP impacts measured in constant 2000 US dollars, by five-year period and geographical region. To also give one a feel of the magnitude of the effects relative to the corresponding economies' sizes, Table 3 shows the same impact as a share of the corresponding countries' GDP, averaged over the applicable countries and time periods.

Note that the impact in each table is not for all countries of the corresponding region, but only for those included in our sample (consisting of LDCs, low income countries, and sub-Saharan African countries for which we could determine the initial year of liberalisation, see Section 3.1), which includes only one country (Yemen) for the Middle East and North Africa region, only two countries from Latin America and Carribean (Haiti and Nicaragua), but larger numbers of countries from the other regions.

[5]It might seem more consistent to use tariff rates around the time that the liberalisation dummy becomes one for that particular country as the pre-liberalisation counterfactual; however, given the eclectic sources we have to use for the liberalisation dummy, our method seems more robust until better data on timing of liberalisation is available.

Table 2: GDP impact in billion constant 2000 US$, for countries in our sample

	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001	Total
East Asia and Pacific			9.8	79	145.2	40.4	274.4
Latin America and Caribbean			0.8	3.8	6.4	3.5	14.5
Middle East and North Africa				17.4	8.6	2.9	28.9
South Asia			0.6	30.3	230.3	145.9	407.1
Sub-Saharan Africa	5.6	9.6	14.4	27.9	78.7	35.2	171.4
Total	5.6	9.6	25.6	158.3	469.3	227.9	896.2

Table 3: GDP impact as percentage of the respective country's GDP, for countries in our sample

	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001	Average
East Asia and Pacific			4.40%	10.90%	11.00%	20.90%	11.80%
Latin America and Caribbean			14.00%	18.80%	25.50%	29.40%	21.80%
Middle East and North Africa				22.50%	21.20%	16.10%	20.70%
South Asia			4.60%	6.70%	10.60%	15.60%	10.20%
Sub-Saharan Africa	7.60%	12.70%	11.30%	8.40%	10.80%	16.70%	11.20%

Table 4: Balance of trade impact, billion constant 2000 US$, for countries in our sample

	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001	Total
East Asia and Pacific			3.4	29	56.4	20.3	109.1
Latin America and Caribbean			0.6	2.1	4.2	1.8	8.6
Middle East and North Africa				12.4	5.8	1.5	19.8
South Asia			0.2	7.3	45.9	28.8	82.1
Sub-Saharan Africa	3	4.5	6	12.9	35.9	16.7	79
Total	3	4.5	10.2	63.7	148.2	69	298.6

The GDP impacts in constant dollars are increasing from one period to the next (apart from the last period, which embraces only two years instead of five)[6]. This follows from the regression results we are using, as once a country has liberalised, the gap between export growth and import growth keeps widening, thus impacts will likely grow over time for any given country. Additionally, as time goes by, more countries are liberalising and contributing to the total. In more open and smaller economies, the trade deficit caused by trade liberalisation will be larger as a share of GDP, and consequently the GDP effects will be more pronounced.

The average impacts as percentage of GDP table do not show the same monotone increase, as for newly liberalised countries the impacts will be comparatively low as share of GDP, and thus will drag down the average. For example, this shows in sub-Saharan Africa, where the impacts as percentage of GDP are smaller in 1985-1989 and 1990-1994 than in 1980-1984 due to a large number of new liberalisers in the former two periods.

Overall, we see GDP impacts typically ranging between 10% and 16%, but going as high as 29% in some cases. This loss of aggregate demand towards imports is important both in terms of poverty alleviation and GDP growth potential, since the sectors that are most affected by aggregate demand deficiency are manufacturing and services – the former being a potential high-value-added sector, and the latter often containing a large portion of the poor. This broad picture is corroborated by Taylor [2001], a collection of case studies of liberalisation that show the overall impacts on both growth and equity to be neutral to negative[7].

Tables 4 and 5 show the corresponding information for the pure balance of payments impact, that is for assuming the GDP is unaffected and the balance of trade would absorb all the impact. The overall picture is comparable to that for GDP impacts, but generally the balance of payments impacts are smaller as the GDP impacts are additionally amplified by multiplier effects. The ratio of balance of payments to GDP impacts varies, depending on the degree of trade openness of the respective countries.

[6]The exception is Yemen, for which the historical share of imports of GDP has decreased over time, leading to diminished impacts in the counterfactual

[7]Most countries in these case studies were not part of the sample we consider here, but the trade balance and aggregate demand effects we focus on played an important role in the case studies.

Table 5: Balance of payments impact as percentage of the respective country's GDP, for countries in our sample

	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001	Average
East Asia and Pacific			0.90%	3.40%	4.60%	6.40%	4.20%
Latin America and Caribbean			10.00%	10.60%	18.30%	15.10%	13.90%
Middle East and North Africa				14.30%	13.10%	8.00%	12.60%
South Asia			1.50%	1.70%	3.00%	4.20%	2.80%
Sub-Saharan Africa	5.60%	6.20%	6.20%	4.70%	5.10%	6.50%	5.40%

6 Conclusion

In this paper, we have used regressions by Santos-Paulino [2003], as cited in Unctad [2004], on determinants of export and import growth to provide estimates of the impact of trade liberalisation. Our interest was in the foregone opportunities for aggregate demand stimulation or balance of trade improvement in the past decades (remember that the balance of payments impact and the private disposable income impact are the outcome of two complementary closures, so that the real-life impact would be a combination of the two).

We have seen that as the increase in import demand due to trade liberalisation outpaced the growth in exports, trade liberalisation has likely resulted in additional balance of payments deficits between 2% and 18% of GDP (assuming GDP unaffected), or conversely, in between 4% and 29% aggregate demand loss (assuming balance of payments unaffected). Converting to constant 2000 US dollars, this sums up to $299 \cdot 10^9$ US$ of balance of payments losses, resp. $896 \cdot 10^9$ US$ of aggregate demand losses.

This loss of aggregate demand towards imports is important both in terms of poverty alleviation and GDP growth potential, since the sectors that are most affected by aggregate demand deficiency are manufacturing and services – the former being a potential high-value-added sector, and the latter often containing a large portion of the poor.

A The Model Equations

A.1 The accounting framework

We set up a very simple accounting framework to keep track of economy-wide impacts of changes in the balance of payments. Along with some behavioural assumptions, that gives us a minimalist quantity-clearing CGE model that we will be solving for every country for every year. In fact, this model can be regarded as the demand-driven counterpart of the neoclassical 123 model Devarajan et al. [1993] widely promoted by the World Bank[8].

[8]It might appear that our formulation, in contrast to 123, is lacking a role for money supply and the exchange rate. However, this is merely because we are using an abbreviated form where all accounting is done in dollars. It is straightforward to extend this model to include domestic prices and the money supply with a standard $Y = MV$ kind of equation; however, money supply changes and their impact are not at the center of our present inquiry.

The first accounting constraint is the equilibrium in the goods market in volume terms. It can be written out as

$$x + g + c + i = m + y = m + x + nt \tag{1}$$

Here x, g, c, and i denote the sinks for goods, namely exports, government demand, consumption, and investment demand respectively. y is the real GDP, m are imports, and nt are nontraded goods, all in volume terms. In addition to that, a number of identities in nominal terms need to be satisfied.

First of all, let us have a look at the prices involved. We do all accounting in dollar terms to simplify the notation. For each volume term v, there are two deflators, the market price $\tilde{P}_v$ and the producer price P_v, differing because of taxes paid on that term. Since it is precisely the different tax rates that concern us here, we need to write that out carefully. The basic three deflators are prices for exports, imports, and nontraded goods. We suppose that duties are paid on exports and imports, and all other government revenue derives from a flat-rate income tax. Then the market prices and the producer prices are connected through

$$\begin{aligned} \tilde{P}_{nt} &= P_{nt} && (2)\\ \tilde{P}_m &= P_m\,(1+t_m) && (3)\\ \tilde{P}_x\,(1-t_x) &= P_x && (4) \end{aligned}$$

Since we can choose the base deflators arbitrarily, we normalize

$$\tilde{P}_x = P_m = 1 \tag{5}$$

so that (2)-(4) can be rewritten as

$$\begin{aligned} \tilde{P}_m &= (1+t_m) && (6)\\ (1-t_x) &= P_x && (7) \end{aligned}$$

Since we are doing our accounting in dollars, the only prices among those we have just discussed that would be affected by changes in real exchange rate are P_{nt} and $\tilde{P}_{nt}$. If we denote the real exchange rate by ϵ (larger ϵ corresponds to a real depreciation of the domestic currency), then the equations for P_{nt} and $\tilde{P}_{nt}$ become

$$\tilde{P}_{nt} = P_{nt} = \frac{1}{\epsilon} \tag{8}$$

The remaining interesting deflator is the absorption deflator,

$$\tilde{P}_{abs} = \frac{nt\tilde{P}_{nt} + m\tilde{P}_m}{nt+m} = \frac{nt/\epsilon + m\,(1+t_m)}{nt+m} \tag{9}$$

With the deflators taken care of, we can formulate the accounting framework we use in Table 6. The total tax revenue is likewise just a matter of accounting and is given by

$$T = xt_x + mt_m + (x(1-t_x) + nt)\,t_Y \tag{10}$$

A.2 Behavioural equations and closure

The model is completed by specifying the behavioural equations for exports and imports. The source for the specifications is Table 1. However, the regressions presented therein deal with *growth rates* of exports and imports, which we need to translate to functions giving the *values* of exports and imports for a given year, given their arguments. The somewhat tricky bit are the parts of the functional form that depend on the liberalisation dummy, as their effects on the growth rate of exports or imports cumulate from the beginning of liberalisation onwards.

Let us illustrate the maths on a simple example. Suppose the first year of liberalisation is year 1, and x_t is the natural log of exports. For simplicity let's pretend that x_t depends on just one variable

	Products	Private	Government	Rest of the world
Products		$C+I=Y-\Delta\Omega$	$G=T-\Delta D$	$X=X(\ldots)$
Private	$Y=(x(1-t_x)+nt)(1-t_Y)$			
Government	$T = xt_x+mt_m+ +(x(1-t_x)+nt)t_Y$			
Rest of the world	$M=M(\ldots)$			
Net saving flows		$\Delta\Omega$	ΔD	ΔF

Table 6: The mini-SAM of our model

wy_t, but the coefficient consists of a regular part a_2 and a liberalisation slope dummy $\tilde{a}_2$. Further, let's suppose the coefficient of the dummy variable is $\tilde{a}_0$ (tilde denotes "something to do with the liberalisation dummy).

Let us denote with $\tilde{x}_t$ the export supply function as it develops under historical conditions (with liberalisation). The equations for the historical growth rate of exports under would then be

$$\tilde{x}_1 - x_0 = \tilde{a}_0 + (a_2+\tilde{a}_2)(\widetilde{wy_1} - wy_0) \quad (11)$$

$$\tilde{x}_2 - x_1 = \tilde{a}_0 + (a_2+\tilde{a}_2)(\widetilde{wy_2} - wy_1) \quad (12)$$

Adding these up yields

$$\tilde{x}_2 - x_0 = 2\tilde{a}_0 + (a_2+\tilde{a}_2)(\widetilde{wy_2} - wy_0) \quad (13)$$

and more generally

$$\tilde{x}_n - x_0 = n\tilde{a}_0 + (a_2+\tilde{a}_2)(\widetilde{wy_n} - wy_0) \quad (14)$$

Now let us consider the export function x_n as it would have developed *without* liberalisation, i.e. with liberalisation dummy off. An argument similar to the above shows

$$x_n - x_0 = a_2(wy_n - wy_0). \quad (15)$$

Subtracting (14) from (15), we obtain

$$x_n = \tilde{x}_n + a_2(wy_n - \widetilde{wy_n}) - n\tilde{a}_0 + \tilde{a}_2(wy_0 - \widetilde{wy_n}) \quad (16)$$

Thus, in log terms, the counterfactual export function is the historical exports value, modified by the difference between the historical and counterfactual values of the independent variable times the no-liberalisation coefficient (second term), plus two additional terms. These two additional terms represent the cumulative impact of the liberalisation dummy, through both the shift and the slope dummies. For example, if liberalisation increases the growth rate of exports by 0.5%, then three years later, the export function will be 1.5% larger, ceteris paribus; and the extra impacts of the independent variables that are due to the liberalisation dummy, cumulate in the same way.

The effects of more than one independent variable are added in the same way. Thus in a given year, in log terms, the complete equation for export supply is

$$x = \tilde{x} + a_1(RER - \widetilde{RER}) + a_2(wy - \widetilde{wy}) + a_3(t_x - \tilde{t}_x) - n\tilde{a}_0 + \tilde{a}_1(RER_0 - \widetilde{RER}) + \tilde{a}_2(wy_0 - \widetilde{wy}) \quad (17)$$

Here the subscript 0 refers to the last year before liberalisation began (in a particular country). Since we assume that the world income is not affected by our counterfactual, (17) reduces to

$$x = \tilde{x} + a_1(RER - \widetilde{RER}) + a_3(t_x - \tilde{t}_x) - n\tilde{a}_0 + \tilde{a}_1(RER_0 - \widetilde{RER}) + \tilde{a}_2(wy_0 - \widetilde{wy}). \quad (18)$$

Converting back from log terms, we get

$$x = \tilde{x} \cdot \exp\left(a_3[t_x - \tilde{t}_x] - n\tilde{a}_0\right) \cdot \left(\frac{RER}{\widetilde{RER}}\right)^{a_1} \cdot \left(\frac{wy_0}{\widetilde{wy}}\right)^{\tilde{a}_2} \cdot \left(\frac{RER_0}{\widetilde{RER}}\right)^{\tilde{a}_1}. \quad (19)$$

Similarly, for imports we have

$$m = \tilde{m} \cdot \exp\left(b_3[t_x - \tilde{t}_x] - n\tilde{b}_0\right) \cdot \left(\frac{y}{\tilde{y}}\right)^{b_2} \cdot \left(\frac{RER}{\widetilde{RER}}\right)^{b_1} \cdot \left(\frac{y_0}{\tilde{y}}\right)^{\tilde{b}_2} \cdot \left(\frac{RER_0}{\widetilde{RER}}\right)^{\tilde{b}_1} \cdot \left(\frac{aid_0}{\widetilde{aid}}\right)^{\tilde{b}_2}. \quad (20)$$

The main closure we are using is balance of payments-constrained variable output. To be precise, we assume that the internal and external financing possibilities are constrained, so that when lower tariffs worsen both the balance of payments and the government deficit, both the external inflows ΔF and the domestic government borrowing ΔD stay constant. By the law of Walras, that means that the net lending of the private sector $\Delta\Omega$ will also remain constant. Then government demand must necessarily be given by $G = T - \Delta D$ and total private demand by $C + I = Y - \Delta\Omega$. In this setting, domestic nontraded output is the equilibrating variable. An alternative we also consider is the 'balance of payments' closure, with the balance of payments being the equilibrating variable. The meaning of and justifications for both closures are discussed in the body of the paper.

B Sensitivity of our results to changes in real exchange rate

An important relationship that our model, as presented so far, had to leave unexplored, was the influence of trade liberalisation-induced changes in the real exchange rate on our results. The cause for that omission was the lack of a usable theory of real exchange rate behavior, as discussed in Section 2.4.6.

As a first step towards estimating the importance of the issue, the maximal magnitude of the expected impact of accounting for exchange rate depreciation can already be seen from a back-of-the envelope computation, as follows: suppose as an extreme case, that *all* of the real exchange rate (RER) changes occurring during or close to trade liberalisation episodes are actually due to trade liberalisation. If we look at the data on 13 liberalising LDCs in Tables 38 and 39 of [Unctad 2004, p.187], we see that trade liberalisation has been accompanied on average by a RER depreciation of 35% happening over an average period of about 12 years. That gives us an average rate of RER depreciation of about three percentage points per year associated with trade liberalisation. Combining this with the total RER elasticity of imports of 0.11 (b_1 in Table 1, Section 3.3, compare Equation (19)) gives us a yearly increase in import demand of about 0.33 percentage points (according to Table 1, impact of RER on exports is negligible). This reduces the post-liberalisation import growth increase, ceteris paribus, from 1.87 to 1.53 percentage points, and the gap between exports and imports growth rates (the variable that drives the increase in trade deficit) from 1.37 to 1.04 percentage points. This leads us to conclude that even if we attribute all of the observed exchange rate depreciation to trade liberalisation (that is, we assume it would not have happened, had trade liberalisation not taken place), that would decrease the size of our main effect by less than a quarter (and even less if historical value of imports in the year in question exceeds that of exports).

The exchange rate depreciation effect would cease after those initial 12 years, but as Figure 3 shows, most of the countries in the sample have liberalised since the late 1980s, so this is just about the time frame that our simulations extend over.

Now to the actual simulations. The equations we have derived, such as (8), (19), and (20) did include the real exchange rate, and the purpose of the present appendix is to test the sensitivity of the

model output to two counterfactual scenarios of exchange rate behaviour. The first RER counterfactual is restoring the real exchange rate to its value in the last year before liberalisation began; the second RER counterfactual is assuming a yearly 3% real depreciation starting in the initial liberalisation year – this is an average observed rate derived from Unctad [2004], as discussed in Section 2.4.6. Since typically a real depreciation will decrease imports, it will reduce the GDP and balance of payments impacts that we estimate here; the only question is by how much. In order to indicate this, we reproduce the tables from the Results section, but now with each number followed by the difference between the base run and the two counterfactuals. Thus, $10(1, 3)$ would mean that the base run value was 10, the first counterfactual was 9, and the second counterfactual was 7.

Looking at these simulations, we see two things: firstly, the impact of the second RER counterfactual (assuming yearly 3% RER depreciation) is virtually always stronger than of the first (restoring RER to its last pre-liberalisation value), so the 3% value was a reasonable one to choose. Secondly, the overall sensitivity to changing the RER is rarely above a quarter of the underlying number, and in most cases is less than a tenth thereof. Thus, while not insignificant, not dealing with RER impacts in the body of the paper was not a crippling problem.

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Table 7: GDP impact in billion constant 2000 US$, for countries in our sample

	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001	Total
East Asia and Pacific			9.8 (1.4 , 1.6)	79.0 (2.4 , 9.2)	145.2 (7.2 , 17.9)	40.4 (6.7 , 6.7)	274.4 (17.8 , 35.4)
Latin America and Caribbean			0.8 (0.0 , 0.1)	3.8 (0.1 , 0.6)	6.4 (-0.4 , 1.1)	3.5 (-0.1 , 0.7)	14.5 (-0.4 , 2.6)
Middle East and North Africa				17.4 (0.0 , 3.9)	8.6 (0.0 , 2.2)	2.9 (0.0 , 0.9)	28.9 (0.0 , 7.0)
South Asia			0.6 (0.0 , 0.1)	30.3 (6.4 , 6.1)	230.3 (17.6 , 31.9)	145.9 (14.8 , 20.4)	407.1 (38.8 , 58.4)
Sub-Saharan Africa	5.6 (-0.4 , 0.6)	9.6 (0.2 , 1.2)	14.4 (1.5 , 2.1)	27.9 (3.6 , 4.8)	78.7 (9.8 , 15.3)	35.2 (8.6 , 7.6)	171.4 (23.3 , 31.6)
Total	5.6 (-0.4 , 0.6)	9.6 (0.2 , 1.2)	25.6 (2.9 , 3.8)	158.3 (12.5 , 24.7)	469.3 (34.2 , 68.4)	227.9 (30.0 , 36.3)	896.2 (79.4 , 135.0)

Table 8: GDP impact as percentage of the respective country's GDP, for countries in our sample

	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001
East Asia and Pacific			4.4% (0.4% , 0.4%)	10.9% (0.3% , 1.1%)	11.0% (0.8% , 1.1%)	20.9% (1.9% , 1.8%)
Latin America and Caribbean			14.0% (-0.1% , 2.3%)	18.8% (0.3% , 3.2%)	25.5% (-1.1% , 4.5%)	29.4% (-0.8% , 5.9%)
Middle East and North Africa				22.5% (0.0% , 4.7%)	21.2% (0.0% , 5.1%)	16.1% (0.0% , 4.8%)
South Asia			4.6% (-0.3% , 0.5%)	6.7% (0.6% , 0.8%)	10.6% (0.6% , 1.3%)	15.6% (1.1% , 1.8%)
Sub-Saharan Africa	7.6% (-0.8% , 1.2%)	12.7% (0.8% , 1.4%)	11.3% (1.2% , 1.3%)	8.4% (0.9% , 1.2%)	10.8% (1.2% , 1.7%)	16.7% (2.4% , 2.2%)

Table 9: Balance of trade impact, billion constant 2000 US$, for countries in our sample

	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001	Total
East Asia and Pacific			3.4 (0.5 , 0.5)	29.0 (0.8 , 2.9)	56.4 (3.3 , 5.6)	20.3 (2.5 , 2.4)	109.1 (7.1 , 11.5)
Latin America and Caribbean			0.6 (0.0 , 0.1)	2.1 (0.0 , 0.2)	4.2 (-0.1 , 0.5)	1.8 (0.0 , 0.2)	8.6 (-0.1 , 1.0)
Middle East and North Africa				12.4 (0.0 , 2.0)	5.8 (0.0 , 0.9)	1.5 (0.0 , 0.2)	19.8 (0.0 , 3.2)
South Asia			0.2 (0.0 , 0.0)	7.3 (1.1 , 1.2)	45.9 (2.9 , 5.8)	28.8 (2.6 , 3.6)	82.1 (6.6 , 10.5)
Sub-Saharan Africa	3.0 (-0.2 , 0.3)	4.5 (0.1 , 0.4)	6.0 (0.5 , 0.6)	12.9 (1.2 , 1.6)	35.9 (3.7 , 5.2)	16.7 (3.7 , 2.7)	79.0 (9.1 , 10.8)
Total	3.0 (-0.2 , 0.3)	4.5 (0.1 , 0.4)	10.2 (1.0 , 1.2)	63.7 (3.1 , 7.9)	148.2 (9.8 , 18.0)	69.0 (8.7 , 9.2)	298.6 (22.6 , 37.0)

Table 10: Balance of trade impact as percentage of the respective Country's GDP, for countries in our sample

	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2001
East Asia and Pacific			0.9% (0.2% , 0.2%)	3.4% (0.1% , 0.3%)	4.6% (0.5% , 0.5%)	6.4% (1.1% , 1.1%)
Latin America and Caribbean			10.0% (0.0% , 1.2%)	10.6% (0.1% , 1.1%)	18.3% (-0.4% , 2.0%)	15.1% (-0.3% , 1.9%)
Middle East and North Africa				14.3% (0.0% , 2.3%)	13.1% (0.0% , 2.0%)	8.0% (0.0% , 1.3%)
South Asia			1.5% (-0.1% , 0.2%)	1.7% (0.2% , 0.2%)	3.0% (0.2% , 0.4%)	4.2% (0.3% , 0.5%)
Sub-Saharan Africa	5.6% (-0.3% , 0.5%)	6.2% (0.7% , 0.7%)	6.2% (0.6% , 0.5%)	4.7% (0.4% , 0.5%)	5.1% (0.6% , 0.7%)	6.5% (1.4% , 1.1%)

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