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Morocco's Free Trade Agreement with the European Community

A Quantitative Assessment

Thomas F. Rutherford
E. E. Rutström
and
David Tarr

Welfare benefits to Morocco from a free trade agreement with the European Community would be about 1.5 percent of GDP. But welfare benefits would be 2.5 percent of GDP if Morocco liberalized trade with the whole world — and with only slightly higher adjustment costs.

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Morocco is interested in developing a reciprocal free trade agreement with the European Community (EC), although it already enjoys free access to EC markets in industrial products and is not obligated to give EC exporters reciprocal access. But Moroccan agricultural exports are impeded by agricultural protection in the European Community.

A free trade agreement would require that Morocco lower its moderately high tariffs against its most important trading partner. Tariff reductions against the European Community but not against the rest of the world may provide benefits provided the trade diversion costs of preferential tariff reduction do not dominate.

Rutherford, Rutström, and Tarr apply a 39 sector general equilibrium model of the Moroccan economy which includes the sectors most likely to be affected by such an agreement. They investigate the economic effects of the prospective free trade agreement as well as five other trade liberalization scenarios for Morocco. Among their most important findings:

- The welfare benefits to Morocco from a free trade agreement with the European Community would be about 1.5 percent of GDP. Such substantial welfare gains partly reflect the benefits of reducing dispersion in the tariff regime.

- Welfare benefits of about 2.5 percent of GDP would accrue from liberalizing trade with the rest of the world — with only slightly higher adjustment costs. Liberalizing trade with the world would provide greater benefits because it would eliminate the trade diversion costs associated with discriminatory trade liberalization. (Although the fact that significant benefits would accrue from discriminatory liberalization against imports from either the European Community or the rest of the world indicates that trade diversion is not dominant.)

- As a result of improved access to the European Community, employment and output in the vegetable and citrus fruit sectors would expand. But the phosphate sector stands to gain most from the free trade agreement because liberalization would induce a depreciation in the real exchange rate.

- Morocco's cereal, meat, dairy, and sugar sectors would lose most in terms of employment, because of significantly lower import prices from the European Community. The nontraded goods sector would also contract slightly.

- The value-added tax would have to be increased to compensate for the loss in tariff revenues, on which Morocco depends.

Estimates are provided as ranges, with probability assessments, because of the element of uncertainty.

MOROCCO'S FREE TRADE AGREEMENT WITH THE EC:

A QUANTITATIVE ASSESSMENT

by

Thomas F. Rutherford

E.E. Rutström

and

David Tarr

* University of Colorado, University of South Carolina, and World Bank, respectively.

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1. INTRODUCTION

Since 1986 Morocco has shown an interest in developing a closer trade association with the European Community (EC). This interest culminated in March 1992 with concretes discussions for a reciprocal Free Trade Agreement with the EC. To some the Moroccan interest may be surprising, since Morocco already enjoys privileged relations with the EC. It has free access to markets in industrial products (there are some minor exceptions such as trousers and canned sardines), and is not obligated to provide reciprocal access to its market to producers of the EC. However, EC agricultural protection impedes Moroccan exports (notably in the areas of vegetables and citrus fruits), so that improved access to EC markets is an important issue. Moreover, the reciprocal obligations of a Free Trade Agreement (FTA) with the EC will require that Morocco lower its moderately high tariffs against its most important trade partner. These tariff reductions against the EC may provide additional trade liberalization benefits to Morocco, provided the trade diversion costs of preferential tariff reduction do not dominate.

This paper reports on an applied general equilibrium modelling exercise that investigates the economic effects of the Moroccan proposal. Given the questions of improved market access of Moroccan fruits and vegetables and of trade diversion and trade creation (which arises in any preferential trade area), we decompose the effects on the Moroccan economy from this proposal into the following six policy scenarios: a) improved access for Moroccan fruits and vegetables in the EC ("ACCESS"); b) unilateral tariff reductions in Morocco against the EC alone ("ECLIB"), against imports from the rest of the world alone ("LIBROW"), and against all trading partners ("LIBALL"), without improved access to EC agricultural markets; c) cooperative tariff reductions with the EC, where on the EC side this implies extended market access for Moroccan fruit and vegetables ("FTA"); and d) full free trade agreement with the EC augmented by unilateral liberalization of tariffs against rest of world imports ("FTAALL"). Our analysis provides a quantitative indication of the income gain to Morocco of these strategies.

Among our most important results, we find that the welfare benefits to Morocco from the free trade agreement are about 1.5 of percent GDP, and are about 2.5 percent of GDP if Morocco adds trade liberalization with the rest of the world to the free trade agreement. These welfare gains are quite substantial in the context of other model estimates with constant returns to scale such as ours, and partly reflect benefits from eliminating dispersion in the tariff regime, since dispersion is eliminated in the process of liberalization. The larger welfare gains from Morocco adding elimination of protection against the rest of the world to a free trade agreement with the EC, reflects the trade diversion costs associated with discriminatory trade liberalization. On the other hand, the significant benefits that accrue from discriminatory liberalization against either EC or rest of world imports indicates that trade diversion is not dominant.

One interesting conclusion is that broader trade liberalization yields greater welfare gain than the FTA, but with only slightly higher adjustment costs. This can be seen as an important argument in favor of the efforts towards lowering tariffs against non-EC sources subsequent to achieving a FTA.

We evaluate the overall welfare effects on the Moroccan economy from the above scenarios, as well as the sectoral impacts. The sectoral impacts are particularly important given the emphasis that has been placed in Morocco on diversification of production and exports, as well as concern over the costs of adjustment. The model provides a quantitative indication of the extent of output (not reported) and employment (reported below) adjustment that will be required by industry. We find that although citrus fruits and vegetables expand as expected from their improved access to the EC market from the FTA, by far the sector that gains the most from the trade liberalization scenarios is the phosphate sector. Phosphate exports expand significantly after the FTA or other trade liberalization scenarios due to the depreciation of the real exchange rate induced by the liberalization. Conversely, non-traded goods sectors slightly contract after the FTA or other liberalizing scenarios. The largest losers of employment, however, are the cereals, meat and dairy and sugar sectors. These

sectors face significantly lower import prices after trade liberalization. Estimates are provided within a range (with probability assessments over the range), as there is an element of uncertainty in the estimates which we also quantify.

Given the importance of the tariff as an instrument of revenue generation in Morocco, we exploit the ability of a "simulation laboratory" to control for this effect by adopting the value added tax (VAT) as an explicit replacement tax such that government revenue remains constant. The VAT induces distortion costs (marginal excess burden). We indicate the extent the VAT would have to be changed in order to avoid a reduction in government revenue. The marginal excess burden of raising government revenue from the VAT is incorporated in the analysis.

The model we use is a 39 sector computable general equilibrium model of the Moroccan economy. This level of disaggregation captures most of the important sectors of the Moroccan economy that would be affected by the Free Trade Agreement. In particular, citrus fruits, vegetables, cereals, sugar and meat and dairy products, textiles, apparel, fishing and phosphates are included as separate sectors. The model that we use is deliberately very simple, to facilitate the confrontation of policy-makers' intuition with easily interpreted simulations. The model assumes no terms-of-trade effects, a single household, no capital accumulation, and constant returns to scale production with competitive pricing. In addition, the model is a "comparative statics" model which ignores the costs of adjustment of factors. Consequently, the benefits of the integration-liberalization scenarios will be less than our estimates to the extent of costs of adjustment.

2. A SMALL OPEN ECONOMY MODEL

2.1 Trade Protection in Morocco and the Free Trade Agreement Shocks

Structure of Protection.

Since 1983 Morocco has dramatically liberalized its foreign trade regime. In 1983 import licenses were required in all sectors, tariff rates were high and dispersed (some over 100% in addition to the special import tax of 15%), and

there were export licensing requirements and a state marketing board monopoly on exports of processed food products.[1] In 1985, the maximum rate for customs duties was lowered to 45%. Most impressively, Morocco has progressively reduced its import licensing requirements so that by 1993 no imports will require a license (other than for health and safety reasons). On the export side only minor restraints remain since special customs regimes for exporters were extended and improved, export licensing was removed with only a few exceptions, and the monopoly of the state marketing board was abolished [see Mateus et al. (1988, p.11)]. We therefore take as our point of departure, a trade regime that is free of non-tariff barriers.

Tariff rates as of 1991 by sector are presented in column 10 of table 1. The structure of the rates is taken from legal applicable rates at the tariff line level that are aggregated, based on an unweighted average, to the 39 sectors of our model. Legal tariff rates, however, are not indicative of actual tariff collections, because there are exemptions to the tariff (as well as exemptions to the fiscal import tax and the value-added tax) for a number of purposes, most importantly for inputs into products that will be exported. In view of the importance of the revenue implications of the proposed tariff changes, we therefore proportionally adjusted all the legal rates. The rates that appear in table 10 have been proportionately adjusted for all sectors, such that the total tariff collections in the economy, based on 1991 imports, equals actual aggregate tariff collections from budget data for 1991.[2] The average import tariff based on collections is 19%, which includes tariff surcharge (fiscal import duty).[3] The most important sectors regarding import revenues are Industrial Machinery, and Coal and Crude Oil, which together account for over 30% of revenues from trade taxes.

Among the most important non-tariff barriers scheduled to be removed in early 1993 are those in several agriculture sectors: sugar, cereals, meat, dairy

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[1] See Mateus et al. [1988] and UNDP-World Bank [1992] for details.

[2] Appendix B discusses this adjustment.

[3] As members of the Maghreb preferential trading area, imports from Algeria and Tunisia are exempted from the fiscal import duty.

Table 1: Morocco - Basic Data for the Social Accounting Matrix

SECTOR (Abbrev.)		SECTOR SHARE OF TOTAL: (1) Output	(2) Labor	(3) Capital	(4) Imports	(5) % fromEC	(6) Exports	(7) % to EC	TRADE BY SECTOR: (In percent) (8) Imports / Consumption	(9) Exports / Output	TARIFF RATE (In percent) (10)
AGRICULTURE											
1. Cereals (CER)	R*	5.44	3.04	10.32	7.16	53.8	0.85	54.2	13.20	1.50	45**
2. Sugar (SUG)	R	0.26	0.12	0.41	0.00	0.0	0.00	0.0	0.00	0.00	45**
3. Citrus Fruits (CIT)	R	2.18	1.50	2.84	0.03	64.8	9.26	69.8	0.40	40.20	31.56
4. Vegetables (VEG)	R	1.84	1.14	2.15	0.26	100.0	2.75	89.6	2.40	14.00	11.35
5. Meat and Dairy (MAD)	R	4.90	1.62	9.88	0.23	50.2	0.02	100.0	0.70	0.00	45**
6. Fishing (FSH)	R	0.38	0.08	0.25	0.00	64.8	0.66	53.6	0.00	16.30	
7. Forestry and Other Agriculture (FOR)		1.02	0.51	1.74	2.44	59.4	0.77	86.6	32.80	7.00	29.54
MINING AND RELATED											
8. Phosphates (PHS)		2.52	2.85	4.04	0.00	0.0	22.45	51.1	0.00	89.20	
9. Other Non-Metallic Mining (NMM)	R	0.40	0.46	0.30	1.99	7.7	0.73	41.2	41.10	15.40	16.48
10. Metals Mining (MIN)	R	0.59	0.58	0.91	0.14	86.4	4.57	80.6	18.30	81.40	14.74
11. Coal and Crude Oil (CAO)	R	0.16	0.47	0.08	18.82	1.6	0.14	84.2	96.20	22.90	11.35
12. Refined Oil (OIL)		4.14	0.31	0.20	1.89	51.6	2.19	73.9	19.50	7.50	23.80
13. Electricity and Water (ELE)		1.80	1.54	1.77	0.00	0.0	0.00	0.0	0.00	0.00	
MANUFACTURING											
14. Food Products (FOO)		4.10	5.38	0.96	3.38	53.6	0.44	95.7	10.90	1.00	35.23
15. Other Food Products (OFP)		5.40	4.24	2.16	3.98	47.7	7.40	63.3	12.90	13.30	27.91
16. Beverages and Tobacco (BEV)		1.01	1.84	0.51	0.34	76.8	1.53	94.2	5.30	15.00	30.02
17. Textiles (TXT)		4.10	6.07	2.28	5.30	71.0	6.25	61.0	21.10	14.40	25.30
18. Clothing (CLO)		2.31	2.27	1.81	0.02	86.7	4.02	94.1	0.20	15.50	34.13
19. Leather and Shoes (LEA)		1.24	1.88	0.68	0.15	89.5	4.78	71.5	2.40	38.50	24.01
20. Wooden Products (WDN)		1.95	2.93	0.64	2.36	31.4	0.26	83.7	17.60	3.00	19.98
21. Paper and Printing (PAP)		1.11	1.92	0.29	2.27	47.1	0.92	69.4	28.20	8.20	27.65
22. Cement (CEM)		1.66	3.58	0.41	0.95	38.1	0.11	68.2	11.00	0.70	21.36
23. Iron and Steel (IAS)		0.46	0.44	0.12	6.57	63.3	1.87	79.2	75.60	31.90	16.84
24. Electro-Mechanical Industry (EMI)		1.79	3.93	1.12	2.29	88.9	0.11	87.3	22.60	0.60	21.45
25. Industrial Machinery (IND)		0.98	0.74	0.62	17.83	45.3	0.06	68.2	74.10	0.60	20.44
26. Transport Equipment (TEQ)		1.14	1.53	0.46	4.56	62.4	0.25	66.1	46.90	2.10	15.04
27. Electrical Equipment (EEQ)		0.78	1.40	0.17	3.84	57.4	0.13	99.4	49.80	1.60	26.73
28. Office Machinery (MAC)		0.07	0.04	0.02	1.06	73.9	0.02	98.2	73.70	1.90	30.54
29. Chemicals (CHM)		3.41	3.80	2.45	8.15	67.1	7.41	29.4	34.90	21.20	19.40
30. Rubber and Plastics (RBR)		0.75	1.22	0.24	1.50	74.5	0.15	20.5	21.50	0.80	23.16
31. Other Industries (OTH)		0.33	0.44	0.18	0.19	77.2	0.05	44.7	11.00	1.50	26.26
SERVICES											
32. Construction (CON)		9.51	3.83	6.44	0.00	0.0	0.00	0.0	0.00	0.00	
33. Trade (TRD)		12.57	2.99	21.61	0.00	0.0	0.00	0.0	0.00	0.00	
34. Transport (TRN)		5.49	3.87	4.19	1.41	100.0	9.39	57.2	4.80	20.90	10.00
35. Communications (COM)		0.50	0.46	0.70	0.01	100.0	0.02	57.2	0.40	0.60	10.00
36. Banking (BNK)		1.63	1.73	2.10	0.00	100.0	0.02	57.2	0.00	9.30	
37. Insurance (INS)		0.34	0.38	0.00	0.00	100.0	1.24	57.2	3.20	10.70	10.00
38. Other Services (SRV)		11.82	6.99	14.87	0.86	100.0	7.70	57.2	1.20	7.60	10.00
39. Administration (ADM)		12.86	21.85	0.00	0.00	0.0	0.00	0.0	0.00	0.00	

* Sectors marked R (for resource) have sector-specific capital.

** Non-tariff barrier estimated at 45 percent; legal tariff rates after adjustment for collections are 10 percent, 16 percent and 28 percent in cereals, sugar and meat and dairy respectively.

and edible oils. These non-tariff barriers are believed to be quite binding, and Morocco intends to increase tariffs in the meat and dairy industries, and impose variable levies in the others to cushion the adjustment costs. We therefore assume in our benchmark that the tariff levels in the meat and dairy, sugar and cereals sectors are 45 percent.

Shocks of the Free Trade Agreement

As a result of the decade long liberalization of trade, some diversification in exports has been achieved, mainly in textiles and phosphate derivatives, but the development of export markets in agriculture has been inhibited by protectionist policies in the EC. Given the generally free access to EC markets by Moroccan producers, EC restrictions of importance on imports from Morocco only remain in fruit and vegetables, trousers, and canned sardines. At the level of aggregation of our model, increased access to the EC markets for Moroccan products will primarily influence the export price of the fruit and vegetable sectors.[4]

The Moroccan Free Trade Agreement proposal would involve a lowering and eventual elimination of all remaining trade barriers on all imports from the EC (i.e., lowering of the tariff), with correspondingly increased market access for Moroccan products into the EC, most notably in agriculture.

We estimate the price distortion in agriculture due to border barriers in the EC to be about 8%, following the EC model developed by Harrison, Rutherford, and Wooton [1989]. An "upperbound" scenario would assume that the EC demand schedule for Moroccan fruits and vegetables is infinitely elastic, so that a removal of tariffs and other barriers will be entirely passed on to Moroccan producers as an increase in the export price. If the EC demand schedule were less than infinitely elastic, the price increase passed on to Moroccan exporters would be less than 8%. Moreover, if Moroccan exporters are currently capturing some of the rents from the EC trade barriers, then the export price increase would result in less than the full 8% of benefits to Moroccan exporters. Since Moroccan

[4] Morocco's exports in fruit and vegetables are dominated by oranges and other citrus fruits, which are both the major components of our citrus fruits, and by tomatoes, potatoes, and preserved vegetables, which are the major components of our vegetables sector.

production is small relative to EC demand (suggesting highly elastic demand in the EC), and since the variable levy is assumed to capture rents in the EC, we take as our base case scenario the full 8% increase in the price of fruits and vegetables from improved access to the EC market.

Domestic taxes consist of the value added tax (VAT), employment and corporation taxes, and production taxes and subsidies. Since we do not have good updated data on collections by sector, all of these rates have been set uniformly. The most important tax in our model is the value-added tax, and import taxation is the next most important. The legal VAT rate is 19%, applied to both imports and domestic production. As with import taxation, however, there are exemptions to the VAT. In order to be consistent with aggregate VAT revenues collected on domestic production and imports, the domestic VAT rate has been set to 3% and the rate applied to imports to 11%.[5] The VAT taxation on imports introduces further distortion in the trade regime.[6] The other tax rates are calibrated based on aggregate tax collections as recorded in the SAM. They are: 1% production tax (net of subsidies), an 8% labor tax (net of subsidies), and a 5% corporation tax (net of subsidies).

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[5]In the appendix we provide a detailed documentation of the tax rates applied in our model. Briefly, however, total Moroccan value-added in 1991 was 185.4 billion dirhams, while total imports were 59.7 billion dirhams. Value-added tax on domestic sales (imports) was 5359 (7853) million dirhams, which represents 3 percent of value-added and 11 percent of imports. We applied these rates to the structure of value-added and imports in our 1980 SAM, which yields an amount of value-added government revenue equal to 32 percent of total government revenue.

Import taxes (including the P.F.I.) equal 11,465 million dirhams in 1991, or 19 percent of the value of imports. We scale all actual tariff rates in 1991 so that the weighted average rate equals this 19 percent. This yields that 30 percent of government revenue in our model is from tariff collections.

Actual value-added and tariff collections in 1991 were 24 and 21 percent of government revenue, respectively, but there are many taxes employed in Morocco that are not present in our model (such as a personal income tax, excise taxes, licensing fees and a corporate tax). With our mapping we have assured that the structure of the VAT and import tax from 1991 is implemented in our model. Moreover, regarding what is important for the revenue implications of the model, the relative importance of the VAT to import taxes as a percent of total government revenue is preserved approximately (32/30 versus 24/21).

[6]Given that the VAT is applied on all production and in our model it is not rebated on exports, the entire VAT applied on imports is a discriminatory tax on imports. There are two methods of value-added taxation that do not discriminate against imports: (1) apply the VAT on all domestic production, including that destined for exports, but do not apply the VAT on imports (the origin principle); or (2) apply the VAT on imports and domestic production for the domestic market only (the destination principle). If all domestic production is subject to the VAT and imports are also taxed the VAT on imports is a discriminatory tariff.

In Morocco, an effort is made to rebate the VAT on exports. Then, in principle, Morocco implements the VAT according to the destination principle, and provided the rebate of VAT on exports is complete, the VAT is not discriminatory against imports.

2.2 General Model Structure

Our Small Open Economy (SOE) model is designed for trade policy analysis with a large number of sectors. The model is a "generic" general equilibrium model of a single economy along the lines of de Melo and Tarr [1992] and Harrison, Rutherford and Tarr [1993].

Goods are produced using primary factors and intermediate inputs. Primary factors include labor and capital. Land is not included explicitly, but we nonetheless have a sector-specific factor by varying the share of capital that is sector-specific in "resource" sectors (the nine resource sectors are denoted by an R following their names in table 1). Labor is assumed fully mobile across sectors.

Production exhibits constant returns to scale, and producers behave competitively, selecting output levels such that marginal cost at these output levels equals the given market price. In export sectors, output is differentiated between goods destined for the domestic, EC and all other export markets. This relationship is characterized by a two-level constant elasticity of transformation frontier. Composite output is an aggregate of domestic output and composite exports; composite exports are an aggregate of exports for the EC and non-EC markets.

Final demand by private households arises from nested constant elasticity of substitution utility functions. This allows consumer decision-making to occur in multi-stage budgeting. At the top level, goods from different sectors compete subject to the budget constraint of the consumer, where all income elasticities are unity. In the second stage, the consumer decides how much to spend on domestic versus aggregate imports, subject to income allocated to spending in the sector from the first stage, with possibly different elasticities of substitution by commodity. Finally, having decided how much to spend on imports, the consumer allocates this expenditure on EC versus non-EC imports.

In two sectors, meat and dairy, and sugar, we depart from the "Armington" assumption and assume that imports and domestic production are perfect substitutes. This is because there are no (or negligible) imports in the initial

equilibrium due to the non-tariff barriers discussed above; the Armington assumption, without very high elasticities of substitution, will imply (contrary to expectations) that trade liberalization yields very little increase in imports. In principle, the appropriate model is the one that is benchmarked to an econometrically estimated elasticity of supply in the sugar, and meat and dairy industries. Absent explicit estimates, we use the model that is closest to our assessment of the supply elasticity. In our sensitivity analysis, we adjust the share of sector-specific capital and thereby the supply elasticity, yielding alternate estimates of import penetration after liberalization.

As discussed above, the only Moroccan trade distortions currently included in the model are *ad valorem* tariffs (or subsidies) on imports and a value added tax that is applied at different rates on imports and domestic products. The model allows tariff rates on imports to differ depending on whether the import is from the EC or the rest of the world (ROW); and we allow exports to have different prices depending on whether they are sold in the EC or ROW. These distinctions allow us to study policies such as accession to a free trade area. The Free Trade Association with the EC also involves changes in Morocco's access to EC markets. The main effect of increased access would be an increase in the Moroccan export price, and these are therefore included as policy instruments that can be varied in counterfactual simulations.

Government expenditures and Investment demand are exogenous. Funding of government expenditures is provided by net tax revenues. There are three other components of government income in addition to import tariffs. These are (i) value-added taxes on factor inputs to production and on imports, (ii) employment and corporation taxes on factor employment, and (iii) *ad valorem* production subsidies net of excise taxes on production output. In a counter-factual scenario the value-added tax adjusts endogenously to balance government (net) tax revenues with expenditures. Thus the welfare effects of changes in trade policy explicitly incorporate the appropriate marginal excess burden of raising government revenue from other sources.

Since private consumption equals the income from primary factors plus net transfers to the consumer by the government (from domestic and foreign trade taxes), Walras law is satisfied. Public consumption is balanced with the value of public endowments and tax revenue.

World market import and export prices are fixed, so there are no endogenous changes in the terms of trade. In other words, import supplies and export demands are infinitely elastic. The current account balances the value of exports and imports taking into account exogenously-fixed capital inflows. This guarantees no "free-lunch" either taken from or given to foreigners.[7]

2.3 Empirical implementation of the Morocco model

We employ a 1980 Social Accounting Matrix (SAM) for Morocco which distinguishes 39 production sectors. This provides a consistent set of input-output relationships showing intermediate, final demand and value added transactions. Table 1 summarizes some of the most important industry data employed in our model, and displays the names of each of our sectors along with a 3-letter acronym for later reference.[8] Columns 1-3 show the share of Moroccan output, employment and capital by sector, derived from the 1980 SAM. Although a full update of the 1980 SAM is unavailable, appendix B shows that, at the 9 sector level of aggregation, output shares did not significantly change between 1980 and 1991. Over 40% of both output and factor employment originates in the service sectors, about 30% of the economy is in manufacturing (food and textiles and apparel comprise about half the manufacturing sector) and the remaining 30% is in the agricultural and mining sectors.

Columns 4 and 6 display the sectoral decomposition of imports and exports, where the share accounted for by EC imports and exports is displayed in columns 5 and 7. These shares are updated 1991 data, aggregated from tariff line data provided by the government of Morocco. Phosphates are the most important export

[7] A more formal description of the model is given in Appendix D.

[8] This SAM was constructed by Mateus et al. (1988).

sector, and they encounter no trade barriers in the EC. Fruit and vegetables exports together make up 14% of all exports to the EC.

Columns 8 and 9 show the importance of trade for each sector. Clearly the mining sectors are very dependent on exports, as is the citrus fruit sector to a lesser degree. We therefore expect some benefits to this latter sector from increased access to EC markets.

The benchmark values of all elasticities in the model are reported in Appendix A. Estimates of elasticities must be assembled for primary factor substitution, import demand, import source, domestic demand, and the transformation of domestic supply into domestic and exported products.[9] Despite our literature search, there are many elasticities about which there is considerable uncertainty. Our "remedy" for this problem, which is endemic to any large-scale model of this kind, is to undertake systematic sensitivity analyses of our major results with respect to plausible bounds on these elasticities. Even if we are unable to specify a point estimate with any precision, our priors over the likely bounds that these elasticities could take are quite strong. To the extent that our major conclusions are robust to perturbations over these bounds, we do not see our uncertainty over specific values of these elasticities as a weakness of the model.[10] We report the results of these sensitivity analyses, which involve a minimum of 1000 simulations for each counter-factual policy in Section 4. They will allow us to conclude whether or not our main results are robust, at least with respect to plausible uncertainty over elasticities.

We numerically elaborate in appendix C, the model parameters that define the gross substitute-complement relationship between domestic and export production. Although this relationship is important for sectors such as citrus

[9] In detail, these elasticities refer to the elasticity of substitution between primary factors of production in each sector; the elasticity of substitution between domestic production and an imports composite in each sector; the elasticity of substitution between imports distinguished by source, also by sector; the elasticity of substitution between domestic consumption of each good (the components of which are, in turn, composites of domestic and imported production); and the elasticity of transformation of domestic production into domestic uses and export.

[10] These remarks should not be interpreted as denying the value of any new empirical work on generating such elasticities. On the contrary, any effort that could generate better bounds on these point estimates is useful in generating policy conclusions that carry greater credibility, even if those conclusions will still be probabilistic in nature.

fruits and vegetables, which are expected to experience export price increases, it is typically not transparent in models of this type for the following reason.

Let ϵ denote the supply elasticity of the composite output in a sector and φ denote the elasticity of transformation between domestic and exported output in a sector. Abstracting from general equilibrium effects from other markets, de Melo and Tarr [1992] show that if and only if $\epsilon > \varphi$, an increase in the export price will increase output of the domestic variety and raise the domestic price, i.e., the import and domestic varieties are gross complements in production.[11] Although a similar condition exists in consumption, all elasticities in consumption are entered parametrically, and it is straightforward to examine whether the import and domestic varieties are gross substitutes.[12] Although φ is entered parametrically, ϵ (the industrywide elasticity of supply) is only defined implicitly and, in a model with constant returns to scale such as ours, could potentially assume extremely large values, especially for small sectors where output expansion will not significantly alter the relative costs of its inputs.

We report our basic results for the cases of low, medium and high industrywide elasticities of supply. We implement a change in the elasticity of supply, by assuming three different shares of sector specific capital in all the resource (R) sectors: 50, 75 and 90 percent. *Ceterus paribus*, the larger the share of capital that is sector specific, the lower the industrywide elasticity of supply. Appendix C numerically elaborates the relationship between the assumed share of sector-specific capital in the citrus and vegetable sectors, and the

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[11]The intuition for this result is as follows. When the export price increases, firm revenues will increase if output levels are held constant. Firms will therefore purchase more inputs in order to produce more. Disregarding the relative price change between domestic and export markets for a moment, this would result in an increase in composite production, i.e., of goods destined for both the domestic and export market. This increase in composite output we label the output effect. The extent of this effect depends on ϵ. It is equivalent to the income effect in consumer theory. There is also a transformation effect, however, away from producing domestic goods in favor of export production, due to the change in the relative price of exports to domestic varieties. The extent of this transformation effect depends on φ, the transformation elasticity, and it is equivalent to the substitution effect in consumer theory. When $\epsilon > \varphi$, the output effect dominates the transformation effect, and the goods are gross complements.

[12]de Melo and Tarr [1992] show that a necessary and sufficient condition for the price of the domestic import competing good in a sector to be a gross substitute with the import good is that the price elasticity of demand for the composite Armington good is less than the Armington substitution elasticity. This condition ensures that the substitution effect will dominate the income effect in demand. A similar result is discussed in Rutström [1992].

supply elasticity of the composite output for domestic firms in these sectors. In the case of citrus fruits, the industrywide elasticity of supply varies from about unity to 3.5, but takes slightly lower values in the vegetable sector. Given that the elasticity of transformation (φ) is 5 in our benchmark, this implies that exports and domestic outputs in these sectors are gross substitutes.

In the present version of the model we only have one private household in Morocco. It is important to note, however, that there are several powerful theorems in international trade theory to show that one can effect Pareto-efficient reforms for multiple households providing there are aggregate (real) income gains and one accepts some weak conditions on patterns of demand and ownership.[13] These results do nct rely on the availability of lump-sum redistributive taxes, nor do they address the issue of an optimal reform package. What they do show is that one can focus initially on aggregate gains in income and welfare, knowing that the redistributive aspects of the problem do have a solution that leaves each household at least as well off as before the reform. This is not a complete substitute for actually solving for the equity effects of a reform package, but it is a partial substitute.

The SOE model is generated with the GAMS software developed by Brooke, Kendrick and Meeraus [1988] and solved with the MPS/GE software developed by Rutherford [1989]. The systematic sensitivity analyses are undertaken with the MPSS software developed by Harrison [1990] and using the procedures developed by Harrison and Vinod [1992].

3. RESULTS

The policy simulations that we consider and the aggregate results on welfare and taxes are summarized in table 2, and the employment effects by sector are summarized in table 3. In the following section, we present the results of systematic sensitivity analysis to determine the robustness of the results to

[13] See Dixit and Norman [1980; pp. 79/80] [1986]. The conditions on demand and factor ownership patterns are primarily to rule out "pure exchange" economies. These conditions are trivially met in our model.

parameter specification. One parameter which stands out in importance regarding some of the results is the industry-wide elasticity of supply assumed in the resource sectors. Consequently, in this section, we present our "best guess" estimates under three different assumptions regarding the industry-wide elasticity of supply in resource sectors.

3.1 Welfare, Revenue and Aggregate Primary Factor Movement

The first three columns of table 2 show the welfare gain measured as the Equivalent Variation as a percent of benchmark GDP. Columns 7-9 show the percentage labor adjustment measured by the necessary reallocation of labor across sectors as a percentage of total labor supply. Columns 10-12 likewise measure the necessary reallocation of capital across sectors as a percentage of total capital supply.

The results depend on the industrywide elasticity of supply assumed in the resource sectors. The greater the elasticity of supply, the more resource movement across sectors (more labor has to change jobs), but the more welfare gain as well. For example, under ACCESS, the citrus fruits and vegetables sectors obtain higher EC prices. With larger elasticity of supply, they expand output more. This results in greater welfare gain to the economy, but also more movement of capital and labor between sectors. Conversely, the meat and dairy, sugar, and cereal producers will suffer a decline in demand as a result of lowering tariffs under all scenarios except ACCESS. The greater the elasticity of supply, the more output, labor and capital reduction there will be in these sectors, but the larger the welfare gain as a result of shifting these resources into more efficient sectors.[14] All the results of columns 1-3, 7-9 and 10-12 follow this pattern.

[14]The different elasticities of supply are implemented through varying the share of sector specific capital. Given sector specific capital, in response to a change in demand, the rent on capital in the sector will change which implies there will be less movement of resources in or out of the sector. For example, specific capital owners in citrus fruits and vegetables earn greater rents under ACCESS, but the increase in their rents increases their prices and diminishes the expansion of output. Conversely, in contracting sectors, sector specific capital results in a reduction of rents, costs and prices, and a diminished reduction in output.

Table 2: Free Trade Agreement with the EC and Related Trade Liberalization: Welfare, Tax and Factor Adjustment Effects on Morocco[a]

	% Change in Welfare			%Change in VAT rate			% of labor that change jobs			% of capital that adjusts		
	H	M	L	H	M	L	H	M	L	M	M	H
FTA	2.28	1.52	1.20	54.0	58.3	60.3	3.2	2.5	2.2	5.1	3.3	2.7
ECLIB	2.05	1.29	0.97	54.6	58.9	60.9	3.3	2.6	2.3	5.4	3.6	3.0
ACCESS	0.31	0.27	0.25	-1.8	-1.2	-1.0	0.4	0.3	0.3	0.6	0.4	0.3
LIBROW	1.86	1.10	0.78	55.7	60.1	62.0	3.2	2.5	2.2	5.3	3.5	2.9
LIBALL	3.12	2.37	2.06	80.7	85.5	87.7	3.7	3.0	2.8	6.0	4.3	3.6
FTAALL	3.36	2.60	2.29	80.0	84.9	87.1	3.6	3.0	2.7	5.6	3.9	3.3

a. All simulations use the Value-Added Tax as replacement tax. Results are for high (H), medium (M), and low (L) elasticity of supply in resource sectors.

DESCRIPTION OF POLICIES:

FTA ... Full free trade agreement with the EC. Increased export prices for citrus fruits and vegetables for EC destinations by 8 percent, elimination of import protection from EC sources.

ECLIB ... Elimination of import protection against EC imports.

ACCESS ... Increased export prices for citrus fruits and vegetables to EC destinations by 8 percent.

LIBROW ... Elimination of import protection against non-EC imports.

LIBALL ... Elimination of import protection against all imports, EC and non-EC.

FTAALL ... Full free trade agreement with the EC, augmented by elimination of import protection from non-EC sources as well.

First consider the policy scenario ACCESS. Improved access to the EC for citrus fruits and vegetables will improve Moroccan welfare by slightly more than one-fourth of a percent of GDP, due to improved resource allocation and better terms-of-trade in citrus fruits and vegetables. Since columns seven through nine show that factor movement is small under ACCESS, it is primarily the terms-of-trade improvement that is providing the benefits from improved access.

Removing tariffs against EC imports (ECLIB) results in an improvement in Moroccan welfare of between one and two percent, which is about 4 to 7 times the benefits of improved access alone. The free trade agreement (FTA), which combines the policies of ACCESS and ECLIB, results in gains in Moroccan welfare that are

roughly additive in the separate policies. Removing tariffs against the non-EC rest of the world (LIBROW) results in gains of about 80 percent of those from liberalizing trade with the EC alone, reflective of the fact that the EC is the larger trade partner.

If tariffs are lowered against all imports (LIBALL) another substantial increase in Moroccan welfare (of about one percent of GDP) is obtained (compared with ECLIB), interestingly, without significantly additional shifting of labor and capital among sectors. The reason that the additional welfare is obtained with little additional resource movement is that lowering tariffs against only the EC induces resource movement, but that resource movement is not necessarily toward the most efficient sectors by world standards, i.e., there is trade diversion from the Morocco-EC Free Trade Agreement.[15] Resource movement that is induced by trade diversion will not occur when tariffs are lowered to all supplying countries. The significant benefits that accrue from discriminatory liberalization against either EC or rest of world imports indicates, however, that trade diversion is not dominant.

Liberalizing tariffs to the rest of the world in combination with a free trade agreement (FTAALL) with the EC results in benefits that are roughly additive in the separate policies that make up FTAALL, i.e., LIBALL plus ACCESS.

All simulations are performed assuming that the rate of VAT taxation would be altered so that revenue to the government is unchanged. For scenarios involving reduced tariffs against the EC, columns 4-6 of table 2 show that the VAT would have to be increased by about 55-60 percent. This means that the VAT collection rate on imports would rise to about 16-17 percent (from the collected 11 percent) and on domestic products to about 4-5 percent (from the collected 3 percent). For scenarios involving full tariff liberalization against all imports, the VAT rate would have to rise by about 80-90 percent.

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[15]Trade diversion would occur in a Moroccan Free Trade Agreement with the EC, when a supplier outside the EC would supply the product to Morocco at a cheaper price than the EC supplier, but the tariff inclusive price of the EC supplier is cheaper. Trade diversion costs are more likely to be high relative to trade creation benefits: (1) the higher the tariff rate against and (2) the larger the share of trade with the countries that are excluded from the integration agreement. We also show in section 4.1 that (3) the lower elasicticity of substitution of composite imports and (4) the higher the elasticity of substitution for imports from different countries of origin, the greater the relative costs of trade diversion.

To sum up the aggregate effects, there are significant trade diversion costs when only partially liberalizing import protection, implying that a complete elimination of the protective system would result in higher welfare gains than a free-trade agreement with the EC. Moreover, there is a clear correlation between the welfare effects and the necessary factor adjustments. The higher the welfare gain, the higher is generally the adjustment needed. One interesting conclusion is that broader trade liberalization yields greater welfare gain than the FTA, but with only slightly higher adjustment costs. This can be seen as an important argument in favor of the efforts towards lowering tariffs against non-EC sources subsequent to achieving a FTA. Finally, welfare benefits of 1.5 to 2.5 of GDP, from the free trade agreement or broader liberalization, is quite substantial for models with constant returns to scale. We have shown, however, that a considerable portion of the benefits derives from eliminating dispersion in the tariff regime, since dispersion is eliminated in the process of liberalization.[16]

3.3 Employment Impact by Sector

The sectoral employment adjustments occasioned by the policies are depicted in table 3. By far the sector that gains the most from the trade liberalization scenarios is the phosphate sector, where employment increases by over 60 percent. Despite the fact that phosphate exporters do not obtain improved terms of trade on world markets from the free trade agreement, the reduction of tariffs depreciates the real exchange rate in Morocco, and allows them to obtain more in domestic currency for their exports even if the price of their exports in foreign currency is unchanged.[17] Citrus fruits, vegetables and leather goods (all significant exporters) are the other industries that expand the most.

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[16]In fact, when we first harmonized tariffs for all sectors to their weighted average level in the benchmark (21.5 percent) and subsequently simulated the various policies of shown in table 2 (in the medium elasticity scenario) we obtained considerably smaller benefits. In particular, the welfare benefits as a percentage of GDP are as follows: FTA, 0.549; ECLIB, 0.325; ACCESS, 0.243; LIBROW, 0.290; LIBALL, 1.233; FTAALL, 1.456. This shows that about two-thirds of the benefits in many of the scenarios derives from harmonization of the tariff regime.

[17]Formally speaking (since there is no money in the model), the price of exports buys more in terms of domestic non-traded goods.

Conversely, since the cost of the imported goods rises in terms of non-traded goods, sectors which are primarily non-traded generally lose employment after the FTA or other liberalizing scenarios. The largest losers of employment, however, are the agricultural sectors that lower tariffs significantly (cereals, meat and dairy and sugar). For reasons mentioned above, we treat two sectors in the model as homogeneous: meat and dairy, and sugar. In these sectors the industry-wide elasticity of supply plays an especially important role in determining the decline in employment. The elasticity of supply in these sectors is controlled by the share of sector specific capital. More precise estimates for these sectors could be obtained if econometrically estimated supply elasticities were available. The estimates for these sectors are illustrative, given our best guess of the supply elasticities.

Table 3, Percent Employment Change by Sector and Scenario *

SECTOR (Abbrev.)		FTA H	FTA M	FTA L	ECLIB H	ECLIB M	ECLIB L	ACCESS H	ACCESS M	ACCESS L	LIBROW H	LIBROW M	LIBROW L	LIBALL H	LIBALL M	LIBALL L	FTALL H	FTALL M	FTALL L
AGRICULTURE																			
1. Cereals (CER)	R**	-11.3	-9.4	-8.6	-11.5	-9.5	-8.7	0.0	0.1	0.1	-11.1	-9.1	-8.3	-13.4	-11.6	-10.9	-13.3	-11.5	-10.8
2. Sugar (SUG)	R	-82.5	-68.4	-61.5	-82.3	-68.1	-61.2	-2.4	-1.3	-1.0	-82.6	-68.5	-61.6	-78.5	-63.7	-56.6	-78.7	-78.7	-56.9
3. Citrus Fruits (CIT)	R	22.4	17.6	15.9	2.3	1.7	1.6	17.6	14.6	13.3	2.2	1.5	1.4	2.9	2.2	2.1	23.1	18.2	16.4
4. Vegetables (VEG)	R	9.1	8.4	8.1	-1.1	-1.4	-1.6	8.9	8.7	8.7	-1.6	-2.0	-2.2	-1.4	-1.7	-1.9	8.6	8.0	7.7
5. Meat and Dairy (MAD)	R	-67.3	-52.0	-45.3	-67.1	-51.7	-45.1	-1.8	-0.9	-0.8	-67.7	-52.4	-45.7	63.6	-48.2	-41.6	-63.8	-48.5	-41.9
6. Fishing (FSH)	R	-2.0	-2.0	-3.8	-2.2	-3.3	-4.2	0.1	0.2	0.2	0.7	0.2	-0.8	1.7	1.0	0.4	1.9	1.3	0.8
7. Forestry & other Agric. (FOR)		-4.7	-4.9	-5.0	-4.5	-4.7	-4.8	-0.4	-0.3	-0.3	-3.1	-3.3	-3.5	-6.9	-7.1	-7.2	-7.1	-7.3	-7.5
MINING AND RELATED																			
8. Phosphates ((PHS)		92.6	68.5	58.1	108.7	79.9	67.3	-8.6	-7.1	-6.2	102.2	73.3	60.7	129.3	91.5	79.1	104.1	80.8	69.7
9. Other Non-Metallic Mining (NMM)	R	6.4	5.7	5.4	6.8	6.1	5.8	-1.0	-0.7	-0.6	-2.7	-2.5	-2.4	-1.3	-1.1	-1.0	-1.7	-1.4	-1.3
10. Metals Mining (MIN)	R	3.8	2.7	2.4	4.0	2.9	2.6	-0.7	-0.4	-0.3	2.9	2.1	1.9	4.2	3.0	2.7	3.9	2.8	2.5
11. Coal and Crude Oil (CAO)	R	9.3	8.5	8.1	9.7	9.0	8.6	-0.9	-0.7	-0.7	-0.7	-0.3	-0.1	2.4	2.6	2.7	2.8	2.1	2.2
12. Refined Oil (OIL)		-2.0	-3.4	-4.0	-1.8	-3.3	-3.9	0.1	0.1	0.0	6.6	5.0	4.2	4.4	2.8	2.1	4.2	2.7	2.0
13. Electricity and Water (ELE)		-1.1	-0.4	-0.1	-1.0	-0.2	0.1	-0.1	-0.1	-0.1	-1.0	-0.2	0.1	-1.0	0.1	0.4	-1.0	-0.1	0.2
MANUFACTURING																			
14. Food Products (FOO)		-6.0	-5.2	-4.9	-6.1	-5.3	-5.0	0.1	0.1	0.1	-6.0	-5.2	-5.0	-8.0	-6.8	-6.5	-7.4	-6.7	-6.4
15. Other Food Products (OFP)		-3.9	-3.1	-2.8	-4.0	-3.1	-2.8	-0.3	-0.6	-0.1	-4.9	-4.1	-3.8	-5.8	-5.0	-4.7	-5.7	-4.9	-4.6
16. Beverages and Tobacco (BEV)		-2.2	-2.3	-2.3	-2.3	-2.3	-2.4	-0.2	-0.2	-0.1	-1.8	-1.9	-1.9	-3.0	-3.1	-3.1	-3.0	-3.0	-3.1
17. Textiles (TXT)		-4.0	-3.7	-3.8	-4.0	-3.9	-3.9	-0.3	-0.2	-0.1	-2.8	-2.7	-2.7	-5.5	-5.3	-5.3	-5.4	-5.3	-5.2
18. Clothing (CLO)		-1.0	-1.1	-1.1	-1.1	-1.1	-1.2	-0.2	-0.2	-0.1	-1.7	-1.8	-1.9	-1.8	-1.8	-1.9	-1.7	-1.8	-1.9
19. Leather and Shoes (LEA)		13.2	10.9	9.7	14.1	11.6	10.3	-1.6	-1.3	-1.1	8.0	5.7	4.5	12.7	10.5	9.4	12.0	9.9	8.9
20. Wooden Products (WDN)		0.5	0.5	0.5	0.4	0.4	0.5	-0.1	-0.0	0.0	-2.7	-2.7	-2.7	-2.0	-2.0	-2.0	-2.0	-1.9	-1.9
21. Paper and Printing (PAP)		-2.8	-2.7	-2.7	-2.8	-2.7	-2.6	-0.3	-0.2	-0.2	-3.3	-3.2	-3.2	-5.0	-4.8	-4.8	-5.0	-4.8	-4.8
22. Cement (CEM)		-1.3	-1.1	-1.0	-1.3	-1.1	-0.9	-0.1	-0.1	-0.1	-1.6	-1.3	-1.2	-2.2	-2.0	-1.8	-2.2	-2.0	-1.9
23. Iron and Steel (IAS)		2.5	1.8	1.5	3.0	2.3	2.0	-1.3	-1.0	-0.9	3.2	2.7	2.4	1.0	0.4	0.1	1.0	-0.1	-0.3
24. Electro-Mechanical Industry (EMI)		-4.2	-3.7	-3.4	-4.3	-3.8	-3.5	0.1	0.0	0.0	0.8	0.6	0.9	3.8	-3.2	-2.9	-2.7	-3.1	-2.8
25. Industrial Machinery (IND)		-3.7	-2.8	-2.5	-3.6	-2.6	-2.2	-0.4	-0.4	-0.4	-7.0	-6.1	-5.7	-11.2	-10.3	-9.9	-11.3	-10.5	-10.1
26. Transport Equipment (TEQ)		-1.8	-1.3	-1.1	-1.7	-1.2	-0.9	-0.3	-0.3	-0.3	0.2	0.7	1.0	-2.6	-2.0	-1.7	-2.6	-2.1	-1.9
27. Electrical Equipment (EEQ)		-6.3	-6.1	-6.0	-6.1	-6.0	-5.9	-0.4	-0.3	-0.3	-4.7	-4.5	-4.4	-10.0	-9.3	-9.2	-10.0	-9.4	-9.3
28. Office Machinery (MAC)		-17.2	-17.0	-16.8	-16.9	-16.6	-16.5	-0.8	-0.7	-0.6	-3.2	-2.9	-2.8	-20.0	-19.2	-19.1	-19.9	-19.5	-19.4
29. Chemicals (CHM)		1.2	0.3	-0.1	1.6	0.7	0.3	-0.9	-0.7	-0.7	5.7	4.8	4.4	3.0	2.2	1.9	2.5	1.8	1.5
30. Rubber and Plastics (RBR)		-0.7	-1.5	-1.8	-0.4	-1.2	-1.6	-0.3	-0.2	-0.2	2.4	1.5	1.1	-0.1	-0.9	-1.3	-0.4	-1.2	-1.5
31. Other Industries (OTH)		-1.8	-1.8	-1.8	-1.8	-1.9	-1.9	0.1	0.1	0.1	-1.4	-1.5	-1.5	-1.2	-1.3	-1.3	-1.2	-1.2	-1.3
SERVICES																			
32. Construction (CON)		-1.5	0.1	0.5	-1.5	0.2	1.0	0.0	-0.1	-0.2	-1.6	0.2	1.0	-1.4	0.3	1.1	-1.6	0.2	0.9
33. Trade (TRD)		-4.0	-1.9	-0.9	-5.7	-2.8	-1.5	1.2	0.7	0.4	-5.3	-2.5	-1.1	-6.1	-3.3	-2.0	-6.5	-2.4	-1.4
34. Transport (TRN)		2.3	2.2	2.1	2.8	2.7	2.6	-0.5	-0.5	-0.5	5.3	5.2	5.1	5.5	5.4	5.4	5.0	4.9	4.9
35. Communications (COM)		-1.0	-0.1	0.3	-1.0	0.0	0.5	-0.1	-0.1	-0.2	-0.6	0.5	0.9	-0.5	0.5	0.9	-0.5	0.4	0.7
36. Banking (BNK)		0.4	1.0	1.2	0.7	1.3	1.6	-0.3	-0.3	-0.4	0.8	1.4	1.7	0.7	1.3	1.6	0.5	1.0	1.2
37. Insurance (INS)		0.4	0.9	1.1	0.4	1.0	1.2	-0.4	-0.3	-0.3	1.7	2.2	2.4	1.2	1.8	2.0	1.2	1.7	1.9
38. Other Services (SRV)		-0.3	0.5	0.9	-0.3	0.7	1.1	0.1	-0.2	-0.2	-0.3	0.6	1.1	0.1	1.0	1.4	0.1	0.9	1.2
39. Administration (ADM)		-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1

* H, M, L refer to high, medium and low industrywide elasticity of supply in the resource (R) sectors.

** Sectors denoted with R (resource) have sector specific capital.

Source: Model estimates

4. IMPACT OF KEY PARAMETERS AND SENSITIVITY ANALYSIS

4.1 Impact of Key Parameters

Sensitivity analysis over the parameters of our model has revealed the parameters which are most important regarding the welfare, revenue and factor adjustment estimates. One which we discussed above is the industrywide elasticity of supply. We have also found that the results are sensitive to the elasticity between imports and domestic consumption (the Armington elasticity), and to a lesser extent the elasticity of substitution in consumption between imports from the EC and the ROW. In this section we discuss the impact of these parameters as well as the Armington assumption in sectors with small initial shares of imports.

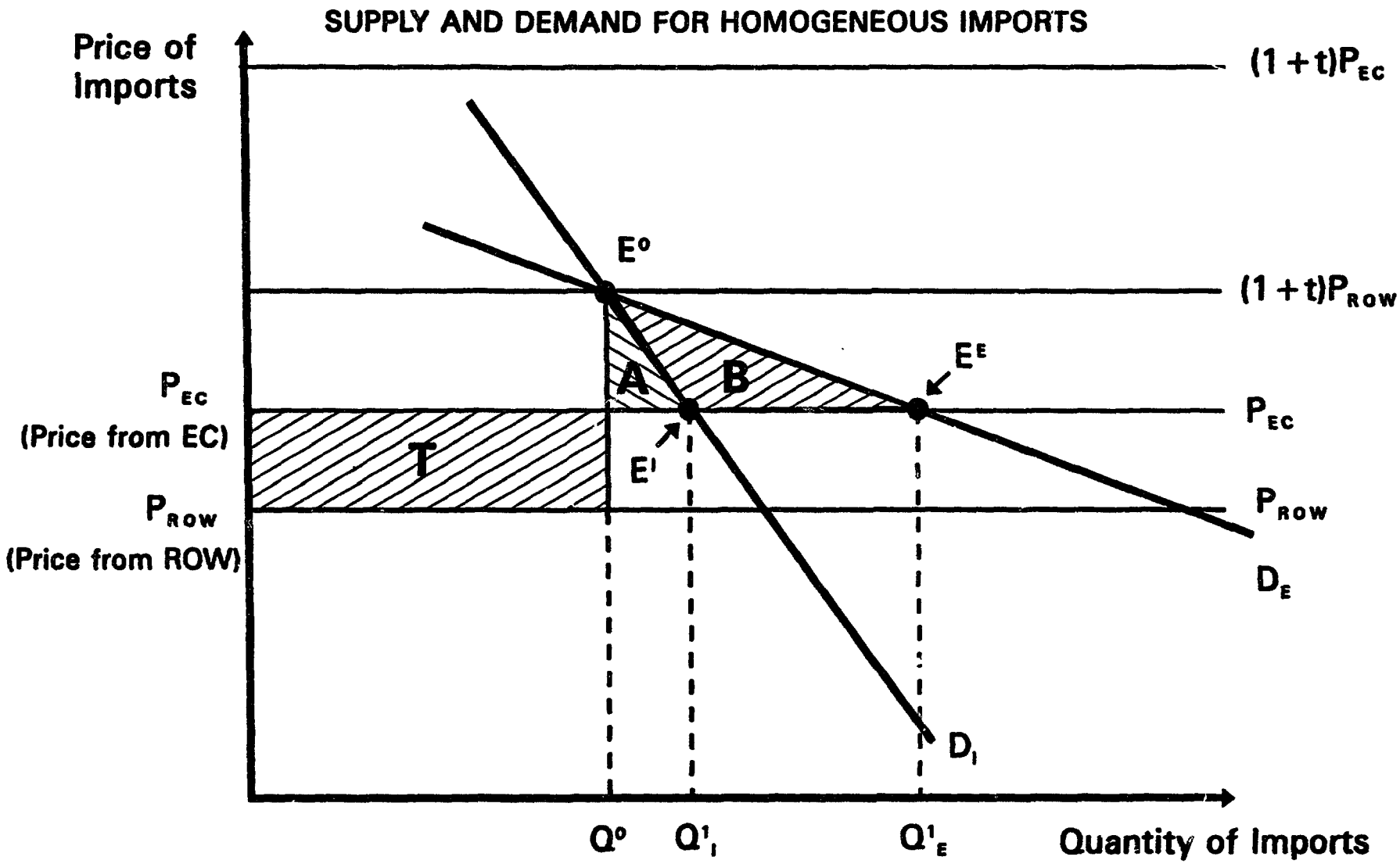
Elasticity between Domestic Consumption and Composite Imports

In the results reported in table 2, the Armington elasticity is equal to 2 for all sectors other than sugar and meat and dairy (imports and domestic production are assumed to be perfect substitutes in these latter two sectors). Increasing the Armington elasticity for all Armington sectors increases the welfare benefits, as shown in table A2. At a value of 10 for the Armington elasticity, the welfare benefits of the integration-liberalization strategies increase more than 3 times in all scenarios except ACCESS (where trade diversion is not an issue). At a value of 1 for the Armington elasticity the welfare benefits are reduced.

In figure 1 we provide an interpretation of the welfare economics of why an increase in the Armington elasticity increases the welfare benefits of trade integration. To simplify, and to isolate the impact of the Armington elasticity, we assume that imports from EC and ROW sources are homogeneous in the preferences of consumers. (In figure 2 we show how to generalize the graphical interpretation to where imports from different sources are imperfect substitutes, as in our model.) The case of trade diversion in a given sector is depicted. Tariffs are lowered preferentially against imports from the EC, but imports from the ROW are the cheapest. The cost advantage of ROW suppliers is not large enough to overcome the tariff preference toward the EC, so that Moroccan importers shift from all ROW imports to all EC imports. Initially equilibrium is at E^0 and shifts to

1: of n

Increase with the Elasticity of Demand for Composite Imports*



* The trade diversion case, where consumers regard imports from different sources as homogenenous, is pictured. If tariffs are eliminated preferentially against the EC, the welfare change is equal to: A - T with D_I (inelastic demand for imports), or A + B - T with D_E (elastic demand for imports). In the trade creation case there is no area T to subtract, and the triangles A and B extend down to the price of the low cost supplier.

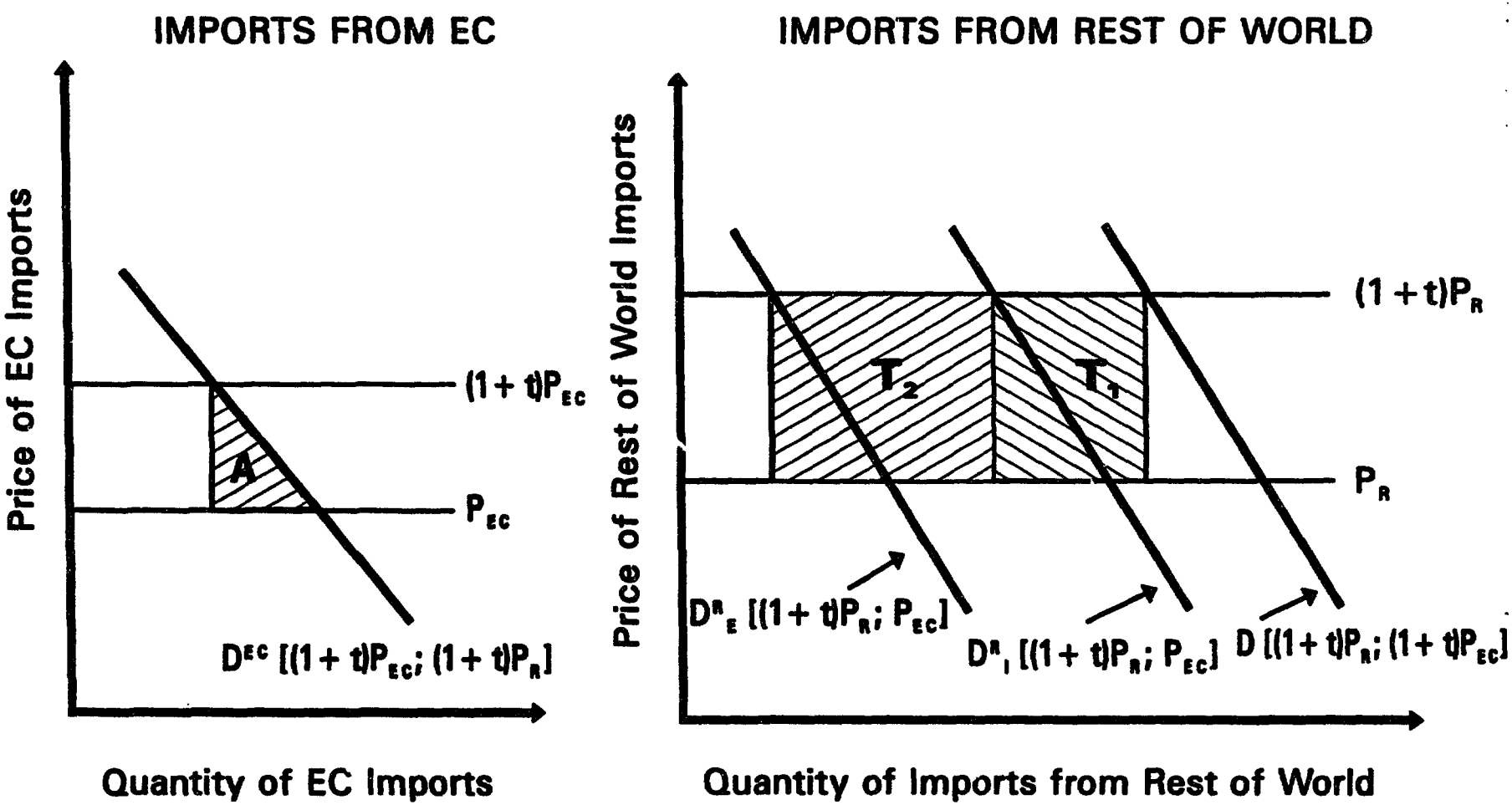
either E^I or E^E depending on the elasticity of demand for composite imports. Ceteris paribus, the larger the Armington elasticity, the larger the elasticity of demand for composite imports. Consumers' surplus analysis (our general equilibrium model uses Hicksian equivalent variation) implies that the net change in welfare is equal to A - T in the inelastic case, or A + B - T in the elastic demand case, i.e., the triangle B represents the net difference in the welfare between the elastic and inelastic demand cases. In the case of trade creation, there is no rectangle T to subtract and the triangles A and B extend down to the delivered price of the low cost supplier; but an enlarged triangle B remains the net difference in welfare between the elastic and inelastic demand cases.

Elasticity of Substitution between Imports from Different Sources

Our benchmark value of the elasticity of demand between imports from the EC and imports from the ROW is 5. In table A2, we show that increasing this value reduces the welfare benefits of preferential tariff reduction, either against the EC or against the ROW. This parameter has no effect on the welfare effects when the tariff changes are not preferential.

Figure 2 depicts how an increase in the elasticity of substitution among imports impacts on the estimates of the change in welfare. The demand curves of Moroccan consumers for imports from the EC and from the ROW are drawn to show that they depend on their own price and among other prices, most notably the price of the import substitute (in all cases it is the tariff inclusive price that is relevant). Preferential tariff reduction against EC imports will reduce the tariff inclusive price of EC imports, and therefore induce an inward shift in the demand curve for imports from the ROW. The inward shift in the demand curve for imports from the ROW will be larger the larger the elasticity of substitution among imports from different sources. In the market for EC imports, triangle A is the gain in consumers surplus that is not offset by lost tariff revenue. In the market for ROW imports, there is a loss of tariff revenue equal to T_1 in the low cross-elasticity case or equal to $T_1 + T_2$ in the high cross-

FIGURE 2: Welfare Benefits of Trade Integration Decrease with Greater Substitutability among Imports



* If tariffs are eliminated preferentially against the EC, the welfare change is equal to: $A - T_1$ with D^R_I (small cross-elasticity of demand between EC and Rest of World imports), or $A - T_1 - T_2$ with D^R_E (large cross-elasticity of demand between EC and Rest of World imports).

elasticity case, that is not offset by a consumers' surplus change. Thus, the net change in welfare is equal to $A - T_1$ or $A - T_1 - T_2$.[18]

Homogeneous or Armington Sectors

Since both the sugar and the meat and dairy sectors have little or no imports, we have assumed that they are homogeneous sectors in our model. An alternative modelling procedure would be to assign a very small amount of imports to a sector that has no imports and treat the sector as an Armington sector. In view of the above discussion on the impact of the Armington elasticity, it should be apparent that treating the sector as a homogeneous sector (equivalent to an infinite Armington elasticity) will increase the welfare benefits of our trade integration scenarios, i.e., the Armington assumption mutes resource movement and reduces the welfare impact.[19] What may be less apparent is that under the Armington assumption, in response to a change in trade policy in a given sector, resource movement and the welfare impact will be quite small in sectors with a small import share compared with sectors with a large share of imports. For example, with our point estimate Armington elasticity (elasticity of substitution) of 2, a fifty percent decline in the relative price of imports will induce a 100 percent increase in the ratio of imports to domestic sales in consumption. But if imports were less than 0.5 percent of consumption, they will remain under one percent after their relative price reduction, i.e., the absolute increase in the import share of consumption is less than 0.5 percent. With the same elasticity of substitution, if a sector has a significant initial share, the same relative price reduction will result in a much larger absolute increase in imports as a percent of total consumption in the sector. That is, ceterus

[18]The justification for the welfare analysis of figure 2 is equation (8) [or its special case, equation (5'')] in Harberger (1971). Harberger considers the case where there is a change in the tax on good 1 (in our case lowering the tariff against EC imports) in the presence of taxes on other goods in the economy say goods 2,...,n. In our case, the most notable other tax is the tariff on competing imports from the rest of the world in the same sector. Then, the change in welfare is the change in surplus on good 1, plus the change in surplus on goods 2,...,n, where the latter is equal to the tax in the other sectors times the change in quantity in those sectors, summed over all such sectors. To simplify figure 2, and because the cross-substitution effect in demand will be smaller and of either sign in other sectors, we have ignored sectors outside of the directly competing import sector. Our quantitative analysis, however, which is based on Hicksian equivalent variation, incorporates the welfare changes from all goods.

[19]See de Melo and Tarr (1992, chapter 2) for an elaboration.

paribus, there is dramatically less resource movement (and consequently welfare impact) in the case of a small initial import share.

In the case of sugar and meat and dairy, it appears inappropriate to model these sectors as Armington sectors after quantitative restraints are removed, where the removal of tariff equivalents of even as high as 100 percent would result in an import share of less than 2 percent. These sectors have been protected by quantitative restraints because of the fear that they would contract precipitously. On the other hand, the homogenous product assumption will tend to result in excessive resource movement without the presence of specific factors of production. Thus, as discussed in section 3, we have employed specific factors in the homogeneous sectors, to approximate the appropriate supply response.

4.2 Sensitivity Analysis

How robust are our major policy conclusions to the many assumptions of our numerical model? We answer this question partially by considering a systematic sensitivity analysis of the main results with respect to all of the elasticities of the model.[20]

Our sensitivity analysis employs the procedures developed by Harrison and Vinod [1992]. Essentially these procedures amount to a Monte Carlo simulation exercise in which a wide range of elasticities are independently and simultaneously perturbed from their benchmark values. These perturbations follow prescribed distributions, such as a *t* distribution with a specified standard deviation and degrees of freedom, or a uniform distribution over a specified range.[21] For each Monte Carlo run we solve the counter-factual policy with the selected set of elasticities. This process is repeated until we arrive at the desired sample size, in our case 1000. The results are then tabulated as a distribution, with equal weight being given (by construction) to each Monte Carlo run. The upshot is a probability distribution defined over the endogenous

[20] We appreciate that there are many other assumptions that remain fixed as we just vary elasticities, but regard those extensions as beyond the scope of the present study.

[21] The exact distributional assumptions used are documented in Appendix A.

variables of interest. In our case we focus solely on the welfare impacts of each policy.

TABLE 4: Results from sensitivity analysis

	FTA	ACCESS	ECLIB	LIBROW	LIBALL	FTAALL
sample size	1005	2284	1096	1002	1002	1078
WELFARE PE	1.52	0.27	1.29	1.10	2.37	2.60
Median	1.72	0.29	1.51	1.39	2.73	2.96
Mean	1.74	0.29	1.51	1.39	2.72	2.96
St. d.	0.39	0.02	0.31	0.32	0.35	0.35
Prob>0	1.0	1.0	1.0	1.0	1.0	1.0
Prob>PE	0.705	0.789	0.721	0.870	0.809	0.826
50% LB	1.49	0.28	1.27	1.11	2.43	2.69
50% UB	2.00	0.31	1.77	1.64	2.96	3.23
75% LB	1.38	0.27	1.14	1.00	2.26	2.52
75% UB	2.14	0.32	1.90	1.79	3.12	3.40
VAT rate PE	58.3	-1.20	58.90	60.10	85.50	84.90
Median	56.33	-1.55	57.08	57.11	81.69	80.99
Mean	56.39	-1.58	57.11	57.25	81.75	81.01
St.d.	2.95	0.03	3.07	3.24	3.13	3.07
Prob>0	1.0	0.0	1.0	1.0	1.0	1.0
Prob>PE	0.262	0.086	0.297	0.197	0.133	0.129
50% LB	54.42	-1.81	54.96	55.06	79.52	78.75
50% UB	58.49	-1.39	59.35	59.63	84.19	83.34
75% LB	53.02	-1.99	53.53	53.72	78.11	77.32
75% UB	59.90	-1.29	60.60	61.55	85.70	85.00
LABOR ADJ PE	2.4	0.3	2.5	2.5	3.0	2.9
Median	2.65	0.32	2.75	2.77	3.48	3.38
Mean	2.67	0.32	2.78	2.80	3.49	3.39
St.d.	0.36	0.04	0.38	0.39	0.48	0.45

PE = point estimate, st.d. = standard deviation, LB = lower bound, UB = upper bound

The results of the sensitivity analysis are reported in Table 4. In the interests of reporting all of the pertinent data in a compact manner, some of the column and row headings are necessarily somewhat cryptic at first glance. The acronyms for each simulation (column heading) are defined in Figure 1. The "Sample Size" row refers to the number of Monte Carlo runs that were actually completed. In each case we have at least 1000 runs, which should be enough to obtain a reliable picture of the distribution of results. The "Point Estimate" (PE) row shows the effect of the policy when all elasticities are set equal to their benchmark, or point estimate (PE), values. These are the results reported and discussed earlier. As before, we report the change in welfare due to the policy as a percent of GDP, the revenue as the change in the VAT rate required, and the labor adjustment as the percent of the labor force that is reallocated.

The remaining rows report the results of the sensitivity analysis proper. We list the median, the mean, and the standard deviation, so as to provide simple indicators of the location and dispersion of the distribution of results. We do not report here the skewness and kurtosis statistics that are necessary to gain a more complete impression of the distribution. In all cases we find that both the skewness and kurtosis are insignificant.

In order to obtain an indication of the *qualitative* policy results we report the "Prob. ≥ 0" row for the welfare and the VAT rate results, which shows the probability from the empirical distribution that welfare increased in the counter-factual policy. This gives us a measure of the confidence that we have the *sign* right when we look at the Point Estimate effect or the Mean or Median. Similarly, we report a row showing the probability that an effect greater than or equal to the PE effect was obtained. If the PE result is perfectly representative of the location of the distribution of results we should see this value around one-half; this would be the case if the PE result exactly equalled the reported Median result. A value lower (higher) than one-half indicates that the distribution generally lies below (above) the PE result.[22]

[22]With the exception of the intermediate input substitution, where the point estimate is 0.

Finally, to gain a better sense of the confidence to be attached to the PE or Mean welfare and VAT rate result, we report lower and upper bounds from 50% and 75% symmetric confidence intervals around the Median result. These confidence intervals simply show the smallest and largest values that lie within 50% or 75% of the distribution centered on the Median. Thus a 50% confidence interval between 1.1 and 2.3 can be interpreted as saying that 50% of the Monte Carlo runs resulted in welfare results between these values.

What, then, do we learn from these sensitivity analyses regarding our policy conclusions? Most mean and median welfare effects are above the point estimates reported earlier. These higher welfare effects are also coupled with higher adjustment costs. We can confirm our conclusion above that FTA is a preferred policy package to ECLIB in the sense of providing higher median welfare gains at lower median adjustment costs. Note, however, that the mean welfare effect for ECLIB lies within one standard deviation of the mean for FTA. There is therefore considerable overlap between the two distributions so the conclusion regarding which policy package is preferred might still not be robust. We find, however, that the welfare effect in FTA is greater then the median welfare effect in ECLIB with a probability of 0.711. The reverse case that the welfare effect in ECLIB is larger than the median welfare effect in FTA only occurs with a probability of 0.282, however.

Similarly, we find the second-best argument in favor of eliminating all import protection and not just protection from EC competition to be robust to variations in the value of key parameters. The welfare effect in LIBALL is much larger than the welfare effect of ECLIB, but with not much additional labor adjustment.

Interestingly we find that the median revenue effects are smaller than the point estimates. In no case would the VAT rate have to increase to more than about 5.5 and 20 percent from a benchmark value of 3 and 11 percent for domestically produced and imported goods, respectively.

In summary, we find that our general conclusions are quite robust with respect to any uncertainty in key parameters. Welfare and labor adjustments tend

to be higher, due to the inclusion of higher Armington elasticities, but the revenue effect is smaller.

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APPENDICES TO

MOROCCO'S FREE TRADE AGREEMENT WITH THE EC: A QUANTITATIVE ASSESSMENT

by

Thomas F. Rutherford
E.E. Rutström
and
David Tarr

APPENDIX A

Elasticity Parameters

A.1. Choice of Point-Estimates

In all sectors, the elasticity of transformation (between output for domestic and export markets) is set at 5 and the transformation elasticity (between exports for the EC and non-EC markets) is set at 8. The elasticity of substitution between domestic and imported goods (the Armington elasticity) is set equal to 2 across all sectors, and the substitution elasticity between EC and non-EC imports is set at 5.[1] Effects due to the choice of values of these parameters are traced out in the next section. Detailed estimates of the Armington elasticities for the ORANI model of Australia are reported in Dixon, Parmenter, Sutton, and Vincent [1982], ranging from 0.34 for oil and coal products to 6.8 for footwear, however the majority of sectors receive a value of 2. Lacking more specific information about substitutability in Morocco, we set this elasticity to 2 for all sectors, but trace out the effects from variations in its value in the next section. The consumer's "top level" elasticity of demand for composite output of the sector is taken to be one for all sectors. Given that this value, which does not vary in the sensitivity analysis, is less than the Armington elasticity, imports and domestic goods within a sector may be expected to be gross substitutes.

The primary factor substitution elasticities are based on the detailed regression estimates of Harrison, Jones, Kimbell, and Wigle [1991], and are listed in Table A1 as they apply here. They range from 0.43 for OIL up to 1.99 for services sectors (CON, COM, SRV, and ADM), but the vast majority are close

[1]The systematic sensitivity analysis investigates variations in these elasticities based on uniform distributions which have the following range: between 2.5 and 7.5 for the transformation elasticity between domestic and foreign outputs; between 6.5 and 9.5 for the transformation elasticity between foreign outputs of different destinations; between 0.5 and 3.5 for the Armington elasticity between imports and domestic output; and between 2.5 and 7.5 for the Armington elasticity for imports from different sources.

TABLE A1: Capital-Labor Substitution elasticities

Sector in Morocco model	Sector in H J K W	Point estimate	Standard deviation
CER	20	0.95	0.04
SUG	20	0.95	0.04
CIT	20	0.95	0.04
VEG	20	0.95	0.04
MAD	20	0.95	0.04
FSH	20	0.95	0.04
FOR	20	0.95	0.04
FOO	20	0.95	0.04
BEV	20	0.95	0.04
OFP	20	0.95	0.04
PHS	14	0.43	0.11
NMM	14	0.43	0.11
MIN	14	0.43	0.11
CAO	14	0.43	0.11
OIL	13	0.43	0.09
ELE	B	1.88	0.25
TXT	22	0.93	0.08
CLO	23	1.19	0.03
LEA	31	0.75	0.16
WDN	24, 25	0.93	0.10
PAP	26, 27	1.00	0.13
CEM	32	0.96	0.13
IAS	33	0.91	0.24
TEQ	35	1.20	0.09
EEQ	36	0.98	0.03
IND	35	1.20	0.09
MAC	35	1.20	0.09
EMI	39	1.19	0.05
CHM	28	1.01	0.03
RBR	30	0.97	0.08
OTH	39	1.19	0.05
TRD	C, D	1.28	0.53
TRN	B	1.88	0.25
BNK	E	2.06	0.25
INS	E	2.06	0.25
CON	Nontraded	1.99	0.48
COM	Nontraded	1.99	0.[illegible]
SRV	Nontraded	1.99	0.48
ADM	Nontraded	1.99	0.48

Source: Harrison, Jones, Kimbell, and Wigle [1992].

to unity.

In addition there is an elasticity of substitution between intermediate inputs and value-added in each sector. The tradition, no doubt born of Input-Output modelling habits, is to set this elasticity at zero. We do likewise, but also consider values of 0.25, 0.5, 0.75, and 1 (for each sector) in our sensitivity analysis.

A.2 Effects of choice of trade elasticities

We trace out the effects on welfare in order to assess the model's sensitivity to the choice of value of the Armington elasticity (σ_A) between goods from domestic and foreign sources and (σ_M) between EC and ROW sources. These results are presented in Tables A2.

The welfare effects are very sensitive to variations in the substitution elasticity between domestic and foreign sources. The welfare effects from the FTA simulation, for examples, goes from 1 to 5 percent as the elasticity increases from 1 to 10. With the exception of ACCESS, the welfare effects are at least quadrupled. The sensitivity with respect to the elasticity of substitution between EC and ROW sources is not that pronounced. The table illustrates, however, how trade diversion costs become more pronounced with the value of this elasticity. Again ACCESS provides a slight exception due to the small effects in general.

In summary, the confidence intervals provided by the sensitivity analysis of the main text provide more reliable estimates of welfare and adjustment effects than a point estimate. This is especially true due to the sensitivity of the estimates to the Armington elasticity, and the uncertainty regarding an exact point estimate.

TABLE A2: Welfare Effects of variations in elasticities of substitution in demand *

	FTA	ECLIB	LIBALL	ACCESS	LIBROW	FTAALL
$\sigma_A = 1$ **	1.184	0.962	1.814	0.243	0.882	2.035
$\sigma_A = 2$	1.518	1.288	2.369	0.265	1.099	2.598
$\sigma_A = 3$	1.859	1.622	2.939	0.285	1.317	3.176
$\sigma_A = 4$	2.213	1.970	3.535	0.306	1.541	3.777
$\sigma_A = 5$	2.587	2.338	4.164	0.326	1.775	4.412
$\sigma_A = 6$	2.986	2.732	4.837	0.347	2.024	5.089
$\sigma_A = 7$	3.419	3.160	5.557	0.368	2.292	5.814
$\sigma_A = 8$	3.890	3.676	6.323	0.389	2.584	6.584
$\sigma_A = 9$	4.406	4.137	7.127	0.411	2.905	7.393
$\sigma_A = 10$	4.969	4.695	7.956	0.433	3.260	8.225
$\sigma_M = 1$	2.005	1.774	2.369	0.265	1.652	2.598
$\sigma_M = 2$	1.857	1.626	2.369	0.265	1.499	2.598
$\sigma_M = 3$	1.723	1.493	2.369	0.265	1.351	2.598
$\sigma_M = 4$	1.610	1.380	2.369	0.265	1.216	2.598
$\sigma_M = 5$	1.518	1.288	2.369	0.265	1.099	2.598
$\sigma_M = 6$	1.448	1.219	2.369	0.265	1.002	2.598
$\sigma_M = 7$	1.398	1.169	2.369	0.265	0.927	2.598
$\sigma_M = 8$	1.365	1.136	2.369	0.265	0.871	2.598
$\sigma_M = 9$	1.346	1.117	2.369	0.265	0.832	2.598
$\sigma_M = 10$	1.339	1.110	2.369	0.265	0.809	2.598

* Table values represent the change in welfare (equivalent variation) as a percentage of GDP. See table 2 for an explanation of the policies.

** σ_A = the Armington elasticity of substitution between domestic output and composite imports. σ_M = the elasticity of substitution between imports from different sources.

Source: Model estimates

APPENDIX B

Adjustments to the Social Accounting Matrix

This appendix documents the adjustments to the SAM required to benchmark the Moroccan SOE model, and the extraneous data incorporated. The original SAM is explained in Mateus et al. [1988].

The 1980 SAM consists of 39 sectors, and all are retained in the SOE model. 14 labor accounts are aggregated into one. Three capital accounts are aggregated into one. One private representative household owns both of these aggregated production factors, and any ownership by the government and the enterprise sector has been transferred into the private household. Final demand by four "true households" are aggregated into this private representative household. Government demand is only for sector Administration (the public sector).

The vector called "endow" shows consumption of citizens living abroad. We show this as exports by the banking sector. The tourist account (consumption by tourists in Morocco) is similarly incorporated into exports.

Several input taxes are levied in production. The value-added tax is levied on both capital and labor as well as imports of all goods, the social-security tax only on labor, and the corporate tax only on capital. These taxes are all calculated net of any subsidies. There is also a production subsidy (net of the excise tax) on output. All these taxes show some variation in collection rates in the SAM. Lacking more detailed information regarding existing exemptions and variations in tax collections across sectors we assume that collection rates are the uniform across sectors for these taxes, however. Therefore we are able to isolate resource allocation effects that derive from distortions due to trade restrictions (assuming that trade taxes do not offset other sectoral differentials). The income tax is only about 3% and is therefore excluded for simplicity.

As the SAM is constructed based on data from 1980, before the major liberalizations were undertaken, we considered it important to establish whether the structure of the economy had changed dramatically between 1980 and 1991.

TABLE B1: Comparison of value-added in 1980 and 1991

Aggregated sector	1980 SAM share	1991 share
Agriculture	20.1	24.0
Mining	4.8	2.4
Coal and Oil	0.2	0.2
Refined Oil	0.2	4.6
Electricity and Water	1.7	3.4
Manufacturing	15.9	22.7
Trade	15.2	14.2
Transportation and Communication	5.7	7.8
Other Services	36.2	20.6
	100.0	99.9

Table B1 summarizes a description of value-added shares in some aggregated sectors according to the 1980 SAM and official value-added data for 1991. As can be seen no such dramatic structural changes have occurred, so we can retain our confidence in the results based on the 1980 SAM.

We decided to use 1991 data on tariff rates rather than tariff revenue collections recorded in the 1980 SAM. The rates we applied are based on the legal rates from World Bank "Sintia" trade files based on data provided by the Moroccan Ministry of External Commerce, adjusted so revenues match the 1991 collected tariff revenues. This adjustment to match collections was needed due to the number of exemptions that exist in tariff collections. We encountered some problems in the sectoral mapping from the Sintia data base to the 39 sectoral level of the SAM. We therefore had to turn to auxiliary data for rates on sectors CIT, FOO and MAC. For all 39 sectors we applied the simple average of the legal rates reported at the most disaggregated level before adjusting to collection rates.

We also calibrated the import and export shares by source and destination

country to 1991 according to the Sintia files. Again, due to mapping difficulties, we needed to refer to auxiliary data for imports sectors CIT, FSH, PHS, FOO, WDN, MAC, and exports sectors CER, SUG, CAO, FOO, CEM, EMI, EEQ, MAC, RBR, as well as exports and imports for all services sectors are therefore disaggregated by source and destination country according to the United Nations database on Direction of Trade (the COMTRADE data base) for 1990.

We decided against including more detail in the model by identifying the Maghreb and Other Arab countries as separate trading partners due to their relatively small importance. The Maghreb countries account for 3 and 8% respectively in imports and exports and corresponding figures for Other Arab countries are 10 and 3%.

We also decided to adjust the VAT rate to reflect the collections in 1991. We therefore set the domestic rate to 3% and the rate on imports to 11%. When the VAT rates are adjusted to keep the government budget balanced through the counterfactural simulations the domestic and the imported rates are adjusted by the same proportion. Therefore, as imported rates are higher than domestic rates in the benchmark they will tend to change by a larger number of percentage points. This reflects the differences in exemptions between imported and domestically produced commodities. Finally, the corporation tax (levied on capital use) of 5 percent reflects the collected rate in 1991.

APPENDIX C

The Relationship Between the Elasticity of Supply and the Sector-specific Capital Share

This appendix numerically establishes the relationship between the share of sector-specific capital in the citrus fruits (CIT) and vegetables (VEG) sectors and the industry-wide elasticity of supply in these sectors. Our numerical procedure is as follows. We start with a value of φ, which is the elasticity of transformation between output destined for exports or the domestic market. This value is given in the first column of table C1. We first confirm that the prices of the domestic variants of CIT and VEG decrease in ACCESS (where their export prices increase) for a situation where the entire capital stock in each sector is mobile. We then increase the share of the sector-specific capital stock in the resource sectors in small steps until we encounter a situation where the domestic price in citrus fruits increases. The critical value of the share of sector specific capital where the export and domestic varieties are on the edge of the gross complement-substitute relationship, given the elasticity of transformation and other parameters of the model, is listed in column 2. As discussed in the text, we may infer from the relationship in de Melo and Tarr [1992], that at the listed value of the share of sector specific capital, φ the elasticity of transformation is approximately equal to ε, industry elasticity of supply. With a point estimate of the export transformation elasticity of 5.0, we would need ε sector specific capital share of at least 37.5 percent to ensure that a gross-substitute relationship exists between export and domestic varieties of citrus fruits. We may infer from table C1, that (given all the parameters of the model) if the share of sector specific capital in all resource sectors is 92.5 (45) percent, then the elasticity of supply in citrus fruits is about 1 (4).

TABLE C1: The Relationship between the Supply Elasticity and the Share of Sector-specific Capital

Imputed Elasticity of Supply	Percentage of sector specific capital in resource sectors
1	92.5
2	70
3	55
4	45
5	37.5
6	32.5
7	27.5
8	25
9	22.5
10	20

APPENDIX D

ALGEBRAIC FORMULATION OF THE MODEL

The model is formulated as a system of nonlinear equations corresponding to the three classes of equilibrium conditions associated with an Arrow-Debreu general equilibrium: price-cost relations for producers, supply-demand balance for commodity and factor markets (including balance of payments), and income-expenditure balance for domestic consumers and government. In SOE these models are generated using the GAMS programming language and solved using the modified Newton (SLCP) algorithm due to Mathiesen [1985]. In this framework a central set of variables (prices, activity levels and income levels) characterize the economic equilibrium.

All important notation is summarized in Figure A1.

Technology, Preferences and Market Clearance Conditions

Domestic production is an aggregate of domestic and exported varieties with

Variables

X_i	Export of good i.
D_i	Domestic sales of good i.
M_i	Composite import of good i.
m_{ir}	Import of good i from region r.
S_i	Armington aggregate of domestic supply and imports.
V_i	Value added function for variable factors.
C_i	Private consumer demand for good i.
W	Welfare index for the representative domestic consumer.
L_i	Labor inputs to sector i.
K_i	Capital inputs to sector i.
x_{ki}	Intermediate inputs of good k in sector i.
f_{ki}	Variable input of primary k in sector i.
f^F_{ki}	Fixed input of primary k in sector i.
Y_i	Domestic production of good i.
p_i	Price of domestic produced good i.
π_i	Price of domestic-import good i composite.
w_k	Factor prices k.
τ_T	Replacement tax multiplier on lump-sum transfers.
τ_v	Replacement tax multiplier for value-added taxes.
τ_f	Replacement tax multipliers for factor taxes.
p^E_i	Export price of good i (exogenous).
p^M_{ir}	Import price of good i from region r(exogenous).

Parameters

G_i	Government demand for good i from region.
I_i	Final demand for output of sector i for investment purposes.
t_{ir}	Import tariff rate on commodity i from region r.
t_{ik}	Factor taxes on factor K in sector i.
s^P_i	Rate of production subsidy for good i.
s^E_i	Export subsidy rate for good i.
v_i	Tax rate on factor inputs to sector i.
T	Lump-sum tax on consumers.
B	Current account balance (net capital inflows).
E_k	Endowment of factor K
a_{ij}	Intermediate input requirements, good i in sector j.
F_k	Primary factor supplies.
ϵ_i	Elasticity of transformation between domestic production and exports in sector i.
θ_i	Elasticity of trasformation between exports to different regions.
σ_i	Elasticity of substitution between domestic consumption and aggregate imports in sector i.
θ_i	Elasticity of substitution in consumption in sector i between imports and from different regions.

Figure A1: Notation

a constant elasticity of transformation:

$$Y_i = \phi_i(D_i, X_i) = (\alpha_{Di} D_i^{(\epsilon_i-1)/\epsilon_i} + \alpha_{X_i} X_i^{(\epsilon_i-1)/\epsilon_i})^{\epsilon_i/(\epsilon_i-1)} \quad (1)$$

where X_i represents a composite export for two or more destinations r:

$$X_i = (\sum_r \beta_{ir} x_{ir}^{(\theta_i-1)/\theta_i})^{\theta_i/(\theta_i-1)} \quad (2)$$

This relationship can be interpreted as implying differences in the technical processes associated with production for domestic and export markets. The elasticity of transformation defined by ϵ_i will be lower for goods which are highly differentiated and higher for goods which are relatively homogeneous. The specification of this elasticity may be influenced by the intended time frame of the analysis. In the short-run it is more difficult to transform plants between domestic and export oriented products.

Imports from different trading partners trade off with domestic varieties in intermediate demand, investment demand and final demand. For simplicity (and due to limitations of data) we assume that the import composition and import-domestic substitution possibilities in investment, intermediate and final demand are identical. Under these conditions we can represent inputs as though they were composed of a single import-domestic aggregate for each commodity. The aggregation of domestic and imported varieties is characterized by a nested constant-elasticity function of domestic and imported goods:

$$S_i \equiv \psi_i(D_i, M_i) = \left(\alpha_{Di}^{1/\sigma_i} D_i^{(\sigma_i-1)/\sigma_i} + \alpha_{Mi}^{1/\sigma_i} M_i^{(\sigma_i-1)/\sigma_i} \right)^{\sigma_i/(\sigma_i-1)} \qquad (3)$$

where M_i represents a composite import from two or more regions r:

$$M_i \equiv \left(\sum_r \beta_{ir} m_{ir}^{(\gamma_i-1)/\gamma_i} \right)^{\gamma_i/(\gamma_i-1)}$$

The market clearance condition for domestic supply balances output from the Armington aggregation function with intermediate, investment and final demand. This condition is:

$$S_i = \sum_j a_{ij} Y_j + G_i + I_i + C_i \qquad (4)$$

in which Y_j is the activity level of sector j, a_{ij} is the input requirements of good i in sector j, and G_i, I_i and C_i are components of final demand associated with government, investment and final consumption.

Variable inputs to production include primary factors as well as intermediate inputs of commodities. These are combined in a linearly homogeneous nested Leontief-CES form:

$$Y_i = \min\left[\frac{x_{1i}}{a_{1i}}, \frac{x_{2i}}{a_{2i}}, \ldots, \frac{x_{ni}}{a_{ni}}, \frac{V_i(f_i) + \sum_k f_{ki}^F}{a_{VA}}\right] \quad (5)$$

where

$$V_i(f_i) = \left(\sum_k \delta_{ki} f_{ki}^{(\sigma-1)/\sigma}\right)^{\sigma/\sigma-1}$$

In this equation x_{ki} represents intermediate inputs of good k in sector i, f_{ki} is the variable input of primary factor k in sector i, $V_i()$ represents the value-added function for variable factors, f_i represents primary factor inputs to variable cost in sector i, and f_{ki}^F represents the input of factor k to the formation of fixed costs in sector i, due to the possibility of sector-specific capital.

Domestic welfare is defined by consumption levels of market goods:

$$W=U(C_1, \ldots, C_n) \quad (6)$$

The current account is balanced at international prices (p_i^X and p_i^M), taking into account exogenous capital flows (B):

$$\sum_i p_i^X X_i + B = \sum_r p_{ir}^M m_{ir} \quad (7)$$

The prices which appear in this equation are exogenous parameters, the international prices of imports and exports. This constraint has an associated variable which is the "real exchange rate". The model, however, contains no monetary instruments and determines only relative prices. The exogenous increase in the export price that represents access to EC markets in our model, is equivalent to an improvement in this "real exchange rate".

Factor markets always clear with flexible prices:

$$\sum_i f_{ki} + f_{ki}^F = E_k \quad (8)$$

Income-Expenditure Balance

Consumer income includes primary factor earnings plus foreign capital inflows less transfers. Final demand is modelled by budget-constrained utility

maximization by a representative agent. The budget constraint is written:

$$\sum_i \pi_i C_i = \sum_k w_k E_k + B - \tau_T T \tag{9}$$

In this equation w_k represents the market price of primary factor k, B represents the foreign exchange balance and $\tau_T T$ represents the level of lumpsum transfer.

Unlike private households, government demands are held constant in all simulations. The government budget constraint is accommodated through endogenous scaling of one of the three government tax instruments so that revenue balances with expenditure. Government income consists of five components: (i) lumpsum transfers from households (T), (ii) import tariffs (t_{ij}), (iii) value-added taxes on factor inputs to production and on imports (ν_i), (iv) employment and corporation taxes on factor employment (t_{ik}), (v) less production subsidies net of excise taxes (s_i^P), (vi) less export subsidies (s_i^X). The government budget is:

$$\begin{aligned}\sum_i \pi_i G_i = {} & \tau_t T + \tau_f \sum_{ik} w_k t_{ik} f_{ik} + \tau_v \sum_{ik} \nu_i w_k f_{ik} + \sum_{iv} p_{iv}^M t_{iv} mir \\ & - \sum_i s_i^P \left(p_i D_i + p_i^X X_i \right) - \sum_i s_i^X p_i^X X_i\end{aligned} \tag{10}$$

In the government budget equation parameters which endogenously adjust to balance income and expenditure are: τ_T for lumpsum transfers, τ_f for factor taxes, and τ_v for value-added taxes. In any given equilibrium only one of these parameters departs from the default value of unity.

Price-Cost Balance in Competitive Markets

When technology exhibits constant returns to scale producers price at marginal cost. In production the marginal cost of supply for sector i (c_i) is defined by:

$$c_i Y_i = \sum_j \pi_j x_{ji} + (1+\tau_v \nu_i) \sum_k w_k f_{ki} \tag{11}$$

The competitive market structure with constant returns to scale technology and no barriers to entry drives excess profits to zero. Producers then equate marginal cost with market price gross of subsidy, providing the following zero profit condition:

$$\left(1+s_i^p\right)\left(p_i D_i + p_i^x X_i\right) + p_i^x X_i s_i^x = c_i Y_i \qquad (12)$$

In this equation the first term represents the value of output gross of production subsidy, and the second term captures the effect of the export subsidy.

The import aggregation always equates price with marginal cost. This means that the value of domestic supply equals the cost of domestic inputs plus imports gross of tariffs and rents:

$$\pi_i S_i = p_i D_i + \sum_r \left(1+\tau_r t_{ir}\right) p_{ij}^M m_{ir} \qquad (13)$$

Model solver

The model is solved with the MPS/GE software developed by Rutherford [1989], and generated with the GAMS software developed by Brooke, Kendrick, and Meeraus [1988]. For the purposes of this model some modifications of GAMS have been included allowing the specification of the MPS/GE format in an index format. We include an annotated version of this code:

```
*            MODEL DEFINITION IN MPS/GE VECTOR SYNTAX

$MODEL:MOROCCO
```

The sectors statement lists all the activities of the model: the utility aggregator for the consumer (U), the same for the government (G), all production activities (Y(I)), export activities (X(I)), and import activities (M(I)).

```
$SECTORS:
      U G NVK Y(I) X(I)$EXPORT(I) M(I)$IMPORT(I) A(I)
```

The commodities on the model include: a utility good for the private consumer (PU), foreign exchange that translates export revenues into purchasing power for imports (PFX), an investment good (PNVK), a government consumption good (PG), factors of production (PF(F)), Armington goods (PA(I)), domestic output goods (PD(I)), export and import goods (PE(I) and PI(I)).

```
$COMMODITIES:
      PU PFX PNVK PG PF(F)$E(F)
      PA(I) PD(I) PE(I)$EXPORT(I) PI(I)$IMPORT(I)
```

The auxiliary constraints formulates the equal yield constraint tax for the government.

```
$AUXILIARY:
      TAU(AUX)
```

```
$CONSUMERS:
      REPAGT  GOVT

$REPORT:
      V:DF(F,I)$DFB(F,I) I:PF(F)  PROD:Y(I)
      V:DS(I)     I:PD(I)  PROD:A(I)
```

Producers demand production factors and Armington intermediate goods and produce output for domestic and export destinations. The production subsidy applies independent of destination. Either the VAT or the FACT (taxes on factor employment) can be used as an equal yield constraint.

```
*     AGGREGATE PRODUCTION:

$PROD:Y(I)  t:ETRNDX(I)  a:ESUBKL(I)
O:PD(I)                  Q:DB(I)        P:PYB(I)  A:GOVT  T:(-SP(I))
O:PE(I)$EXPORT(I) Q:XD(I)    P:PYB(I)  A:GOVT  T:(-SP(I))
I:PA(J)                  Q:IOB(J,I)
I:PF(F)                  Q:DFB(F,I)  P:PFB(F,I) a:
+                A:GOVT  N:TAU("VAT") M:VATD(I)
+                        N:TAU("F")   M:FACT(F,I)
```

The export variety of the good can be exported to different export destinations. The aggregate export good produced above is the input to this activity. Exports generate foreign exchange, which quantity depends not only on the quantity of exports but also on the price received. The transformation effect between export varieties to different destinations caused by a change in the relative price of the varieties in captured in the P: field. The good with the higher relative export price (PX) will tend to become a relatively cheaper contributer to purchases of foreign exchange than other goods. PXB represents the international price of exports in the benchmark.

```
*     EXPORT:

$PROD:X(I)$EXPORT(I)  t:ETRNXX(I)
I:PE(I)     Q:XD(I)
O:PFX#(XR) Q:(XB(I,XR)*PX(I,XR))
+     P:(PXB(I,XR)/PX(I,XR))    A:GOVT T:(-SX(I,XR)/(1-SX(I,XR)))
```

Imports are aggregated with a CES function in two steps

```
*     ARMINGTON IMPORT AGGREGATOR:

$PROD:A(I)  s:ESUBDM(I)
O:PA(I)      Q:AB(I)
I:PD(I)  Q:DB(I)
I:PI(I)      Q:(AB(I)-DB(I))

$PROD:M(I)$IMPORT(I)  s:ESUBMM(I)
O:PI(I)  Q:(AB(I)-DB(I))
I:PFX#(MR)  Q:(MB(I,MR)*PM(I,MR)) P:(PMB(I,MR)/PM(I,MR))
+     A:GOVT T:T(I,MR) N:TAU("VAT") M:((1+T(I,MR))*VATI(I))
+     A:REPAGT T:NTB(I,MR)
```

The private consumer utility aggregator is a Cobb-Douglas function.

```
*     COBB-DOUGLAS UTILITY:

$PROD:U  s:1
O:PU  Q:UB
I:PA(I)     Q:CF(I)
```

The government consumption aggregator assumes no substitutability between goods demanded

```
*     GOVERNMENT CONSUMPTION:

$PROD:G
O:PG  Q:(SUM(I, GB(I)))
I:PA(I)     Q:GB(I)
```

Neither does the aggregation of the investment good

```
*     CAPITAL FORMATION:

$PROD:NVK
O:PNVK      Q:(SUM(I, IB(I)))
I:PA(I)     Q:IB(I)
```

Domestic consumer and government endowments (E:) and expenditures (D:).

```
*     DOMESTIC CONSUMER:

$DEMAND:REPAGT
E:PF(F) Q:E(F)
E:PA(I)     Q:EN(I)
E:PNVK      Q:(-SUM(I, IB(I)))
E:PFX Q:BOPDEF
E:PG  Q:(-GOVDEF)
E:PU  Q:-1    R:TAU("LS")
E:PU  Q:1     R:TAU("LO")
D:PU  Q:UB

*     GOVERNMENT AGENT:

$DEMAND:GOVT
E:PG  Q:GOVDEF
E:PU  Q:1    R:TAU("LS")
E:PU  Q:-1   R:TAU("LO")
D:PG

*     AUXILIARY CONSTRAINTS DETERMINE LEVELS OF FACTOR OR LUMPSUM
*     TAXATION, DEPENDING ON WHICH INSTRUMENT IS USED TO ACHIEVE
*     EQUAL YIELD:

$CONSTRAINT:TAU("F")$ENDOG("FACT",SC)
Z:G
K:-1

$CONSTRAINT:TAU("F")$(NOT ENDOG("FACT",SC))
Z:TAU("F")
K:-1

$CONSTRAINT:TAU("VAT")$ENDOG("VAT",SC)
Z:G
K:-1

$CONSTRAINT:TAU("VAT")$(NOT ENDOG("VAT",SC))
Z:TAU("VAT")
K:-1

$CONSTRAINT:TAU("LS")$ENDOG("LUMPSUM",SC)
Z:G
K:-1
```

```
$CONSTRAINT:TAU("LS")$(NOT ENDOG("LUMPSUM",SC))
K:-1 Z:TAU("LS")

$CONSTRAINT:TAU("LO")
K:1
K:-1 Z:G
```

ADDITIONAL REFERENCES APPENDIX D

Mathieson, Lars, "Computation of Economic Equilibria by a Sequence of Linear Complementarity Problems", *Mathematical Programming Study 23* (Amsterdam: North-Holland, 1985).

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