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Morocco's free trade agreement with the EU: A quantitative assessment

Thomas F. Rutherford[a], E. Elisabet Rutström[b], David Tarr[c,*]

[a]*University of Colorado, Economics Department, Boulder, CO 80309-0256, USA*
[b]*University of South Carolina, Dept. of Economics, BA College, Columbia, SC 29 208, USA*
[c]*The World Bank, 1818 H. St., N.W., Washington D.C. 20433, USA*

Abstract

Using an applied general equilibrium model, we find that the EU–Morocco free trade area (FTA) will increase Moroccan welfare by about 1.5% of its GDP, showing that trade diversion is not dominant. The gains increase to about 2.5% of GDP if Morocco adds trade liberalization with the rest of the world while adjustment costs are only slightly higher, partly reflecting the absence of trade diversion with global liberalization. We show what are the key modeling assumptions and parameter choices that affect the estimates in models of this type, employing systematic sensitivity analysis as well as graphical exposition.

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1. Introduction[1]

With the completion of the North American Free Trade Agreement (NAFTA) and a number of Association agreements on trade and economic assistance

* Corresponding author. E-mail: dtarr@worldbank.org.

[1] An earlier French language version of this paper, that emphasized the effects on the Moroccan economy, appeared as Rutherford et al. (1994). The present paper examines the consequences of modeling assumptions in greater detail, presents the equations of the model in detail which are not otherwise available, and develops new graphical interpretations of the results.

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between the European Union (EU) and most of the countries of Central and Eastern Europe (the 'Europe Agreements'), and the development of the Mediterranean policy of the European Union,[2] there has been a great surge of interest in regional trade integration among developing countries. These agreements differ from the old (and in many cases failed) regionalism among developing countries in that the partner country or region is a major industrialized country that is also the most significant trading partner of the developing country.[3] Concern about the welfare and sectoral implications of the NAFTA in particular has led to the development of over thirty applied general equilibrium models designed to estimate these effects. The results, however, are quite varied and reasons for the differences sufficiently opaque that the United States International Trade Commission (USITC) convened a conference for the purpose of determining why the NAFTA models produced different results (see USITC, 1992).

Given that there is widespread interest among policy-makers of results from applied general equilibrium models, and that the quantitative importance of a number of assumptions is now well known, as well as the fact that correspondence between the theory of regional integration and its implementation in the applied models is not always straightforward, we believe it is important to identify the key assumptions and parameters that affect the results.

The purpose of this paper is twofold. First, we provide a careful applied general equilibrium modeling exercise of the economic effects of an EU–Morocco free trade area (FTA), as well as some of the other principal trade policy options open to Morocco. Second, we use our Moroccan model as a vehicle to demonstrate the key modeling assumptions and parameter choices that affect the estimates in models of this type, by sequentially altering a number of modeling assumptions and parameter values and comparing the results to our central case.

Concrete discussions for an FTA between the EU and Morocco began in March 1992. To some the Moroccan interest in a reciprocal FTA may be surprising, since Morocco already enjoys privileged relations with the EU. It has free access to markets in industrial products (there are some minor exceptions such as trousers), and is not obligated to provide reciprocal access to its market to producers in the EU. However, EU agricultural protection impedes Moroccan exports (notably in the areas of vegetables and citrus fruits), so that improved access to EU markets is an important issue. Moreover, the reciprocal obligations of a free trade agreement (FTA) with the EU will require that Morocco lower its moderately high tariffs against its most important trade partner. These tariff reductions against the EU may provide additional trade liberalization benefits to Morocco, provided the trade diversion costs of preferential tariff reduction do not dominate. For the task of

[2]The countries covered by the EU's Mediterranean policy are Morocco, Algeria, Tunisia, Libya, Malta, Cyprus, Egypt, Israel, Jordan, Lebanon, Syria and Turkey. The EU Commission believes that if events proceed as planned, Europe and the Mediterranean could complete creation of a new free trade area, the biggest in the world, by the year 2010. See Commission of the European Communities (1994) for an elaboration of the objectives of the European Union.

[3]See de Melo and Panagariya (1992) for an elaboration of the issues in the 'new regionalism'.

evaluating the FTA, we develop our central model which we assess is the most accurate model to characterize the Moroccan economy, and base our best estimates on this central model.

In our central case we find that the welfare benefits to Morocco from the free trade agreement are about 1.5% of GDP, and are about 2.5% 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 found from Morocco's adding elimination of protection against the rest of the world to a free trade agreement with the EU can be obtained with only slightly higher adjustment costs. This reflects the trade diversion costs associated with discriminatory trade liberalization, and can be seen as an important argument in favor of the efforts towards lowering tariffs against non-EU sources subsequent to achieving an FTA. On the other hand, the significant benefits that accrue from discriminatory liberalization against either EU or rest of the world imports indicate that trade diversion is not dominant.

In this paper we devote considerable effort to investigating what are the key parameters driving the results. This is investigated numerically and to aid the exposition graphically. We show that trade creation and welfare increase with the elasticity of substitution between domestic varieties and import substitutes on the one hand; but that trade diversion and welfare losses increase with the elasticity of substitution between imports from different regions. We perform many thousands of simulations to systematically investigate the impact of the elasticities and find that our basic results are quite robust.

In Section 2 we provide a brief overview of the structure of the Moroccan economy, its trade regime and our model.[4] In Section 3 we present the results in our central model case. In Section 4, we investigate the impact of key elasticities of demand. In Section 5 we perform systematic sensitivity analysis with respect to the elasticities; this allows us to provide estimates within a range (with probability assessments over the range).

2. A small open economy model

2.1. Trade protection in Morocco and free trade agreement shocks

2.1.1. Structure of protection

Since 1993 Morocco has dramatically liberalized its foreign trade regime. By 1993, the maximum rate for customs duties had been lowered to 45% and, most

[4] Further details are available in Rutherford et al. (1993), available to the reader upon request. Please send an e-mail message to: mpatena@worldbank.org.

[5] See Mateus et al. (1988) and UNDP–World Bank (1992) for details on these liberalizations.

impressively, no imports required a license (other than for health and safety reasons). On the export side only minor restraints remain.[5] 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. The rates that appear in Table 1 have been proportionately adjusted for all sectors, such that the total tariff collections in the economy, based on 1991 imports, equal actual aggregate tariff collections from budget data for 1991.[6] The average import tariff based on collections is 19%, which includes tariff surcharge (fiscal import duty).[7] 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 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%.

2.1.2. 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 EU. Given the generally free access to EU markets by Moroccan producers, EU 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 EU markets for Moroccan products will primarily influence the export price of the fruit and vegetable sectors.[8]

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[6]Appendix B of Rutherford et al. (1993) discusses this adjustment.

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

[8]Morocco's exports in fruit and vegetables are dominated by oranges and other citrus fruit, 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.

[9]There is some question of whether a free trade agreement which excludes agriculture formally, but which negotiates agriculture separately would be the outcome. This was how agriculture was handled in the Europe Agreements and in the customs union between the EU and Turkey (see Intermedia, 1995). GATT rules require that preferential trade agreements include substantially all trade. With the conclusion of the Uruguay Round, with its strengthened restraints on the interpretation of substantially all trade within a preferential trade agreement, some experts in the European Commission now believe that agriculture cannot be excluded from the agreements. Even if agriculture is excluded from the agreements, its separate negotiation will lead to some improved preferential access for both parties to the agreement.

Table 1
Morocco: basic data for the social accounting matrix

Sector (abbrev.)		Sector share of total							Trade by sector, (%)		Tariff rate, (%)
		(1) Output	(2) Labor	(3) Capital	(4) Imports	(5) Percentage from EC	(6) Exports	(7) Percentage to EC	(8) Imports (consumption)	(9) Exports (output)	(10)
Agriculture											
1. Cereals (CER)	R[a]	5.44	3.04	10.32	7.16	53.8	0.85	54.2	13.20	1.50	45[b]
2. Sugar (SUG)	R	0.26	0.12	0.41	0.00	0.0	0.00	0.0	0.00	0.00	45[b]
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[b]
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 (OFF)		5.40	4.24	2.16	3.98	47.7	7.40	65.3	12.90	13.30	27.91
16. Beverages and tobacco (BEV)		1.01	1.84	0.61	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

Table 1 (*continued*)

Sector (abbrev.)	Sector share of total							Trade by sector, (%)		Tariff rate, (%)
	(1) Output	(2) Labor	(3) Capital	(4) Imports	(5) Percentage from EC	(6) Exports	(7) Percentage to EC	(8) Imports (consumption)	(9) Exports (output)	(10)
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	21.86
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	4.96	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	26.43
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	1.10	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	

[a] Sectors marked R (for resource) have sector specific capital.

[b] Non-tariff barrier estimated at 45% legal tariff rates after adjustments for collections are 10%, 16% and 28% in cereals, sugar and meat and dairy respectively.

The free trade agreement would involve a lowering and eventual elimination of all remaining trade barriers on all imports from the EU (i.e. lowering of the tariff), with correspondingly increased market access for Moroccan products to the EU, most notably in agriculture.[9]

We estimate the price distortion in agriculture due to border barriers in the EU to be about 8%, following the EU model developed by Harrison et al. (1989). An 'upperbound' scenario would assume that the EU 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 EU 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 EU trade barriers, then the export price increase would result in less than the full 8% of benefits to Moroccan exporters. Since Moroccan production is small relative to EU demand (suggesting highly elastic demand in the EU), and since the variable levy is assumed to capture rents in the EU, we take as our base case scenario the full 8% increase in the price of fruits and vegetables from improved access to the EU market.

Domestic taxes consist of value-added tax (VAT), employment and corporation taxes, and production taxes and subsidies. Since we do not have good updated data

[10] In Rutherford et al. (1993) we provide a detailed documentation of the tax rates applied in our model. Briefly, however, total Moroccan value added in 1991 was 189.4 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% of value-added and 11% of imports. We applied these rates to the structure of value-added and imports in our social accounting matrix (see below), which yields an amount of value-added government revenue equal to 32% of total government revenue.

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

Actual value-added and tariff collections in 1991 were 24 and 21% 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 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 VAT to import taxes as a percentage of total government revenue is preserved approximately (32/30 versus 24/21).

[11] Given that 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 VAT on all domestic production, including that destined for exports, but do not apply VAT on imports (the origin principle); or (2) apply VAT on imports and domestic production for the domestic market only (the destination principle). If all domestic production is subject to VAT and imports are also taxed, the VAT on imports is a discriminatory tariff.

In Morocco, an effort is made to rebate 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.

on collections by sector, all of these rates have been set uniformly. The most important tax in our model is VAT, and import taxation is the next most important. The legal VAT rate is 19%, applied to both imports and domestic production. As with important taxation, however, there are exemptions to 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%.[10] VAT taxation on imports introduces further distortion in the trade regime.[11] The other tax rates are calibrated based on aggregate tax collections as recorded in the social accounting matrix (SAM). They are: a 1% production tax (net of subsidies), an 8% labor tax (net of subsidies), and a 5% corporation tax (net of subsidies).

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 et al. (1993). 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 equality for producers, supply–demand balance for commodity and factor markets (including balance of payments), and income–expenditure balance for domestic consumers and government.

Goods are produced using primary factors and intermediate inputs, according to a linearly homogeneous nested Leontief–CES (Constant Elasticity of Substitution) production function:

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

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. Appendix A gives a complete listing of all variables and parameters of the model.

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 to be fully mobile across sectors.

Production exhibits constant returns to scale, and producers behave competitively, selecting output levels such that marginal cost at those output levels equals the given market price gross of subsidy, providing the following zero profit condition:

$$(1 + s_i^{\mathrm{P}})(p_i D_i + p_i^{\mathrm{X}} X_i) + p_i^{\mathrm{X}} X_i s_i^{\mathrm{X}} = c_i Y_i. \tag{2}$$

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.

In export sectors, output is differentiated between goods destined for the domestic, EU and all other export markets. This relationship is characterized by the following two-level constant elasticity of transformation frontier:

$$Y_i = \phi_i(D_i, X_i) = \left(\alpha_{DX_i} D_i^{(\epsilon_i - 1)/\epsilon_i} + \alpha_{X_i} X_i^{(\epsilon_i - 1)/\epsilon_i}\right)^{\epsilon_i/(\epsilon_i - 1)}. \tag{3}$$

Composite output is an aggregate of domestic output (D_i) and composite exports (X_i) for two or more destinations r (EU and non-EU markets):

$$X_i = \left(\sum_r \beta_{X_{ir}} x_{ir}^{(e_i - 1)/e_i}\right)^{e_i/(e_i - 1)}. \tag{4}$$

Our model has one representative consumer. 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 EU versus non-EU imports. The aggregation of domestic and imported varieties is characterized by a nested constant-elasticity function of domestic and imported goods:

$$S_i = \psi_i(D_i, M_i) = \left(\alpha_{DM_i}^{1/\sigma_i} D_i^{(\sigma_i - 1)/\sigma_i} + \alpha_{M_i}^{1/\sigma_i} M_i^{(\sigma_i - 1)/\sigma_i}\right)^{\sigma_i/(\sigma_i - 1)}. \tag{5}$$

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

$$M_i = \left(\sum_r \beta_{M_{ir}} m_{ir}^{(s_i - 1)/s_i}\right)^{s_i/(s_i - 1)}.$$

[12] By an Armington sector we mean a sector where imported goods and domestic goods are differentiated products based on country of origin. In these sectors we also assume that exported goods and domestic goods are differentiated by country of destination. See de Melo and Tarr (1992, chapter 2) for a fuller explanation of the impact of the Armington assumption.

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.

In two sectors, meat and dairy, and sugar, we depart from the 'Armington'[12] 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. We show below, however, that the homogeneous versus Armington assumption has very important implications and that the homogeneous model is not easily approximated in the Armington framework by choosing a high Armington elasticity.

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

$$S_i = \sum_j a_{ij} Y_j + G_i + I_i + C_i, \tag{6}$$

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. Factor markets always clear with flexible prices:

$$\sum_i f_{ki} + f_{ki}^{\mathrm{F}} = E_k. \tag{7}$$

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 EU or the rest of the world (ROW); and we allow exports to have different prices depending on whether they are sold in the EU or ROW. These distinctions allow us to study policies such as accession to a free trade area. The free trade agreement with the EU also involves changes in Morocco's access to EU markets. The main effect of increased access would be an increase in the Moroccan export prices, 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.

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 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 that VAT would have to be changed in order to avoid a reduction in government revenue. The marginal excess burden of raising government revenue from VAT is incorporated in the analysis.

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. The budget constraint for the private consumer is written:

$$\sum_i \pi_i C_i = \sum_k w_k E_k + B - \tau_T T. \tag{8}$$

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 lump sum transfer.

Public consumption is balanced with the value of public endowments and tax revenue. The government budget is:

$$\begin{aligned}\sum_i \pi_i G_i = {} & \tau_T T + \tau_f \sum_{ik} w_k t_{ik} f_{ik} + \tau_v \sum_{ik} v_i w_k f_{ki} + \sum_{ir} p_{ir}^{\mathrm{M}} t_{ir} m_{ir} \\ & - \sum_i s_i^{\mathrm{P}} (p_i D_i + p_i^{\mathrm{X}} X_i) - \sum_i s_i^{X} p_i^{X} X_i.\end{aligned} \tag{9}$$

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:

$$\sum_i p_i^{\mathrm{X}} X_i + B = \sum_{ir} p_{ir}^{\mathrm{M}} m_{ir}, \tag{10}$$

where p^{X} and p^{M} are the exogenously given international prices and B is the exogenous capital flow. This guarantees no 'free lunch' either taken from or given to foreigners.

2.3. Empirical implementation of the Morocco model

We employ a social accounting matrix (SAM) for Morocco, based on a SAM constructed by Mateus et al. (1988), which distinguishes 39 production sectors, but which also incorporates updated data where deemed crucial. 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, meat and dairy products, textiles, apparel, fishing and phosphates are included as separate sectors.

The SAM incorporates an internally consistent set of relationships. Among the most important identities in the SAM are zero profits for each production activity,

market clearance for all commodities and factors, budget balance for households and the government, and the value of imports equals the value of exports, net of capital flows. In fact, an Arrow–Debreu type applied general equilibrium model, such as ours, must be based on a SAM; otherwise the data would be inconsistent with the underlying behavior assumptions of the model (which are based on optimizing behavior of all agents subject to budget constraints and adding up conditions).

A basic component of a SAM is an input–output table. Based on the work of Mateus et al., we employed the most recent input–output table available from survey work, which is a 1890 table. We have also shown (Rutherford et al., 1993) that, at the nine-sector level of aggregation, value-added shares did not significantly change between 1980 and 1991. Over 40% of value added originates in services sectors, about 30% in manufacturing (food, and textiles and apparel comprise about half the manufacturing sector) and the remaining 30% is in agriculture and mining. Thus, utilizing data from 1980 for production and value-added should not present a great problem.

On the other hand, tariff rates have changed significantly since 1980, and we know that results in models that examine changes in trade policy are highly dependent on the tariff rates employed in the SAM. Thus, we updated the protection data to 1991 rates, as discussed above, but kept the import value at domestic prices constant, to maintain consistency. In addition, we have disaggregated imports and exports by trading partners according to source and destination shares of 1991, so that we have captured any significant changes in the mix of imports from the EU and the rest of the world. Introducing this data on tariffs and shares does not affect the balancing of the SAM in any way, and therefore does not affect the consistency of our data.

A final choice we made was to preserve the sectoral pattern of trade. Although the trade liberalizations since 1983 have changed the sectoral pattern of trade, updating the model to reflect this new pattern would necessitate (due to consistency requirements) altering the sectoral composition of value-added or final demand or altering the input–output table such that they would not have reflected the actual structure of either 1980 or 1991. Thus, we preferred to stay with the production structure of the 1980 SAM, since that is based on an empirical survey.

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 three-letter acronym for later reference. Columns 1–3 show the share of Moroccan output, employment and capital by sector, derived from the 1980 SAM.

Columns 4 and 6 display the sectoral decomposition of imports and exports, where the share accounted for by EU 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 sector, and they encounter no trade barriers in the EU. Fruit and vegetables exports together make up 14% of all exports to the EU.

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 EU markets.

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.[13] Despite our literature search, there are many elasticities about which there is considerable uncertainty. We assess the consequences of varying the elasticities with 'systematic sensitivity analysis' in Section 5.

The SOE model is generated with the GAMS software developed by Brooke et al. (1988) and solved with the MPS/GE software developed by Rutherford (1989, 1992). 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

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 evaluate the following six policy scenarios: (a) improved access for Moroccan fruits and vegetables in the EU (*ACCESS*); (b) unilateral tariff reductions in Morocco against the EU alone (*EULIB*), against imports from the rest of the world alone (*LIBROW*), and against all trading partners (*LIBALL*), without improved access to EU agricultural markets; (c) cooperative tariff reductions with the EU, where on the EU side this implies extended market access for Moroccan fruit and vegetables (*FTA*); and (d) full free trade agreement with the EU augmented by unilateral liberalization of tariffs against rest of the world imports (*FTAALL*). The aggregate results on welfare and taxes are summarized in Table 2. The impact on employment by sector is presented in Table 3.

The first three columns of Table 2 show the welfare gain measured as the equivalent variation as a percentage 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.

Before discussing the results in detail, we first present a partial equilibrium consumer surplus analysis in Fig. 1. Although our model is general equilibrium and employs Hicksian equivalent variation as the welfare measure, the figure should be

[13] 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. The benchmark values of all elasticities in the model are reported in appendix A of Rutherford et al. (1993).

Table 2
Free trade agreement with the EU and related trade liberalization: welfare, tax and factor adjustment effects on Morocco[a]

	change in welfare (%)			change in VAT rate (%)			Percentage of labor that changes jobs			Percentage of capital that adjusts		
	(1) H	(2) M	(3) L	(4) H	(5) M	(6) L	(7) H	(8) M	(9) L	(10) M	(11) M	(12) H
FTA[b]	2.28	1.52	1.20	54.0	58.3	60.3	3.2	2.5	2.2	5.1	3.3	2.7
EULIB[c]	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[d]	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[e]	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[f]	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[g]	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 value-added tax as replacement tax. Results are for high (H), medium (M), and (L) elasticity of supply in resource sectors.
[b]Full free trade agreement with the EU. Increased export prices for citrus fruits and vegetables for EU destinations by 8% and elimination of import protection from EU sources.
[c]Unilateral elimination of import protection against EU imports.
[d]Increased export prices for citrus fruits and vegetables to EU destinations by 8%.
[e]Elimination of import protection against non-EU imports.
[f]Elimination of import protection against all imports, EU and non-EU.
[g]Full free trade agreement with the EU, augmented by elimination of import protection from non-EU sources as well.

helpful in illustrating some of the key elements of the welfare economics. The demand curves of Moroccan consumers for imports from the EU and from the ROW are drawn to show that they depend on their own tariff inclusive price, the tariff inclusive price of the other import substitute good, and the income allocated to all imports.[14]

Preferential tariff reduction against EU imports will reduce the tariff inclusive price of EU imports (a movement along the demand curve for EU imports). The reduction in the price of EU imports will induce shifts in the demand curves for imports of both varieties and for the domestic substitute. First consider the demand curve for imports from the EU. The decline in the price of EU imports implies that composite imports have declined in price; thus, there will be a shift away from domestic goods and toward imports.[15] That is, the income allocated to

[14]That is, we have assumed that imports substitute for each other in a CES nest, and composite imports substitute with the domestic good, also within a CES framework. It follows from the theorems on weak separability that the price of the domestic good in the sector will affect the demand for any import variety only through the impact of the income allocated to composite imports. Although not fundamental to our analysis, and easily changed, we have also assumed that demand for the composite output of the various sectors substitute for each other in a Cobb–Douglas model of final consumption choices. Consequently, the expenditures on the output of any sector are independent of relative prices.
[15]As discussed in Section 2.2, our structure of demand allows multistage budgeting.

Table 3
Percentage employment change by sector and scenario

Sector (abbrev.)		*FTA*			*ECLIB*			*ACCESS*			*LIBROW*			*LIBALL*			*FTALL*		
		H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
Agriculture																			
1. Cereals (CER)	R[h]	−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	−0.3	−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 and other agriculture (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	−7.3
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	120.3	91.5	79.1	104.1	80.0	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	2.0	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

Table 3 (*Continued*)

Sector (abbrev.)	*FTA*			*ECLIB*			*ACCESS*			*LIBROW*			*LIBALL*			*FTALL*		
	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
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	−1.0	−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	0.00	0.00	0.00	0.6	0.9	3.8	−3.2	−2.9	−0.7	−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

Table 3 (*Continued*)

Sector (abbrev.)	*FTA*			*ECLIB*			*ACCESS*			*LIBROW*			*LIBALL*			*FTALL*		
	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
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	0.8	−1.5	0.2	1.0	0.0	−0.1	−0.2	−1.6	0.2	1.0	−1.4	0.3	1.1	−1.4	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	−4.5	−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	0.00	0.00	0.00	−0.1	−0.2	−0.2	−0.1	−0.1	−0.1	−0.1	−0.1	−0.1

[a] H, M, L refer to high, medium and low industry-wide elasticity of supply in the resource (R) sectors.
[b] Sectors denoted with R (resource) have sector specific capital.
Source: model estimates.

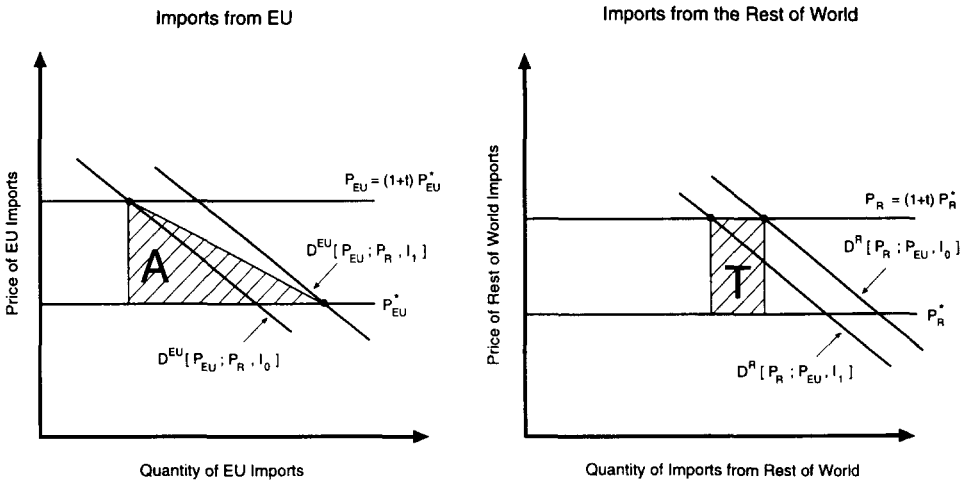

Fig. 1. Welfare effects of trade integration: tradeoff of trade creation and trade diversion. If tariffs are eliminated preferentially against the EU, the welfare change is equal to the trade creation triangle A minus the trade diversion rectangle T.

imports will increase (from I_0 to I_1 in the figure) as a share of total sectoral expenditures. That increase in income allocated to imports will induce an increase in the demand for imports from the EU, as shown in the figure as an outward shift of the demand for EU imports.[16] Also, the demand for the domestic variety of the good, which is not pictured, will decrease.

Now consider the demand curve for imports from the rest of the world. The decline in the price of EU imports means that there will be a substitution away from ROW imports toward the EU, i.e. an inward shift in the demand for imports from the ROW. On the other hand, the reduction in the price of composite imports, which induces an increase in the demand for EU imports, also induces an increase in the demand for imports from the ROW, i.e. this is an offsetting effect, analogous to an income effect, that mitigates the reduction in demand from the substitution effect. We have drawn the figure under the presumption that the substitution effect is dominant and that therefore the demand for imports from the ROW declines.

Regarding the welfare analysis, there is a triangle A of gains (trade creation) in the market for EU imports. Following the principles derived by Burns (1973), one side of triangle A is obtained by connecting the before and after equilibria points. Following from the principles developed by Harberger (1971), there is a rectangle

[16] The decline in the price of EU imports is partly illusory since it involves a loss of government revenue from tariffs for which the government will have to obtain compensatory sources. If the government applies taxation evenly across production from all sources, such as through VAT, then there will nonetheless be a decline in the relative price of imports which will shift the demand curve for EU imports in the direction indicated in the figure.

of trade diversion losses in the market for imports from the ROW, equal to the rectangle T; but we ignore the domestic market in the welfare analysis since there is no difference between price and marginal costs which we model.[17]

The net effect is equal to A − T. The figure takes into consideration that the reduction in price of EU imports reduces the demand for the domestic good and therefore shifts to the right the demand for imports from both sources (a partial equilibrium effect). This demand increase for imports increases the triangle A and reduces the rectangle T.

Now turn to the results. They depend importantly on the industry-wide 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 EU 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.[18] All the results of columns 1–3, 7–9 and 10–12 follow this pattern.

First consider the policy scenario *ACCESS*. Improved access to the EU for citrus fruits and vegetables will improve Moroccan welfare by slightly more than one-fourth of a percentage point of GDP, due to improved resource allocation and better terms of trade in citrus fruits and vegetables. Since columns 7 through 12 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 EU imports (*EULIB*) results in an improvement in Moroccan welfare of between 1 and 2%, which is about four to seven times the

[17] The justification for the welfare analysis of Fig. 1 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 EU imports) in the presence of taxes on other goods in the economy, say good 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 Fig. 1, and because the cross-substitution effect in demand will be smaller and of either sign in other sectors, we have ignored sectors outside the directly competing import sector. Our quantitative analysis, however, which is based on Hicksian equivalent variation, incorporates the welfare changes from all goods.

[18] 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.

benefits of improved access alone. The free trade agreement (*FTA*), which combines the policies of *ACCESS* and *EULIB*, results in gains in Moroccan welfare that are roughly additive in the separate policies. Removing tariffs against the non-EU rest of the world (*LIBROW*) results in gains of about 80% of those from liberalizing trade with the EU alone, reflecting the fact that the EU is the larger trade partner.

If tariffs are lowered against all imports (*LIBALL*) another substantial increase in Moroccan welfare (of about 1% of GDP) is obtained (compared with *EULIB*), interestingly, without significant 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 EU 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–EU free trade agreement.*[19] 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 EU or rest of the world imports indicate, 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 EU 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 would be altered so that revenue to the government is unchanged. For scenarios involving reduced tariffs against the EU, columns 4–6 of Table 2 show that VAT would have to be increased by about 55–60%. This means that the VAT collection rate on imports would rise to about 16–17% (from the collected 11%) and on domestic products to about 4–5% (from the collected 3%). For scenarios involving full tariff liberalization against all imports, the VAT rate would have to rise by about 80–90%.

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 EU. 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-EU sources subsequent to achieving an FTA. Finally, welfare benefits of 1.5 to 2.5% of GDP, from the free

[19] Trade diversion would occur in a Moroccan free trade agreement with the EU when a supplier outside the EU supplied the product to Morocco at a cheaper price than the EU supplier, but the *tariff inclusive* price of the EU 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 the elasticity 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.

trade agreement or broader liberalization, are 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.[20]

4. Impact of key modelling parameters

Sensitivity analysis over the parameters of our model has revealed the parameters that are most important regarding the welfare, revenue and factor adjustment estimates. One which we discussed above in detail is the industry-wide 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 EU 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.

4.1. Industry-wide elasticity of supply and sector specific capital

As interpreted below, one parameter that 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 results for the cases of low, medium and high industry-wide elasticities of supply. We implement a change in the elasticity of supply by assuming three different shares of sector specific capital in the resource (R) sectors: 50, 75 and 90%. Ceteris paribus, the larger the share of capital that is sector specific, the lower the industry-wide elasticity of supply. Appendix C of Rutherford et al. (1993) numerically elaborates the relationship between the assumed share of sector specific capital in the citrus and vegetable sectors, and the supply elasticity of the composite output for domestic firms in these sectors. In the case of citrus fruits, the industry-wide elasticity of supply varies from about unity with 90% sector specific capital to 3.5 with 50% sector specific capital, but takes slightly lower values in the vegetable sector.

The relationship between the share of sector specific capital (and therefore the industry-wide elasticity of supply) and the transformation elasticity is crucial in determining whether domestic and export production are gross substitutes or complements. Although this relationship is important for sectors such as citrus 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.

[20] In fact, when we first harmonized tariffs for all sectors to their weighted average level in the benchmark (21.5%) and subsequently simulated the various policies shown in Table 2 (in the medium elasticity scenarios) we obtained considerably smaller benefits. In particular, the welfare benefits as a percentage of GDP are as follows: *FTA*, 0.549; *EULIB*, 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 derive from harmonization of the tariff regime.

Let φ_i denote the supply elasticity of the composite output in a sector and ϵ_i 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 $\varphi_i > \epsilon_i$, an increase in the export price will increase output of the domestic variety and raise the domestic price, i.e. the export and domestic varieties are gross complements in production.[21] 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.[22] Although φ is entered parametrically, ϵ (the industry-wide 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.

Given that the elasticity of transformation (φ) is 5 in our benchmark, and that with the shares of sector specific capital the maximum industry-wide elasticity of supply is 3.5, exports and domestic output in these sectors are gross substitutes in our model. However, if we were to choose shares of sector specific capital less than 35%, the industry-wide elasticity of supply would exceed 5, and domestic output and exports would be gross complements.[23]

4.2. 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 (σ_i) for all Armington sectors increases the welfare benefits, as shown in Table 4. At a value of 10 for the Armington elasticity, the welfare benefits of the integration–liberalization strategies increase more than three 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.

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[21] 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, 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.

[22] 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).

[23] The industry-wide elasticity of supply in small sectors rises rapidly and reaches 10 with a sector specific capital of 20% in citrus fruits and vegetables.

Table 4
Welfare effects of variations in elasticities of substitution in demand[a]

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

[a]Table values represent the change in welfare (equivalent variation) as a percentage of GDP. See Table 2 for an explanation of the policies.
[b]σ_i = the Armington elasticity of substitution between domestic output and composite imports.
[c]σ_i = the elasticity of substitution between imports from different sources.
Source: model estimates.

In Fig. 2 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 EU and ROW sources are homogeneous in the preferences of consumers. The case of trade diversion in a given sector is depicted. Tariffs are lowered preferentially against imports from the EU, 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 EU, so that Moroccan importers shift from all ROW imports to all EU imports. Initially equilibrium is at E^0 and shifts to either E^1 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. Consumer 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

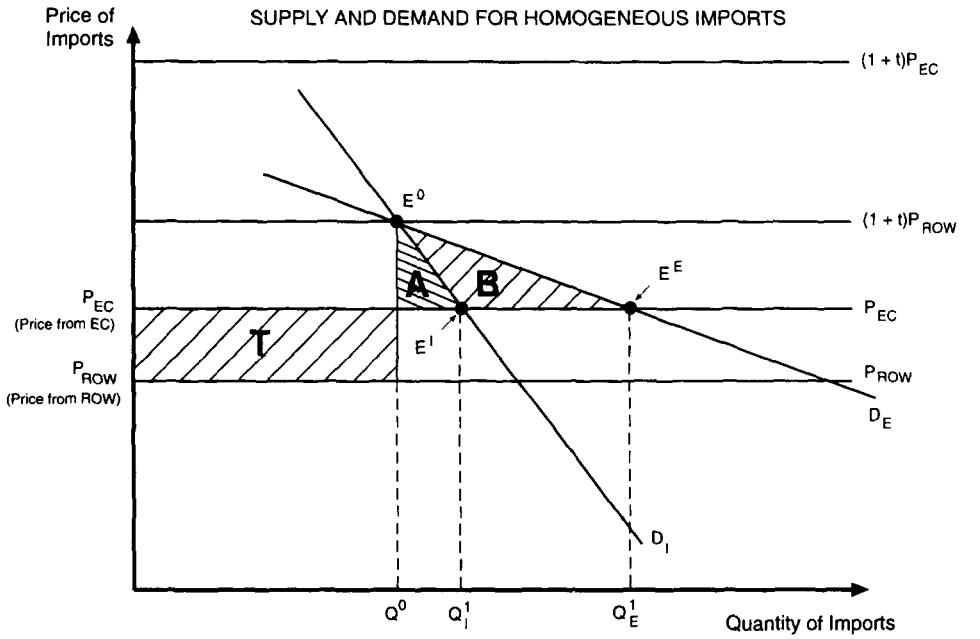

Fig. 2. Welfare benefits of trade integration increase with the elasticity of demand for composite imports. The trade diversion case, where consumers regard imports from different sources as homogeneous, is pictured. If tariffs are eliminated preferentially against the EC, the welfare change is equal 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.

cost supplier; but an enlarged triangle B remains the net difference in welfare between the elastic and inelastic demand cases.

4.3. Elasticity of substitution between imports from different sources

Our benchmark value of the elasticity of demand between imports from the EU and imports from the ROW is 5. In Table 4, we show that increasing this value reduces the welfare benefits of preferential tariff reduction, either against the EU or against the ROW. This parameter has no effect on the welfare effects when the tariff changes are not preferential.

Fig. 3 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 EU and from the ROW are drawn analogously to Fig. 1. The difference between Figs. 1 and 3 is that we depict alternate new shifts in demand and new equilibria depending on the elasticity of substitution between EU and ROW imports. The inward shift in the demand curve for imports from the ROW will be larger the larger the elasticity of substitution among imports from

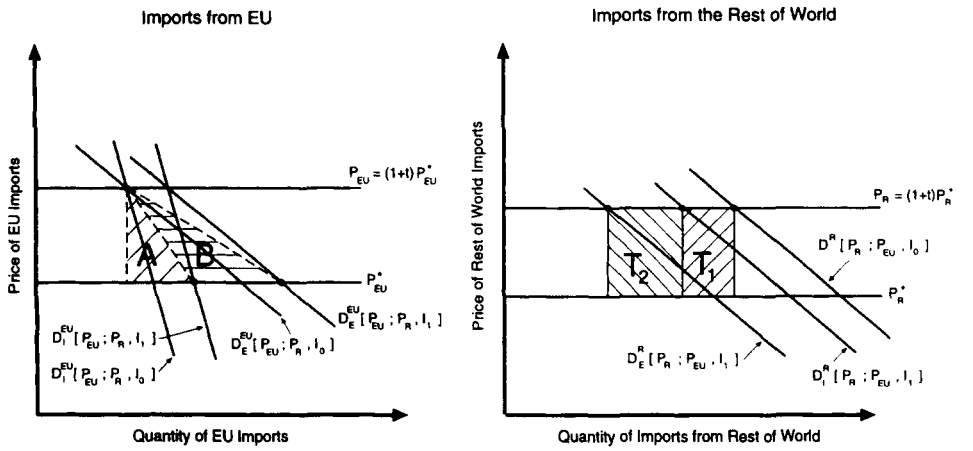

Fig. 3. Welfare benefits of trade integration decrease with greater substitutability among imports. If tariffs are eliminated preferentially against the EU, the welfare change is equal to A − T, with respectively inelastic demands D_I, and equal to A + B − T_1 − T_2 with relatively elastic demands D_E.

different sources. In the market for EU imports, triangle A is the gain in consumer surplus that is not offset by lost tariff revenue in the low elasticity case. With higher elasticities of substitution the demand for EU imports would be flatter so that the larger triangle A + B is the gain in consumer surplus in the market for EU imports.

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-elasticity case, that is not offset by a consumer surplus change. Thus, the net change in welfare is equal to A − T_1 in the low elasticity case or A + B − T_1 − T_2 in the high elasticity case. In our simulations the rectangle T_2 exceeds the area B, so that trade diversion costs are higher with increases in the elasticity of substitution among imports.

4.4. Homogeneous or Armington sectors

Since both the sugar and the meat and dairy sectors have few or no imports, we have assumed that they are homogeneous sectors in our model. An alternative modeling 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

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

scenarios, i.e. the Armington assumption mutes resource movement and reduces the welfare impact.[24] 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 50% decline in the relative price of imports will induce a 100% increase in the ratio of imports to domestic sales in consumption. But if imports were less than 0.5% of consumption, they will remain under 1% after their relative price reduction, i.e. the absolute increase in the import share of consumption is less than 0.5%. 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 percentage of total consumption in the sector. That is, ceteris 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 appropriate to model these sectors as homogeneous products such that after quantitative restraints are removed there will be a substantial increase in the import share. These sectors have been protected by quantitative restraints because of the fear that they would contract precipitously. On the other hand, the homogeneous 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.

5. Sensitivity analysis

Estimates of elasticities for primary factor substitution, import demand, import source, domestic demand, and the elasticity of transformation from domestic into exported output must be assembled. Despite our literature search for elasticity values, there are many elasticities in our model about which there is uncertainty. Our 'remedy' for this uncertainty, 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.[25] We report the

[25] 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.

results of these sensitivity analyses in this section, which involve a minimum of 1000 simulations for each counter-factual policy. They will allow us to conclude whether or not our main results are robust, at least with respect to plausible uncertainty over elasticities.[26]

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. The point estimates employed in the simulations underlying Table 2 are the means of these distributions, with one exception. The exception is that the point estimate for the elasticity of substitution between intermediates and value added is zero, i.e. Leontief; whereas in the systematic sensitivity analysis we allow for a CES production structure.[27] 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 variables of interest. In our case we focus solely on the welfare impacts of each policy.

The results of the sensitivity analysis are reported in Table 5. 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 Table 2. 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, values. These are the results reported and discussed earlier. As before, we report the change in welfare due to the policy as a percentage of GDP, the revenue as the change in the VAT rate required, and the labor adjustment as the percentage 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.

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

[27] The exact distributional assumptions used are documented in appendix A of Rutherford et al. (1993). For the purposes of this paper suffice it to notice here that we employ uniform distributions for the Armington elasticities (values = {1, 2, 3}), the elasticity of substitution between EU and non-EU sources (values = {3, 5, 7}).

Table 5
Results from sensitivity analysis

	FTA	*ACCESS*	*EULIB*	*LIBROW*	*LIBALL*	*FTAALL*
Sample size	1005	2284	1096	1002	1002	1078
Welfare	1.52	0.27	1.29	1.10	2.37	2.60
PE[a]						
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.[b]	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[c]	1.49	0.28	1.27	1.11	2.43	2.69
50% UB[d]	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	58.3	−1.20	58.90	60.10	85.50	84.90
PE						
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	84.34
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

[a] PE = point estimate.
[b] St.d. = standard deviation.
[c] LB = lower bound.
[d] UB = upper bound.

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 counterfactual 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

[28] With the exception of the intermediate input substitution, where the point estimate is zero.

(higher) than one-half indicates that the distribution generally lies below (above) the PE result.[28]

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 notably, since the standard deviation of the estimate is 0.39, a 95% confidence interval for the welfare impact of the FTA gives a range of welfare improvement from 1.06 to 2.42% of GDP. Thus, even at the low end of the confidence interval of the estimates, there is a welfare improvement, establishing robustness of the basic policy message with respect to the elasticity parameters.

Most mean and median welfare effects are above the point estimates reported earlier due to the fact, as mentioned above, that the point estimate between intermediates and value-added is Leontief, whereas greater substitution possibilities are allowed in the systematic sensitivity analysis. 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 *EULIB* in the sense of providing higher median welfare gains at lower median adjustment costs. Note, however, that the mean welfare effect for *EULIB* 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 than the median welfare effect in *EULIB* with a probability of 0.711. The reverse case that the welfare effect in *EULIB* 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 EU 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 *EULIB*, 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% from a benchmark value of 3 and 11% 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.

6. Conclusions

The purpose of this paper has been to illustrate the importance of several key

parameters in a general equilibrium model for a small open economy. This is done within the framework of a model exercise of the economic effects of an EU–Morocco free trade area. The model is a 'generic' general equilibrium model with a large number of production sectors, each employing intermediate and primary factors in constant returns to scale production processes, and a representative consumer that derives income from these factors and maximizes utility subject to that income constraint. A number of innovative features are introduced to allow better control of the properties of the model. For example, to allow for differential degrees of substitution in consumption, products are differentiated into domestic and imported, as well as EU and non-EU varieties. For some commodities, however, a homogeneous good assumption is employed in order to better capture expected supply responses. For the same reason the model also allows both mobile and sector specific capital to be employed across sectors, with the proportion of mobile to sector specific capital being variable. On the export side we also adopt a differentiation across output varieties, both according to whether products are destined for domestic and foreign markets, and according to whether the foreign markets are EU or non-EU.

Our general results for the EU–Moroccan free trade agreement show that fairly large welfare gains are to be expected for Morocco. More gains are expected to arise out of the import liberalizations in Morocco than out of the improved access to EU markets. Expanding the import liberalizations to incorporate all trading partners will give substantial added benefits with very little additional adjustment cost. We conclude that there is some trade diversion in the EU–Moroccan FTA, but that it is dominated by trade creation effects such that the net effects are positive.

The key parameters responsible for whether a regional trade agreement leads to net positive or negative results are, in addition to import shares and tariff levels, the substitution elasticities in consumption. We generally find that regional agreements are more likely to be detrimental to welfare when domestic varieties are not close substitutes to imported varieties, i.e. when the Armington elasticity is low. With a higher Armington elasticity the own elasticity of demand for partner imports is larger, which allows more trade creation. Moreover, the decline in the composite price of imports results in a substitution away from domestic goods in favor of imports of all varieties, i.e. a shift in demand for imports; with a larger Armington elasticity, this leads to greater trade creation effects in the market for partner country imports and a reduction in the trade diversion costs of lost tariff revenue in the market for imports from the rest of the world.

The elasticity of substitution between import sources has a more ambiguous influence on the welfare effects. On the one hand a higher elasticity will lead to a larger shift away from the non-partner imports, causing larger losses in tariff revenues. On the other hand, it will also yield larger consumer gains on the market for partner imports. In the Morocco model, where the Armington elasticity is set at 2.0 and the cross-elasticity is set at 5.0, we find net positive welfare effects from a regional agreement. Due to uncertainties in the estimates of many elasticities, we

have performed systematic sensitivity analysis and have found that our results are quite robust with respect to the elasticities.

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Appendix

Variables

X_i	Exports of good i
X_{ir}	Exports of good i to region r
D_i	Domestic sales of good i
M_i	Composite imports of good i
m_{ir}	Imports of good i from region r
S_i	Armington aggregate of domestic goods 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 used in sector i
K_i	Capital inputs used in sector i
x_{ki}	Intermediate inputs of good k in sector i
f_{ki}	Variable input use of primary factor k in sector i
f_{ki}^{F}	Fixed input use of primary factor k in sector i
Y_i	Domestic production of good i
p_i	Price of domestically produced good i
π_i	Price of domestic–import good i composite
w_k	Price of factor k
τ_T	Replacement tax multiplier on lump-sum transfers
τ_v	Replacement tax multiplier for value-added taxes
τ_f	Replacement tax multiplier for factor taxes
p_i^{X}	Export price of good i (exogenous)
p_{ir}^{M}	Import price of good i from region r (exogenous)

Parameters

G_i	Government demand for good i

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_i^P Rate of production subsidy for good i
s_i^X Export subsidy rate for good i
ν_i Tax rate on factor inputs in sector i
T Lump-sum tax on consumers
B Current account balance (equal to net capital inflows)
E_k Endowment of factor k
a_{ij} Intermediate input requirements; amount of good i required to produce one unit of good j
$''\alpha_{DX_i}$ Distributive parameter for domestic composite good i in export transformation function, Y_i
α_{X_i} Distributive parameter for export composite good i in export transformation function, Y_i
α_{M_i} Distributive parameter for import composite good i in import aggregation function, M_i
α_{DM_i} Distributive parameter for domestic composite good i in import aggregation function, M_i
$\beta_{X_{ir}}$ Distributive parameter for exports of good i to region r in regional export transformation function, X_i
$\beta_{M_{ir}}$ Distributive parameter for imports of good i from region r in regional import transformation function, M_i
F_k Primary factor supplies
δ_{ki} Distributive parameter for primary input k in value added for good i
σ Elasticity of substitution between primary factor inputs in value added
ϵ_i Elasticity of transformation between domestic production and exports in sector i
e_i Elasticity of transformation between exports to different regions
σ_i Elasticity of substitution between domestic goods and aggregate imports in sector i
s_i Elasticity of substitution in consumption in sector i between imports and from different regions.

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