REVIEWER APPENDIX

A Comparative Analysis of the EU-Morocco FTA vs. Multilateral Liberalization

Aziz Elbehri*

Economic Research Service, USDA, Washington DC, USA

Thomas Hertel

Global Trade Analysis Project, Purdue University, W. Lafayette, Indiana, USA

Appendix A: GTAP Model Description

A.1. Intermediate and Final Demand

Demand for intermediate inputs is modeled via a two-stage CES function. In the lower stage, a CES function is used to aggregate each imported good, differentiated by region of origin into a single import composite (Hertel, 1997; chapter 2). A second CES function aggregates imports and domestically produced goods into a single composite good (Armington assumption). Firms first decide on the sourcing of their imports and then based on the resulting price of the import composite, determine the optimal mix of imported and domestic goods. Although the same value of Armington substitution elasticity is used across uses (final versus intermediate demand) firms or consumers' composite import demand are distinguished by their different import shares.

Final demand is treated via a regional household, which receives all income that is generated in the economy including factor income, quota rents, and net taxes adjusted for the value of depreciation. Regional income is allocated to private consumption, government and savings according to a Cobb Douglas utility function. Consumers' utility takes the form of a Constant Difference Elasticity (CDE) minimum expenditure function (Hanoch 1975). This functional form allows for non-homothetic preferences, which are important when per capita income changes significantly. The CDE form also lends itself to calibration based on existing data on income and own-price elasticities (Hertel et al., 1992).

There are five factors of production (land, unskilled labor, skilled labor, capital and natural resources) in fixed supply with labor and capital mobile across sectors while land and natural resources are sector-specific. Perfect mobility of labor and capital across sectors means that wage and rental rates are equalized across sectors. In this analysis, the aggregate economy-wide level of unemployment implicit in the benchmark data base is assumed to be unaffected in the

long run by the FTA[1]. In the formation of a value added composite, firms substitute among the five primary factors using a common elasticity of factor substitution (farmland is exclusively employed in agriculture and extractive natural resources are also sector-specific).

Welfare is derived at the regional level as an equivalent variation computed from regional income and prices, based on the regional household's utility function. Moreover, it can be decomposed into component parts using an approach developed by Huff and Hertel (1996). This decomposition approach may be viewed as a generalization of Baldwin and Venables' analytical decomposition, which accommodates domestic distortions and handles non-marginal changes via numerical integration.

A.2. Derivation of perceived demand elasticity

The derivation of the perceived demand elasticity for a given industry starts from the demand function of the form (industry subscript is dropped for clarity):

$$X_{r,s} = \alpha_{r,s}^{\sigma} P_{r,s}^{-\sigma} \theta_s^{\sigma-1} E_s \qquad \text{(A1)}$$

where $X_{r,s}$ is demand by region *s* for goods of origin *r*, $P_{r,s}$ is price of commodity in region *s* of origin *r*, θ_s is price index in region *s* dual to the Armington aggregator, E_s is total expenditure value of region *s* on the commodity group, and σ is elasticity of substitution between goods of different origin – assumed to be identical across all regions.

By assumption, both domestic and export markets are integrated – that is domestic firms are not able to engage in regional price discrimination, but face a single, world-wide market demand curve for their product, and thus have only one decision variable (namely their total quantity to

the integrated world market). We write the total demand function faced by oligopolists in region *r* as:

$$X_r(.) = \sum_s X_{r,s}(.) \tag{A2}$$

Assuming total constant expenditure for the composite commodity, a general form of the perceived market demand elasticity can be written as (Francois and Roland Holst, 1997):

$$\varepsilon_r = -\hat{X}_r / \hat{P}_r = \sigma + (1-\sigma)\sum_s \frac{X_{r,s}}{X_r}\frac{\hat{\theta}_s}{\hat{P}_r} \tag{A3}$$

where the hat notation is used to indicate proportional changes.

Now the elasticity of the share θ_s with respect to P_r depends on Moroccan firms' conjectures about foreign rivals' responses to a change in their own price. In general form:

$$\frac{\hat{\theta}_s}{\hat{P}_r} = \sum_k S_{k,s}\frac{\hat{P}_{k,s}}{\hat{P}_r} \tag{A4}$$

where

$$S_{k,s} = \alpha_{k,s}^{\sigma}\left[\frac{P_{k,s}}{\theta_s}\right]^{1-\sigma} \tag{A5}$$

denotes the market share of goods from region *k* in region *s* within the commodity group under consideration. Now we assume that the firms take foreign rival' prices as given, so that:

---

[1] The analysis assumes that wages are market-determined such that the base-year unemployment rate is unaffected by the FTA. This assumption, however, could be relaxed by fixing wages and allowing aggregate labor demand to adjust, thereby altering the aggregate rate of unemployment.

$d \ln P_k / d \ln P_r = 0$ for $k \neq r$ (the Bertrand assumption). The perceived market demand elasticity from equation (A3) becomes

$$\varepsilon_r = -\hat{X}_r / \hat{P}_r = \sigma + (1-\sigma)\sum_s \frac{X_{r,s}}{X_r} S_{r,s} \qquad \text{(A6)}$$

Appendix Table A1. Composition of Morocco's exports to EU and third countries (1970-98; % of total exports by destination)

	1970-74	1975-79	1980-84	1985-89	1990-94	1995-98
EXPORTS TO EU						
AgProd	75.0	59.6	40.6	32.1	21.6	13.0
Clothing	3.5	9.7	16.5	31.3	45.1	38.7
ChemIndus	1.1	3.6	7.1	6.7	7.3	6.7
LightMnfct	0.4	1.4	2.6	4.5	6.5	8.7
OthMnfct	2.6	4.3	6.3	5.7	4.9	3.9
Other	17.4	21.4	26.8	19.7	14.6	29.0
EXPORTS TO ROW						
AgProd	55.0	41.7	20.9	17.9	23.5	21.4
Clothing	2.1	4.9	5.1	7.9	6.5	5.5
ChemIndus	4.1	14.5	39.6	36.5	34.0	26.1
LightMnfct	1.6	0.4	0.4	1.8	5.0	5.5
OthMnfct	14.6	9.9	4.9	6.9	8.0	4.7
Other	22.7	28.5	29.2	29.1	23.0	36.9

Source: GTAP database version 5.3

Appendix Table A2. Scale and profit shifting effects for oligopolistic manufacturing sectors under FTA and Multilateral liberalization for Morocco

	NO ENTRY		WITH ENTRY	
	Scale effects	Profit shifting effects	Scale effects	Profit shifting effects
FTA				
Meat products	-0.39	0.33	-0.07	0.32
Vegetable oils & fat	-0.02	0.00	0.67	-0.29
Dairy products	-9.98	-3.56	-1.08	-9.29
Sugar	-1.19	-2.93	-0.58	1.77
Other food products	-2.26	1.38	11.43	-2.75
Beverages & Tobacco	0.65	3.51	2.88	-0.51
Textiles	-3.34	2.84	3.55	-4.12
Wearing apparel	6.55	-1.67	22.43	-1.02
Wood products	-24.15	1.57	1.92	-10.21
Paper & Publishing	-48.15	21.54	-5.39	21.60
Chemical products	-31.63	2.48	12.93	-0.89
Metal products	-57.22	-7.27	13.69	-29.20
Motor vehicles	-169.79	151.31	-26.40	195.92
Light manufacturing	35.57	-13.14	27.75	-16.96
Other maunfacturing	-8.44	-2.52	2.40	-13.77
MULTI-LATERAL				
Meat products	0.90	-0.72	0.21	-1.16
Vegetable oils & fat	-1.18	0.36	0.43	0.48
Dairy products	0.71	0.39	3.65	-0.37
Sugar	-8.68	-17.12	2.42	-34.14
Other food products	22.69	-13.55	18.93	-14.98
Beverages & Tobacco	1.68	8.89	3.61	-1.52
Textiles	-4.18	3.61	0.51	2.84
Wearing apparel	-0.32	0.04	4.79	-0.09
Wood products	-3.17	-0.76	2.71	-1.59
Paper & Publishing	-8.23	3.03	1.17	3.96
Chemical products	18.99	-0.04	27.33	0.27
Metal products	-8.95	-2.82	9.16	-5.33
Motor vehicles	-35.56	30.30	-1.36	48.93
Light manufacturing	7.64	-2.86	7.21	-3.62
Other maunfacturing	-1.08	-0.68	2.32	-2.38

Source: Authors' simulation results

Appendix Table A3. Commodity Aggregation and Mapping with the GTAP V4 Sectoral Classification

Model sectors:		*GTAP sectoral classification:*
Agriculture & Other Primary sectors:		
1	Grains crops	Paddy rice (pdr); Wheat (wht); Cereal grains nec (gro)
2	Vegetables-fruits	Vegetables, fruit, nuts (v_f)
3	Oil seeds	Oil seeds (osd)
4	Sugar crops	Sugar cane, sugar beet (c_b)
5	Plant-based fibers	Plant-based fibers (pfb)
6	Other agriculture	Crops nec (ocr); Wool silk-worm cocoons (wol)
7	Livestock	Bovine cattle, sheep and gots, horses (ctl); Animal products nec (oap); Raw milk (rmk)
8	Fishing	Fishing (fsh)
9	Forestry	Forestry (for)
10	Energy products	Coal (col); Oil (oil); Gas (gas); petroleum coal products (p_c)
11	Minerals	Minerals nec (omn)
Manufacturing:		
12	Meat products	Bovine cattle, sheep, goat, horse meat products (cmt); Meat products nec (omt)
13	Vegetable oils & fat	Vegetable oils and fats (vol)
14	Dairy products	Dairy products (mil)
15	Sugar	Sugar (sgr)
16	Other food products	Processed rice pcr); Food products nec (ofd)
17	Beverages & Tobacco	Beverages and tobacco products (b_t)
18	Textiles	Textiles (tex)
19	Wearing apparel	Wearing apparel (wap); Leather products (lea)
20	Wood products	Wood products (lum)
21	Paper & Publishing	Paper products, publishing (ppp)
22	Chemical products	Chemical, rubber, plastic products (crp)
23	Metal products	Mineral products nec (nmm); Ferrous metals (i_s); Metals nec (nfm); Metal products (fmp)
24	Motor vehicles	Motor vehicles and parts (mvh); Transport equipment nec (otn)
25	Light manufacturing	Electronic equipment (ele); Machinery and equipment nec (ome)
26	Other maunfacturing	Manufactures nec (omf)
Services:		
27	Utilities	Electricity (ely); Gas manufacture distribution (gdt); water (wtr)
28	Other services	Construction (cns); Trade, transport (t_t); Financial, business, recreational services (osp); Public admin and defence, education, health (osg); Dwellings (dwe)