METU Studies in Development, 33 (June), 2006, 33-62

Scale economies, horizontal product differentiation and the FTA between Tunisia and the EU: Some general equilibrium effects

Rim CHATTI

Ecole Supérieure des Sciences Economiques et Commerciales (ESSEC), 4 Rue Abou Zakaria El Hafsi, 1089 Montfleury, Tunisia

Abstract

Tunisia was the first country south of the Mediterranean to conclude a free trade agreement with the European Union in 1995. The agreement is expected to promote growth and employment through efficient reallocation of resources and scale economies exploitation. The aim of this paper is to provide some general equilibrium estimates of the agreement impact on scale economies exploitation as well as on pro-competitive and varieties effects. Simulation results show that welfare gains under monopolistic competition would be greater than those that would be achieved under perfect competition. The expansion of firm's average size and the increase of the number of available varieties are behind such results, despite the adverse terms of trade change. At the sectoral level, the models predict that mechanical and electrical machineries, chemicals and textiles, apparel and leather are the goods for which Tunisia has a comparative advantage.

1. Introduction

Tunisia was the first country south of the Mediterranean to sign an association agreement with the European Union (EU) in July 1995. The pact called for a gradual removal of all tariff and nontariff barriers on industrial goods and the creation of a nonagricultural free-trade zone, over a twelve-year transition period. It has been progressively implemented since 1996 and came into force on 1998. Actually, 40 percent of total imports from the EU are now wholly exempt from

customs duties, while duties for 30 percent of imports have declined by 56 percent and the protection of the rest of imports reduced by 34 percent.

In the long run, the agreement should enhance growth and employment through a better allocation of scarce resources, according to the comparative advantage. Furthermore, the access to a larger market, should allow the exploitation of scale economies (Jbili and Enders (1996)). In this context, computable general equilibrium (CGE) models have appeared as proper tools for analyzing the free trade agreement (FTA) between Tunisia and the EU. Whereas Rutherford *et al*. (1995) and Boughanmi (1997) have focused on the effects of the arrangement on reallocation of factors of production between sectors, Decaluwé and Souissi (1996), Chemingui and Dessus (1999) and Dessus and Suwa-Eisenmann (2000) were interested by the consequences of the enlargement of the agreement to agricultural products. Given revenue importance of tariffs, the fiscal impact of the agreement and the search for the optimal replacement taxes have been inspected by Devarajan (1997), Chemingui and Dessus (1999) and Dessus and Suwa-Eisenmann (2000).

All these studies are firmly grounded in the traditional trade theory. They all assume a combination of constant returns to scale (CRTS) and perfect competition. There is therefore no room in these studies for the analysis of the potential scale efficiency effects of the agreement, stressed in Jbili and Enders (1996).

Kress (1994) gives evidence supporting the existence of increasing returns to scale (IRTS) in the different Tunisian manufacturing industries. With IRTS, firms enjoy market power and set price as a markup over marginal cost. Ben Jelili (2001) provides estimates of markup ratios for 6 manufacturing industries in Tunisia over the period 1975-1999. Markup rates range from 16 to 39 percent and they are particularly high in concentrated industries, like chemicals. He also finds differences in market power across manufacturing industries, which he attributes to differences in entry conditions. However, given data limitations, he does not shed light on the characteristics of market structures and it is not so obvious whether Tunisian manufacturing industries are of oligopolistic or monopolistic competition type.

Given this background, the Tunisian manufacturing industries clearly have features which can be captured only in a model with imperfect competition and IRTS. Kress (1994), Cockburn *et al*. (1999) and Chatti (2003) propose an earlier attempt to handle IRTS and

imperfect market structures in Tunisian industries within a CGE model. Yet, they all assume oligopolistic market structures. In the present study, however, the Tunisian manufacturing industries are of monopolistic competition type and firms are producing different varieties. Brown *et al*. (1997) already offer some economic effects of the FTA between Tunisia and the EU within a setting of monopolistic competition and product differentiation at the firm level. But the framework we adopt in this paper is somewhat different. It is rather a single country model and the world prices of imports are exogenous, reflecting Tunisia's lack of market power on the world markets of imports.

Our model builds on the seminal work by Harris (1984), but goes beyond it into two important respects. First, the model does not rely on *ad hoc* pricing rules, but firms are allowed to price discriminate between internationally segmented markets. Second, we consider both Cournot and Bertrand behaviors. The difference between the two is that the former is less competitive in the sense that it represents a greater departure from perfect competition. Hertel (1994) shows, and this study confirms, that the form of firms' assumption about rivals' reactions affects the magnitude, but not the direction of pro-competitive effect of the trade policy.

The paper is organized as follows. A description of the numerical models is given in Section 2, wherein emphasis is placed on the modeling of monopolistic competition. The models are used to first calibrate, among others, data on market structures, and then replicate the initial equilibrium. The calibration results are provided in Section 3. Once the base year equilibrium is replicated, the models are used to evaluate the effects of the removal of tariffs on nonagricultural EU imports, while maintaining unchanged the protection on the Rest of the World (ROW) imports. We capture the effects of this fiscal design alternatively under perfect competition and monopolistic competition with Cournot or Bertrand conjectures. The simulation results are reported and discussed in Section 4. Finally, the paper ends with a brief conclusion.

2. Models description

Supplies and demands in each market come from the independent producers and household optimizing decisions. A detailed treatment of sectors and regional trading partners is developed, with the multi-regional character of the model being of particular

importance. Bilateral trade flows take place with the EU and the ROW, identified in the model by the index *k*.

Tunisia is modeled either as a small open economy (SOE) or as an almost SOE. The SOE assumption means that Tunisian policy changes do not alter prices in other regions. This assumption holds with CRTS and perfectly competitive firms, whereas the almost SOE assumption indicates that Tunisian manufacturing firms alter the world prices of exports. The latter holds under the assumption of IRTS, monopolistic competition and product differentiation at the firm level[1].

In the model, there are 15 sectors producing outputs. Each sector is using labor, capital and intermediate inputs. The different sectors are identified by indices *i* and *j*, with *i*,*j*=1,15. When some of these sectors are non-competitive, they are identified by the index *n*. The remaining competitive ones (both tradable and non tradable) are recognized by the index *p*.

2.1. The technology

Domestic output is given by a two-level nesting production function. In the first level, final output is produced in a Leontief function with the use of intermediate inputs and real value-added. In the second level, composite intermediate inputs are demanded with fixed (Leontief) input-output coefficients, as there is no scope for substitution between sector intermediate demands. A constant elasticity of substitution (CES) function describes, however the substitutability between labor and capital factors into the real value-added nest.

The demands for variable labor and capital at the industry level are determined by minimizing total costs of production, subject to the nested production function. Then, replacing the first-order conditional factors demands into the total cost function of competitive industries, gives the total cost of each unit of output.

As long as unit costs are decreasing with firm's output, marginal cost pricing rule induces losses. Thus, firms enjoy market power and price mark-up over marginal cost. To model decreasing unit costs and

[1] Relying on a sample of 23 LDCs, Faini *et al.* (1992) show that 17 countries, including Tunisia, reject the small country hypothesis and the perfectly elastic export demand, which implies exogenous world price of exports. Hence, both supply and demand factors interactions explain these 17 countries export performance. The authors also show that exports from any LDC compete mostly with other LDCs' exports. Therefore price elasticities of export demand are finite but high; their study sustains thus the choice of decreasing export demands for Tunisian manufacturing sectors.

increasing returns to scale (IRTS) in monopolistically competitive industries, total cost becomes now equal to the sum of fixed setup costs and variable costs.

Fixed costs combine the minimum fixed capital and labor that must be borne by each symmetric domestic firm before starting the production of a differentiated good.

2.2. Firms' behavior

Firms' behavior depends on whether they rely on CRTS or IRTS technology. When there are CRTS, producers are assumed to behave competitively and take a three-step supply decision. First they select output levels such that marginal cost at those output levels equals the given market price.

In the second step, competitive producers allocate their output between domestic market and foreign market according to a constant elasticity of transformation (CET) function.

Finally, in a third step, firms share out the composite export between the different trading partners k by maximizing revenue subject to a CET function.

The competitive equilibrium which follows from CRTS is unsuitable with IRTS technology. Then, when production involves both fixed and variable costs, some alternative to the competitive paradigm has to be considered.

Given the difference in consumer preferences, transport costs and/or trade barriers, the international markets are assumed to be segmented. Thus, in the case of monopolistic competitive industries, the non-competitive firms exploit the monopoly power they have on each individual (regional) market and may choose separate price and supply decisions for each market based on the perceived elasticity of demand. They also expect to have smaller shares of sales on export markets than on the local market.

With product differentiation at the firm level and monopolistic competition market structure, each firm is facing a downward sloping demand function for its specific variety, described by (A1.20) and (A1.28), and behaves like a monopoly. Given the total cost, the first order conditions from profit maximization are such that marginal revenue from sales on each market is equal to marginal cost. This means that the sale price of products from the home country is different on each destination, according to the perceived elasticity of demand. It is also greater than the marginal cost by a markup, where

the markup reflects the degree of product differentiation and market shares.

It is assumed, in line with Devarajan and Rodrik (1991), that the perceived export demand elasticity in each non-competitive sector is exogenous and high; reflecting the home country's low market power in world markets. The perceived domestic demand elasticity is, however, derived from the total differentiation of (A1.31). It is endogenous and depends crucially on whether monopolistic firms use Bertrand or Cournot conjectures when maximizing profits.

Bertrand pricing means that firms set prices to maximize profits, taking prices charged by competitors as given, and Bertrand equilibrium occurs when each firm's price is equal to the price that other firms expect it to choose. Cournot quantity setting means that firms set quantities to maximize profits, taking quantities selected by competitors as given and Cournot equilibrium occurs when each firm's quantity is equal to the quantity that other firms expect it to choose.

If firm's behavior is *à la* Bertrand, profits maximization with respect to domestic price will lead to the perceived domestic demand elasticity, given by (A1.13). Yet, if Cournot assumption describes firm's behavior, the perceived elasticity of domestic demand will be instead given by (A1.14).[2]

When the number of firms becomes large, their monopoly power vanishes; reducing their perceived elasticity of domestic demand. To ensure such relationship, the common elasticity of substitution among the different varieties, η_n, and the elasticity of the composite good demand, ξ_n, are chosen so that $\eta_n - \xi_n \phi 0$. In such a case, it is straightforward to show that the Cournot elasticity of demand is lower than the Bertrand one[3]. This means that the Cournot case represents a greater departure from competition than the Bertrand case, as it generates smaller perceived demand elasticity, and larger markup and domestic market power. However, the form of firms' conjecture about

---

[2] The analytical expressions of perceived elasticities of domestic demand draw inspiration from Smith and Venables (1988), Norman (1990) and Mercenier (1995).

[3] If we note $z_i = \frac{PD_i DD_i}{PQ_i Q_i ND_i}$, with $0 \pi z_n \pi 1$, then comparing the Bertrand and Cournot elasticities of demand gives: $\psi_n^d(C) - \psi_n^d(B) = -\frac{z_n(1-z_n)(\eta_n - \xi_n)}{\xi_n(1-z_n) + \eta_n z_n} \pi 0$.

their rivals' reactions affects the magnitude, but not the direction, of firms' market power and production scale changes.

With free entry and exit, the number of firms (varieties) is endogenous and profits are driven to zero.

2.3. Demands

The home country is assumed to be a price taker in the world market of imports and either a price taker (of homogenous goods) or a price maker (of differentiated goods) in the world market of exports. The latter assumption is even more realistic when each monopolistically competitive firm produces and exports a variety for which it has a monopoly power and perceives a downward sloping demand curve.

We consider a representative household who receives income from wages and capital revenues. Given this income, the representative household decides how to allocate its disposable budget between final consumption and saving so as to maximize a Cobb-Douglas utility function. In a second step and given the total final consumption budget, the representative consumer chooses the level of the different composite consumption goods as a fixed budget share in total expenditures budget.

Producers also demand composite goods for intermediate use, according to a Leontief input-output technology.

The model furthermore explicitly features the expenditures flows arising from government behavior and the activities of investors. The government maximizes a Cobb-Douglas utility function over saving and final composite consumption goods, subject to its given revenue. The latter derives from direct and indirect taxes collection. In addition, the government chooses to allocate its consumption budget over the composite goods according to fixed shares.

The investment demands for the different composite consumption goods are also assumed to be in fixed shares of total investment demand, which is equal to total saving.

Each composite consumption good is thus a sum of household, government and investors' final consumption demands and all producers' intermediate composite good demands.

Products of competitive and tradable industries p from different geographical origin are deemed to be imperfect substitutes by all the domestic purchasers. They nevertheless consider as specific each good

produced by individual firms operating in the non-competitive industries *n*. The composite good is accordingly an aggregation of domestic and imported goods, either through a nested CES specification, in competitive and tradable *p* sectors, or through the Dixit and Stiglitz (1977) sub-utility function in the imperfectly competitive *n* sectors.

In the case of *national product differentiation*, the composite import and the domestic goods are imperfect substitutes. Domestic buyers therefore trade off composite imports with domestic goods according to a CES function.

To capture the effects of geographically discriminatory protection policies, the imports are allowed to bear different tariffs depending on their source. This feature allows studying policies such accession to a free trade area. Imports from different sources substitute with each other at a lower nest to form a composite import good for each competitive sector. Then, given a budget for composite imports, cost minimization subject to a CES function of composite imports from the different regions *k*, gives the optimal selection of imports purchases from the various sources.

In the case of *horizontal product differentiation*, the domestic demanders have a "love of variety", i.e., all the available imported or domestic goods are imperfect but close substitutes and the more varieties they consume, the more they are satisfied. However, there will not be an infinite number of varieties, since fixed costs impose a limit to this number. But, if fixed costs are enough low, there will be room in the industry for a high number of firms, producing each one a specific variety and no two firms produce and sell the same variety.

Following Dixit and Stiglitz (1977), modelers have typically chosen the CES function to add different varieties into a single aggregate. Accordingly, demanders minimize the cost of purchasing all the varieties *v* of good *n* subject to a Dixit-Stiglitz aggregator. It is also assumed that all varieties and firms are symmetric, so that the welfare depends on the number of available varieties.

Minimizing the cost of purchasing all varieties, subject to the Dixit-Stiglitz aggregator, gives the demands for each representative domestic and imported variety, (A1.28) and (A1.29).

As a closure rule, it is also assumed, in this single country model of monopolistic competition, that the number of imported varieties

from region *k* matches proportionally any change in the domestic number of varieties, by an exogenous constant[4].

In addition to domestic demands for local and imported varieties, the model distinguishes decreasing trading partners export demands for the home country produced varieties. Only manufacturing and thus monopolistic competitive sectors are facing foreign decreasing export demands. To keep things tractable, export demands are specified at the industry level rather than at the firm level, and they are of the constant elasticity form. The foreign demand for each domestic variety is then derived by simply dividing total exports destined to region *k* by the number of symmetric domestic varieties.

To close the models description the set of equations and variables of which is given in Appendix A, all demand and supply functions are homogenous of degree zero in prices. Hence, only relative prices matter. In equilibrium, all prices adjust such that excess demands equal zero for all goods and factors, household income is equal to total expenditures, total saving is equal to total investment and total imports net of total exports are equal to the net foreign capital inflow.

The above models of competitive and monopolistic competition have been implemented to calibrate then replicate the observed data for Tunisia in the base year 1998 and then simulate the impact of the removal of tariffs on nonagricultural imports from the EU on welfare and sectoral adjustments.

3. Calibration results

To carry on calibration, apart from a social accounting matrix (SAM), and elasticities of substitution and transformation, information on the number of firms in each non-competitive industry is needed[5]; this information is drawn from a secondary source.

The number of symmetric firms in each industry is estimated on the basis of the Herfindahl index concentration. The index provides a useful measure of competitiveness: its inverse ratio is an approximate measure of the number of equal sized and symmetric firms. Table 1 displays, in column (1), the Herfindahl index, which reveals that food processing and chemicals are the most concentrated industries, with

[4] This closure rule represents a weakness of the single country model of monopolistic competition and horizontal product differentiation, which is overcome in multi-country models.

[5] The calibration technique is exposed in Appendix B.

concentration ratios greater than 50%.[6] Textiles, apparel and leather, and cement, ceramics and quarrying are, on the other hand, the most competitive, with concentration ratios around 20%.

Given the Herfindahl index, the perceived elasticity of domestic demand, the elasticity of scale and the number of imported varieties from the trading partner *k* have been calibrated. Columns (3) and (4) of Table 1 show respectively the sectoral Bertrand and Cournot calibrated elasticity of domestic demand. In all cases, the elasticity in the Bertrand case is higher than the Cournot case. This is inherent to the fact that the Bertrand behavior is more competitive, as the market power of firms, given by the inverse ratio of the elasticity of demand, is lower with Bertrand conjecture. In addition, the more concentrated the industry is, the higher is firms' market power and the lower is the perceived elasticity of demand.

Table 1
Calibration Relevant Variables Under Bertrand and Cournot Conjectures

		Calibrated Variables			
		Elasticity of domestic demand		Share of fixed costs in total costs (%)	
	Herfindahl Index (1)	Bertrand Conjecture (2)	Cournot Conjecture (3)	Bertrand Conjecture (4)	Cournot Conjecture (5)
1. AGR	—	—	—	—	—
2. FOO	0.517	5.145	4.943	18.2	18.9
3. CCQ	0.203	6.066	5.864	15.9	16.4
4. MEM	0.490	5.526	5.462	16.2	16.4
5. CHM	0.558	5.055	4.950	16.1	16.4
6. TEX	0.203	7.244	7.049	11.6	11.7
7. MIS	0.404	5.122	5.026	18.4	18.7
8. MNG	—	—	—	—	—
9. ELE	—	—	—	—	—
10. WAT	—	—	—	—	—
11. CON	—	—	—	—	—
12. TRA	—	—	—	—	—
13. HAR	—	—	—	—	—
14. SER	—	—	—	—	—
15. PUB	—	—	—	—	—

Notes: AGR: agriculture and fishing; FOO: food processing; CCQ: cement, ceramics and quarrying; MEM: mechanical and electrical machineries; CHM: chemicals; TEX: textiles, apparel and leather; MIS: Miscellaneous manufacture; MNG: mining; ELE: electricity; WAT: water; CON: construction; TRA: transport and telecommunication; HAR: hotels and restaurants services; SER: other services; PUB: public services.
Source: Author's calculations.

[6] The Herfindahl indexes are estimated using the 1993 two- and four-firms cumulated market shares, provided in Lahouel (1999). The methodology used to generate the concentration ratios is presented in Chatti (1999).

As to the extent of unrealized scale economies in each industry, we report in columns (4) and (5) the share of fixed costs in total costs. The larger is the share of fixed costs in total costs, the higher is the elasticity of scale[7]. Calibration shows that in the Bertrand case, the share of fixed costs varies from 11.6%, in the most competitive textile, apparel and leather sector, to 18.2% and 18.4%, in food processing and miscellaneous manufacture; two concentrated industries. Nearly the same figure appears in the Cournot case.

4. Counterfactual results of the FTA between Tunisia and the EU

The EU is the main economic and trading partner of Tunisia. In recent years, over three-quarters of Tunisia's trade takes place with the EU and the EU is the source of nearly two-thirds of the capital that flows into the country.

Table 2 provides the sectoral features of Tunisia's trade in 1998. For each of the 11 tradable sectors, the base-year data for shares of exports in gross output (column 1), imports in total demand (column 2), and respectively each trading partner imports in total imports (columns 3 and 4) and exports in total exports (columns 5 and 6) are given. Generally speaking, average sectoral import dependence is greater than export dependence in 1998. The Tunisian economy exports 24.5 % of total gross output but imports 27.5% of total demand.

The most export-intensive sectors in the current aggregation are hotels and restaurants services (79.6%), textiles, apparel and leather (67.7%), mechanical and electrical machineries (45.8%) and chemicals (39.1%). Together, these sectors account for 73.7% of total exports in the base year. The most import-dependent sectors are mechanical and electrical machineries (77.6%), textile, apparel and leather (62.7%) and chemicals (46.4%). They, together, account for 69.6% of all imports.

Columns (3)-(8) confirm that the EU is the main trading partner of Tunisia. It is straightforward to see from columns 3 and 5 that Tunisia relies upon EU markets for most of its import supply and export demand, with economy-wide averages of 73.2% for imports and 75.2% for exports. Thus, the potential for trade diversion by

[7] The share of fixed costs FC in total costs TC is equal to FC/TC = (TC- MC*X)/TC = 1- (MC*X)/TC = 1- (MC/AC) = 1- 1/ES; where AC represents the unit cost and ES the elasticity of scale.

Tunisia in response to the FTA with the EU is unlikely to be considerable. The ROW is the most important supplier of solely agricultural goods (54.5%) and buys three-quarters of Tunisia's cement, ceramics and quarrying products exports and over half of its chemicals (60.8%) and mining (55.7%) exports. Generally speaking, Tunisia has significantly higher export dependence on the EU than import dependence under the 1998 protection patterns.

As Tunisia is already engaged in sizable amount of trade with the EU, it is not strong to argue that the FTA is likely to lead to relatively low welfare losses resulting from trade diversion. These losses could be overcompensated by potential welfare gains accruing from i) trade creation with EU; ii) efficient resources re-allocation; iii) realization of scale economies; iv) greater number of varieties; and/or v) terms of trade improvement.[8]

We experiment in this paper a removal of all tariffs on nonagricultural goods from the EU, while maintaining unchanged the existing protection on all imports from the ROW. This simulation is performed under three distinct contexts. First, a domestic industry regime of CRTS and perfect competition is considered. Second, protection is removed under IRTS with Bertrand conjecture. The third context is analogous to the second one, except that we rather use Cournot conjecture. In each context, attention is given to the aggregate as well as to the sectoral effects of the FTA. The results we provide give an estimation of the long run effects of the agreement, at the end of the twelve-year transition period.

The aggregate results of the preferential removal of tariffs on nonagricultural imports from the EU with alternative assumptions on industries structure and firms' conjectures are summarized in Table 3. In all figures, trade intensifies with both the EU and the ROW as Tunisia is trade dependent and the EU imports become cheaper. As expected, the EU absorbs the lion's share of trade with Tunisia. The level of imports from the EU expands from 43.9% with perfect competition to 64.3% with Cournot competition. The expansion of EU imports switches expenditures away from ROW imports both in Bertrand and Cournot cases, which fall identically by 20.4%. Yet, given the heavy weight of the EU in Tunisian imports, the diversion of imports from the ROW is more than offset by the creation of imports

[8] The welfare change resulting from trade policy is decomposed into three distinct effects in Flam and Helpman (1987). The scale effect, due to decreasing average cost with output, the varietal effect resulting from the number of available varieties change, and the terms of trade effect. The trade policy induces welfare gains, if the number of varieties increases and/or the output per firm expands and/or the world price of export moves up.

Table 2
Tunisia's Sectoral Pattern of Trade in 1998 (percent)

			Share of imports from		Share of exports to	
	M/Q	EX/X	EU	ROW	EU	ROW
	(1)	(2)	(3)	(4)	(5)	(6)
1. AGR	14.4	3.7	38.7	54.5	68.7	31.3
2. FOO	15.5	12.0	55.3	40.7	71.9	28.1
3. CCQ	13.9	9.2	48.8	46.9	24.0	76.0
4. MEM	77.6	45.8	72.3	21.9	56.1	43.9
5. CHM	46.4	39.1	75.7	21.2	39.2	60.8
6. TEX	62.7	67.7	92.4	6.8	95.0	5.0
7. MIS	37.0	12.5	66.9	25.5	55.3	44.7
8. MNG	35.5	29.9	62.0	36.4	44.3	55.7
9. ELE	—	—	—	—	—	—
10. WAT	—	—	—	—	—	—
11. CON	—	—	—	—	—	—
12. TRA	12.9	32.1	71.3	23.5	78.9	21.1
13. HAR	33.6	79.6	71.3	23.5	78.9	21.1
14. SER	7.3	6.9	71.3	23.5	78.9	21.1
15. PUB	—	—	—	—	—	—
Economy-wide	27.5	24.5	73.2	26.8	75.2	24.8

Notes: M/Q: the share of composite imports in internal demand of each good; EX/X: the share of composite exports in sectoral output. The sectoral split of imports by area of origin and exports by area of destination relies on Konan and Maskus (2002). See Table 1 for key to abbreviations.
Source: Author's calculations from 1998 SAM.

with the EU. Indeed, the total volume of Tunisia's imports grows by 34.2% under perfect competition and about 40% under monopolistic competition.

The reduction of EU imports cost is globally favorable to local producers, whose outputs are intermediate goods intensive; the share of intermediate goods in national production is almost equal to 49% in 1998 and to 73% in non-competitive manufacturing industries. Thus production costs lessen. Furthermore, increased import penetration raises competitiveness, so expanding firms' sales to both local and foreign markets. The national output increases by 6.4% under perfect competition and more than 11% in both Bertrand and Cournot competition.

A share of output growth is occasioned by booming exports to both the EU and the ROW, which expand from 35.6% under perfect competition to 52% under monopolistic competition.

Table 3
Aggregate Effects of Tunisia's FTA with the EU Under Alternative Market Structures and Firms' Conjectures (Percentage Change)

	Perfect Competition	Bertrand conjecture	Cournot conjecture
Welfare change	3.748	4.534	4.687
Real exchange rate	-0.005	-1.955	-1.970
Labor unit price	1.436	0.307	0.506
Capital unit price	3.949	4.629	4.745
Consumption price index	-2.202	-1.235	-1.207
Terms of trade index	—	-4.345	-4.334
Total output change	6.368	11.003	11.480
Number of varieties change	—	10.558	10.292
Average output per firm change	—	13.488	14.185
Change of imports volume from :			
EU	43.914	64.081	64.295
ROW	12.033	-20.375	-20.396
All	34.187	40.470	40.706
Change of exports volume to:			
EU	41.952	50.629	49.757
ROW	16.216	53.764	58.377
All	35.575	51.414	51.917

Source: Author's calculations.

The FTA appears to be potentially beneficial to Tunisia in every case. Equivalent variation aggregate welfare gains range from 3.7% of 1998 GDP with perfect competition to 4.7% with Cournot conjecture. The aggregate effects of the FTA differ, depending upon the extent of unrealized scale economies and the conduct of domestic firms. In every case, however, increases of labor and capital prices, accompanied by a reduction of the consumption price index, contribute to the improvement of the representative consumer's real income.

The aggregate welfare gains with IRTS and monopolistic competition are greater than those under perfect competition, since the inter-industry resources reallocation gains are stimulated by the average output per firm expansion by more than 13.5% and the rise in the number of varieties by over 10%, allowing scale efficiency gains and positive varieties effects, respectively. The entry of new firms does not inhibit incumbent ones to climb up their average cost curves as the industry average output level rises by more than 11%. The welfare gains in this context could have been more substantial, if there

had not been 4.3% deterioration of terms of trade, following excess supply of exports.

As the Bertrand behavior is more competitive than the Cournot one, in the latter case, firm's actions have strong impact on prices. The reduction in domestic prices is less significant under the Bertrand assumption, leading to positive welfare gains equal to 4.5% but lower to those achieved under the Cournot assumption.

Turning now to a closer examination of sectoral adjustments, Table 4 presents sectoral results of the FTA under CRTS and perfect competition. Tables 5 and 6 instead report comparable sectoral information under monopolistic competition, with respectively Bertrand and Cournot conjectures.

Column 1 of Tables 4-6 shows that the price of all liberalized EU items goes down. The higher is the initial sectoral protection in 1998, the stronger is the fall of the corresponding imports price. The fall of imports prices varies from 3.5% in the least protected textile, apparel and leather to 33.5% in the most protected cement, ceramics and quarrying. As a result, except for agricultural European goods, which remain protected, the demand of all the remaining EU imports expands as it is revealed by Column 2 of the three tables. However, for each good, the import demand expansion is stronger when we move from perfect competition to monopolistic competition and Cournot conjecture, as it is also positively correlated to the extent of national revenue change.

Column 3 of Tables 4-6 indicates that the representative consumer switches expenditure away from the ROW imports of only four goods under perfect competition, whereas the substitution of EU imports for ROW imports occurs for six out of eleven goods under monopolistic competition, explaining why diversion of imports from the ROW happens only under the latter market structure.

The FTA disturbs in addition the initial equilibrium of both local and export markets and the mechanisms by which the final equilibrium is achieved on each market are deeply complicated as several effects exert competing and opposite influences.

When the domestic and/or export sales rise, the level of output expands. This is the actual experience of textile, apparel and leather and mechanical and electrical machineries sectors which production increases respectively by 91% and 67.5% under perfect competition. These are the most booming sectors, with the most important production costs reduction. As it can be seen from Column 7 of table 4, marginal cost reduces in these sectors by 5.1% and 6%,

respectively. These leading sectors are followed by three others, i.e. electricity, construction and other services, which register small output increases equal to 0.6%, 2.5% and 0.4%, respectively. Resources in the economy are then reallocated from the ten contracting sectors towards the five expanding ones. Production losses vary from low 1.4% in non-tradable water to 29.9% in cement, ceramics and quarrying.

When we turn to the examination of the sectoral output effects of the FTA under monopolistic competition displayed in Tables 5 and 6, we see that the Bertrand assumption leads to results closely similar to the Cournot assumption in qualitative terms. Yet, compared to perfect competition, the difference with monopolistic competition is both qualitative and quantitative. First, as Column 5 reveals, the number of expanding sectors under monopolistic competition is greater. Chemicals now add to the five growing sectors under perfect competition, with output increasing by 10.2% and 11.4%, respectively, with Bertrand and Cournot assumptions. Second, except for textiles, apparel and leather, the magnitude of output expansion is always higher under monopolistic competition, ranging from a low of 2.8% (3.1%) in construction to a high of 140% (158%) in mechanical and electrical machineries with Bertrand (Cournot) firms' rivalry.

As the representative monopolistic firm in manufacturing maximizes profits by setting price equal to a markup over marginal cost, for a given markup, any identical decrease (increase) of marginal cost under monopolistic competition is expected to lead to a higher fall (rise) of firm's prices in absolute terms, compared to perfect competition. The fall (rise) in price is more substantial when the markup ratio and equally the monopoly power go down (up) and the firm's perceived demand becomes elastic (inelastic); even in relative terms. In our model, this is only possible on the local market, as the perceived export demands and the domestic firms' monopoly power on the world markets are assumed fixed.

Increased competition allowed by imports penetration, which reduces the share of domestic sales in internal demand, and the entry of new competitors render the domestic demand faced by firms more elastic, as it is illustrated by the expressions (A1.13) and (A1.14) of the perceived elasticity of domestic demand. For an identical increase of the number of firms and decrease of the domestic market share, the crumbling of firm's market power under the Cournot assumption is more substantial.

Table 4
Sectoral Results of the FTA Under Perfect Competition and CRTS
(Percentage Change)

	PM_{EU}	M_{EU}	M_{ROW}	EX	XS	MC	DS	PD	PQ
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. AGR	—	-3.254	-3.254	-15.622	-8.670	2.674	-8.405	2.774	2.367
2. FOO	-23.686	159.637	51.210	-19.862	-19.820	0.018	-19.813	0.020	-3.710
3. CCQ	-33.534	300.873	77.097	-28.125	-29.954	-0.855	-30.150	-0.948	-5.814
4. MEM	-14.660	29.492	-5.691	101.896	67.516	-6.033	33.739	-12.828	-11.439
5. CHM	-15.916	35.038	-4.526	-3.281	-12.317	-3.217	-18.403	-5.510	-9.176
6. TEX	-3.472	48.477	38.344	99.891	91.053	-1.496	70.927	-5.084	-3.921
7. MIS	-20.845	81.151	13.502	-15.698	-22.368	-2.710	-23.361	-3.127	-8.626
8. MNG	-10.861	19.393	-5.133	-15.994	-11.973	1.571	-9.636	2.462	-2.021
9. ELE	—	—	—	—	0.569	1.364	0.569	1.364	1.364
10. WAT	—	—	—	—	-1.383	2.382	-1.383	2.382	2.382
11. CON	—	—	—	—	2.489	-2.666	2.489	-2.666	-2.666
12. TRA	—	7.595	7.595	-8.111	-1.956	2.185	1.014	3.206	2.768
13. HAR	—	8.455	8.455	-30.313	-26.389	1.843	-9.132	9.249	5.598
14. SER	—	6.517	6.517	-7.364	0.407	2.721	0.731	2.832	2.707
15. PUB	—	—	—	—	-19.442	0.835	-19.442	0.835	0.835

Notes: PM_{EU} : the unit price of imports from EU; M_{EU} : imports from EU; M_{ROW} : imports from ROW; EX : composite exports; XS : industry level output; MC: marginal cost; PD: the unit price of the domestic good; PQ : the composite consumption good price. See Table 1 for key abbreviations.
Source: Author's calculations.

Table 5
Sectoral Results of the *FTA* Under Bertrand Conjecture
(Percentage Change)

	PM_{EU}	M_{EU}	M_{ROW}	EX	XS	DS	MC	N	Ψ^d	PD	PWE	XS/N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. AGR	—	-3.839	-3.839	-18.927	-10.505	-10.184	3.349	—	—	3.472	—	—
2. FOO	-23.686	293.176	-22.335	-4.437	-22.120	-25.160	0.479	-24.957	-0.575	0.619	0.479	3.780
3. CCQ	-33.534	752.702	-40.061	3.385	-34.433	-38.770	-0.350	-38.066	-0.115	-0.327	-0.350	5.867
4. MEM	-14.660	47.993	-40.045	224.963	140.221	58.827	-15.495	87.224	1.171	-15.711	-15.495	28.307
5. CHM	-15.916	74.760	-32.644	44.930	10.255	-15.061	-3.831	-7.557	1.279	-4.129	-3.831	19.268
6. TEX	-3.472	32.070	1.319	90.218	84.240	70.470	-6.544	65.633	1.066	-6.702	-6.544	11.234
7. MIS	-20.845	135.013	-35.027	31.560	-15.906	-23.637	-2.846	-24.625	0.205	-2.894	-2.846	11.568
8. MNG	-10.861	28.876	2.402	-7.489	-3.814	-1.675	1.307	—	—	2.052	—	—
9. ELE	—	—	—	—	6.960	6.960	0.910	—	—	0.910	—	—
10. WAT	—	—	—	—	-0.472	-0.472	2.086	—	—	2.086	—	—
11. CON	—	—	—	—	2.794	2.794	-6.544	—	—	-3.382	—	—
12. TRA	—	8.770	8.770	-5.630	0.029	2.763	-2.846	—	—	2.881	—	—
13. HAR	—	10.735	10.735	-40.359	-35.315	-13.545	1.307	—	—	13.174	—	—
14. SER	—	10.181	10.181	-4.889	3.535	3.886	0.910	—	—	2.985	—	—
15. PUB	—	—	—	—	-21.883	-21.883	2.086	—	—	-0.456	—	—

Notes : PM_{EU} : the unit price of imports from EU; M_{EU} : imports from EU; M_{ROW} : imports from ROW; EX : composite exports; PWE : the world price of exports; XS : industry level output; LD : variable labor demand; KD : variable capital demand; N: number of domestic firms (varieties); XS/N: output per firm; MC: marginal cost; Ψ^d : Bertrand perceived elasticity of demand change; PD: the unit price of the domestic good. See Table 1 for key abbreviations.
Source: Author's calculations.

Table 6
Sectoral Results of the FTA Under Cournot Conjecture
(Percentage Change)

	PM_{EU}	M_{EU}	M_{ROW}	EX	XS	DS	MC	N	Ψ^d	PD	PWE	XS/N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1. AGR	—	-3.712	-3.712	-19.245	-10.584	-10.255	3.454	—	—	3.581	—	—
2. FOO	-23.686	293.413	-22.288	-4.287	-22.048	-25.131	0.462	-25.046	-0.626	0.623	0.462	4.000
3. CCQ	-33.534	756.573	-39.788	3.643	-34.054	-38.407	-0.376	-37.894	-0.135	-0.348	-0.376	6.183
4. MEM	-14.660	49.106	-39.595	249.086	158.155	70.592	-16.355	97.922	1.611	-16.652	-16.355	30.432
5. CHM	-15.916	75.414	-32.392	46.186	11.451	-14.043	-3.918	-7.154	1.481	-4.272	-3.918	20.038
6. TEX	-3.472	30.556	0.157	83.574	74.244	65.246	-6.194	59.902	1.737	-6.458	-6.194	11.345
7. MIS	-20.845	134.752	-35.099	32.615	-16.650	-23.337	-2.928	-24.547	0.230	-2.983	-2.928	12.032
8. MNG	-10.861	30.646	3.809	-6.631	-3.698	-0.500	1.365	—	—	2.142	—	—
9. ELE	—	—	—	—	6.693	8.019	0.955	—	—	0.955	—	—
10. WAT	—	—	—	—	-3.001	-0.353	2.237	—	—	2.237	—	—
11. CON	—	—	—	—	3.115	3.115	-3.543	—	—	-3.543	—	—
12. TRA	—	9.164	9.164	-6.036	-0.071	2.809	2.073	—	—	3.044	—	—
13. HAR	—	11.149	11.149	-41.264	-36.104	-13.880	2.846	—	—	13.606	—	—
14. SER	—	10.809	10.809	-4.906	3.868	4.233	2.985	—	—	3.106	—	—
15. PUB	—	—	—	—	-21.756	-21.756	-0.323	—	—	-0.323	—	—

Notes: PM_{EU} : the unit price of imports from EU; M_{EU} : imports from EU; M_{ROW} : imports from ROW; EX : composite exports; PWE : the world price of exports; XS: industry level output; LD: variable labor demand; KD: variable capital demand; N: number of domestic firms (varieties); XS/N: output per firm; MC: marginal cost; Ψ^d: Cournot perceived elasticity of demand change; PD: the unit price of the domestic good. See Table 1 for key abbreviations.
Source: Author's calculations.

When the marginal cost diminishes and the perceived domestic demand becomes more elastic, the domestic firms perceive themselves as having much less control over their prices, which reduce, and hence increase production, permitting the realization of scale economies.

All these processes are experienced in four out of six non competitive sectors: mechanical and electrical machineries, chemicals, textiles apparel and leather and miscellaneous manufacture. In the Bertrand variant of the model, the marginal cost in these sectors reduces from 2.8% to 15.4% (Column 12) and the increase of the perceived elasticity of domestic demand ranges from 0.2% to 1.3% (Column13). The smallest change is observed in miscellaneous manufacture, whereas the highest variation is registered in mechanical and electrical machineries. These two effects combine to reduce the domestic price from 2.9% to 15.7% (Column 14) and the export price from 2.8% to 15.5% (Column 7), contributing to the expansion of the output per firm from 11.2% in textile apparel and leather to 28.3% in mechanical and electrical machineries (Column 9) and thereby the exploitation of scale economies.

As to the remaining food processing and cement, ceramics and quarrying non-competitive sectors, they also experience relatively smaller scale efficiency gains measured by the expansion of the firm average output, increasing respectively by 3.7% and 5.9%. In cement, ceramics and quarrying sector, despite the perceived elasticity of domestic demand becomes more inelastic, reinforcing the market power of local firms, the marginal cost reduction by 0.3% is enough to reduce the domestic and export price by the same rate as marginal cost. A quite different picture appears, nevertheless, in food processing, which is deeply dependent on agriculture. Indeed, marginal cost increases as agricultural products become expensive and the domestic perceived demand becomes less elastic, leading to an increase of both domestic and export price. The average output per firm expands, however, in this sector following the intra-industry rationalization, since the number of firms in this sector decreases by 25%.

The Cournot behavior makes no important differences for the effects of the FTA on sectoral production. The policy works in the same direction as in the Bertrand case, but since the latter is more competitive, each firm's actions have less impact on prices. Comparing Column 10 of Tables 5 and 6 corroborates the fact that the FTA leads to greater domestic price reduction in five out of six monopolistic competitive sectors under the Cournot assumption. The greater magnitude of price reductions means that firm's scale of production expands more than in the Bertrand case, leading to larger scale efficiency and welfare gains.

5. Conclusion

The aim of this paper is to quantify the potential effects of the FTA between Tunisia and the EU. The focus of the paper is on scale economies and horizontal product differentiation. Reaping scale economies provides an additional source of potential gain from trade liberalization, which is thought to be important in the Tunisian case because of the small size of its national market.

Three models were built. The first one is a standard small open economy CGE model with perfect competition and CRTS. It represents a reference framework to compare with two others models with IRTS, monopolistic competition and product differentiation at the firm level. The latter differ by the assumption about the conjecture of firm about its rivals' reactions: Bertrand or Cournot.

The computational results from the model with perfect competition indicate that strong inter-industry specialization occurs, with output declining in ten of the fifteen sectors and exports declining in nine of the eleven tradable sectors. The FTA is especially favorable to mechanical and electrical machineries and textile, apparel and leather and to a less extent to electricity, water and other services. These are the five sectors experiencing output expansion. Intersectoral specialization is responsible in the competitive context for an increase in Tunisian welfare by 3.7% of 1998 GDP, as captured by the equivalent variation.

With IRTS, monopolistic competition and horizontal product differentiation, the inter-sectoral specialization gains are intensified by scale efficiency and varieties gains. Inter-industry specialization produces the contraction of nine of the fifteen sectors, as chemicals output also expands. Scale efficiency gains result essentially from pro-competitive effects, reducing firms' market power, and lowered marginal cost, resulting from cheaper imports. These two effects combine to translate into a drop of producers prices and increased production.

Except for food processing and cement, ceramics and quarrying, scale efficiency gains occur in the remaining four non-competitive sectors, despite the entry of new firms. Indeed, the industry output expansion is greater than the increment in number of firms. Furthermore, the varieties gains in the latter sectors overcompensate the varieties losses in the rationalized sectors, leading to an overall increase of the number of varieties in the economy.

Tunisia thus would significantly benefit from capturing scale economies and increased product variety that the FTA should make possible. Further, the influx of tariff-free imports will improve the competitive environment for firms selling domestically, with the result that price-cost margins reduce following the rise in the elasticity of demand perceived by producers. Increasing firm output, thereby reducing average total cost, is a key source of welfare gain in this imperfectly competitive context. The Tunisian welfare improves by 4.5% in the Bertrand case and 4.7% in the Cournot case.

References

BEN JELILI, R. (2001), "Markup Pricing in Tunisian Manufacturing Industries", paper presented at the ERF 8th Annual Conference, Cairo, Egypt.

BOUGHANMI, H. (1997), "Impact de l'Accord de la Zone de Libre Echange Entre la Tunisie et l'Union Européenne : Evaluation en Equilibre Général Calculable", in M. Boudhiaf (ed.), *Intégration Economique Internationale : Actes du Colloque de Tunis, Relations Economiques entre Pays de l'U.M.A et U.E.*. Tunis: FSEGT.

BROWN, D. K. and STERN, R. M. (1989), "US-Canada Bilateral Tariff Elimination: The Role of Product Differentiation and Market Structure", in Robert C. Feenstra (ed.), *Exchange Rate and Trade Policies for International Competitiveness*, Chicago: University of Chicago Press.

BROWN, D. K., DEARDORFF, A.V. and STERN, R. M. (1997), "Some Economic Effects of the Free Trade Agreement Between Tunisia and the European Union", in A. Galal and B. Hoekman (eds.), *Regional Partners in Global Markets: Limits and Possibilities of the Euro-Med Agreements*, London: Centre for Economic Policy Research.

CHATTI, R. (1999), "General Equilibrium Assessment of Trade Liberalization Effects under Cournot Oligopoly Market Structures: The Case of Tunisia", paper presented at the Workshop: Preparing for the WTO 2000 Negotiations: Mediterranean Interests and Perspectives, Cairo, Egypt, July 14-15.

———— (2003), "A CGE Assessment of the FTA between Tunisia and the EU under Oligopolistic Market Structures, *Review of Middle East Economics and Finance*, 1(2): 99-127.

CHEMINGUI, M. and DESSUS, S. (1999), "La Libéralisation de l'Agriculture Tunisienne et l'Union Européenne: Une Vue Prospective", Technical Paper No. 144, Paris: OECD Development Centre.

COCKBURN, J., DECALUWÉ, B. and DOSTIE, B. (1998), "Les Leçons du Mariage entre les Modèles d'Equilibre Général Calculable et la Nouvelle Théorie du Commerce International: Application à la Tunisie", *L'Actualité Economique, Revue d'Analyse Economique*, 74(3) : 381-410.

DECALUWÉ, B. and SOUISSI, M. (1996), "L'Accord de Libre Echange entre la Tunisie et l'Union Européenne: le cas de l'Agriculture", Ministère (Tunisien) de la Coopération Internationale et de l'investissement étranger, unpublished report.

DESSUS, S. and SUWA-EISENMANN, A. (2000), *Regional Integration and Internal Reforms in the Mediterranean Area*, OECD, Paris.

DEVARAJAN, S. and RODRIK, D. (1991), "Pro-competitive Effects of Trade Reform: Results from a CGE Model of Cameroon", *European Economic Review*, 35:1157-84.

DEVARAJAN, S. (1997), "Direct and Indirect Fiscal Impact of the EURO-MED Agreements", paper presented at the conference: "Facing the Euro-Med Challenge : The Fiscal Dimension" Marakesh, Morocco, May 14-16.

DIXIT, A. K. and STIGLITZ, J. E. (1977), "Monopolistic Competition and Optimum Product Diversity", *American Economic Review*, 67: 297-308.

FAINI, R., CLAVIJO F. and SENHADJI-SEMLALI, A. (1992), "The Fallacy of Composition Argument: Is it Relevant for LDCs' Manufactures Exports?", *European Economic Review*, 36:865-82.

FLAM, H. and HELPMAN, E. (1987), "Industrial Policy under Monopolistic Competition", *Journal of International Economics*, 22:79-102.

HARRIS, R. G. (1984), "Applied General Equilibrium Analysis of Small Open Economy with Scale Economies and Imperfect Competition", *American Economic Review*, 74:1016-33.

HERTEL, T. W. (1994), "The Pro-competitive Effects of Trade Policy Reform in a Small, Open Economy", *Journal of International Economics*, 36: 391-411.

INS (2002), Les Comptes de la Nation.

JBILI, A. I. and ENDERS, K. (1996), "The Association Agreement between Tunisia and the European Union", *Finance & Development*, 18-20, September.

KONAN, D. E. and MASKUS, K. E. (2002) "Quantifying the Impact of Services Liberalization in a Developing Country", Working Paper, University of Colorado at Boulder.

KRESS, D. H. (1994), *Trade Liberalization and Employment in Tunisia: A General Equilibrium Analysis with Increasing Returns to Scale and Imperfect Competition*. Ph.D. Dissertation, University of North-Carolina, Chaptel Hill.

LAHOUEL, M. H. (1999), "Competition Laws in MENA: An Assessment of the Status Quo and the Relevance of a WTO Agreement", paper presented at the Workshop, Preparing for the WTO 2000 Negotiations: Mediterranean Interests and Perspectives, Cairo, Egypt, July 14-15.

de MELO, J. and TARR, D. (1992), *A General Equilibrium Analysis of US Foreign Trade Policy*, Cambridge: The MIT Press.

MERCENIER, J. (1995), "Can "1992" Reduce Unemployment in Europe? On Welfare and Employment Effects of Europe's Move to a Single Market", *Journal of Policy Modeling*, 17: 1-37.

RUTHERFORD, T. F., RUTSTRÖM E. E. and TARR, D. (1995), "The Free Trade Agreement between Tunisia and the European Union", Tunisian Ministry of International Cooperation and Foreign Investment, unpublished report.

THE WORLD BANK (1995), *Republic of Tunisia towards the 21st Century*, Country Economic Memorandum, Volume I.

Appendix A

Model equations, variables and parameters

A1. List of equations

There are $i,j = 1,s$ sectors (and goods), of which $p = 1,c$ are competitive and $n = c+1,s$ are non competitive. We also distinguish k trading partners denoted r, with $r = 1,k$.

Technology of Production

Input-output technology	$X_i = \frac{CI_{ij}}{a_{ij}}$	(A1.1)
Variable labor demand	$LD_i = AX_i^{\varepsilon_i - 1}\left(\frac{\beta_i VC_i}{W}\right)^{\varepsilon_i} X_i$	(A1.2)
Variable capital demand	$KD_i = AX_i^{\varepsilon_i - 1}\left(\frac{(1-\beta_i)VC_i}{R}\right)^{\varepsilon_i} X_i$	(A1.3)
Unit variable cost of primary factors	$VC_i = \frac{1}{AX_i}\left[\beta_i^{\varepsilon_i} W^{1-\varepsilon_i} + (1-\beta_i)^{\varepsilon_i} R^{1-\varepsilon_i}\right]^{\frac{1}{1-\varepsilon_i}}$	(A1.4)
Total cost in competitive sectors	$TC_p(X_p) = MC_p \times X_p$	(A1.5)
Total cost in non-competitive sectors	$TC_n(X_n) = FC_n + MC_n \times X_n$	(A1.6)
Fixed cost	$FC_n = W \times ND_n \times \overline{lf}_n + R \times ND_n \times \overline{kf}_n$	(A1.7)
Marginal Cost	$MC_i = VC_i + \sum_j PQ_j a_{ij}$	(A1.8)
Total output in non-competitive sectors	$X_n = DS_n + \sum_k EXR_{nk}$	(A1.9)

Firms' behavior

Marginal Cost pricing	$PX_p = MC_p$	(A1.10)
Domestic price-cost margin	$PD_n = MC_n \frac{\psi_n^d}{\psi_n^d - 1}$	(A1.11)
Export price-cost margin	$PER_{nk} = MC_n \frac{\psi_{nk}^e}{\psi_{nk}^e - 1}$	(A1.12)
Bertrand perceived elasticity of demand	$\psi_n^d(B) = \eta_n - (\eta_n - \xi_n)\frac{PD_n \times DD_n}{PQ_n \times Q_n \times ND_n}$	(A1.13)

Cournot perceived elasticity of demand	$\frac{1}{\psi_n^d(C)} = \frac{1}{\eta_n} - \left(\frac{1}{\eta_n} - \frac{1}{\xi_n}\right)\frac{PD_n \times DD_n}{PQ_n \times Q_n \times ND_n}$	(A1.14)
	Trade block	
Domestic sales of competitive goods	$DS_p = BX_p^{-(1+\kappa_p)}\left(\frac{\gamma_p PD_p}{PX_p}\right)^{\kappa_p} X_p$	(A1.15)
Composite export sales of competitive goods	$EX_p = BX_p^{-(1+\kappa_p)}\left(\frac{(1-\gamma_p)PE_p}{PX_p}\right)^{\kappa_p} X_p$	(A1.16)
Composite production price in competitive sectors	$PX_p = \frac{1}{BX_p}\left[\gamma^{-\kappa_p} PD_p^{1+\kappa_p} + (1-\gamma_p)^{-\kappa_p} PE_p^{1+\kappa_p}\right]^{\frac{1}{1+\kappa_p}}$	(A1.17)
Export sales of competitive sectors by country of destination	$EXR_{pk} = BE_p^{-1(1+\rho_p)}\left(\frac{\mu_{pk} PER_{pk}}{PE_p}\right)^{\rho_p} EX_p$	(A1.18)
Competitive sectors composite price of exports	$PE_p = \frac{1}{BE_p}\left[\sum_k \mu_p^{-\rho_p} PER_{pk}^{1+\rho_p}\right]^{\frac{1}{1+\rho_p}}$	(A1.19)
Trading partners' export demand of non-competitive goods	$EX_{nk} = A_n\left(\frac{PWROW_n}{PWE_{nk}}\right)^{\psi_{nk}^e}$	(A1.20)
World price of exports	$PWE_{ik} = \frac{PER_{ik}}{ER}$	(A1.21)
Non-competitive sectors varieties exports	$exf_{nk} = \frac{EXR_{nk}}{ND_n}$	(A1.22)
Demand of domestically and competitive produced goods	$DD_p = BM^{\sigma_p - 1}\left(\frac{\delta_p PQ_p}{(1+tx_p)PD_p}\right)^{\sigma_p} Q_p$	(A1.23)
Composite demand of imports competing with competitive goods	$M_p = BM^{\sigma_p - 1}\left(\frac{(1-\delta_p)PQ_p}{PM_p}\right)^{\sigma_p} Q_p$	(A1.24)
Composite competitive firms consumption goods price	$PQ_p = \frac{1}{BM_p}\left[\delta_p^{\sigma_p} PD_p^{1-\sigma_p} + (1-\delta_p)^{\sigma_p} PM_p^{1-\sigma_p}\right]^{\frac{1}{1-\sigma_p}}$	(A1.25)

Demand of imports, competing with competitive firms goods, by country of origin	$MR_{pk} = BR_p^{\theta_p - 1} M_p \left(\frac{(1-\alpha_{pk}) PM_p}{PMR_{pk}} \right)^{\theta_p}$	(A1.26)
Composite price of imports	$PM_p = \frac{1}{BR_p} \left[\sum_k \alpha_{pk}^{\theta_p} PMR_{pk}^{1-\theta_p} \right]^{\frac{1}{1-\theta_p}}$	(A1.27)
Local demand of non-competitive firms' varieties	$df_n = \left(\frac{PQ_n}{(1+tx_n) PD_n} \right)^{\eta_n} Q_n$	(A1.28)
Imported varieties competing with local non-competitive firms' varieties	$mf_{nk} = \left(\frac{PQ_n}{PMR_{nk}} \right)^{\eta_n} Q_n$	(A1.29)
Composite consumption price of local and imported varieties	$PQ_n = \left[ND_n PD_n^{1-\eta_n} + \sum_k NM_{nk} PMR_{nk}^{1-\eta_n} \right]^{\frac{1}{1-\eta_n}}$	(A1.30)
Aggregate demand of local varieties	$DD_n = ND_n \times df_n$	(A1.31)
Aggregate demand of imported varieties	$MR_{nk} = NM_{nk} \times mf_{nk}$	(A1.32)
Domestic currency price of imports from trading partner's *k*	$PMR_{ik} = \overline{PWM}_{ik} (1+tm_{ik})(1+tx_i) ER$	(A1.33)
Closure rule	$\frac{ND_n}{NM_{nk}} = \overline{N}_{nk}$	(A1.34)

Demands

Representative household's revenue	$YM = W \times \overline{LS} + R \times \overline{KS}$	(A1.35)
Representative household's saving	$SH = (1-shrc)(1-t_{YM}) YM$	(A1.36)
Representative household's expenditures	$CH = shrc(1-t_{YM}) YM$	(A1.37)
Representative household's demand of composite consumption good *i*	$C_i = \Lambda_i \frac{CH}{PQ_i}$	(A1.38)
Government saving	$SG = (1-shrcg) YG$	(A1.39)

Government demand of composite good *i*	$CGG_i = \chi_i \dfrac{shrcg\ YG}{PQ_i}$	(A1.40)
Government revenue	$YG = \sum_i \sum_k \left(tm_{ik} + tx_i + tm_{ik} tx_i\right) \overline{PWM}_{ik} MR_{ik} ER + \sum_i tx_i PD_i DS_i + t_{YM} YM$	(A1.41)
Investment demand by sector of origin	$INV_i = \Omega_i \dfrac{S}{PQ_i}$	(A1.42)
Total saving	$S = SH + SG + ER \times \overline{B}$	(A1.43)
Total composite consumption demand	$Q_i = C_i + INV_i + CGG_i + \sum_j CI_{ij}$	(A1.44)

General equilibrium conditions

Labor market clearing condition	$\overline{LS} = \sum_i LD_i + \sum_n \overline{lf}_n ND_n$	(A1.45)
Capital market clearing condition	$\overline{KS} = \sum_i KD_i + \sum_n \overline{kf}_n ND_n$	(A1.46)
Domestic good market clearing condition	$DD_i = DS_i$	(A1.47)
Trade balance constraint	$\overline{B} = \sum_i \sum_k \overline{PWM}_{ik} MR_{ik} - \sum_i \sum_k PWE_{ik} EXR_{ik}$	(A1.48)

A.2. List of endogenous variables

X_i	Gross production of sector *i*
PX_p	Composite production price (in competitive sectors)
LD_i , KD_i	Variable labor and capital used by sector *i*
VC_i	Unit cost of primary factors
W , R	Rent of capital and wage rates
MC_i , FC_n , TC_i	Marginal, fixed and total costs
ND_n , NM_{nk}	Domestic and imported varieties
DD_i , DS_i	Domestic demand and supply of good *i*
EXR_{ik} , MR_{ik}	Levels of export to and import from region *k* of good *i*
PER_{ik} , PMR_{ik}	Unit prices of export to and import from region *k* of good *i*
M_p , EX_p	Levels of composite import and export
exf_{nk} , df_n , mf_{nk}	Exported, locally sold and imported varieties at the firm level
PD_i , PE_p , PM_p	Prices of locally produced goods, composite exports and imports
Q_i	Composite consumption good *i*

PQ_i	Price of composite consumption good *i*
PWE_n	Endogenous world price of export of good *n*
ψ_n^d	Perceived elasticity of domestic demand
YM , YG	Household and government revenue
SH , SG , S	Household, government and total saving
C_i , INV_i , CGG_i	Households, investors and government demand for the composite consumption good *i*
CH	Household's total expenditures
ER	The exchange rate
CI_{ij}	Intermediate demand for composite consumption good *i* by sector *j*

A.3. List of exogenous variables and parameters

ε_i , κ_p , ρ_p , θ_p , σ_p , η_p	Elasticities of substitution in CES and CET functions
β_i , μ_{pk} , α_{pk} , δ_p , γ_p	Share parameter in CES and CET functions
AX_i , BX_p , BE_p , A_n , BM_p , BR_p	Shift parameters
lf_n , kf_n	Fixed labor and capital by firm
LS , KS	Labor and capital supply
t_{YM} , tx_i , tm_i	Income, consumption and trade taxes
a_{ij}	Input-output coefficients
PWM_{ik} , PWE_{pk} , $PWROW_n$	World prices of import and export
ψ_{nk}^e	Perceived elasticity of export demand
B	Budget deficit
Ω_i , Λ_i , χ_i	Share parameters
$shrcg$, $shrc$	Share parameters

Appendix B

Calibration procedure in monopolistic competition models

It is common, in CGE models with IRTS and imperfect competition, to calibrate the marginal, average and fixed costs using information on estimated elasticities of scale, provided by the literature[9]. Given the lack of information on the ratios of average to marginal cost in the different Tunisian manufacturing industries, the elasticities of scale are rather calibrated[10]. This technique, which relies on Brown and Stern (1989) and Mercenier (1995), has been so far implemented within multi-country CGE models. We here fit it to an almost small country CGE model.

To begin, a composite price PX_n is defined as a weighed average of sale prices in each market, i.e.,

$$PX_n = \left[PD_n \frac{DS_n}{X_n} + \sum_k PER_{nk} \frac{EXR_{nk}}{X_n} \right] \tag{B.1}$$

The value of total supply of goods produced in each non-competitive industry n, which is equal to the sum of sales on domestic and foreign markets k, is written as:

$$\left[PD_n DS_n + \sum_k PER_{nk} EXR_{nk} \right] = PX_n \left[DS_n + \sum_k EXR_{nk} \right] \tag{B.2}$$

Multiplying and dividing simultaneously the right-hand side of (B.2) both by the marginal cost MC_n and unit prices PD_n and PER_{nk} yields:

$$\left[PD_n DS_n + \sum_k PER_{nk} EXR_{nk} \right] = \frac{PX_n}{MC_n} \left[\frac{DS_n PD_n}{\frac{PD_n}{MC_n}} + \sum_k \frac{EXR_{nk} PER_{nk}}{\frac{PER_{nk}}{MC_n}} \right] \tag{B.3}$$

Then, replacing with (A1.11) and (A1.12), (B.3) becomes:

$$\left[PD_n DS_n + \sum_k PER_{nk} EXR_{nk} \right] = \frac{PX_n}{MC_n} \left[DS_n PD_n \frac{\psi_n^d}{\psi_n^d - 1} + \sum_k EXR_{nk} PER_{nk} \frac{\psi_{nk}^e}{\psi_{nk}^e - 1} \right] \tag{B.4}$$

---

[9] Devarajan and Rodrik (1991) and De Melo and Tarr (1992) provide detailed explanation of marginal, average and fixed costs calibration relying on external information on the elasticities of scale and substitution.

[10] Kress (1994) shows the existence of IRTS in the Tunisian manufacturing industries. However, his estimates of the elasticity of scale in the different industries are unreasonably high. In addition, his models suffer from multicollinearity.

Given the zero profit condition in the base year, the composite price PX_n is also equal to the average costs AC_n. If the composite price PX_n is normalized to one and the levels of the perceived elasticities of demand are calculated according to (A1.13) or (A1.14), then the values of domestic and foreign sales, $DS_n PD_n$ and $EXR_{nk} PER_{nk}$, given from the base year data, could also be used to calibrate the marginal cost by applying the following:

$$MC_n = \frac{\left[DS_n PD_n \frac{\psi_n^d}{\psi_n^d - 1} + \sum_k EXR_{nk} PER_{nk} \frac{\psi_{nk}^e}{\psi_{nk}^e - 1} \right]}{\left[PD_n DS_n + \sum_k PER_{nk} EXR_{nk} \right]} \tag{B.5}$$

Once marginal cost is calibrated, the normalization rule $PX_n = AC_n = 1$ allows calibrating the elasticities of scale ES_n, defined by the ratios of average to marginal cost, as follows:

$$ES_n = \frac{1}{MC_n} \tag{B.6}$$

Given ES_n and the values of total costs, provided in the base year data, the fixed costs components as well as the fixed primary factors are calibrated in a conventional way. For this we refer to De Melo and Tarr (1992).

The final step of calibration consists in deriving the number of imported varieties NM_{nk} from each trading partner k. Given the information on the number of existing symmetric domestic firms in each industry in the base year, the calibrated price of each domestic variety PD_n and normalizing the unit price of each imported variety from region k, PMR_{nk} to one, the numbers of imported varieties from each region are calibrated according to equations (A1.28)-(A1.29) and (A1.31)-(A1.32), i.e.,

$$NM_{nk} = ND_n \left(\frac{PMR_{nk}}{(1 + tx_n) PD_n} \right)^{\eta_n} \frac{MR_{nk}}{DD_n} \tag{B.7}$$

Özet

Ölçek ekonomileri, yatay ürün farklılaştırması ve Tunus ile AB arasındaki serbest ticaret anlaşması: Bazı genel denge etkileri

Tunus, Akdeniz'in güneyindeki ülkelerden AB ile 1995 yılında serbest ticaret anlaşması yapmış olan ilk ülkedir. Bu anlaşmanın etkin kaynak tahsisi ve ölçek ekonomilerinden yararlanma yolu ile büyüme ve istihdamı teşvik etmesi beklenmektedir. Makalenin amacı, anlaşmanın ölçek ekonomilerinden doğacak kazanımları ile rekabet ve ürün çeşitlendirme etkilerini genel denge analizi çerçevesinde tahmin etmektir. Simülasyon sonuçları, tekelci rekabet koşulları altında erişilecek refah kazançlarının tam rekabet koşulları altında erişilecek olandan yüksek olduğunu ortaya koymaktadır. Ticaret hadlerindeki olumsuz gelişmelere karşın böyle bir sonuç elde edilebilmesi, ortalama firma büyüklüğünün ve ürün çeşitliliğinin artması dolayısıyladır. Modellerin sektörel düzeydeki bulguları Tunus'un elektriksiz ve elektrikli makinalar, kimya, dokuma-giyim ve deride karşılaştırmalı üsütünlüğe sahip bulunduğunu öngörmektedir.