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Commitment to Reform and the Success of Service Trade Liberalization

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Abstract

In this paper, we analyze how a country's commitment to regulatory reform affects the success of its service trade liberalization. For this purpose, we set up a computational general equilibrium (CGE) model with a single imperfectly competitive service sector that in the benchmark is dominated by a domestic monopolist. Service trade liberalization is modelled as a two-stage game with incomplete information. In stage 1, a single license is allocated to a foreign service provider. In stage 2, the government chooses the market structure between the foreign entrant and domestic incumbent. In such a setting, the effect of service trade liberalization depends on three factors: (i) the license allocation mechanism; (ii) the adopted market structure; and (iii) the government's perceived commitment to reform. We apply our model to a CGE model for Tunisia to estimate the magnitudes of these effects.

JEL classification: F12, F13, F23

Keywords: reform commitment, telecommunications liberalization, regulation, market structure, imperfect competition, CGE.

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1 Introduction

The General Agreement on Trade in Services (GATS) has been heralded as one of the crowning achievements of the Uruguay Round negotiations which led to the development of the World Trade Organization (WTO). The potential for countries to gain from services liberalization appear to be significant, far outweighing gains from further goods trade liberalization. Yet, negotiations that were launched in 2000 have been essentially stalled and no significant progress has been made. At the time of this writing, the Doha Round of WTO negotiations has failed to meet numerous deadlines. Hoekman and Mattoo (2007) point out three key concerns of developing economies in the context of the GATS negotiations. First, they seek to retain flexibility in making commitments to services liberalization. Second, they seek commitments to foreign market access in other sectors (agriculture) to promote their export comparative advantage. Finally, they are requesting 'aid for trade' or technical assistance to enhance their capacity to liberalize services sectors. Many developing countries have weak or inadequate regulatory institutions, and may lack the basic technical expertise needed to implement services liberalization initiatives successfully.

Early estimates of services trade liberalization focused on cross-border transactions by incorporating tariff equivalents of impediments to service trade into standard CGE trade models. Brown, et al. (1996), for example, convert Hoekman (1996)'s frequency indices into an ad-valorem tariff equivalent and use this approach to simulate service trade liberalization in their multi-country Michigan Model of World Production and Trade. Francois and Hoekman's (1999) develop gravity-equation estimates of services border barriers. Hertel (1999) uses these border estimates to simulate service trade liberalization in the multi-country GTAP model. Dee and Hanslow (2001), Brown and Stern (2001) and Jensen et al. (2004) take similar approaches in CGE models with endogenous FDI flows. This literature did not account for the role of strategic behavior and market structure on the success of service trade liberalization (Whalley, 2004). In this class of CGE models, service sectors are assumed to exhibit perfect competition or large-group Dixit-Stiglitz monopolistic competition both before and after service trade liberalization.

In order to achieve any significant increase in coverage or depth of services commitments by WTO members, attention must be given to the regulatory backdrop upon which services liberal-

ization would be implemented. Regulation of services may be desirable to offset market failures, such as imperfect competition, which may arise for network services (telecommunications, postal services) where there are issues of infrastructure and connectivity. Services liberalization promises benefits of enhanced product variety, access, and lower consumer prices. Domestic regulatory standards may be required to limit the market power of foreign firms, assure equitable service access (particularly to rural locations and poor households), or maintain domestic standards for service quality.

In this paper, we model alternative mechanisms for liberalizing services markets in the presence of a domestic monopolist. Closed domestic markets create conditions for a natural monopolist in sectors (such as telecommunications or transportation) as infrastructure costs are barriers to entry. Without competition and facing small markets, the domestic incumbent has limited incentives to invest in risky technological innovation. Thus, technology will lag the international frontier. Upon liberalization, an incumbent monopolist is exposed to competition from a foreign entrant. The government controls market entry by requiring the payment of an a priori license fee, a *licensing effect*. By auctioning the entry license to the highest bidder, the government is able to extract rents from the foreign entrant. The outcome depends on the judgment of the entrant on whether it could strike a cartel arrangement with the incumbent ex ante.

The characteristics of services make foreign direct investment a major channel for entry into liberalized markets, Hoekman and Mattoo (2008). In the case of telecommunications, for example, proximity matters and it is not possible to deliver coverage without a domestic presence. The impacts are two-fold. First, foreign entry injects global competition into the system and this will lower the markup that the incumbent firm will charge. This pro-competitive effect may be enhanced further if firms differentiate their products and offer customers greater variety. Second, a foreign entrant may utilize advanced technologies and may operate at lower average costs owing to its access to large global markets. This efficiency effect drives down consumer prices and expands the quantity of services provided. In addition, the foreign subsidiary hires local labor and capital, and hence factor prices in both sectors may be improved. The general equilibrium analysis of Konan and Maskus (2006) quantified these potential gains for Tunisia and found that broad service liberalization could increase welfare substantially above that available from goods liberal-

ization. Similarly, using a cross-sectional cross-country regression analysis, Mattoo, Rathindran, and Subramanian (2006) find that countries with open financial and telecommunications sectors grew about one percentage point faster than other countries. In a computable general equilibrium model with trade and Dixit-Stiglitz productivity effects, Rutherford, Tarr, and Shepotylo (2008) assess Russia's accession to the WTO. Of the overall gains, FDI liberalization in services represents more than 70 percent of total potential WTO gains.

Yet, signatory developing countries have been relatively slow to liberalize in spite of a successful ratification of the GATS/WTO in 1995. Offsetting potential pro-competitive and efficiency gains are several threats. In large integrated economies, market size might be sufficient to assure multiple competitors before and after liberalization. However, small developing markets may only support a few players. Prior to liberalization, for example, Tunisia hosted one telecom firm, four insurance companies, and fourteen banks. In such cases, what matters is not just liberalization but also changes in the regulation of market entry (Mattoo and Sauv 2003). Free entry of foreign firms is not assured in a post-liberalization environment. Regulatory imperfect competition creates the threat that a foreign entrant to form a cartel with the domestic incumbent (Francois and Wooton 2001); or extract and expropriate monopoly rents (Low and Mattoo 2000, Copeland 2002).

In Konan and Van Assche (2007), we have analyzed the role of market structure in the liberalization of one single service sector. For this purpose, we incorporated a single imperfectly competitive services sector into a standard CGE framework and derived the Lerner markup conditions for multiple market structures: monopoly, oligopoly, cartel and monopolistic competition. This extension allowed us to analyze the role of market structure on the effect of partial service trade liberalization in a single sector. Assume that in the benchmark scenario only one or few domestic service providers operate in a services sector. In the counterfactuals, the services sector is liberalized and one or more licenses are provided to foreign services providers. If regulations can enforce competition between the domestic and foreign providers, then the telecommunications market structure turns into a Cournot oligopoly. If regulations are weak, then the domestic and foreign providers form a cartel. We discuss the welfare effects associated with the adoption of different market structures in such a framework. We introduced our method into a CGE model for Tunisia to investigate the possible welfare impacts of allowing one foreign provider to enter Tunisia's telecommunications sector. Our

results highlight the role that market structure plays in Tunisia's telecommunications liberalization. According to our conservative estimates, the potential welfare implications of telecom liberalization are clearly positive if competition can be guaranteed between the two providers. Tunisia's welfare is estimated to increase up to 0.65 percent if the foreign provider is more efficient and does not shift its profits abroad. In contrast, telecom liberalization can lead to a welfare deterioration of up to 0.25 percent if the two providers collude and the foreign provider shifts its profits abroad. Our results thus call for Tunisia to step up its pro-competitive regulatory reforms while liberalizing its telecom sector.

In this paper, we adapt the Konan and Van Assche (2007) model to analyze the role of reform commitment on the success of service trade liberalization. In the benchmark of our model, we assume that the imperfectly competitive service sector is dominated by a domestic monopolist. Service trade liberalization is then modelled as a two-stage game with incomplete information. In stage 1, the government assigns a telecom license to a single foreign provider. It can adopt two mechanisms to assign the unique telecom license to a foreign service provider. On the one hand, it can auction the telecom license off to the highest bidder. On the other hand, it can freely assign a telecom license to a foreign provider. In stage 2, the foreign provider enters the market. The market structure that the domestic incumbent and foreign entrant adopt depends on the regulatory environment that the government puts into place. If a pro-competitive regulatory environment is in place, the domestic incumbent and foreign entrant strategically compete in quantities. Otherwise, the domestic incumbent and foreign entrant form a cartel. The two-stage game is assumed to be a game with incomplete information. Specifically, the foreign provider does not necessarily know in stage one which market structure the government will implement in stage 2. In such a setting, we will show that the success of service trade liberalization depends on three factors: (i) the license allocation mechanism; (ii) the adopted market structure; and (iii) the government's perceived commitment to reform.

The paper is organized as follows. In Section 2, we use the case of Tunisia's telecom sector to demonstrate the relative lack of commitment that it has shown towards regulatory reforms and service trade liberalization. In Section 3, we then set up a CGE model for Tunisia to analyze the effect of Tunisia's reform commitment on the success of its telecommunications liberalization. In

Section 4, we discuss the results of our analysis. Finally, Section 5 concludes.

2 Commitment to Reform in Tunisia's Telecom Sector

Tunisia represents a good case study to investigate the impact of reform commitment on the success of service trade liberalization. Services comprise a significant portion of the Tunisian economy, but the Tunisian government has been cautious in adopting pro-competitive regulatory reforms in conjunction with service trade liberalization.

Services comprise a significant component of the Tunisian economy. Services accounted for nearly half of all output, Table 1. Services make up one-third of household consumption and eighteen percent of intermediate demand (Institute National de la Statistique 1998). Of the tradable services, tourism plays the most significant role. Tunisia's revealed comparative advantage is most significant in manufacturing, particularly clothing and textile exports. Communications reflected approximately one percent of total output and 1.7 percent of intermediate demand.

[Table 1 about here]

From 1995 to 2005, per capita income in Tunisia grew from US$ 1,651 to 2,407, which is a 31 percent increase. As shown in Table 2, the Tunisia growth experience is typical to other lower middle income countries, where per capita income grew by about 39 percent to $US 1,156. Tunisia per capita income grew faster than the economies of Morocco (26 percent), Egypt (21 percent), Jordan (18 percent), or the Kingdom of Saudi Arabia (9 percent).

[Table 2 about here]

Telecommunications services are becoming and increasingly important component of Tunisia's growing economy. In 1995 Tunisia telecommunications revenues were 1.46 percent of GDP, a share that lagged behind world averages as well as most middle and higher income countries, Table 2. Within a decade, telecom revenue shares grew three-fold to 4.28 by 2005. Tunisia now devotes a higher share of output to telecommunications than most countries, including Japan, Germany, and the US.

Connectivity has also improved in Tunisia and throughout the developing world. In 1995, only 6 out of every 100 people had a fixed telephone line and mobile services were unavailable, Table 3. By 2005, while fixed telephone lines remained unchanged, mobile telephone subscriptions expanded to cover 57 percent of the population. Similar trends are observed in Saudi Arabia, Morocco, Jordan, and to a lesser extent Egypt. With the introduction of mobile technology, telecommunications have matured from an unavailable luxury to a necessity within the developing world.

[Table 3 about here]

Despite the growing importance of telecommunications in Tunisia's economy, its telecommunications market has a long reputation as being closed and heavily regulated. The Office National des Télécommunications, or Tunisie Telecom, is a fully state-owned company with a national monopoly on fixed telephony services and internet infrastructure. Regulation of the industry is the domain of the Ministry of Communications Technology. Before 2002, telecommunication services were limited and highly regulated. Tunisie Telecom had a monopoly on mobile services through its subsidiary Tunicell. In 1999, Tunisia's telecommunications liberalization index was below the average of the worst-performing developing region in the world, the Middle East and North Africa, Varoudakis and Rossotto (2004). The telecommunications sector was underperforming in terms of fixed line penetration and internet services.

The Tunisian government recognized the potential to enhance overall economic performance by upgrading telecommunications. Thus, in 1997 Tunisia was among the first 56 signees of the WTO Agreement of Basic Telecommunications Services. However, Tunisia has refrained from signing on to the GATS Telecommunications Reference Paper, which committed to a schedule of pro-competitive regulatory reforms. In accordance to the Agreement, Tunisia committed to permitting telex and data transmission competition from 1999, mobile telephone and paging, frame relay, and teleconferencing from 2000, and local telephone competition in 2003.[1] However, Tunisia was less inclined to make binding commitments to pro-competitive regulatory reforms. During the GATS Telecommunications negotiations, Tunisia was one of the few signees that refrained from signing

[1]For all services, foreign ownership was capped at 49%, and foreign ownership of Tunisie Telecom was only permitted to 10% beginning in 2002.

on to the Reference Paper, which committed members to a schedule of pro-competitive regulatory reforms.

In January 2001, Tunisia enacted a new Communications Code (Law n. 2001-1), which would regulate the telecommunications sector. The law enabled the opening-up of the market to private companies by introducing a licensing regime for the supply of telecommunications services and networks. In addition, the Code created two regulatory agencies: the National Instance of Telecommunications (NIT) and the National Agency for Frequency (NAF). The NIT is in charge of the regulation of the telecommunications sector and the NAF is in charge of spectrum management. But, once again, the Code falls short of setting up an independent regulatory agency since significant lawful capacities are left to the Ministry of Communications Technologies with regard to licence awarding, dispute settlements and application of sanctions.

In summary, Tunisia's telecom sector is currently dominated by a large domestic player. The Tunisian government is aware of the potential benefits that telecom liberalization may enhold and is taking initial steps to liberalize the market. It is wary of committing to full-fledged liberalization, however, and has been reluctant to embrace significant regulatory reforms.

3 Model

In this section, we set up a CGE model for Tunisia that allows us to analyze the impact of reform commitment on the success of telecommunications liberalization in Tunisia.

Consider a CGE model with $I-1$ perfectly competitive sectors that produce output Y_i and one imperfectly competitive telecom sector Y_z. Sectoral output is used both as an intermediate good by sectors I and as a final good by the representative consumer. We denote intermediate good use by superscript x and final good use by superscript c. In the imperfectly competitive telecom sector Y_z, N providers each produce a single differentiated service z_j. The providers are not necessarily symmetric and can be both domestic and foreign. Users perceive a constant elasticity of substitution between each provider's service, and we thus represent total industry output Y_z as a CES function

of services provided by each provider z_j:

$$Y_z = \left(\sum_{j=1}^{N} z_j^{\epsilon} \right)^{\frac{1}{\epsilon}}. \tag{1}$$

The elasticity of substitution between each variety is $\sigma = \frac{1}{1-\epsilon}$, where $\sigma > 1$.

The telecom sector Y_z is one of a select group of H producer services that positively affect value-added productivity when used as an intermediate good (Markusen et al., 2000; Markusen et al., 2005). Finance, insurance, business services and transportation are generally considered to also belong to this category. To model this, we assume that industry $i \in I$'s composite producer services PS_i is a Leontief function of the share of producer service sector H's output allocated to sector i:

$$PS_i = min\left[\frac{Y_{1,i}^x}{\kappa_{1,i}}, ..., \frac{Y_{H-1,i}^x}{\kappa_{H-1,i}}, \frac{Y_{z,i}^x}{\kappa_{z,i}} \right]. \tag{2}$$

Composite producer services PS_i are an imperfect substitute to value added $K_i^{\alpha_i} L_i^{\beta_i}$ in that industry:

$$V_i = \left[\left(K_i^{\alpha_i} L_i^{\beta_i} \right)^{\gamma} + PS_i^{\gamma} \right]^{\frac{1}{\gamma}}, \tag{3}$$

where the constant elasticity of substitution between value added and producer services is $\rho = \frac{1}{1-\gamma}$. We call function V_i composite value added of industry i. The production function for all sectors except for Y_z is approximated with Leontief technologies using composite intermediate inputs from $i \notin H$ and composite value added V allocated to the industry.

$$Y_i = min\left[\frac{Y_{H+1,i}^x}{\lambda_{H+1,i}}, ..., \frac{Y_{I,i}^x}{\lambda_{I,i}}, \frac{V_i}{\lambda_{v,i}} \right]. \tag{4}$$

Similarly, The Leontief production function for firm j in sector Z takes the following form:

$$z_j = min\left[\frac{Y_{H+1,j}^x}{\lambda_{H+1,j}}, ..., \frac{Y_{I,j}^x}{\lambda_{I,j}}, \frac{V_j}{\lambda_{v,j}} \right]. \tag{5}$$

Finally, preferences of the representative consumer are represented by a Cobb-Douglas utility func-

tion.

$$U(C) = \prod_{i=1}^{I} Y_{i,c}^{\mu_i}. \tag{6}$$

3.1 Market Structure and Telecom Pricing

Firms in the imperfectly competitive telecom sector Y_z do not price discriminate, but sell their services to all sectors in the economy and to the representative agent at the same price. Since each user might have a different demand elasticity for the service, a question arises which markup rule the service provider will choose to maximize profits. In Konan and Van Assche (2007), we illustrate that the general equilibrium Lerner markup condition for a service provider j in that case is a weighted average of the perceived demand elasticities for the different users:

$$p_j^k = \left(1 + \frac{1}{\omega_u \Phi_{j,u}^k + \sum_i \omega_i \Phi_{j,i}^k}\right)(1 + \Delta_j)c^*(w, r), \tag{7}$$

where ω_u and ω_i stand for the share of services Z that are sold to the representative consumer and sector i respectively. $\Phi_{j,u}^k$ and $\Phi_{j,i}^k$ represent provider j's perceived demand elasticity from the representative consumer and from sector i in market structure k, respectively. $c^*(w, r)$ is the world's best-practice marginal cost of production, which depends on wages w and the return to investment r. Δ_j is the percentage inefficiency markup of service provider j above c^*.

To compute the general equilibrium markup condition for each firm j under each market structure k, we will proceed by first deriving the perceived demand elasticity for intermediate inputs $\Phi_{j,i}^k$ and then calculating the perceived demand elasticity for final demand $\Phi_{j,u}^k$. Finally, we will insert all elasticities into equation (7) to derive the general equilibrium Lerner markup condition.

3.1.1 Demand Elasticity for Intermediate Inputs

To determine $\Phi_{j,i}^k$, we first need to derive the price p_j^k that service provider j charges under each market structure k. To simplify notation, we will drop superscript k throughout the derivation of the general equilibrium Lerner markup condition. Let P_y denote the domestic price of final good output Y_i in sector i and p_j denote the price received by service provider j in sector Z. Note that P_y and p_j do not differ from sector to sector since we assume that there is no price discrimination.

Since final Y_i production is assumed perfectly competitive in our model, p_j is the value of the marginal product of z_j in producing Y_i. The price of service p_j can thus be derived from the chain rule:

$$p_j = P_y \frac{\partial Y_i}{\partial Y^x_{z,i}} \frac{\partial Y^x_{z,i}}{\partial z_{j,i}}. \tag{8}$$

Using the price function, we can then derive the inverse of the perceived elasticity of demand from sector i for provider j under each market structure k:

$$(8) \qquad \frac{1}{\Phi_{j,i}} = \begin{cases} s_{v,i}(1-\gamma) & \text{if monopoly} \\ s_{v,i}(1-\gamma) & \text{if cartel} \\ 1-\epsilon-s_j\left((1-\epsilon-s_{v,i}\left(1-\gamma\right)\right) & \text{if oligopoly} \\ 1-\epsilon & \text{if monopolistic competition} \end{cases}$$

where $s_{v,i} = \frac{p_{v,i}^{1-\rho}}{p_{v,i}^{1-\rho}+p_{ps,i}^{1-\rho}}$ and the market share of provider j equals $s_j = \frac{p_j^{1-\sigma}}{\sum_{j=1}^{N} p_j^{1-\sigma}}$. A comparison across market structures identifies that service providers in a cartel each act as if they are a monopolist with a share $s_j = 1$. In addition, the inverse of the perceived demand elasticity under a Cournot oligopoly reduces to the monopoly scenario when $s_j = 1$ and to the monopolistic competition scenario when $s_j = 0$. Taking into account these characteristics, we can generalize the inverse of the perceived demand elasticity to:

$$\frac{1}{\Phi^k_{j,i}} = 1-\epsilon-s^k_j\left(1-\epsilon-s_{v,i}\left(1-\gamma\right)\right), \tag{9}$$

where s^k_j is perceived to be equal to 1 under a cartel, and equals provider j's actual market share otherwise.

3.1.2 Demand Elasticity for Final Demand

We next derive provider j's perceived demand elasticity from the final consumer. Since preferences of the representative consumer are represented by a Cobb-Douglas utility function, the industry demand elasticity equals to one. As a result, the perceived demand elasticity for each provider equals to 1 under a monopoly and a cartel. It is straightforward to demonstrate that under an

oligopoly, the perceived final demand elasticity for provider j is:

$$\frac{1}{\Phi^k_{j,u}} = 1 - \epsilon(1 - s^k_j), \tag{10}$$

where s^k_j is perceived to be equal to one under a cartel, and equals provider j's actual market share otherwise.[2]

3.1.3 General Equilibrium Telecom Price

We can now insert equations (9) and (10) into equation (7) to find the general equilibrium Lerner markup condition for each provider j under each market structure k:

$$p^k_j = \frac{\Sigma^k_j}{\Sigma^k_j - 1}(1 + \Delta_j)c^*(w, r), \tag{11}$$

where

$$\Sigma^k_j = \left(\frac{\omega_u}{1 - \epsilon(1 - s^k_j)} + \sum_i \frac{\omega_{y,i}}{(1 - s^k_j)(1 - \epsilon) + s_{v,i}s^k_j(1 - \gamma)} \right). \tag{12}$$

From equations (11) and (12), the general equilibrium markup above marginal cost $\frac{\Sigma^k_j}{\Sigma^k_j - 1}$ reduces to $\frac{\sigma}{\sigma - 1}$ if $s^k_j = 0$. The markup rises in s^k_j as long as the realistic condition $s_{v,i}(1 - \gamma) + \epsilon \geq 1$ holds.

Similar to Konan and Maskus (2006), equation (11) implies that the total price-cost wedge can be decomposed into two types of wedges. On the one hand, barriers to FDI and excessive regulation create a *cartel wedge* $\frac{\Sigma^k_j}{\Sigma^k_j - 1}$ by limiting both domestic and foreign participants in certain service sectors and thus hampering competition. On the other hand, the exclusion of low-cost foreign suppliers from the market and the additional costs of bureaucratic procedures create a *cost inefficiency wedge* $1 + \Delta_j$.

The price of the composite service P_z then becomes:

$$P^k_z = \left(\sum_j {p^k_j}^{1-\sigma} \right)^{\frac{1}{1-\sigma}} = \left(\sum_j \left(\frac{\Sigma^k_j}{\Sigma^k_j - 1}(1 + \Delta_j)c^*(w, r) \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \tag{13}$$

[2] See Head and Mayer (1999) for proof.

3.2 CGE Model for Tunisia

We introduce the theoretical model of section 3.1 into a CGE framework for Tunisia by taking on a number of behavioral assumptions concerning Tunisia's telecommunication sector. First, we assume that in the benchmark the telecom sector is governed by a domestic monopoly. Second, we use Konan and Maskus' (2006) estimate that the price-cost wedge in Tunisia's telecom sector is 30%.

As is explained above, the price-cost wedge can be decomposed into two types of wedges: a *cartel wedge* and a *cost inefficiency wedge*. Since we do not have the empirical information to determine the relative size of these two wedges, we assume that in the benchmark both wedges are of equal weight. In other words, the domestic monopolist in the benchmark faces a marginal cost that is 15% above the world's best practice (cost inefficiency wedge) and a cartel wedge of 15%.

The nesting structure of the Tunisia CGE model builds on the theoretical framework introduced in Section 2. A figure of the full nesting structure and the list of the main equations is provided in Appendix A. We assume that all sectors other than the telecom sector is characterized by constant returns to scale and perfect competition, implying that prices equal marginal cost of output. In all sectors, production functions are approximated with Leontief technologies using composite intermediate inputs and composite value added. Composite value added is approximated with a CET technology using producer services and real value added. A Cobb-Douglas production function describes the substitutability between labor and capital inputs in producing value added. Intermediate inputs and final goods are differentiated by country of origin according to the Armington assumption, so that export and import prices differ across regions. The three trading regions are the European Union (EU), the Arab League Countries (MENA) and the rest of the world (ROW).

In each sector, demand for domestically produced and imported goods is represented by a CES function, and intermediate imports are also differentiated across regional sources of supply in a CES structure. Similarly, industries supply regionally differentiated goods to both domestic and foreign markets (exports). Production follows a nested two-stage constant elasticity of transformation (CET) function. Total output is first calculated as the sum of domestic supply and total exports, with the latter then being allocated across the same destination regions according to a sub-CET function. Capital and labor are assumed to be freely mobile across sectors, whereas the stock of

factor endowments are endogenous, implying that our simulations pertain to long-run outcomes of telecom liberalization.

A representative consumer maximizes a nested CES utility function with a corresponding multi-staged budget constraint. In the first stage, the consumer decides how much to spend on goods from each sector, given the budget constraint. Income elasticities across sectors are set at unity as given by a Cobb-Douglas (CD) utility nest. In the second nest, the consumer determines domestic and aggregate import expenditures in each sector according to a CES function. Then given a budget for imports, the consumer selects purchases of imports from each region. These latter functions also characterize the split between government consumption and investment spending on domestic and imported goods and services. The representative consumer receives income from primary factors (labor and capital), net transfers from the government, the current-account deficit, and any net economic rents from the operation of restrictions on telecom trade.

Two standard closure rules are imposed: the savings-investment balance and a fixed current-account balance. The savings-investment balance is based on the assumption that the capital stock is exogenously fixed at the benchmark level. This stock is financed through forced consumer savings that act as a direct (lump-sum) tax. The interest rate (an index price of the composite capital stock) is endogenous and determined by factor-demand conditions. The current-account balance is the sum of the merchandise trade balance, the services balance, net foreign worker remittances, and (negative) net payments on foreign capital. We assume that foreign reserves will be held constant so that the current account will be just offset by (the negative of) the capital account. The current-account balance itself is held constant in real terms throughout the simulations. Income from foreign remittances less foreign capital payments enters as an exogenous addition to the representative agent's income. To hold the current-account balance fixed while international prices are constant requires a balancing item. This is accomplished by means of a change in the home "real exchange rate," which refers implicitly to a change in the home price index (generated by changes in price of home-produced goods) sufficient to sustain a constant current-account balance as import and export volumes change.

The data required for the CGE model consist of a Social Accounting Matrix (SAM) and of other parameters such as import and export trade flows by region and elasticities of substitution

and transformation. The core input-output model is the 1995 table provided on a diskette by the Institut National de la Statistique (INS). The 56 sector table was combined with the INS *Les Comptes de la Nation* (1998) report and then assembled into a consistent set of relationships between intermediate demand, final demand and value-added to produce the SAM. In Table 1, we use this dataset to present each industry's telecom usage intensity, producer service usage intensity and labor intensity. The industries are ranked in descending order by telecom usage intensity (column 2). The ten industries with the highest telecom input as share of sectoral output all are service sectors. Agriculture, automobile & trucks and food are the three industries with the lowest telecom usage intensity.

[Table 4 about here]

Trade and tariff data were aggregated to the input-output sectoral basis using import weights consistent with the concordance between the input-output table and the tariff classification. Tariff rates were determined by collections data for 1995 and vary across regions due to duty drawback provisions as well as preferential treatment of the EU and the Arab League. There are no data on tariff collections on services, reflecting the absence of formal trade taxes, and we take their tariff rates to be zero.

More information about the data can be found in Konan and Maskus (2006). In addition, we have made the data available for the GTAP model version 6 (Konan and Van Assche, 2005).

Because there is little empirical evidence on relevant elasticities for the Tunisian market, we make standard assumptions about their values. In particular, labor-capital substitution is set at unity in a Cobb-Douglas value-added production function. Benchmark trade elasticities are drawn from Rutherford et al. (1995) and Konan and Maskus (2000). The trade elasticities are 2.0 for substitution between domestic and imported goods, 5.0 for substitution among regional imports and for transformation between domestic output and exports, and 8.0 for transformation among regional export destinations. We also assume that the trade elasticities are 0.5 for services.

3.3 Telecommunications Liberalization

To estimate the role of Tunisia's reform commitment on the success of its telecommunications liberalization, we analyze the effect of allowing a single foreign provider to enter Tunisia's telecom market. As Low and Mattoo (2000) have indicated, recent service liberalization discussions have focused primarily on freeing up ownership restrictions rather than necessarily allowing free entry *per se*. As a result, there is a strong policy and academic interest in understanding the impact of partial service trade liberalization where only few firms are allowed to enter a service sector.

In our model, telecommunications liberalization takes place as a two-stage game with incomplete information. In stage 1, the Tunisian government assigns a telecom license to a single foreign provider. It can adopt two mechanisms to assign the unique telecom license to a foreign service provider. First, it can auction the telecom license off to the highest bidder (*auction scenario*). In this scenario, we assume that multiple foreign providers with best-practice marginal costs c^* enter the competitive bidding process and that all bidders' outside options are zero. As a result, the foreign entrant in equilibrium pays its entire expected profits from entering the Tunisian market as a licensing fee to the domestic representative consumer. Second, the Tunisian government can decide to freely assign a telecom license to a foreign provider with a world's best-practice marginal cost c^* (*no auction scenario*). As will be demonstrated below, a welfare-maximizing government will always choose for a competitive auction since it allows the government to extract at least a portion of the foreign service provider's profits that otherwise would be shifted abroad by the foreign provider.

In stage 2, the foreign provider enters the Tunisian telecom market. The market structure that the domestic incumbent and foreign entrant adopt depends on the regulatory environment that the government puts into place. If a pro-competitive regulatory environment is in place, the domestic incumbent and foreign entrant strategically compete in quantities (*Cournot duopoly*). Otherwise, the domestic incumbent and foreign entrant form a *cartel*. In the remainder of the paper, we will refer to stage 1 as *ex ante* (i.e. before entry) and stage 2 as *ex post* (i.e. after entry).

The two-stage game is a game with incomplete information. Specifically, the foreign provider does not necessarily know *ex ante* which market structure the government will choose *ex post*. The government may *ex ante* make declarations about the market structure it will pursue, but

these declarations are generally nonbinding and therefore not credible. To see this, assume that the government *ex ante* declares that it will *ex post* ensure competition in quantities between the domestic incumbent and the foreign entrant. This commitment is not necessarily credible since it is cheap for the government to *ex post* relent on this commitment and for example give in to political economy pressures from the domestic incumbent. Similarly, assume that the government declares *ex ante* that a cartel between the domestic incumbent and the foreign provider will be allowed *ex post*. The government may do so to try to raise its revenues from the competitive auction. Given that the foreign entrant's profits will be higher under cartel than under Cournot duopoly, the foreign entrant might be willing to bid more for the license. *Ex post*, however, the government may have the incentive to relent on its declaration and put into place a Cournot duopolistic market structure so as to maximize the welfare-enhancing effect of telecommunications liberalization. Due to this incomplete information, the amount that the foreign entrant bids for the telecom license depends on its *ex ante* expectation of the *ex post* market structure that the government will put in place. Since this expectation is related to a government's perceived commitment to reform, we will below talk about reform commitment.

In summary, the effect of telecommunications liberalization in our model depends on three factors: (i) the *ex ante* license assignment mechanism that the government puts into place; (ii) the *ex post* market structure that the government chooses; and (iii) the government's perceived reform commitment. We will analyze the effects of each of these factors in the next section.

4 Results

In this section, we present the results of our model. We start off in section 4.1 by presenting the effects of telecommunications liberalization if a government can *ex ante* credibly commit which market structure it will put in place *ex post*. In that case, the game turns into a complete-information game. The foreign entrant *ex ante* knows which market structure will be put in place *ex post* and which profits it will make. If the telecom license is auctioned off, the government can extract these profits through the license fee. If the foreign provider receives the license freely, it shifts its profits abroad. In section 4.2, we then consider the effect of telecommunications liberalization when the

government cannot credibly commit *ex ante* which market structure will be in place *ex post*. If the telecom license is auctioned off, the license fee that the foreign service provider pays then depends on the government's perceived reform commitment.

4.1 *Ex ante* Credible Commitment

If a government can *ex ante* credibly commit which market structure it will put in place *ex post*,the foreign entrant *ex ante* knows which market structure will be put in place *ex post* and which profits it will make. In that case, we end up with four counterfactual scenarios. In Table 2, we depict the impact of telecom liberalization on the performance of the telecom sector, the macro-economy and on household welfare for these four counterfactual telecom liberalization scenarios.

[Table 5 about here]

Scenario 1 in Table 2 depicts the telecom liberalization scenario where the foreign entrant has acquired its license through a competitive auction and where it competes in quantities with the domestic incumbent. In this case, the composite price of telecom services drops by 0.15 percent and the telecom sector's output grows by 53.06 percent. Telecommunications liberalization leads to an increase of real GDP increasing by 0.47 percent. Due to a significant reduction of the consumer price index (CPI) by 0.59 percent, the economic expansion is export-led with aggregate exports growing 2.49 percent. The benefits of telecom liberalization accrue primarily to labor, with returns to labor increasing by 0.80 percent and returns to capital increasing 0.29 percent. Overall, household welfare (measured as Hicksian-neutral equivalent variation) improves by 0.65 percent. This is a considerable increase in household welfare, since we are considering liberalization of just one sector in a static context.

In scenario 2, the foreign entrant has also acquired its license through a competitive auction, but it forms a cartel with the domestic incumbent. Due to the absence of a pro-competitive effect, the effect of telecommunications liberalization is more subdued. The drop in the composite price of telecom services by 0.04 percent and the expansion of telecom output by 8.47 percent is much smaller than in scenario 1. Household welfare and real GDP only expand by 0.54 percent and 0.36 percent respectively.

Scenario 3 is identical to scenario 1, except that the government assigns the telecom license freely to the foreign provider instead of through a competitive bidding process. In that case, the foreign service provider's profits are not extracted by the government and it shifts all of its profits abroad. When compared to scenario 1, the choice of license allocation mechanism does not significantly affect the size and type of economic expansion. Similar to scenario 1, the telecom sector expands 53.06 percent, while Tunisia's real GDP and exports increase by 0.44 percent and 6.99 percent, respectively. However, allocating the license freely does lead to a significantly lower growth of household welfare. In contrast to the 0.65 percent growth of household welfare when the license was auctioned off (scenario 1), the free allocation of the licenses induces household welfare to grow only 0.26.

We obtain similar results for scenario 4. In scenario 4, the foreign entrant freely acquires a telecom license and colludes with the domestic incumbent. When compared to scenario 2, the choice of license allocation mechanism does not significantly affect the size and type of economic expansion. In both scenarios, the telecom sector expands 8.47 percent, while Tunisia's real GDP and exports increase by 0.3 percent and 1.50 percent, respectively. But the fact that the foreign entrant's profits are not extracted by the government but rather shifted abroad implies that Tunisia's welfare actually declines by 0.21 percent. This is by itself an interesting results since it implies that telecommunications liberalization is not necessarily welfare improving.

4.2 *Ex ante* non-credible commitment

...

5 Conclusion

Recent academic and policy studies on service trade liberalization consider developing countries' lack of commitment to regulatory reforms as a significant barrier to the success of service trade liberalization. In this paper, we have incorporated a single imperfectly competitive service sector into a standard computational general equilibrium (CGE) model to quantify the role of reform commitment on the effects of service trade liberalization. In the benchmark of our model, we

assume that the imperfectly competitive service sector is dominated by a domestic monopolist. Service trade liberalization is then modelled as a two-stage game with incomplete information. In stage 1, the government assigns a telecom license to a single foreign provider. It can adopt two mechanisms to assign the unique telecom license to a foreign service provider. On the one hand, it can auction the telecom license off to the highest bidder. On the other hand, it can freely assign a telecom license to a foreign provider. In stage 2, the foreign provider enters the market. The market structure that the domestic incumbent and foreign entrant adopt depends on the regulatory environment that the government puts into place. If a pro-competitive regulatory environment is in place, the domestic incumbent and foreign entrant strategically compete in quantities. Otherwise, the domestic incumbent and foreign entrant form a cartel.

The two-stage game is assumed to be a game with incomplete information. Specifically, the foreign provider does not necessarily know in stage one which market structure the government will implement in stage 2. In such a setting, we show that the success of service trade liberalization depends on three factors: (i) the license allocation mechanism; (ii) the adopted market structure; and (iii) the government's perceived commitment to reform.

In the second part of the paper, we have introduced our framework into a CGE model for Tunisia to estimate the impact of these three factors for telecommunications liberalization in Tunisia. Our results provide academics and policy makers with new insights into the importance of commitment to reform on the success of service trade liberalization.

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Appendix A: Full Description of the CGE Model

In this Appendix, we will list the main equations of the model. For a full list of all identities, please refer to Konan (2003).

Consider a CGE model with $I-1$ perfectly competitive sectors that produce output Y_i and one imperfectly competitive producer service sector that provides service Y_z. Sectoral output is used both as an intermediate good by sectors I and as a final good by the representative consumer. We denote intermediate good use by superscript x and final good use by superscript c. In the imperfectly competitive producer service sector Y_z, N service providers each produce a single differentiated service z_j. The service providers are not necessarily symmetric and can be both domestic and foreign. Users perceive a constant elasticity of substitution between each provider's service, and we thus represent total industry output Y_z as a CES function of services provided by each provider z_j:

$$Y_z = \left(\sum_{j=1}^{N} z_j^{\epsilon} \right)^{\frac{1}{\epsilon}}. \tag{A-1}$$

The elasticity of substitution between each variety is $\sigma = \frac{1}{1-\epsilon}$, where $\sigma > 1$.

Producer service sector Y_z is one of a select group of H producer services that positively affect value-added productivity when used as an intermediate good (Markusen et al., 2005). Telecommunications, finance, insurance, business services and transportation are generally considered to belong to this category. To model this, we assume that industry $i \in I$'s composite producer services PS_i is a Leontief function of the share of producer service sector H's output allocated to sector i:

$$PS_i = min\left[\frac{Y_{1,i}^x}{\kappa_{1,i}}, ..., \frac{Y_{H-1,i}^x}{\kappa_{H-1,i}}, \frac{Y_{z,i}^x}{\kappa_{z,i}} \right]. \tag{A-2}$$

Composite producer services PS_i are an imperfect substitute to value added $K_i^{\alpha_i} L_i^{\beta_i}$ in that industry:

$$V_i = \left[\left(K_i^{\alpha_i} L_i^{\beta_i} \right)^{\gamma} + PS_i^{\gamma} \right]^{\frac{1}{\gamma}}, \tag{A-3}$$

where the constant elasticity of substitution between value added and producer services is $\rho = \frac{1}{1-\gamma}$. We call function V_i composite value added of industry i. The production function for all sectors

except for Y_z is approximated with Leontief technologies using composite intermediate inputs from $i \notin H$ and composite value added V allocated to the industry.

$$Y_i = min\left[\frac{Y^x_{H+1,i}}{\lambda_{H+1,i}}, ..., \frac{Y^x_{I,i}}{\lambda_{I,i}}, \frac{V_i}{\lambda_{v,i}}\right]. \tag{A-4}$$

Similarly, The Leontief production function for firm j in sector Z takes the following form:

$$z_j = min\left[\frac{Y^x_{H+1,j}}{\lambda_{H+1,j}}, ..., \frac{Y^x_{I,j}}{\lambda_{I,j}}, \frac{V_j}{\lambda_{v,j}}\right]. \tag{A-5}$$

In export sectors, the production for the domestic market D_i is distinguished from that for export EX_i according to a two-tier nested constant elasticity of transformation (CET) frontier:

$$Y_i = \left[\delta_{D,i} D_i^{\frac{\zeta_i - 1}{\zeta_i}} + \delta_{EX,i} EX_i^{\frac{\zeta_i - 1}{\zeta_i}}\right]^{\frac{\zeta_i}{\zeta_i - 1}}. \tag{A-6}$$

The second-tier CET-nest aggregates total exports, X_i, from exports by destination, EX_{ri}, indexed by r (EU, MENA, and ROW):

$$EX_i = \left[\sum_r \eta_{i,r} EX_{i,r}^{\frac{\kappa_i - 1}{\kappa_i}}\right]^{\frac{\kappa_i}{\kappa_i - 1}}. \tag{A-7}$$

In sector l, intermediate good demand $x_{i,l}$ and final demand c_l is differentiated by country of origin. Domestic output $D_{l,i}$ and $D_{l,c}$, and region r imports, $IM_{r,l,i}$ and $IM_{r,l,c}$ are aggregated in the following nested Armington CES functions:

$$x_{l,i} = \left[\lambda_{D,l} D_{l,i}^{\frac{\mu_l - 1}{\mu_l}} + \lambda_{IM,l} IM_{l,i}^{\frac{\mu_l - 1}{\mu_l}}\right]^{\frac{\mu_l}{\mu_l - 1}} \tag{A-8}$$

and

$$C_l = \left[\nu_{D,l} D_{l,C}^{\frac{\xi_l - 1}{\xi_l}} + \nu_{IM,l} IM_{l,C}^{\frac{\xi_l - 1}{\xi_l}}\right]^{\frac{\xi_l}{\xi_l - 1}}, \tag{A-9}$$

where composite intermediate imports $IM_{l,i}$ and final imports $IM_{l,C}$, are given by the following:

$$IM_{l,i} = \left[\sum_r \varpi_{l,r} IM_{l,i,r}^{\frac{\psi_i - 1}{\psi_i}}\right]^{\frac{\psi_i}{\psi_i - 1}} \tag{A-10}$$

and

$$IM_{l,C} = \left[\sum_r \varpi_{l,r} IM_{l,C,r}^{\frac{\psi_i - 1}{\psi_i}} \right]^{\frac{\psi_i}{\psi_i - 1}}. \tag{A-11}$$

In all sectors except for the telecommunications sector, firms face constant returns to scale and behave competitively, implying that prices $p_{y,l}$ equal marginal cost c_l, for output within sector l. The domestic policy environment is reflected by government-revenue-producing tariffs on sector l imports from region r, $t_{l,r}$ and a tax on primary input value added, τ_l

$$c_l Y_l = \sum_l p_l D_{l,i} + \sum_l \sum_r (1 + t_{l,r}) p_{y,l,r}^{im} IM_{l,i,r} + (w_K K_i + w_L L_i) \tag{A-12}$$

In the imperfectly competitive telecom sector, the domestic and foreign firm face the following Lerner markup condition:

$$p_j^k = \frac{\Sigma_j^k}{\Sigma_j^k - 1} c_j(w, r), \tag{A-13}$$

where

$$\Sigma_j^k = \left(\frac{\omega_u}{1 - \epsilon(1 - s_j^k)} + \sum_i \frac{\omega_{y,i}}{(1 - s_j^k)(1 - \epsilon) + s_{v,i} s_j^k (1 - \gamma)} \right), \tag{A-14}$$

$$s_{v,i} = \frac{p_{v,i}^{1-\rho}}{p_{v,i}^{1-\rho} + p_{ps,i}^{1-\rho}} \tag{A-15}$$

and the market share of provider j equals

$$s_j = \frac{p_j^{1-\sigma}}{\sum_{j=1}^N p_j^{1-\sigma}}. \tag{A-16}$$

The price of the composite service Z then becomes:

$$P_z^k = \left(\sum_j {p_j^k}^{1-\sigma} \right)^{\frac{1}{1-\sigma}} = \left(\sum_j \left(\frac{\Sigma_j^k}{\Sigma_j^k - 1} c_j(w, r) \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}. \tag{A-17}$$

In the model, private household expenditures are determined by a representative agent with a multi-nested CES utility function. This allows the agent to make separable multi-staged budget decisions. In the top-tier budgeting decision the income elasticity is assumed to be unity with a

Cobb-Douglas nested utility function:

$$U = \Pi_i C_i^{bi}, \qquad \text{with } \textstyle\sum_i b_i = 1. \tag{A-18}$$

The second budgeting stage involves the consumer deciding how much to spend on domestic versus imported commodities, which is determined in equations (A-8)-(A-11).

Private households receive income generated by returns to endowments of labor, $\bar{E}_L$, and other value added, $\bar{E}_K$. Households receive monopoly rent transfers from the domestic telecom incumbent $\pi_d z_d$ and under some scenarios from the multinational telecom provider $\pi_m z_m$. Households support a government budget deficit, D, and engage in savings through exogenously fixed investment instruments, I_i.

$$\sum_i \tilde{p}_i^C C_i = w_K \bar{E}_K + w_L \bar{E}_L - \sum_i p_i I_i^I - \sum_i \tilde{p}_i^{IF} I_i^F - r^F K^F - D + \pi_d z_d + \pi_m z_m \tag{A-19}$$

The model simplifies the treatment of government and intertemporal decisions. The government is assumed to spend based on a fixed real income, with preferences reflecting those of households. A lump-sum tax adjusts endogenously in response to policy shocks to maintain a revenue-neutral government budget.

$$\sum_i \tilde{p}_i^G G_i = D + \sum_i \tau_{Vi} \tilde{p}_i^C V_i + \sum_i \sum_r t_{i,r} p_{i,r}^{im} (IM_{i,C,r} + IM_{i,I,r}^F) \tag{A-20}$$

Similarly, real private investment in each sector, I_i, is exogenously fixed at the benchmark level.

As noted above, import and export prices are exogenous following the small-economy assumption. The real current account balance, B, is exogenously given at international prices and is assumed to be exogenous. That is, the volume of trade adjusts endogenously to ensure a constant real current account. The balance of payments conditions also holds.

$$B = \sum_i \sum_r p_{r,i}^{ex} EX_{r,i} - \sum_i \sum_l \sum_r p_{r,i}^{im} IM_{r,i}^l - \sum_i \sum_r p_{r,i}^{im} IM_{r,i}^C \tag{A-21}$$

$$0 = \sum_r \sum_i \frac{1}{e} (p_{r,i}^{im} IM_{r,i} - p_{r,i}^{ex} EX_{r,i} - w_L^F L^F - r^F K^F - \pi_m z_m) \tag{A-22}$$

It is important to note that key identities hold as the optimizing behavior of agents assures that income will equal expenditures. Market clearance is achieved in each goods market, each factor market and the total supply value in the economy is balanced.

$$S_i = \sum_l a_{l,i} Y_l + G_i + I_i^F + I_i^I + C_i \tag{A-23}$$

$$\sum_i K_i = \bar{E}_K; \qquad \sum_i L_i = \bar{E}_L \tag{A-24}$$

$$\begin{aligned} \tilde{p}_i S_i \;=\; & \tilde{p}_i^Z \sum_l a_{i,l}(1+v_i) Y_l + \tilde{p}_i^C D_{i,C} + \tilde{p}_i^{IF} D_{i,I}^F + \tilde{p}_i^G D_{i,G} + \\ & \tilde{p}_i^{IF} I_i^I + \sum_r (1+\tau_{V,i}+u_i+t_{i,r}) p_{i,r}^{im} (IM_{i,C,r} + IM_{i,G,r} + IM_{i,I,r}^F) \end{aligned} \tag{A-25}$$

In this Arrow-Debreu type model, Walras' law is satisfied and, given a numeraire, a unique set of real prices is determined in each scenario.

Table 1: List of Variables

B	Current-account balance
c_i	Index of marginal cost of production
C_i	Private consumption
D	Government budget deficit
D_{ij}	Domestic sales in sector i used by j
e	Real exchange rate (price index for foreign exchange)
EX_{ir}	Exports in sector i to region r
G_i	Public consumption
I_i^F, I_i^I	Fixed capital formation and inventory
IM_{ijr}	Imports in sector i from region r used in j
K^F	Net payments on foreign capital holdings
K_i	Non-labor (capital) inputs
L_i	Domestic labor inputs
p_i	Domestic producer price index
p_i^j	Price index of domestic goods used by j
p_{ir}	Producer price index for goods exported to region r
p_{ijr}	Domestic price index for imports in sector i from region r used in j
$\tilde{p}_i$	Composite price index for total domestic supply
$\tilde{p}_{ij}$	Composite price index (weighted average of home and imported prices)
PS_i	Producer services
S_i	Supply on domestic market
U	Utility of representative consumer
V_i	Value added
w_K, w_L	Factor price indexes
x_{ij}	Composite intermediate input of j into i
Y_i	Output of good i
Z_D	Telecom services provided by domestic incumbent
Z_M	Telecom services provided by foreign entrant
θ_i	Share of total telecom services used by i
ρ	Elasticity of substitution between value added and producer services
τ_{Vi}	Endogenous tax rate on value added
ϕ_i	Elasticity of demand for telecom user i

Table 2: List of Parameters

α_i	Labor share of value added in sector i
β_i	Non-labor share of value added
γ	$\frac{\rho-1}{\rho}$
ϵ	$\frac{\sigma-1}{\sigma}$
ζ_i	Transformation elasticity between domestic and exported output
κ_i	Transformation elasticity on exports between regions
λ_i	Service resource-using barriers on output ($\lambda_i = 0$ for non-service sectors)
μ_j	Substitution elasticity between domestic and imported intermediates
ξ_j	Substitution elasticity between domestic and imported consumption
π_i	Telecom rents for service provider i
σ	Elasticity of substitution between domestic and foreign telecom services
ψ_i	Armington elasticity on imports between regions
$\bar{E}_K$, $\bar{E}_L$	Endowments of capital and labor
p_{ir}^{im}	Price of imports from region r
p_{ir}^{ex}	Price of exports to region r
r^F	Price of foreign capital payments
t_{ir}	Tariff rate on imports from region r ($t_{ri} = 0$ for service sectors)
u_i	Resource-using services border barriers ($u_i = 0$ for non-service sectors)

Table 1: Tunisia Services Output and Demand (%)

	Production	Imports	Household Demand	Intermediate Demand	Exports
AGGREGATE SECTORS (% of total)					
Agriculture and Fishing	17.5	10.2	32.4	20.1	6.6
Manufacturing	30.0	63.2	29.7	51.3	55.3
Utilities, Mining, Petroleum	5.8	5.8	4.0	10.9	6.8
Services	46.7	20.8	33.8	17.7	31.2
SERVICE SECTORS (% of total)					
Construction	8.2	0.0	0.3	0.4	0.0
Distribution/Commerce	6.9	0.0	0.0	0.0	0.0
Transportation	5.6	2.7	5.7	4.3	8.7
Communication	1.0	0.1	0.3	1.7	0.4
Hotel	1.5	0.0	3.9	0.1	0.0
Restaurant	4.1	0.0	10.9	0.0	0.0
Finance	2.5	0.2	0.1	4.8	0.3
Insurance	0.3	0.2	0.3	0.6	0.0
Business	1.4	2.1	0.1	2.5	2.5
Real Estate	2.6	0.0	5.0	1.3	0.0
Repair	1.3	0.0	1.1	1.8	0.0
Health and Education	2.0	0.0	4.9	0.2	0.0
Public	9.0	0.0	0.6	0.0	0.0
Other Services	0.2	0.0	0.6	0.0	0.0
Tourism	–	15.4	–	–	19.3

Institute National de la Statistique (1998).

Table 2: Macroeconomic Communications Indicators, 2005

	GDP per capita (constant 2000 US$)		Telecommunications revenue (% GDP)		Telecommunications investment (% of revenue)	
Economy	1995	2005	1995	2005	1995	2005
Egypt	1,278	1,643	1.06	3.61	..	68.59
France	19,990	23,650	1.89	2.37	21.17	15.57
Germany	21,073	23,788	1.94	3.00	22.16	8.62
Israel	17,246	19,480	2.67	4.19	21.96	..
Italy	17,565	19,379	1.78	3.03	23.56	18.56
Japan	35,439	38,962	1.78	3.68	37.51	14.59
Jordan	1,723	2,109	..	8.33	..	20.85
Morocco	1,160	1,562	2.00	4.77	47.38	16.50
Saudi Arabia	8,969	9,816	1.27	2.89	5.51	21.52
Tunisia	1,651	2,407	1.46	4.28	51.26	21.71
United States	29,942	37,084	2.38	3.05	13.49	..
World	4,778	5,659	2.02	3.23	28.22	..
Middle East & North Africa	1,381	1,736	1.03	3.17	34.51	..
Low income	310	383	1.50	3.29	32.57	..
Lower middle income	701	1,156	1.56	3.15	33.67	..
Upper middle income	3,326	4,217	1.69	3.34	30.34	..
High income	22,907	27,618	2.10	3.23	23.50	..

World Bank, *World Development Indicators*, 2008. Washington DC

Table 3: Communications Indicators, per 100 people

	Fixed line and mobile phone subscribers		Telephone mainlines		Mobile phone subscribers		Internet users	
Economy	1995	2005	1995	2005	1995	2005	1995	2005
Egypt	4	33	4	14	0	19	0	7
France	58	134	56	55	2	79	2	43
Germany	56	163	51	66	5	96	2	43
Israel	50	154	42	42	8	112	1	24
Italy	51	165	44	43	7	122	1	48
Japan	59	121	50	45	9	76	2	67
Jordan	8	70	8	12	0	58	0	13
Morocco	4	46	4	4	0	41	0	15
Saudi Arabia	9	78	9	17	0	61	0	13
Tunisia	6	69	6	13	0	57	0	10
U.A.E								
United States	73	131	60	59	13	72	9	67
World	14	54	12	20	2	34	1	16
Middle East & North Africa	6	38	5	15	0	23	0	9
Low income	1	10	1	3	0	7	..	3
Lower middle income	3	38	3	15	0	23	0	7
Upper middle income	14	82	14	22	1	59	0	18
High income	58	138	50	52	8	85	4	55

World Bank, *World Development Indicators*, 2008. Washington DC

Table 4: Telecom Usage, Producer Service Usage, and Labor Intensity by Industry

	Telecom input	Telecom input as share of sectoral output	Producer service input	Producer service input as share of sectoral output	Labor share of value added	Sectoral output
	000 dinars	%	*000 dinars*	%	%	*000 dinars*
Business	15 199	5.1	24 712	8.4	47.2	295 460
Commerce	79 572	3.9	135 732	6.6	100.0	2 044 425
Hotel	16 778	2.1	30 978	3.9	22.6	803 168
Finance	15 261	2.0	30 732	3.9	34.0	778 408
Health and education	10 060	1.9	19 531	3.6	26.4	539 356
Telecommunications	4 047	1.3	11 244	3.5	30.7	321 980
Transportation	21 095	1.2	170 678	10.1	50.1	1 695 205
Insurance	1 107	1.0	51 144	46.5	34.0	110 009
Real Estate	1 050	1.0	13 579	12.5	4.4	108 936
Public sector	32 893	0.9	64 472	1.7	100.0	3 857 265
Repair	2 478	0.8	3 402	1.1	21.9	314 355
Water	1 039	0.7	8 564	6.0	52.6	142 448
Apparel	25 624	0.7	68 780	1.9	49.6	3 530 881
Autoparts and repair	167	0.7	714	2.8	100.0	25 131
Petroleum and gas	8 905	0.6	15 021	1.0	7.7	1 433 889
Other sectors	1 025	0.5	1 677	0.8	37.5	210 961
Cement	4 977	0.4	19 922	1.8	39.9	1 106 602
Paper, books, records	1 861	0.4	8 460	2.0	35.7	433 756
Metal work	1 755	0.4	8 292	1.7	44.4	475 533
Minerals	675	0.3	5 822	3.0	84.3	195 339
Machines and equipment	750	0.3	3 561	1.5	83.6	232 134
Electric materials	1 251	0.3	5 044	1.2	30.3	410 115
Electronics	613	0.3	2 775	1.1	82.9	242 991
Construction	5 914	0.2	99 086	4.2	73.3	2 368 369
Electricity	1 340	0.2	6 425	1.1	30.9	562 236
Leather	1 204	0.2	7 114	1.3	30.8	554 517
Household applances	258	0.2	1 032	0.9	41.6	119 174
Non-ferrous metals	748	0.2	5 019	1.3	70.2	390 537
Restaurant	1 855	0.2	2 485	0.3	22.6	981 269
Woodwork	1 087	0.2	19 664	3.4	27.8	576 297
Plastics	466	0.2	2 177	0.9	29.8	247 838
Chemicals	3 460	0.2	84 342	4.4	31.2	1 917 992
Food	4 493	0.1	23 377	0.6	36.4	3 676 665
Automobiles and trucks	291	0.1	6 460	1.7	34.7	387 974
Agriculture	0	0.0	7 071	0.3	12.0	2 778 914

Institut National de la Statistique, 1998, Les Comptes de la Nation Base 1983, agregats et tableaux

Table 5: Effect of Telecom Liberalization under *ex ante* credible commitment (% change)

	Auction		No auction	
	duopoly (1)	cartel (2)	duopoly (3)	cartel (4)
Telecom Sector Indicators				
Composite telecom price	-0.15	-0.04	-0.15	-0.04
Telecom output	53.06	8.47	53.06	8.47
Macroeconomic Indicators				
Household welfare (EV)	0.65	0.54	0.26	-0.21
Output, real	0.47	0.36	0.44	0.31
Consumer price index	-0.59	-0.02	-0.55	-0.02
Aggregate exports	6.99	1.50	6.99	1.50
Aggregate imports	2.29	0.67	2.29	0.67
Return to capital	0.29	0.06	0.29	0.06
Return to labor	0.80	0.15	0.80	0.15

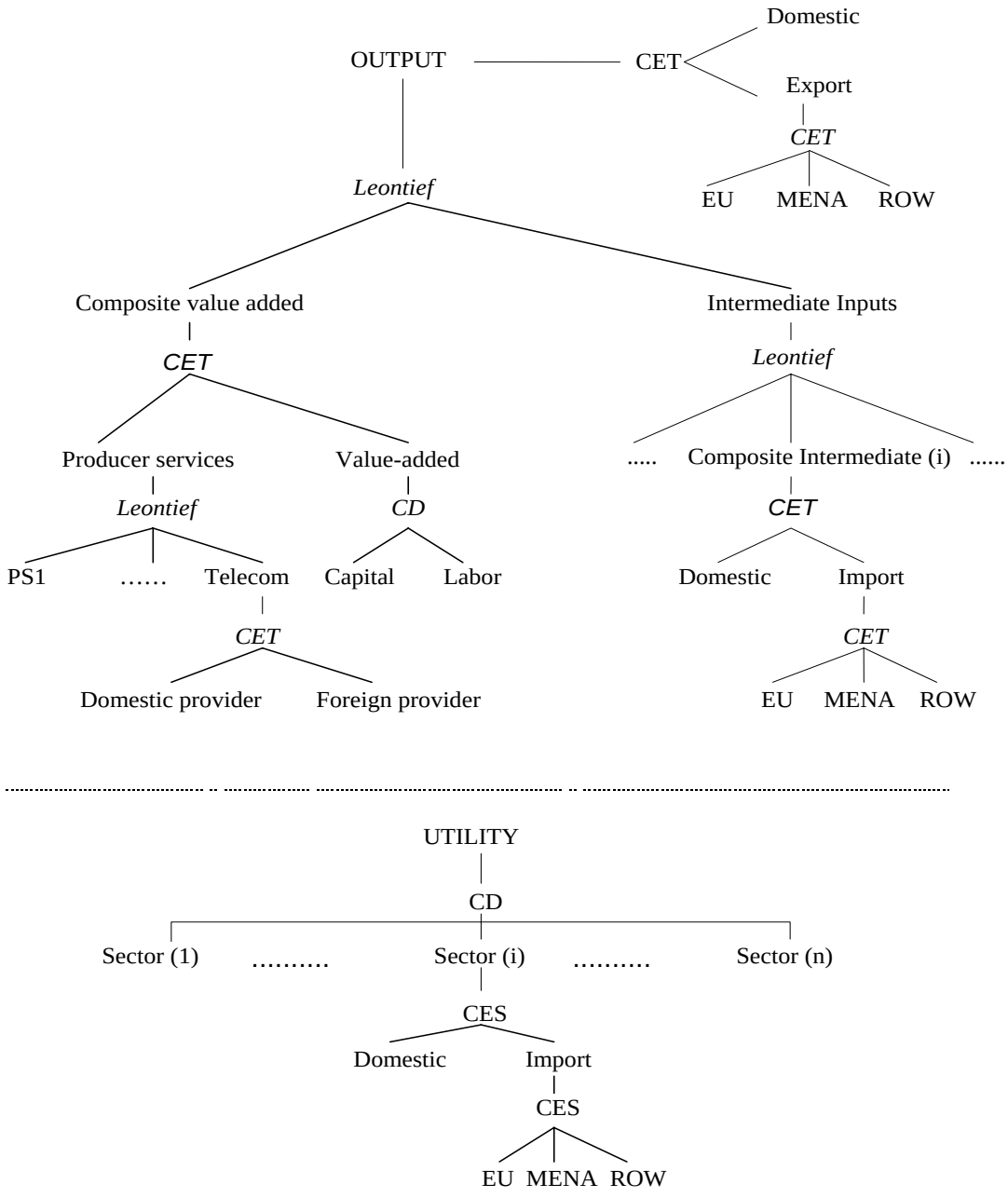

Figure 1: Nesting Structure of Tunisia CGE Model