The Welfare Implications of Services Liberalization in a Developing Country*

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Abstract

Evaluating the impact of services liberalization is challenging. In particular, services trade barriers are often non-observed and the evaluation of their impact is not trivial. Most papers in the literature adopt a two-step methodology consisting of separately evaluating non-tariff barriers and then, the impact of their abolition. A straightforward drawback of this literature is the inconsistency between the routines used in the two different steps. To solve this inconsistency issue, we propose to use an integrated method based on a two-sector small open economy dynamic and stochastic general equilibrium model to estimate non-tariff barriers and quantify the impact of services liberalization. The major component of trade barriers is explicitly modeled through the introduction of entry-sunk costs to the service sector. Hence, liberalization is treated assuming a government's policy decision aimed at reducing those costs. Then, we estimate the model using Bayesian techniques for Tunisia and the Euro Area. The paper presents a precise quantitative evaluation of services trade barriers as the difference between entry-sunk costs in Tunisia versus the Euro Area. We find significant welfare benefits in addition to aggregate and sectoral growth gains the Tunisian economy could attain following services liberalization. Surprisingly, the goods sector is the one that benefits the most from services liberalization.

JEL classification: E1, F1, F4

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1 Introduction

Service liberalization is becoming more appealing for developing countries, in particular, for countries with a large services sector. For these countries the liberalization shock will most likely be significant in both goods and services markets. From a theoretical perspective, several essays tried to advocate the advantage of service liberalization for different reasons. Like goods liberalization, service liberalization permits technology transfer, higher domestic competition, reduction of unemployment, price decrease, and, more interestingly, quantitative welfare gains. The specificity of service advantages, however, includes (i) the magnitude of decrease for both service prices and goods prices given that services intervene also in all goods production processes in a high proportion, as pointed out by Piermartini and Teh (2005) ; (ii) service liberalization particularly stimulates foreign direct investments given that most of service investments require direct contact between the provider and the customer; and (iii) the liberalization of particular sectors such as the financial sector increases efficiency and growth.

Quantifying the impact of services liberalization faces two major challenges. First, because of the simultaneity of the production and consumption of services, border measures such as tariffs will generally be difficult to apply because customs agents cannot readily observe the service as it crosses the border. Qualitatively, barriers can concern any of the four modes identified by the World Trade Organization (WTO) through which service exports can be delivered.[1] It turns out that any intervention against free market practices related to each mode would materialize in non-tariff barriers for which data do not exist. There is a proliferation of methods to quantify the size of services control. The seminal study by Deardorff and Stern (1998) gives a detailed exposition of the calculation of the tariff-equivalent of non-tariff measures of protection using data on individual product prices, and allows for different types of non-tariff measures, market competition, and product substitutability. This method was extended to account for cross-product and cross-country specificities (see Bradford, 2003, 2005; Kee et al., 2009, among many others).

Second, the methodologies adopted so far to quantify the impact of services protection measures exhibit several limitations. In particular, they somehow lack consistency in the sense that the disconnect between the evaluation of services trade barriers and the tool used in evaluating their economic effect is particularly noticeable. Most papers consider gravity model of service trade (e.g., Francois, 1999; Hertel, 2000) or multi-country Computable General Equilibrium (CGE)

[1]Namely, the WTO identifies cross border supply (Mode 1)—services are delivered from the territory of one country into the territory of another country; consumption abroad (Mode 2)—where an individual or firm provides services to an international visitor; commercial presence (Mode 3)—where a service provider sets up operations in a foreign country; and presence of natural persons (Mode 4)—where an individual offers their services while in the destination country.

models (e.g., Konan and Maskus, 2006; Jensen et al., 2007). In the benchmark, production decisions in the service sector are distorted by regulations that raise entry costs and limit the rights of enterprizes to invest. Counterfactual experiments involve the removal of regulatory investment barriers. The quantitative outcomes tend to depend on the structure of the model and the size of the entry barriers—non-tariff measures of protection derived as estimated price wedges due to service barriers—which turn out to be model independent. Clearly, the existing literature analyzing the impact of services trade barriers tends to suffer from the Lucas critique. Additional drawbacks consist of the measurement of welfare—improperly approximated by revenues, and the model's parameters—calibrated and independent of the overall specification.

To solve this inconsistency issue, we propose to use an integrated method based on a two-sector small open economy dynamic and stochastic general equilibrium (DSGE) model to estimate non-tariff barriers and quantify the impact of services liberalization. More precisely, we study the effects of eliminating services barriers consistent with the WTO Mode 3—investment liberalization. To gain some insight into how services barriers work in the model, we include entry-sunk costs to capture the impact of eliminating those barriers. These costs are measured in percentage loss of output following the decision of entering the market. The structure of the model is an extension of the one proposed by Ghironi and Melitz (2005) where firms are assumed to face entry-sunk costs in the domestic market.[2] In particular, we propose a detailed specification of services and goods sectors consistent with the observed input-output structure. Furthermore, the two sectors are asymmetric with regard to different aspects: (i) the nature and the shares of inputs in the production functions; (ii) idiosyncratic technology shocks; and (iii) the structure of the two markets—less competitive in services market owing to substantive entry-sunk costs. Besides, We carefully adopt a model that incorporates a number of assumptions which mimic the specificities of the Tunisian economic context such as the degree of openness, access to international financial markets, rigidities in the labor market, and the exchange rate regime. In contrast to the conjectures in the existing literature, we seriously address the consistency issue rising from the incompatibility between the methodologies to evaluate the size of services trade barriers and quantify the impact of their reduction.

The model is then estimated for the Tunisian economy and used to run counterfactual exercises to evaluate the impact of increasing the degree of competitiveness in the service market by releasing constraints on investors. Obviously, not all of the entry-sunk costs are something a government

[2] In addition to the entry-sunk costs the authors assume that firms also face both fixed and per-unit export costs. For simplicity, and given the low share and weak impact of the these costs, we only consider barriers consistent with the third WTO Mode—commercial presence alteration due to entry costs. This is consistent with the findings of Konan and Maskus (2006) showing that in Tunisia 75 percent of services liberalization gains may be achieved from the liberalization of foreign investment barriers that impede Mode 3 delivery of services.

can eliminate—some of these costs are physical and not policy related. Hence, the counterfactual exercise consists of matching the level of entry-sunk costs estimated in the Euro Area—the major trade partner—where trade in services is free of those barriers. It is worth noting here that estimating services trade barriers within a DSGE model is very appealing. In particular, given that variables are highly endogenous it is not necessary to treat them all as observables. Conceptually, information on trade barriers—considered as unobservable, may show in other variables dynamics such as services output and prices.

The estimation results highlight the specificity of services sector captured by the shares of intermediary factors in the production and the dynamics of idiosyncratic technology shocks. Interestingly, the entry-sunk costs in Tunisia are estimated to be about 4 times those in the Euro Area. Counterfactual exercises which mimic government interventions to free services trade are conducted using a second order approximation of the model under alternative scenarios. This permits precisely evaluating different metrics adopted to rank alternative policies such as households' utility and the growth rates.[3] Numerical results show a high welfare improvement of 3.51 percent measured as the average permanent increase in consumption. Also, aggregate output could grow by an additional 2.67 percent mainly due to the higher growth in goods production evaluated at 3.44 percent; whereas, services sector additional growth corresponds only to 1.28 percent. The intuition behind this is twofold. The first is consistent with the fact that capital is more responsive to liberalization than labor and goods production is more capital intensive. The other reason is related to the structure of the production captured by the input-output matrix. In particular, the production of goods is particularly service intensive as suggested by the data for Tunisia.[4] Despite the apparent difference in our methodology, it turns out that our results in terms of output growth gains are very comparable with findings of the existing literature (see Konan and Maskus, 2006).

The paper is structured as follows. In the next section, we briefly describe the service sector in Tunisia and the main challenges facing policy makers to enhance its performance. In Section 3 we present the small open economy DSGE model that is used in the paper. Section 4 shows the methodology used to estimate the model for Tunisia and describes the estimation results. In Section 5, we investigate the model's ability to reproduce some stylized facts observed in the data, then, we describe the dynamics of the model by examining the impulse-response functions and the variance decomposition. Counterfactual exercises are conducted in Section 6 where the impact of liberalization policies are discussed. Finally, some conclusions are provided in Section 7.

[3]This class of models, based on behavioral equations of economic agents, allows an explicit evaluation of welfare as a metric for defining alternative policy choices.

[4]The share of services as input in the production of goods is 59 percent and the share of goods entering into the production of services is only 12 percent

2 Tunisian Service sector: Context and some Stylized Facts

The Tunisian service sector represents 59 percent of GDP, slightly above the average of the developing countries (53 percent of GDP). When public service is excluded, commercial service contribution falls to 47 percent of GDP. The level of capital formation coming from investment in services exceeds 57 percent in 2009 with only 47 percent for commercial services in particular transport and communication (32 percent) and small commercial services activities (37 percent).

Empirical evidence shows that the labor productivity gap between Tunisia and the European Union exceeds 50 percent in services while it stands below 30 percent in the industrial sector (see World-Bank-Staff, 2008, for details). This weak productivity performance is reflected in the export activity where services record an annual growth rate of about 2.5 percent largely under the average performance of the Middle Eastern and North African countries (12 percent). For several years, the major part of service exports was drawn mainly by tourism and international transport without significant progress in terms of structure and export volumes. Looking forward, backbone services like communication, transport, and finance are all candidates for a large productivity bound and will be subject of heavy investments. For example, the liberalization of telecommunication sector has witnessed a large infrastructure investment leading to a significant decrease in prices and multiplying by 15 the rate of penetration.

Restrictions in the Tunisian service sector persist for both domestic and external investors in particular for the five sectors included in the WTO agreement. Domestically, service supply and market access are limited for some sectors like banking, telecommunication, and transport for which accessibility remain dependent on License agreements. Furthermore, the domestic market suffers from the significant State intervention in some sectors like insurance, finance, health, transport, and environmental services. Efforts toward openness, however, are limited to private capital participation in some activities such as professional services and transport. Besides, international trade with external investors beares the heaviest restrictions. Foreign competition, market access, participation in capital, and license obligation represent the main barriers.

The Tunisian service sector is currently the subject of deep restructuring under both the WTO agreement, even though the negotiations are still ongoing, and the European Union agreement, also is under negotiation. Services commitment under the General Agreement on Trade in Services (GATS) is limited to five sectors (telecommunication, environmental services, financial services, health services, and tourism) and the liberalization for each sector is liable to a particular mode.

This study aims to contribute to the debate on the potential gains—welfare and growth—Tunisia could realize if the government decides to abolish protectionism rules with respect to penetrating the services markets, the major component of services trade barriers.

3 The Model

The economy consists of households, firms, a government, a monetary authority, and the rest of the world. There are four types of products: final products, services, goods, and an imported bundle of goods and services. The final composite product is produced by mixing domestically produced and imported products. Domestically produced products are supplied by a competitive firm that combines non-exported goods and services. Services are produced by a number of firms that pay an entry-sunk cost measured by a loss in their production and necessitate one period after entering the market to be able to sell their products. In addition, sectoral productions are consistent with an input-output structure. In other words, services serve as an input in the goods production and vice versa. In order to account for a number of specificities of the Tunisian economy the model encompasses: (i) wage rigidities in the labor market where household have market power due to differentiated labor service; (ii) incomplete markets through costly adjustment of foreign bonds; and (iii) managed nominal effective exchange rate.[5]

3.1 Households

We assume a continuum of monopolistically competitive households, each of which supplies a differentiated labor service to the production sectors. Household are indexed on the unit interval. Each i^{th} household chooses consumption $C_t(i)$, investment $I_t(i)$, money balances $M_t(i)$, hours worked $N_t(i)$, domestic riskless bonds $B_t^d(i)$, and foreign bonds $B_t^f(i)$ that maximize its expected utility function, and it sets the wage rate constrained to a Calvo-type nominal rigidity in wages.

The preferences of the i^{th} household are given by

$$E_0 \sum_{t=0}^{\infty} \beta^t U\left(C_t(i), \frac{M_t(i)}{P_t}, N_t(i)\right), \tag{1}$$

where $\beta \in (0,1)$, E_0 is the conditional expectations operator, M_t denotes nominal money balances held at the end of the period, and P_t is a price index that can be interpreted as the consumer price index (CPI). The functional form of time t utility is given by

$$U(\cdot) = \log(C_t(i)) + \gamma log\left(\frac{M_t(i)}{P_t}\right) - \mu \frac{N_t(i)^{1+\eta}}{1+\eta},$$

where γ and μ are positive parameters representing the weight of money balance and leisure in utility, respectively; and η is the inverse of the Frisch intertemporal elasticity of substitution in

[5] The only nominal rigidities introduced in the model correspond to wage stickiness. This friction is useful to yield real effects of money changes in the economy; besides, it generates incomplete exchange rate pass-through to local prices in the short term.

labor supply such that $\eta \geq 0$. Total time available to the household in the period is normalized to one.

The household's budget constraint is given by

$$P_tC_t(i) + P_t\left[I_t(i) + CAC_t(i) + BAC_t(i)\right] + M_t(i) + \frac{B_t^d(i)}{R_t} + \frac{e_tB_t^f(i)}{R_t^f} =$$
$$W_t(i)N_t(i) + Q_tK_t(i) + M_{t-1}(i) + B_{t-1}^d(i) + e_tB_{t-1}^f(i) + T_t(i) + D_t(i), \tag{2}$$

where $CAC_t(i) = \frac{\chi}{2}\left(\frac{I_t(i)}{K_t(i)} - \delta\right)^2 K_t(i)$ is the cost faced each time the household adjusts its stock of capital $K_t(i)$, $BAC_t(i) = \frac{\varphi}{2}\left(\frac{B_t^f(i) - B_{ss}^f}{P_t^f}\right)^2 e_tP_t^f$ represents the incurred cost by household (i) for foreign bonds deviations from their long-term level.[6] P_t^f is the price index in the rest of the world, $I_t(i)$ is the investment, $W_t(i)$ is the nominal wage rate, Q_t is the nominal interest on rented capital, $B_t^d(i)$ and $B_t^f(i)$ are domestic-currency and foreign-currency bonds purchased in t, and e_t is the nominal exchange rate. Domestic-currency bonds are used by the government to finance its deficit. R_t and R_t^f denote, respectively, the gross nominal domestic and foreign interest rates between t and $t+1$. The household also receives nominal lump-sum transfers from the government, T_t, as well as nominal profits $D_t = D_t^g + D_t^s + D_t^m$ from domestic producers of goods and services and from importers of intermediate goods.

Investment, $I_t(i)$, increases the household's stock of capital according to

$$K_{t+1} = (1-\delta)K(t) + I(t), \tag{3}$$

where $\delta \in (0,1)$ is the capital depreciation rate.

We assume that each household i sells in a monopolistically competitive market its labor supply, $N_t(i)$, to a representative, competitive firm that transforms it into aggregate labor input, N_t, using the following technology:

$$N_t = \left[\int_0^1 N_t(i)^{\frac{\sigma-1}{\theta}} di\right]^{\frac{\sigma}{\sigma-1}}, \tag{4}$$

where $\sigma > 1$ is defined as the constant elasticity of substitution (CES) between differentiated labor skills. The demand for individual labor by the labor aggregator firm is

$$N_t(i) = \left(\frac{W_t(i)}{W_t}\right)^{-\sigma} N_t, \tag{5}$$

[6] By following this functional form, the foreign bonds adjustment cost insures that the model has a unique steady state. If domestic and foreign interest rates are equal, the time paths of domestic consumption and wealth follow random walks. For an early discussion of this problem, see Giavazzi and Wyplosz (1984). Furthermore, for a comparison between this and alternative ways of closing a small open economy, see Schmitt-Grohé and Uribe (2003).

where W_t is the aggregate wage rate that is related to individual household wages, $W_t(i)$, via the relationship

$$W_t = \left[\int_0^1 W_t(i)^{1-\sigma} di\right]^{\frac{1}{1-\sigma}}. \tag{6}$$

Households face a nominal rigidity coming from a Calvo-type contract on wages. When allowed to do so, with probability $(1-d^w)$ each period, the household chooses the nominal-wage contract, $\tilde{W}_t(i)$, to maximize its utility.[7] Equation (14) below expresses its form in real terms. Otherwise, with probability d^w each period, the household keeps its nominal wage fixed at its value in period $t-1$.

The foreign nominal interest rate, R_t^f, and foreign inflation rate, π_t^f, are exogenous and evolve according to the following stochastic processes:

$$\log(R_t^f) = (1-\rho_{R^f})\log(R^f) + \rho_{R^f}\log(R_{t-1}^f) + \varepsilon_{R^f,t}, \tag{7}$$

$$\log(\pi_t^f) = (1-\rho_{\pi^f})\log(\pi^f) + \rho_{\pi^f}\log(\pi_{t-1}^f) + \varepsilon_{\pi^f,t}, \tag{8}$$

with ρ_{R^f} and $\rho_{R^f} \in (0,1)$. The serially uncorrelated shocks, $\varepsilon_{R^f,t}$ and $\varepsilon_{\pi^f,t}$, are normally distributed with zero means and standard deviations σ_{R^f} and σ_{π^f}, respectively.

Households also face a no-Ponzi-game restriction: $\lim_{T\to\infty}\left(\prod_{t=0}^{T}\frac{1}{\kappa_t R_t^f}\right)B_T^f(i) = 0$.

Household i chooses $C_t(i)$, $B_t(i)$, $B_t^f(i)$, $K_{t+1}(i)$, and $W_t(i)$ to maximize its lifetime utility subject to its budget constraint, Equation (2), the labor demand, Equation (5), the capital accumulation, Equation (3), and a no-Ponzi-game condition on its holdings of assets: $\lim_{T\to\infty}\left(\prod_{t=0}^{T}\frac{1}{R_t}\right)B_T(i) = 0$ and $\lim_{T\to\infty}\left(\prod_{t=0}^{T}\frac{1}{R_t^f}\right)B_T^f(i) = 0$. The first-order conditions for this problem are

$$\lambda_t(i) = \frac{1}{C_t(i)}, \tag{9}$$

$$\frac{\gamma}{m_t(i)} = \lambda_t(i)\left(1-\frac{1}{R_t}\right), \tag{10}$$

$$\frac{\lambda_t(i)}{R_t} = \beta \mathrm{E}_t \lambda_{t+1}(i)\frac{1}{\pi_{t+1}}, \tag{11}$$

[7] There will thus be a distribution of wages $W_t(i)$ across households at any given time t. We follow Christiano et al. (2005) and assume that there exists a state-contingent security that insures the households against variations in households' specific labor income. As a result, the labor component of households' income will be equal to aggregate labor income, and the marginal utility of wealth will be identical across different types of households. This allows us to suppose symmetric equilibrium and proceed with the aggregation.

$$s_t \mathrm{E}_t \frac{\pi^*_{t+1}}{\kappa_t R^*_t}\left[1+\varphi(b^f_t - b^f_{ss})\right] = \mathrm{E}_t \frac{s_{t+1}}{R_t}\pi_{t+1}, \tag{12}$$

$$\lambda_t(i) = \beta \mathrm{E}_t \lambda_{t+1}(i) \frac{\left[1 + q_{t+1} + \chi\left(\frac{I_{t+1}(i)}{K_{t+1}(i)} - \delta\right) - \delta + \frac{\chi}{2}\left(\frac{I_{t+1}(i)}{K_{t+1}(i)} - \delta\right)^2\right]}{1+\chi\left(\frac{I_t(i)}{K_t(i)} - \delta\right)}, \tag{13}$$

$$\widetilde{w}_t(i) = \frac{\sigma}{\sigma - 1}\frac{\mathrm{E}_t \sum_{q=0}^{\infty}(\beta d^w)^q N_{t+q}(i)^{\eta+1}}{\mathrm{E}_t \sum_{q=0}^{\infty}(\beta d^w)^q N_{t+q}(i)\lambda_{t+q}(i)\prod_{l=1}^{q}\frac{1}{\pi_{t+l}}}, \tag{14}$$

where lower-case letters are the real counterparts of the nominal variables explained before, except for s_t, which stands for the real exchange rate, and $\tilde{w}_t$ is the real wage contract.

3.2 Firms

Perfectly competitive firms produce services and goods. Services and goods producers can either sell their products to the domestic or foreign markets given a local currency denominated price. The final products are either produced domestically or imported by monopolistically competitive firms which in turn fix prices following a Calvo contract. It turns out that assuming price inertia in the importing sector is important to generate the commonly observed low exchange rate pass-through to local prices in the short run.

3.2.1 Services sector

Final service producers

The economy produces only one type of final service, $y_{s,t}$. There are many identical final service producers in any period t, with each producing only a fixed quantity of the final service which is normalized to one. There is a fixed cost, $\Phi \in (0,1)$, to enter the final service sector. Entry and exit under perfect competition will determine the volume of final service producers, Ω_t, in each period. The intermediate service for producing $y_{s,t}$ is x_t. Producing one unit of the final service requires a units of x_t, where a is a constant. Without loss of generality we can normalize a to one. Hence, the production function is simply $y_{s,t} = x_t$. Let $P_{s,t}$ and $P_{x,t}$ be the price of final service and input, respectively. A final service producer's profit maximization problem is:

$$\max_{x_t} P_{s,t}x_t - P_{x,t}x_t$$

This yields the demand for input:

$$x_t = \begin{cases} 1 & \text{if } P_{s,t} \geq P_{x,t}; \\ 0 & \text{if } P_{s,t} < P_{x,t}. \end{cases} \tag{15}$$

Real profit in each period for each producer is given by:

$$D_t^s = \begin{cases} p_{s,t} - p_{x,t} & \text{if } P_{s,t} \geq P_{x,t}; \\ 0 & \text{if } P_{s,t} < P_{x,t}. \end{cases} \tag{16}$$

where $p_{s,t} = \frac{P_{s,t}}{P_t}$ and $p_{x,t} = \frac{P_{x,t}}{P_t}$.

In each period, the aggregate supply of output, Y_t^s, is determined by the number of firms and is equal to $\int_0^\Omega y_{s,t} di = \Omega y_{s,t}$, and the aggregate demand for input is $\int_0^\Omega x_t di = \Omega x_t$.

In each period, there are potentially infinite entrants which make the final good industry perfectly competitive. The one-time fixed entry cost, Φ, is paid in terms of the final good. After entry, each firm faces a stochastic probability of exit, $\theta_t \in (0, 1)$. We assume that firms must wait one period to produce output after entry owing to time-to-build. The value of a firm in period t is then determined by:

$$V_t = \beta E_t \frac{\lambda_{t+1}}{\lambda_t} D_{t+1}^s + E_t \sum_{j=1}^{\infty} \beta^{t+j} \left[\prod_{i=1}^{j} (1 - \theta_{t+i}) \right] \frac{\lambda_{t+j+1}}{\lambda_{t+j}} D_{t+j+1}^s$$

We can also write this equation recursively as

$$V_t = \beta E_t \frac{\lambda_{t+1}}{\lambda_t} \left(D_{t+1}^s + (1 - \theta_{t+1}) V_{t+1} \right) \tag{17}$$

Free entry then implies $V_t = \Phi$. The evolution of the number of final service producers is

$$\Omega_{t+1} = (1 - \theta_t)\Omega_t + g_t; \tag{18}$$

where g_t is the number of new entrants in period t.

Intermediate service producers

The intermediate good market is also perfectly competitive. For simplicity, we assume there are no costs to enter this market. The production function of a representative producer of the intermediate good is

$$X_t = A_{s,t} (Y_{g,t}^s)^{\xi^s} \left[(K_{s,t})^{\alpha^s} (N_{s,t})^{1-\alpha^s} \right]^{1-\xi^s}, \tag{19}$$

where $A_{s,t}$ stands for total-factor-productivity (technology) shocks, $K_{s,t}$ and $N_{s,t}$ stand for capital and labor, and $Y_{s,t}^g$ is the quantity of goods used in the production of services. Note that the aggregate output is determined by the number of final service producers in equilibrium, $Y_{s,t} = \Omega_t$, which in turn is also the total demand for intermediate service, $\Omega_t = X_t$.

As mentioned earlier, services can be consumed locally, used as an intermediate input for goods production, and exported. Hence, the maximization problem for intermediate firm is

$$\max_{N_t^s, K_t^s, Y_{s,t}^g} p_{x,t} X_t - w_t N_{s,t} - q_t K_{s,t} - p_{b,t} Y_{b,t}^s,$$

given

$$X_t = A_{s,t} (Y_{s,t}^g)^{\xi^s} \left[(K_{s,t})^{\alpha^s} (N_{s,t})^{1-\alpha^s} \right]^{1-\xi^s}.$$

The intermediate service producers' first order conditions are as follows

$$\frac{w_t}{p_{x,t}} = (1-\xi^s)(1-\alpha_s) \frac{X_t}{N_{s,t}}, \tag{20}$$

$$\frac{q_t}{p_{x,t}} = (1-\xi^s)\alpha_s \frac{X_t}{K_{s,t}}, \tag{21}$$

$$\frac{p_{g,t}}{p_{x,t}} = \xi^s \frac{X_t}{Y_{g,t}^s}. \tag{22}$$

At each period t the supply of final services is equal to local and foreign demand. This implies the following

$$Y_{s,t} = Y_{s,t}^d + Y_{s,t}^f + Y_{s,t}^g, \tag{23}$$

where $Y_{s,t}^d$ is the domestic consumption of services, $Y_{s,t}^f$ corresponds to services exports, and $Y_{s,t}^g$ is the quantity of services used as inputs in the production of final goods.

The foreign demand for locally produced services is as follows:

$$Y_{s,t}^f = (s_t p_{s,t})^{-\mu^f} \omega^s Y_t^f, \tag{24}$$

where μ^f captures the elasticity of substitution between the exported services and foreign-produced services in the consumption basket of foreign consumer, Y_t^f is total revenue in the foreign economy, and ω^s is the share of services in total demand of the rest of the world. Y_t^f is exogenously given following the stochastic processes

$$\log(Y_t^f) = (1-\rho_{Y^f}) \log(Y^f) + \rho_{Y^f} \log(Y_{t-1}^f) + \varepsilon_{Y^f,t},$$

with $0 < \rho_{Y^f} < 1$. The serially uncorrelated shock, $\varepsilon_{Y^f,t}$, is normally distributed with zero mean and finite standard deviation σ_{Y^f}.

3.2.2 Goods sector

Domestic firms producing goods have to solve a similar problem, except that there is a free costless market entry and exit.

The production function is as follows:

$$Y_{g,t} = A_{g,t}(Y_{s,t}^{g})^{\xi^g} \left[(K_{g,t})^{\alpha^g}(N_{g,t})^{1-\alpha^g}\right]^{1-\xi^g}. \tag{25}$$

At each period t the supply of final services is equal to local and foreign demand. This implies the following

$$Y_{g,t} = Y_{g,t}^{d} + Y_{g,t}^{f} + Y_{g,t}^{s}, \tag{26}$$

where $Y_{g,t}^{d}$ is the domestic consumption of goods, $Y_{g,t}^{f}$ corresponds to goods exports, and $Y_{g,t}^{s}$ is the quantity of goods used as inputs in the production of final services. Consequently, the representative final-good producing firm's first order conditions are

$$\frac{w_t}{p_{g,t}} = (1-\xi^g)(1-\alpha_g)\frac{Y_{g,t}}{N_{g,t}}, \tag{27}$$

$$\frac{q_t}{p_{g,t}} = (1-\xi^g)\alpha_g\frac{Y_{g,t}}{K_{g,t}}, \tag{28}$$

$$\frac{p_{s,t}}{p_{g,t}} = \xi^g\frac{Y_{g,t}}{Y_{s,t}^{g}}. \tag{29}$$

The foreign demand for locally produced goods is as follows:

$$Y_{g,t}^{f} = \left(s_t p_{g,t}^{f}\right)^{-\mu^f} \omega^g Y_t^{f}, \tag{30}$$

where ω^g is the share of goods in total foreign demand.

3.2.3 Imported-goods and services sector

Finally, there is a representative goods and services importing firm, which operates in a market with perfect competition. The production of the composite imported product, Y_t^m, yields a combination of imported goods and services. In each period, the importer sets the quantity for imported goods to maximize its profits, D_t^m, taking the price of imported products, P_t^m, as given. The firm solves the following problem

$$\max_{\{Y_t^m\}} D_t^m = \left(P_t^m - e_t P_t^f\right) Y_t^m. \tag{31}$$

Note that the marginal cost of the importing firm is $e_t P_t^f$ and thus its real marginal cost is the real exchange rate $s_t \equiv \frac{e_t P_t^f}{P_t}$.[8] The first-order condition is

$$\frac{P_t^m}{P_t} = s_t. \tag{32}$$

3.2.4 Final product aggregators

The final domestically produced product, Y_t^d, is produced by a competitive firm that combines domestically produced consumable services, $Y_{s,t}^d$, and domestically produced consumable goods, $Y_{g,t}^d$, using the following CES technology:

$$Y_t^d = \left[n^{\frac{1}{\phi}} (Y_{s,t}^d)^{\frac{\phi-1}{\phi}} + (1-n)^{\frac{1}{\phi}} (Y_{g,t}^d)^{\frac{\phi-1}{\phi}} \right]^{\frac{\phi}{\phi-1}}, \tag{33}$$

where $n > 0$ is the share of services in the domestically produced consumable services at the steady state, and $\phi > 0$ is the elasticity of substitution between services and goods. Let's define $P_{d,t}$ as the price of the aggregate product Y_t^d and $p_{d,t} = \frac{P_{d,t}}{P_t}$ its real value. Profit maximization entails

$$Y_{s,t}^d = n \left(\frac{p_{s,t}}{p_{d,t}} \right)^{-\phi} Y_t^d, \tag{34}$$

and

$$Y_{g,t}^d = (1-n) \left(\frac{p_{g,t}}{p_t^d} \right)^{-\phi} Y_t^d. \tag{35}$$

Furthermore, the domestically produced consumable product real price, p_t^d, is given by

$$p_t^d = \left[n(p_{s,t})^{1-\phi} + (1-n)(p_{g,t})^{1-\phi} \right]^{1/(1-\phi)}.$$

Finally, we aggregate domestic and imported goods using a CES function as follows:

$$Z_t = \left[m^{\frac{1}{\nu}} (Y_t^d)^{\frac{\nu-1}{\nu}} + (1-m)^{\frac{1}{\nu}} (Y_t^m)^{\frac{\nu-1}{\nu}} \right]^{\frac{\nu}{\nu-1}}, \tag{36}$$

where $m > 0$ is the share of domestic products in the final-goods and services basket at the steady state, and $\nu > 0$ is the elasticity of substitution between domestic and imported products. The first-order conditions are

$$Y_t^d = m \left(p_t^d \right)^{-\nu} Z_t, \tag{37}$$

and

$$Y_t^m = (1-m) \left(p_t^m \right)^{-\nu} Z_t. \tag{38}$$

[8] For convenience, we assume that the price in foreign currency of all imported intermediate products is P_t^f, which is also equal to the foreign price level.

where the real price indexes p_t^d and p_t^m are defined as $\frac{P_t^d}{P_t}$ and $\frac{P_t^m}{P_t}$, respectively. The final-good price, P_t, which corresponds to the CPI, is given by

$$P_t = \left[m(P_t^d)^{1-\nu} + (1-m)(P_t^m)^{1-\nu}\right]^{1/(1-\nu)}.$$

3.3 The government

The government budget constraint is given by

$$T_t + Bd_{t-1} = M_t - M_{t-1} + \frac{Bd_t}{R_t}. \tag{39}$$

In the following we make sure that we take into consideration the heterogenous policy design for the conduct of monetary policy. In the case of Tunisia, we assume that the monetary authority sets the short-term nominal money growth rate, $\zeta_t = \frac{M_t}{M_{t-1}}$, partially to stabilize the nominal exchange rate fluctuations with the intention of maintaining a desired level of competitiveness in foreign markets in accordance with the following exogenous rule:

$$\log(\zeta_t) = \rho_\zeta \log(\zeta_{t-1}) - \rho_e \log\left(\frac{e_t}{e_{t-1}}\right) + \varepsilon_{\zeta,t}, \tag{40}$$

where $\rho_\zeta \in (0,1)$, $\rho_e \geq 0$, and the stochastic shock term $\varepsilon_{\zeta,t}$ is iid normal with a zero mean and a standard deviation of σ_ζ.

The European Central Bank is assumed to follow an alternative policy which aims to target inflation rate as specified in a standard Taylor rule. More specifically, we use the following rule for the Euro Area

$$\hat{R}_t = \rho_R \hat{R}_{t-1} + (1-\rho_R)\left[\rho_\pi \hat{\pi}_t + \rho_y \hat{y}_t\right] + \varepsilon_{\zeta,t}, \tag{41}$$

where hatted variables denote log-deviations of stationary variables from their steady-state values.

3.4 Closing the model

Aggregate output, Z_t, is used for consumption, investment, and for covering the costs of adjusting capital and foreign bonds

$$Z_t = C_t + I_t + CAC_t + BAC_t. \tag{42}$$

The gross domestic product is

$$Y_t = Y_{s,t} + Y_{g,t}. \tag{43}$$

The current account equation follows

$$s_t \frac{b_t^f}{R_t^f} = s_t \frac{b_{t-1}^f}{\pi_{t+1}^*} + p_{s,t} Y_{s,t}^f + p_{g,t} Y_{g,t}^f - p^{m,t} Y_t^m. \tag{44}$$

Finally, sectoral hours and sectoral capital stocks simply sum to the aggregate hours and capital offered by households, respectively:

$$N_{s,t} + N_{g,t} = N_t, \tag{45}$$

and

$$K_{s,t} + K_{g,t} = K_t. \tag{46}$$

3.5 The steady state and identification

In order to understand the effect of trade liberalization in the present context, we analyze the sensitivity of the steady-state values of some key variables. The policy instrument to reach free trade in services is the parameter Φ governing the share of entry-sunk costs in output. Assuming a non-stochastic environment—variables are at their steady states—it is relatively easy to disentangle the impact of Φ on the long term values of the relative price of services. In particular, taking the first-order conditions of the model at the steady state and solving for the relative price of services, p_s, yield the following non-linear equation

$$\left[\frac{1-n\left(p_s\right)^{1-\phi}}{1-n}\right]^{\frac{1}{1-\phi}A} \left(p_s\right)^B \left[p_s - \Phi\left(\frac{1}{\beta}-1-\theta\right)\right]^C = D, \tag{47}$$

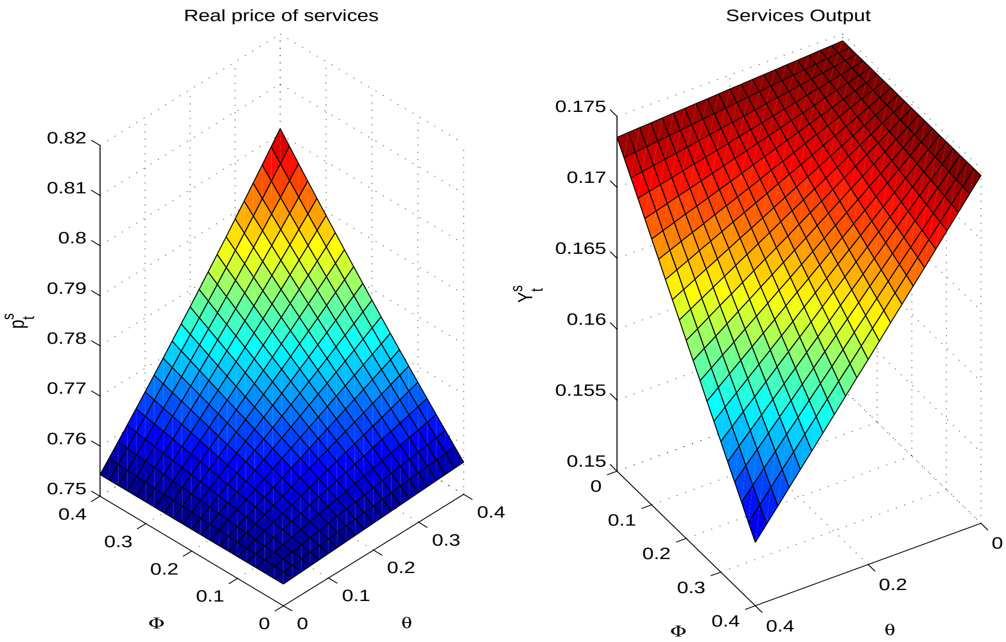
where A, B, C, and D are scalars that depend on a subset of structural parameters, which can be expressed as

$$\begin{aligned}
A &= \frac{1}{1-\alpha^g} + \frac{\xi^g}{(1-\alpha^g)(1-\xi^g)} + \frac{\xi^s}{(1-\alpha^s)(1-\xi^s)},\\
B &= \frac{-\xi^g}{(1-\alpha^s)(1-\xi^g)},\\
C &= -\frac{1}{1-\alpha^g} - \frac{\xi^s}{(1-\alpha^s)(1-\xi^s)},\\
D &= \frac{1-\xi^s}{1-\xi^g}\,\frac{1-\alpha^s}{1-\alpha^g}\,\frac{(\xi^g)^{-\frac{\xi^g}{(1-\alpha^g)(1-\xi^g)}}}{(\xi^s)^{-\frac{\xi^s}{(1-\alpha^s)(1-\xi^s)}}}\,\frac{[(1-\xi^g)\alpha^g]^{-\frac{\alpha^g}{1-\alpha^g}}}{[(1-\xi^s)\alpha^s]^{-\frac{\alpha^s}{1-\alpha^s}}}\left(\frac{1}{\beta}-1-\delta\right)^{\frac{\alpha^g}{1-\alpha^s}+\frac{\alpha^s}{1-\alpha^s}}
\end{aligned}$$

We numerically solve the polynomial and represent in Figure 1 values of the real price and production of services with respect to alternative calibrations of the share of entry-sunk costs in services output, Φ, and the probability of business failure, θ.[9] As expected, a high value of Φ yields a relatively high price for services at the steady-state equilibrium and the production level of services declines.

[9]The simulations are conducted based on an initial calibration of some structural parameters. Namely, ξ^s and ξ^g are calibrated based on the input-output matrix in Tunisia and correspond to 0.59 and 0.12, respectively; both shares of capital in sectoral production functions, α^s and α^g, correspond to 0.35; the share of services in total output, n, is set to 0.4; the subjective discount factor, β, is equal to 0.985; and the depreciation rate, δ, is chosen to be 0.025

Figure 1: The steady state: A sensitivity analysis



The features of the steady state highlighted above may reveal the importance of using data specific to services sector to identify the importance of entry-sunk costs. On the other hand, Equation (47) shows the challenging identification of both parameters Φ and θ. This is particularly clear when the discount factor, β, is set to 1. The same result shows in Figure 1 where the share of the entry cost and the probability of business failure virtually have the same effect on the steady-state values of sectoral variables. This identification issue is difficult to resolve using macro data alone, but micro data should provide some help. As a consequence, in the following section we solely focus on the identification of the parameter Φ; then, we do some sensitivity analysis with respect to the parameter θ.

4 Estimation

4.1 Estimation methodology and data

The model is estimated using Bayesian techniques that update prior distributions for the deep parameters which are defined according to a reasonable calibration. The estimation is done using recursive simulation methods, more specifically the Metropolis-Hastings algorithm, which has been applied to estimate similar dynamic stochastic general-equilibrium models in the literature, such as Schorfheide (2000) and Smets and Wouters (2003). Let Y^T be a set of observable data while θ denotes the set of parameters to be estimated. Once the model is log-linearized and solved, its state-space representation can be derived and the likelihood function, $L(\theta|Y^T)$, can be evaluated using the Kalman filter. The Bayesian approach places a prior distribution $p(\theta)$ on parameters and updates the prior through the likelihood function. Bayes' Theorem provides the posterior distribution of θ:

$$p(\theta|Y^T) = \frac{L(\theta|Y^T)p(\theta)}{\int L(\theta|Y^T)p(\theta)d\theta}.$$

Markov Chain Monte Carlo methods are used to generate the draws from the posterior distribution. Based on the posterior draws, we can make inference on the parameters. The marginal data density, which assesses the overall fit of the model, is given by:[10]

$$p(Y^T) = \int L(\theta|Y^T)p(\theta)d\theta.$$

The model has six structural shock processes: two sector-specific technology shocks—to the services sector and the goods sector; a monetary policy shock; a risk premium shock; and three foreign shocks—to demand, inflation, and interest rates. In addition, measurement errors on each of the observable variables are added. To identify the shock processes during the estimation, we need to use at most the same number of actual series. We choose the observables to be as informative as possible. In particular, for Tunisia and the Euro Area, we estimate the model using six variables: real gross domestic product, real domestic service production, consumer price index inflation, services price index inflation, real imports, and the effective real exchange rate. Real quantities are defined in per capita terms. The real effective exchange rate is constructed by multiplying the nominal effective exchange rate, defined as the price of one unit of the local currency dinar terms of a weighted average of trade partners' currencies, by the ratio of the rest of the world's CPI to the local CPI. All variables are seasonally adjusted and the sample period extends from 2000Q1 through 2010Q4 for both Tunisia and the Euro Area.[11] To maintain consistency with the theoretical model, which involves stationary variables, we transform all series into percentage deviations from a trend obtained with the Hodrick-Prescott filter.

[10]The marginal data densities are approximated using the harmonic mean estimator that is proposed by Geweke (1999).

[11]The sample coverage for some variables such as real gross domestic production, CPI inflation, and real exchange rate can be extended; however, sectoral variables are only available starting from 2000Q1.

4.2 Calibration and prior distributions

Some parameter values are taken as fixed rather than given a prior distribution that will be updated with the data; we calibrate them to values similar to those found in the literature. Starting with the parameters which exhibit the same calibration for Tunisia and the Euro Area, the subjective discount rate, β, is set to 0.985, which implies that the annual real interest rate is equal to 6 percent in the deterministic steady state as observed in the Tunisian data. The preference parameter μ is chosen so that the fraction of hours worked in the deterministic steady state is equal to 0.25. The depreciation rate, δ, is chosen to be 0.025 implying an average annual depreciation rate of capital equal to 10 percent. The elasticity of substitution between intermediate labor skills, ς, is set to 6 implying a markup of 20 percent in the deterministic steady state, which lies between the estimates of the empirical literature (see, for example Basu, 1995). With regard to the probability of business failure, θ, we set its value to 10 percent as in Ghironi and Melitz (2005).[12] Asymmetric calibration concerns the parameters affecting the interrelation between the two sectors with respect to their production structures. In particular, we use average sectoral weights reported in the input-output matrices of 2000 and 2005 for Tunisia. Consequently, the share of goods input in the production of services, ξ^s, is set to 0.12; and the share of services input in the production of goods, ξ^g, is set to 0.59. Turning to the average sectoral weights in the Euro Area, we calibrate them based on the weighted average of the same parameters based on country specific input-output matrices. Results reveal a much less integration between services and goods sectors in the Euro Area, with ξ^s and ξ^s equal to 0.10 and 0.19, respectively.

The third and fourth columns of Table 1 present the mean and standard deviation of the prior distributions, together with their respective densities and ranges. The shapes of the densities are selected to match the domain of the structural parameters, and we deduct the prior mean and distribution from previous studies. The prior mean for the variance of the stochastic components are assumed to have an Inverse Gamma distribution with a degree of freedom equal to 4. We use this distribution because it delivers positive values with a rather large domain. The prior distribution of the autoregressive parameters of the shocks is a Beta distribution that covers the range between 0 and 1. For the other parameters we use prior means that are commonly used in the literature and allow for a reasonable range of possible alternative values. Although, some remarks are worth noticing with respect to asymmetric prior distributions in the cases of Tunisia and the Euro Area. Thus, the parameter governing the extent of the loss in production following a

[12] When included in the set of estimated parameters, θ exhibits a posterior distribution which seems to be virtually the same as the prior distribution implying that observed data do not offer information on the value of that particular parameter.

decision to enter services market, Φ, exhibits a prior mean of 0.35 and 0.10 in Tunisia and the Euro Area, respectively. In the case of Tunisia we consider the financial services sector as a reference. In particular, the level of monetary intermediation in the banking system is about one-third lower than in comparable countries (see Bahlous and Nabli, 2003); further, the estimation of the cost inefficiencies in the financial sector are about the same amount (see Goaied, 1999). In the case of the Euro Area the entry-sun cost corresponds to the value commonly assumed in the literature for a developed country as proposed by Ghironi and Melitz (2005). Finally, the parameters in the Taylor rule for the Euro Area have prior means which are similar to the adopted values in Smets and Wouters (2003), which are standard.

4.3 Estimation results

The four last columns of Table 1 show the posterior means of the structural parameters together with their 90 percent confidence intervals for Tunisia and the Euro Area.

In the case of Tunisia, looking first at the parameters describing capital and foreign bonds dynamics, the posterior means of the parameter of the capital and foreign bonds adjustment costs, χ and φ, are equal to 14.5986 and 0.0009, respectively. Foreign bonds adjustment costs appear to be quite low and comparable to what the literature generally assumes for developed countries (Schmitt-Grohé and Uribe, 2003, assume φ to be equal to 0.0007 for the U.S.). The estimate of posterior averages of α^s and α^g, measuring capitals share in the production functions of services and goods, equal 0.2516 and 0.3225, respectively. As expected, the services sector exhibits a relatively reduced share of capital. Therefore, services and goods are heterogenous in terms of labor intensity.

Turning next to the parameters of the aggregated products, the posterior means of the share of services in total domestic products and their elasticity of substitution with goods are 0.4596 and 1.6674, respectively. This shows some complementarity between goods and services. The posterior means of the share of locally produced goods and services in total available products and their elasticity of substitution with imported goods and services are 0.5143 and 1.2073, respectively. Also, locally produced and imported goods and services tend to be complements.

Concerning the parameter Φ, controlling the extent to which the distortion yielded by costly entries and exits are significant, posterior means are equal to 1.5812 and 0.3567, respectively. Besides, the size of the entry cost, Φ, is sizeable once compared to estimated values for developed countries.[13] Substantive welfare gains following the abolition of trade barriers are expected in view of the estimated high distortion in the services sector.

The posterior means of the Calvo parameter on the frequency of wage negotiations, d_w, is equal

[13] The parameter Φ take the value of 0.10 for the United States economy as suggested by Wang and Wen (2011).

Table 1: Estimated Parameters

Parameter	Prior distribution			Posterior distribution			
				Tunisia		Euro Area	
	Distribution	Mean	std.dev./df	Mean	90% interval	Mean	90% interval
χ	Gamma	10	4	14.5986	[8.7919, 21.5153]	4.4948	[0.6065, 9.8272]
φ	Normal	0.0025	0.0015	0.0009	[0.0001, 0.0015]	0.0010	[0.0003, 0.0017]
α^s	Beta	0.25	0.1	0.2516	[0.1010, 0.4079]	0.2457	[0.1007, 0.3838]
α^g	Beta	0.35	0.1	0.3225	[0.1693, 0.4788]	0.2277	[0.1090, 0.3380]
n	Beta	0.4	0.1	0.4596	[0.3634, 0.5556]	0.5403	[0.4565, 0.6203]
ϕ	Normal	1.25	0.25	1.6674	[1.2850, 2.0601]	1.3788	[0.9941, 1.7372]
m	Beta	0.6	0.1	0.5143	[0.4213, 0.6027]	0.5398	[0.4774, 0.6071]
ν	Normal	1.25	0.25	1.2073	[0.9246, 1.4948]	1.7819	[1.5417, 2.0277]
μ^f	Normal	1.25	0.25	1.0655	[0.6427, 1.4988]	1.2920	[0.8821, 1.6810]
Φ *	Beta	0.35/0.10	0.1/0.05	0.3156	[0.2384, 0.3960]	0.0878	[0.0175, 0.1551]
d^w	Beta	0.5	0.15	0.6531	[0.4402, 0.9174]	0.7310	[0.6533, 0.8200]
$\rho_{A,s}$	Beta	0.5	0.15	0.6132	[0.4643, 0.7576]	0.8531	[0.7982, 0.9100]
$\rho_{A,g}$	Beta	0.5	0.15	0.5733	[0.3982, 0.7708]	0.9637	[0.9456, 0.9832]
ρ_ζ	Beta	0.5	0.15	0.1179	[0.0349, 0.2006]	—	—
ρ_e	Beta	0.85	0.15	1.2066	[0.9873, 1.4291]	—	—
ρ_R	Beta	0.5	0.15	—	—	0.5974	[0.4970, 0.7003]
ρ_π	Normal	1.5	0.5	—	—	1.1427	[1.0238, 1.2534]
ρ_y	Normal	0.25	0.1	—	—	−0.0824	[−0.1146, −0.0484]
ρ_{y^f}	Beta	0.5	0.15	0.5595	[0.3858, 0.7312]	0.8469	[0.7704, 0.9276]
ρ_{π^f}	Beta	0.5	0.15	0.4583	[0.2141, 0.6962]	0.3823	[0.1815, 0.5885]
ρ_{R^f}	Beta	0.5	0.15	0.4856	[0.2976, 0.6791]	0.4387	[0.2527, 0.6316]
$\sigma_{A,s}$	Inv-Gamma	0.01	4	0.0123	[0.0080, 0.0165]	0.0041	[0.0031, 0.0051]
$\sigma_{A,g}$	Inv-Gamma	0.01	4	0.0152	[0.0121, 0.0182]	0.0081	[0.0064, 0.0098]
σ_ζ	Inv-Gamma	0.01	4	0.0267	[0.0210, 0.0320]	0.0017	[0.0013, 0.0021]
σ_{y^f}	Inv-Gamma	0.01	4	0.0163	[0.0077, 0.0221]	0.0075	[0.0051, 0.0098]
σ_{π^f}	Inv-Gamma	0.01	4	0.0030	[0.0013, 0.0047]	0.0024	[0.0011, 0.0035]
σ_{R^f}	Inv-Gamma	0.01	4	0.0058	[0.0032, 0.0083]	0.0015	[0.0010, 0.0020]
Marginal log-likelihood				685.3018		1009.7035	

* The prior distribution for the entry-sunk cost parameter is assumed to be different for Tunisia and the Euro Area. The first (second) numbers in columns 3 and 4 correspond to the parameters of the prior distribution for Tunisian (the Euro Area).

to 0.6531. This value implies an average frequency of wage negotiations of two to three quarters. The high degree of price inertia reflects a low degree of exchange rate pass-through to local prices in Tunisia as shown by Ambler et al. (2003). These results are in line with the empirical literature on the frequency of wage and price adjustments (e.g., Bils and Klenow, 2004; Dickens et al., 2007).

Regarding the estimates of the monetary rule parameters, the posterior mean of the interest rate response to nominal exchange rate fluctuations, ρ_e, is equal to 1.2066, which indicates an aggressive exchange rate targeting. The posterior mean of the degree of money growth rate smoothing, ρ_ζ, equal to 0.1179 suggesting a mild degree of money growth rate inertia. Furthermore, The estimates of other exogenous processes show reasonable persistence for most shocks to the model and observed data seem to be informative about their persistence and standard deviations.

For the sake of saving space, we only focus on some key parameters relative to the Euro Area. The posterior mean of the share of lost output in services due to entry-sunk costs, ϕ, is 0.0878. This low value of entry costs corroborates the existing calibration, $\phi = 0.10$,adopted in the literature for the developed countries. This value is considered in our paper as a benchmark for physical entry costs to services market, which are not under the control of the government. Finally, our estimation delivers plausible parameters for the short-run reaction function of the monetary authorities, broadly in line with those proposed by Taylor (1993).

5 Quantitative results

5.1 Business cycle statistics

One way to assess the performance of our benchmark model is to look at its ability to match a fairly comprehensive set of stylized facts. Table 2 compares business-cycle statistics taken from the data with those predicted by the estimated model. The time series are detrended using the B-P filter as in the estimation procedure. The estimated benchmark model provides a good match on several dimensions of the data. In particular, it has interesting implications for the dynamics of the sectoral productions. The model accounts very well for both relative volatilities and correlations between sectoral outputs. Notice that the model accurately predicts that the volatility of services is about the same as that of the aggregate output, while imports are significantly more volatile (7.90 times larger in the model, while they are found to be 6.12 times larger in the data). Also, the correlation between produced services (imports) and aggregate production in the benchmark model is equal to 0.66 (0.30), while according to the data it corresponds to 0.81 (0.58). In contrast, the benchmark model fails in reproducing the relative volatility of real exchange and output, predicting a ratio of 2.78 compared with 1.09 in the data despite the relatively high degree of monetary policy reaction to nominal exchange rate fluctuations. A different picture emerges when we look at the correlations between the real exchange rate and output and sectoral inflation rates, which are well replicated by the model.

Table 2: Second order moments

Moment	Data	Model
$\frac{std(Y_{s,t})}{std(Y_t)}$	1.01	0.94 [0.66,1.32]
$\frac{std(Y_t^m)}{std(Y_t)}$	7.90	6.12 [2.80,10.60]
$\frac{std(\pi_{s,t})}{std(\pi_t)}$	1.26	1.32 [1.01,1.70]
$\frac{std(s_t)}{std(Y_t)}$	1.09	2.78 [1.22,4.90]
$corr(Y_t, Y_{s,t})$	0.81	0.66 [0.36,0.94]
$corr(Y_t, Y_{m,t})$	0.58	0.30 [−0.09,0.87]
$corr(Y_t, \pi_t)$	−0.04	−0.05 [−0.14,0.03]
$corr(Y_t, \pi_{s,t})$	0.38	−0.05 [−0.22,0.13]
$corr(Y_t, s_t)$	−0.56	−0.10 [−0.81,0.35]
$corr(\pi_t, \pi_{s,t})$	0.39	0.81 [0.73,0.88]
$corr(\pi_t, s_t)$	0.15	0.02 [−0.04,0.11]
$corr(\pi_{s,t}, s_t)$	−0.29	−0.09 [−0.08,0.02]

5.2 Variance decomposition

To understand the extent to which cyclical movements of each variable are explained by the shocks, Table 3 reports the average asymptotic variance decomposition for the model with their 90 percent confidence intervals. Entries show that the rest of the world's shocks explain approximately the third of output fluctuations in Tunisia. Foreign demand shocks are the main drivers of fluctuations in aggregate quantities and prices except services which, are mostly explained by their corresponding sector-specific technology shocks. This result suggests that services sector is less integrated into the rest of the world's economy mainly due to the important estimated trade barriers. Finally, it is interesting to note that the effect of foreign shocks is sizeable for the real exchange rate—almost half of the fluctuations—while the contribution of domestic shocks is limited. This result is quite common in the case of small open economies.

Table 3: Variance decomposition

Variable	ε_s	ε_g	ε_ζ	ε_{y^f}	ε_{π^f}	ε_{R^f}
Y_t	16.27 [5.44,34.91]	40.19 [19.43,60.95]	7.20 [0.30,37.21]	31.68 [11.01,55.18]	0.76 [0.03,5.06]	0.66 [0.16,2.41]
$Y_{s,t}$	53.70 [21.36,86.02]	7.68 [0.68,32.97]	13.10 [0.45,53.55]	17.63 [1.15,50.86]	1.54 [0.06,8.67]	1.33 [0.51,2.86]
$Y_{g,t}$	2.50 [0.21,12.75]	59.59 [30.96,86.23]	3.09 [0.20,21.25]	31.97 [6.53,59.86]	0.25 [0.01,1.77]	0.30 [0.02,1.95]
Y_t^m	11.79 [3.49,27.34]	19.18 [1.25,54.66]	8.91 [0.14,62.11]	48.61 [8.90,77.43]	0.88 [0.02,6.58]	5.22 [1.02,15.39]
C_t	11.64 [3.76,26.69]	19.76 [2.21,54.00]	8.52 [0.16,59.21]	50.75 [10.43,78.37]	0.85 [0.03,6.20]	3.48 [0.71,10.60]
I_t	12.17 [5.16,24.84]	22.32 [6.25,49.02]	6.25 [0.22,34.76]	37.67 [6.33,64.38]	1.96 [0.08,11.64]	15.22 [2.00,35.67]
π_t	4.43 [2.18,8.35]	14.45 [4.01,28.23]	58.67 [42.56,74.24]	7.40 [0.53,17.80]	1.67 [0.34,5.64]	12.14 [5.29,21.02]
s_t	14.64 [5.37,30.49]	24.44 [2.90,58.46]	9.78 [0.23,63.17]	41.74 [6.98,70.43]	0.66 [0.02,5.37]	3.85 [0.99,9.29]

5.3 Impulse-response functions

We now examine the dynamic effects of supply and demand shocks changes in the benchmark model. Figure 1 displays a selection of impulse-response functions to a positive 1 percent shock on services sector technology, goods sector technology, money supply, and foreign demand, separately. There are many interesting features with the estimated impulse response functions worth noting.

At first glance, one can notice that the responses of goods and services are significantly different, not only following idiosyncratic shocks but also given aggregate shocks. This result is a dramatic illustration of our claim that the two sectors are heterogenous.

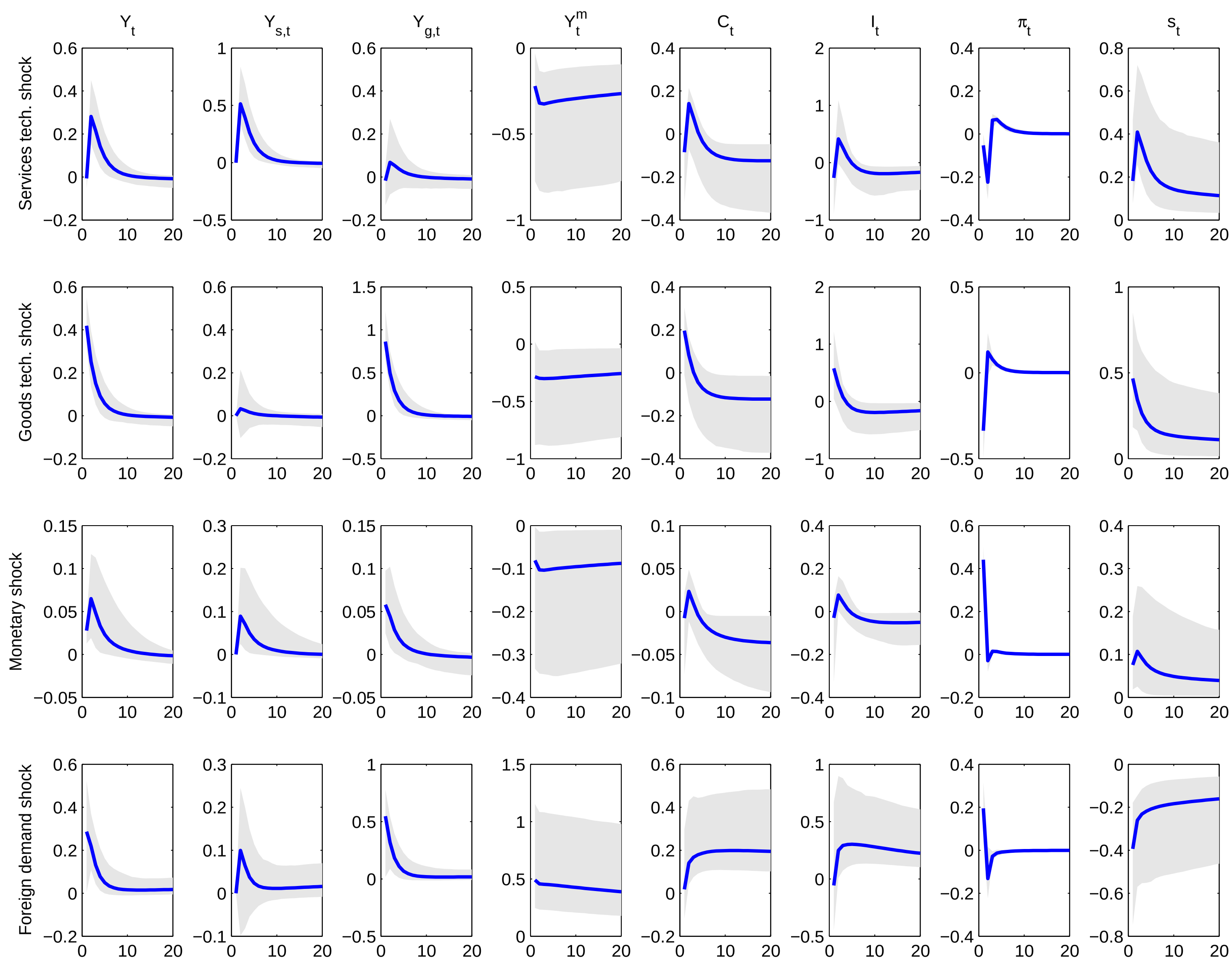
The first row in Figure 1 shows that in reaction to a 1 percent neutral technology shock in the services sector output rises and prices and inflation fall. The increase in output is delayed because of the time-to-build assumption imposed to new entering firms. The production of final goods also rises following the shock owing to the decline in services' relative price . At the same time, imports' relative price becomes higher and consumers substitute demand for imported goods and services toward locally produced goods and services inducing a drop in aggregate imports. The positive technology shock pushes down the nominal exchange rate (i.e., appreciation); however, the combined effect of exchange rate stabilization and the decline in domestic prices yields a real depreciation of the exchange rate. Finally, the real exchange rate depreciation implies a delayed decline in consumption and investment arguing for the presence of the expenditure switching effect. As a consequence, the decline in imports is exacerbated.

The second row in Figure 1 represents the responses to a positive one-period technology shock in the goods sector only. Similarly to the previous shock, increased production in the goods sector raises demand throughout the economy and therefore increases services and aggregate outputs, as well. Prices in the goods sector fall on impact, leading to a drop in overall inflation and an appreciation of the local currency, which in turn causes an expansionary reaction of the monetary policy that feeds into a further increase of demand and causes a real depreciation on impact. Again, a statistically significant expenditure switching effect is observed following this shock as well.

In other similar studies, the monetary policy shock causes a rise in the nominal money supply, and an increase in both inflation and output. However, in the present model in reaction to the same shock, the impact increase in demand does not reflect a stimulation of the production activity. The intuition is straightforward. The first round effect of the monetary shock is an increase in demand, which is then reflected in higher prices and a depreciation of the nominal exchange rate. Assuming price rigidity, inflation increases slightly and the real exchange rate overshoots compared to the frictionless version of the model. The real depreciation discourages consumption and investment and consequently negatively reflects in the production activity in every sector—services, goods, and imports. The difference between the first and the second round effects of an expansionary monetary shock determines the sign of real quantities' responses. It turns out that the second round effect is stronger following the estimation of the model's deep parameters and sectoral output, consumption, and investment decline following the shock. It is noticeable that the response of services production is flat, reflecting the additional demand effect from the goods service as another propagation channel of the monetary shock. In addition, the delayed response of services, owing to the time-to-build assumption, prevents services from declining as much as goods.

The foreign demand shock accounts for a substantial amount of the cyclical behavior of consumption, as reported earlier. Following a positive shock, quite naturally, sectoral producers increase goods and services and the additional revenue serves to finance the desired increase in consumption and investment. The habit persistence and capital adjustment costs generate the persistent responses of consumption and investment, respectively. As a consequence, real imports increase and the real exchange rate declines reflecting a real appreciation of the local currency.

Figure 2: Impulse-response functions



6 The impact of services liberalization on welfare and growth

6.1 Methodology

We take second-order approximations of the nonlinear model to do formal welfare analysis that accounts for the effects that variability has on the mean levels of macro variables. It is now clear that for the purposes of welfare evaluation in dynamic, stochastic general equilibrium models, first-order approximations of the model's equilibrium conditions are not adequate. Kim and Kim (2003) provide a simple example of a model in which welfare appears higher under autarky than under complete markets because of the inaccuracy of the linearization method. Formally, we numerically evaluate the unconditional means of utility and some key variables growth under different values of the parameters of the model. Then, we compare the the gain (or loss) by reducing the value of the sunk entry cost parameter, Φ, taking as a reference the estimated model. This exercise implicitly assumes that the parameter Φ is considered as a policy choice by the government. Although the direct mapping is not straightforward, the literature generally interprets the entry-sunk cost either as a regulation fee or as the cost of purchasing structural capital goods such as buildings or production lines (see Ghironi and Melitz, 2005; Wang and Wen, 2011). Obviously, not all of the entry-sunk costs are something a government can eliminate—some of these costs are physical and not policy related. Hence, the counterfactual exercise consists of matching the level of entry-sunk costs estimated in the Euro Area—the major trade partner—where trade in services is free of those barriers. Namely, this involves bringing down the parameter Φ from its historical estimated value in Tunisia to 0.0878 as estimated for in the Euro Area. We believe that given the economic environment and regulation in Tunisia in addition to the actual structure of services market, one can assume with confidence that the government has a sizeable influence on a considerable share of the entry cost. Unfortunately, the results are somehow sketchy and the model is silent about the explicit design of a policy aiming to reduce the services market entry cost. On the other hand, since our objective is to evaluate trade barriers and the impact of liberalization, it is reasonable to abstract from an elaborate design of those barriers.

We conduct policy evaluations by computing the welfare cost of a particular policy—the level of the entry-sunk cost captured by Φ—relative to the stochastic equilibrium allocation associated with the historical policy. Consider the historical policy, denoted by $\mathcal{H}$, and an alternative policy regime, denoted by $\mathcal{A}$. Let ϵ^c denote the fraction of regime $\mathcal{A}'$s consumption process that a household would be willing to give up to be as well off under regime $\mathcal{A}$ as under regime $\mathcal{H}$. Formally, ϵ^c is implicitly defined by

$$\mathrm{E}\sum_{t=0}^{\infty} U\left(C_t^{\mathcal{H}}, N_t^{\mathcal{H}}\right) = \mathrm{E}\sum_{t=0}^{\infty} U\left((1-\epsilon^c)C_t^{\mathcal{A}}, N_t^{\mathcal{A}}\right).$$

Finally, the fraction ϵ^c is computed from the solution of the second order approximation to the model equilibrium around the deterministic steady state. We assume at time 0 the economy is at its deterministic steady state.

6.2 Results

We find that high entry-sunk costs can be disruptive from not only a welfare point of view but also when production growth rates are considered. The last column of Table 4 shows that the welfare gain of allowing firms to freely enter the services market is sizable. Results reveal that the households would be willing to give up about 3.51 percent of their consumption stream under the optimal policy choice—reducing the entry-sunk cost to only 8.78 percent—to be as well off as under the historical regime, which encompasses services trade barriers. Similarly, large aggregate and sectoral production gains can arise if the barriers are eliminated. Hence, aggregate output growth increases by 2.67 percent in average leading to an average increase of private investment of 4.15 percent. Curiously, services market inefficiency is particularly distorting in the goods market. In particular, imposing Φ equal to 8.78 percent instead of its estimated value yields an increase of services and goods production by 1.28 and 3.44 percent, respectively. Hence, growth in goods sector is the one that particularly benefits from services liberalization. One may wonder why in an economy featuring sectoral production scheme, eliminating the friction in services sector is benefiting more to growth in the goods sector. The reason is twofold. First, following the sensitivity analysis with respect to the share of capital in services production, α^s, results show that higher values yield an increase in services growth as well as welfare (see Table 5). This is particularly due to the higher flexibility in the capital market compared with the labor market. In other terms, capital markets are benefiting from the open economy aspect of the Tunisian economy allowing local agents to borrow externally and increase investment. On the other hand, given the labor immobility through borders and the disutility of higher labor, it is easier for producers to adjust capital in the long run. Hence, the higher the capital share in services the bigger output gain would be following the same reduction in entry-sunk costs.[14]

Second, the potential welfare implications of services liberalization are sensitive to services weight in the production of goods. In particular, a scenario in Table 5 that reflects a symmetric

[14] Labor flexibility is somehow undermined in this model since unemployment is virtually equal to zero. All households are assumed to behave as workers, implying the extensive dimension of total hours worked to be constant. Therefore, only the intensive dimension—hours per worker—changes following shocks or structural changes.

Table 4: The effects of eliminating non-tariff barriers

Percentage gain	Effects of liberalization		
	First order	Second order	Total
Welfare (compensating variation)	3.64 [2.26,5.40]	−0.13 [−0.35,−0.03]	3.51 [1.91,5.43]
Production	2.71 [1.56,4.18]	−0.06 [−0.10,−0.04]	2.67 [1.46,4.14]
Services production	1.35 [0.59,2.68]	−0.07 [−0.10,0.05]	1.28 [0.49,2.73]
Goods production	3.47 [2.13,5.15]	−0.03 [−0.06,−0.01]	3.44 [2.06,5.14]
Exports of services	7.80 [4.53,13.41]	−0.02 [−0.08,0.01]	7.78 [4.45,13.42]
Exports of goods	4.02 [2.47,6.01]	−0.01 [−0.04,0.03]	4.01 [2.43,6.04]
Investment	4.26 [2.61,6.38]	−0.11 [−0.26,0.00]	4.15 [2.35,6.38]
Service real price	−0.67 [−1.05,−0.36]	−0.01 [−0.12,0.04]	−0.68 [−1.17,−0.32]

structure of the input-output matrix—$\xi^g = \xi^s = 0.12$—shows that reducing the share of intermediary services in the production of good dramatically diminishes the initial gain from services liberalization to more than half in terms of welfare and output growth. This is consistent with the findings of Konan and Maskus (2006) arguing for higher gains from services liberalization as opposed to goods liberalization, which mildly enters as an input in the production process of services.

It is interesting to notice that services exports are more responsive to liberalization than goods exports. This happens despite assuming identical value for the foreign demand elasticity of goods and services, μ^f; thus, the only channel by which exports in services overshoot is the relative price effect. In other words, for the same level of foreign demand, the relative price of services declines by more than the one of goods yielding services exports to be almost twice as sensitive as of goods exports to liberalization.

The decomposition of the effects into first and second order effects reveals that the benefit is mainly yielded by a permanent increase in the long-term level of production (for all sectors). On the other hand, more volatile variables induce negative second order effects. In particular, entry-sunk costs allow smooth reaction functions of the variables to stochastic shocks. The rationale is simply because given that production adjustments are costly—entering the market requires losses in terms of the final production—some firms will be willing to relatively wait until the shock impact slows down before starting the production process.

6.3 Sensitivity analysis

To have a better understanding of the quantitative results, we now discuss the sensitivity of our results to changes in the assumptions underlying the baseline model. More specifically, we consider (i) a higher degree of openness (reduction of m to 0.4); (ii) a higher foreign bonds adjustment cost, capturing an increasing access to international financial markets (increase of φ from 0.0009 to 0.1); and (iii) an increase in the share of capital in the production of services ($\alpha^s = \bar{\alpha}^g$); and (iv) a reduction in the share of services used in the production of goods (symmetric input-output matrix with $\xi^g = \xi^s = 0.12$); and (v) a higher probability of business failure (increase of θ from 0.10 to 0.15). The choice of these parameters is motivated by the fact that liberalization is generally accompanied by a higher degree of openness, a lower cost to borrowing from abroad, free exchange rates fluctuations, and a better business environment. By no means we interpret this as a compulsory sequence of events; however, one could argue that these conditions are generally prevalent in countries where trade is fully liberalized.

Table 5: Sensitivity analysis

Gain	Estimated parameters	High degree of openness $m = 0.4$	High cost of intermediation $\varphi = 0.1$	Same share of capital $\alpha^s = \bar{\alpha}^g$	Symmetric input-output matrix $\xi^g = \xi^s = 0.12$	High probability of failure $\theta = 0.15$
Welfare	3.51	3.61	3.64	3.97	1.51	5.88
Production	2.67	2.68	2.70	3.04	0.75	4.35
Services production	1.28	1.31	1.34	1.77	0.52	2.53
Goods production	3.44	3.45	3.46	3.87	0.89	5.55
Exports of services	7.78	8.51	7.78	8.79	-2.96	12.91
Exports of goods	4.01	3.87	4.01	4.48	3.13	6.46
Investment	4.15	4.23	4.25	4.66	1.92	6.71
Service real price	-0.68	-0.65	-0.65	-0.72	-1.19	-1.04

Quantitative results of the exercise are presented in Table 5. Broadly, the results under the baseline estimation are robust to different values of the degree of openness, the cost to borrow, and the exchange rate regime. Some remarks are worth noting, though.

In the context of the present paper assuming a more open Tunisian economy than what is observed—60 percent of total consumed products are imported—have a minimal effect on welfare and growth, although still positive. In contrast, the real exports of services increases more as the economy is more open despite the fact that the increase in aggregate production of services is nearly the same. Surprisingly, the degree of openness has virtually no effect on welfare and growth gains following liberalization. In addition, welfare gain is positively responsive following a trade policy change. Given that the country is a net borrower—B_t^f is negative, a higher value of the parameter φ increases the additional cost incurred following a change in the external debt and consumption smoothing turns out to be harder. The latter reduces the volatility of consumption in the model and increases welfare through a second order effect. On the other hand, the reduction in the volatility of consumption is not found to significantly affect real growth. This is explained by the irresponsiveness of the variables at the steady state towards changes in the parameter φ. Hence, the only effect would occur tat the second order, which appears to be negligible.

By contrast, the only parameter to which liberalization impact is markedly sensitive corresponds to the probability of business failure, θ. Increasing its value from what is generally observed in developed countries, 10 percent, to 15 percent, brings up welfare and aggregate growth gains from 3.51 and 2.67 percent to 5.88 and 4.35 percent, respectively. The same happens to sectoral growth rates, exports, and investment. This suggests that following services trade liberalization, substantive welfare gains are more likely to happen in environments where business success conditions are scarce. The intuition is straightforward, it simply refers to the fact that costs to enter the market are amplified when the exogenous probability of bankruptcy is high; hence, a reduction of those costs is expected to be prominent in such a context.

7 Conclusion

In this paper we have proposed a structural sectoral DSGE model with entry-sunk costs in services market to accurately evaluate the impact of services liberalization on households' welfare as well as aggregate and sectoral growth rates. Based on the estimated parameters for Tunisia, the services sector exhibits high entry costs of the magnitude of 31.56 percent loss in the production. Eliminating this cost would increase welfare (measured as equivalent variation) by 3.51 percent and aggregate output is estimated to further increase by 2.67 percent. The reason of this amelioration in aggregate growth is mainly yielded by the goods sector growth evaluated to 3.44 percent. Key elements of our findings are the high shares of services input and capital in the production of goods. Interestingly, capital flexibility, due to its mobility, significantly contributes to this result. The results are proportional to the degree of business failure. More particularly, if the proportion of unsuccessful businesses happens to be 5 percent higher, welfare and output gains increase by about two-thirds.

We view our approach as an alternative to the previously adopted methods based on evaluating trade barriers through relying on ad hoc non-tariff methods clearly independent from the structure of the model. Our approach can also be used to understanding the impact of market liberalization in different countries by including alternative features in the theoretical model that captures each country specificities. Our framework lends itself to a number of potentially interesting extensions. One would be to introduce further forms of trade barriers such as costs to imports and exports of services in addition to limited labor mobility. A second possible extension would be to allow for heterogeneous sectors in the service market. This setup permits studying the distributional effects of services trade liberalization.

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