
Volume 106, January 2014
ISSN 0304-3878
JOURNAL OF Development ECONOMICS
CONTENTS
Regular Articles
N. Jouini and N. Rebei, The welfare implications of services liberalization in a developing country 1
H. Kazianga, D. de Walque and H. Alderman, School feeding programs, intrahousehold allocation and the nutrition of siblings: Evidence from a randomized trial in rural Burkina Faso 15
C. Lessmann, Spatial inequality and development — Is there an inverted-U relationship? 35
F. de Nicola and X. Giné, How accurate are recall data? Evidence from coastal India 52
J. von Hagen and H. Zhang, Financial development, international capital flows, and aggregate output 66
N.L. Wilson, W. Xiong and C.L. Mattson, Is sex like driving? HIV prevention and risk compensation 78
L.F. Céspedes and A. Velasco, Was this time different?: Fiscal policy in commodity republics 92
J. de Laat, Household allocations and endogenous information: The case of split migrants in Kenya 108
K. Hoff and P. Pandey, Making up people—The effect of identity on performance in a modernizing society 118
S. Dercon, R.V. Hill, D. Clarke, I. Outes-Leon and A. Seyoum Taffesse, Offering rainfall insurance to informal insurance groups: Evidence from a field experiment in Ethiopia 132
Contents continued on outside back cover
106 1–264 (2014)

Journal of Development Economics 106 (2014) 1–14

Contents lists available at ScienceDirect

Journal of Development Economics

journal homepage: www.elsevier.com/locate/devec

The welfare implications of services liberalization in a developing country

Nizar Jouini [a], Nooman Rebei [b,*]

[a] African Development Bank, Tunisia
[b] International Monetary Fund, 700 19th Street, N.W. Washington, D.C. 20431, United States

ARTICLE INFO

Article history:
Received 22 May 2012
Received in revised form 19 June 2013
Accepted 27 July 2013

JEL classification:
E1
F1
F4

Keywords:
Liberalization
Trade in services and goods
General equilibrium
Bayesian estimation
Tunisia

ABSTRACT

We propose 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. 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 good sector is the one that benefits the most from services liberalization in the short- and long-term horizons.

1. Introduction

Service liberalization is becoming more appealing for developing countries, in particular, for countries with a large service sector. For these countries the effect of 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, but 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) models (e.g., Jensen et al., 2007; Konan and Maskus, 2006). 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. Additional drawbacks consist of the measurement of welfare—improperly approximated by revenues—and the identification of the model's parameters, which are calibrated and independent of the overall specification.

* Corresponding author. Tel.: +1 202 6234981; fax: +1 202 5894981.
E-mail addresses: N.JOUINI@afdb.org (N. Jouini), NREBEI@imf.org (N. Rebei).

[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.

0304-3878/$ – see front matter © 2013 Published by Elsevier B.V.
http://dx.doi.org/10.1016/j.jdeveco.2013.07.016

To solve these inconsistencies, 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 the service and good 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 as supported by the data. 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.

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 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 assumed to be 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 existence of trade barriers and the specificity of the service 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 slightly more than 3 times and about 2 times those in the Euro Area in the service and good sectors, respectively. Given the estimated model, 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 2.92% measured as the average permanent increase in consumption. Also, aggregate output could grow by an additional 2.25%, mainly due to the higher growth in goods production evaluated at 3.04%; whereas, the service sector additional growth corresponds only to 1.12%. The intuition behind the low (high) impact of liberalization on services (goods) production 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. Namely, 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 is discussed. Finally, some conclusions are provided in Section 7.

2. Tunisian service sector: context and some stylized facts

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

Empirical evidence shows that the labor productivity gap between Tunisia and the European Union exceeds 50% in services while it stands below 30% 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% largely under the average performance of the Middle Eastern and North African countries (12%). 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 partial 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 bears 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. This study aims to contribute to the debate on the potential gains—welfare and growth—Tunisia could realize if the government decides to reduce cost of penetrating the services markets to the same level witnessed within Tunisia's most important trade partner, the Euro Area.

[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% of services liberalization gains may be achieved from the liberalization of foreign investment barriers that impede Mode 3 delivery of services.

[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% and the share of goods entering into the production of services is only 12%. In the case of the Euro Area the share of services (goods) in the production of goods (services) is only 0.19 (0.10).

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 and goods 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 intermediary 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 *ith* 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 *ith* 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 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

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

where P_t is the price of final consumption products, $CAC_t(i)=\frac{\chi}{2}\left(\frac{I_t(i)}{K_t(i)}-\delta\right)^2K_t(i)$ 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

$$K_{t+1}(i)=(1-\delta)K_t(i)+I_t(i), \tag{3}$$

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:

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

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

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

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, $\widetilde{W}_t(i)$, to maximize its utility.[7] Eq. (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:

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

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

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.

[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.

[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).

[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.

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, Eq. (2), the labor demand, Eq. (5), the capital accumulation, Eq. (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

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

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

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

$$s_t E_t\frac{\pi_{t+1}^*}{\kappa_t R_t^*}\left[1+\varphi\left(b_t^f-b_{ss}^f\right)\right]=E_t\frac{s_{t+1}}{R_t}\pi_{t+1}, \tag{12}$$

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

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

where $\lambda_t(i)$ is the marginal utility of the household i revenue and lowercase letters are the real counterparts of the nominal variables explained before, except for s_t, which stands for the real exchange rate defined as $\frac{e_t P_t^f}{P_t}$, and $\widetilde{w}_t(i)$ is the real wage contract measured as $\frac{\widetilde{W}_t(i)}{P_t}$.

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 perfectly competitive firms.

3.2.1. Final producers

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

$$\max_{x_{i,t}} P_t^i x_{i,t}-P_{x,t}^i x_{i,t}.$$

This yields the demand for input:

$$x_t^i=\begin{cases}1 & \text{if } P_{x,t}^i\le P_t^i;\\ 0 & \text{if } P_{x,t}^i>P_t^i.\end{cases} \tag{15}$$

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

$$D_{i,t}=\begin{cases}p_t^i-p_{x,t}^i & \text{if } P_{x,t}^i\le P_t^i;\\ 0 & \text{if } P_{x,t}^i>P_t^i.\end{cases} \tag{16}$$

where $p_t^i=\frac{P_t^i}{P_t}$ and $p_{x,t}^i=\frac{P_{x,t}^i}{P_t}$.

In each period, the aggregate supply of output, $Y_{i,t}$, is determined by the number of firms and is equal to $\int_0^{\Omega_i}y_{i,t}dj=\Omega_i y_{i,t}$, and the aggregate demand for input is $\int_0^{\Omega_i}x_{i,t}dj=\Omega_i x_{i,t}$.In each period, there are potentially infinite entrants which make the final product industry perfectly competitive. The one-time fixed entry cost, Φ_i, is paid in terms of the final product. After entry, each firm faces a stochastic probability of exit, $\theta_{i,t}\in(0,1)$. 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:

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

We can also write this equation recursively as

$$V_{i,t}=\beta E_t\frac{\lambda_{t+1}}{\lambda_t}\left(D_{i,t+1}+\left(1-\theta_{i,t+1}\right)V_{i,t+1}\right). \tag{17}$$

Free entry then implies $V_{i,t}=\Phi_i$. The evolution of the number of final sector i producers is

$$\Omega_{i,t+1}=\left(1-\theta_{i,t}\right)\Omega_{i,t}+g_{i,t}; \tag{18}$$

where $g_{i,t}$ is the number of new entrants in period t.

3.2.2. Intermediate producers

Again, the service and good sectors are assumed symmetric at the level of the intermediate producers. The intermediate product market is perfectly competitive. For simplicity, we assume there are no costs to enter this market. The production function of a representative producer of the intermediate product is

$$X_{i,t}=A_{i,t}\left(Y_{j,t}^i\right)^{\xi^i}\left[\left(K_{i,t}\right)^{\alpha^i}\left(A_t N_{i,t}\right)^{1-\alpha^i}\right]^{1-\xi^i}, \tag{19}$$

where i and $j=(s,g)$; and $j\neq i$. $A_{i,t}$ stands for temporary idiosyncratic total-factor-productivity shocks specific to the sector i, while A_t is a symmetric labor-augmenting permanent technology shock. The variable $K_{i,t}$ and $N_{i,t}$ stand for capital and labor, and $Y_{j,t}^i$ is the quantity of the product j used in the production of the product i. The parameters ξ^i and α^i correspond to the share of intermediate inputs produced in the other sector and the share of capital in the semifinal product combining labor and capital, respectively. Note that the aggregate output is determined by the number of final service producers in equilibrium, $Y_{i,t}=\Omega_{i,t}$, which in turn is also the total demand for intermediate service, $\Omega_{i,t}=X_{i,t}$.

Each sectoral transitory technology shock, $A_{i,t}$, in logs evolves according to:

$$\log\left(A_{i,t}\right) = \rho_{A_i}\log\left(A_{i,t-1}\right) + \varepsilon_{A_i,t}, \tag{20}$$

and the symmetric technology, A_t, in logs evolves according to:

$$\log(A_t) = \log(A) + \log(A_{t-1}) + \varepsilon_{A,t}, \tag{21}$$

with $\rho_{A_i} \in (0,1)$. The serially uncorrelated shocks, $\varepsilon_{A_i,t}$ and $\varepsilon_{A,t}$ are normally distributed with zero means and standard deviations σ_{A_i} and σ_A, respectively. The constant A corresponds to the gross real growth rate.

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

$$\max_{N_{i,t},K_{i,t},Y^j_{i,t}} p^i_{x,t}X_{i,t} - w_tN_{i,t} - q_tK_{i,t} - p^j_tY^i_{j,t},$$

given

$$X_{i,t} = A_{i,t}\left(Y^i_{j,t}\right)^{\xi^i}\left[\left(K_{i,t}\right)^{\alpha^i}\left(N_{i,t}\right)^{1-\alpha^i}\right]^{1-\xi^i}$$

where lower case prices correspond to the real prices of production inputs.

The intermediate service producers' first order conditions are as follows

$$\frac{w_t}{p^i_{x,t}} = \left(1-\xi^i\right)\left(1-\alpha^i\right)\frac{X_{i,t}}{N_{i,t}}, \tag{22}$$

$$\frac{q_t}{p^i_{x,t}} = \left(1-\xi^i\right)\alpha^i\frac{X_{i,t}}{K_{i,t}}, \tag{23}$$

$$\frac{p^j_t}{p^i_{x,t}} = \xi^i\frac{X_{i,t}}{Y^i_{j,t}}. \tag{24}$$

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

$$Y_{i,t} = Y^d_{i,t} + Y^f_{i,t} + Y^j_{i,t}, \tag{25}$$

where $Y^d_{i,t}$ is the domestic consumption of goods (services), $Y^f_{i,t}$ corresponds to goods (services) exports, and $Y^j_{i,t}$ is the quantity of services (goods) used as inputs in the production of final goods (services).

The foreign demand for locally produced products is as follows:

$$Y^f_{i,t} = \left(s_tp^i_t\right)^{-\mu^f}w^iY^f_t, \tag{26}$$

where μ^f captures the elasticity of substitution between the exported and foreign-produced products in the consumption basket of foreign consumer, Y^f_t is total revenue in the foreign economy, and ω^i is the share of the production of sector i in total demand of the rest of the world. Y^f_t is exogenously given following the stochastic process

$$\log\left(Y^f_t\right) = \left(1-\rho_{Y^f}\right)\log\left(Y^f\right) + \rho_{Y^f}\log\left(Y^f_{t-1}\right) + \varepsilon_{Y^f,t}, \tag{27}$$

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}.

3.2.3. 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^m_t, yields a combination of imported goods and services. In each period, the importer sets the quantity for imported goods to maximize its profits, D^m_t, taking the price of imported products, P^m_t, as given. The firm solves the following problem

$$\max_{\{Y^m_t\}} D^m_t = \left(P^m_t - e_tP^f_t\right)Y^m_t. \tag{28}$$

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

$$\frac{P^m_t}{P_t} = s_t. \tag{29}$$

3.2.4. Final product aggregators

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

$$Y^d_t = \left[n^{\frac{1}{\phi}}\left(Y^d_{s,t}\right)^{\frac{\phi-1}{\phi}} + (1-n)^{\frac{1}{\phi}}\left(Y^d_{g,t}\right)^{\frac{\phi-1}{\phi}}\right]^{\frac{\phi}{\phi-1}}, \tag{30}$$

where $n > 0$ is the share of services in the domestically produced consumable products 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^d_t and $p^d_t = \frac{P^d_t}{P_t}$ its real value. Profit maximization entails

$$Y^d_{s,t} = n\left(\frac{p^s_t}{p^d_t}\right)^{-\phi}Y^d_t, \tag{31}$$

and

$$Y^d_{g,t} = (1-n)\left(\frac{p^g_t}{p^d_t}\right)^{-\phi}Y^d_t. \tag{32}$$

Furthermore, the domestically produced consumable product real price, p^d_t, is given by

$$p^d_t = \left[n\left(p^s_t\right)^{1-\phi} + (1-n)\left(p^g_t\right)^{1-\phi}\right]^{1/(1-\phi)}.$$

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

$$Z_t = \left[m^{\frac{1}{\nu}}\left(Y^d_t\right)^{\frac{\nu-1}{\nu}} + (1-m)^{\frac{1}{\nu}}\left(Y^m_t\right)^{\frac{\nu}{\nu-1}},\right] \tag{33}$$

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

$$Y^d_t = m\left(p^d_t\right)^{-\nu}Z_t, \tag{34}$$

and

$$Y^m_t = (1-m)\left(p^m_t\right)^{-\nu}Z_t. \tag{35}$$

[8] For convenience, we assume that the price in foreign currency of all imported intermediate products is P^f_t, 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

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

3.3. The government

The government budget constraint is given by

$$T_t + B_{t-1}^d = M_t - M_{t-1} + \frac{B_t^d}{R_t}. \tag{36}$$

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:

$$\log(\zeta_t) = \rho_\zeta \log(\zeta_{t-1}) - \rho_e \log\left(\frac{e_t}{e_{t-1}}\right) + \varepsilon_{\zeta,t}, \tag{37}$$

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

$$\widehat{R}_t = \rho_R \widehat{R}_{t-1} + (1-\rho_R)\left[\rho_\pi \widehat{\pi}_t + \rho_y \widehat{y}_t\right] + \varepsilon_{\zeta,t}, \tag{37'}$$

where hatted variables denote log-deviations of stationary variables from their steady-state values. It is worth noting that since several variables in the model are not stationary due to the existence of a trending technology, the steady states of these variables do not exist. To overcome this issue and to solve the model around the steady state, we first proceed with transforming the non-stationary variables in the model by dividing them by the symmetric technology, A_t, as commonly done in the literature. Hence, the output gap in Eq. (37′) is defined as $\widehat{y}_t \equiv \log(y_t) - \log(y)$, where $y_t \equiv \frac{Y_t}{A_t}$.

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

$$Z_t = C_t + I_t + CAC_t + BAC_t. \tag{38}$$

The gross domestic product is

$$Y_t = Y_{s,t} + Y_{g,t}. \tag{39}$$

The current account equation follows

$$s_t \frac{b_t^f}{R_t^f} = s_t \frac{b_{t-1}^f}{\pi_{t-1}^*} + p_t^s Y_{s,t}^f + p_t^g Y_{g,t}^f - p_t^m Y_t^m \tag{40}$$

where $b_t^f \equiv \frac{B_t^f}{P_t^f}$ is the real stock of foreign bonds held by the households.

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

$$N_{s,t} + N_{g,t} = N_t, \tag{41}$$

and

$$K_{s,t} + K_{g,t} = K_t. \tag{42}$$

3.5. The steady state and identification

In order to understand the effect of trade liberalization in the context of this model, 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_s governing the share of entry-sunk costs in output. Assuming a non-stochastic environment—variables are at their steady states—and a steady-state relative price of goods equal to one, it becomes relatively easy to disentangle the impact of Φ_s on the long term values of the relative price of services.[9] 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

$$\left[\frac{1-n(p^s)^{1-\phi}}{1-n}\right]^{\frac{1}{1-\phi}A} (p^s)^B \left[p^s - \Phi_s\left(\frac{1}{\beta} - 1 - \theta_s\right)\right]^C = D, \tag{43}$$

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

$$A = \frac{1}{1-\alpha^g} + \frac{\xi^g}{(1-\alpha^g)(1-\xi^g)} + \frac{\xi^s}{(1-\alpha^s)(1-\xi^s)},$$

$$B = \frac{-\xi^g}{(1-\alpha^s)(1-\xi^g)},$$

$$C = -\frac{1}{1-\alpha^g} - \frac{\xi^s}{(1-\alpha^s)(1-\xi^s)},$$

$$D = \frac{1-\xi^s}{1-\xi^g}\frac{1-\alpha^s}{1-\alpha^g}\frac{(\xi^g)^{-\frac{\xi^g}{(1-\alpha^g)(1-\xi^g)}}}{(\xi^s)^{-\frac{\xi^s}{(1-\alpha^s)(1-\xi^s)}}}\frac{\left[(1-\xi^g)\alpha^g\right]^{-\frac{\alpha^g}{1-\alpha^g}}}{\left[(1-\xi^s)\alpha^s\right]^{-\frac{\alpha^s}{1-\alpha^s}}}\left(\frac{1}{\beta} - 1 - \delta\right)^{\frac{\alpha^g}{1-\alpha^s} + \frac{\alpha^s}{1-\alpha^s}}$$

We numerically solve the polynomial Eq. (43) and represent in Fig. 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_s, and the probability of business failure, θ_s.[10] As expected, a high value of Φ_s generates a relatively high price for services at the steady-state equilibrium and the production level of services declines.

The features of the steady state highlighted above may reveal the importance of using data specific to the service sector to identify the importance of entry-sunk costs. On the other hand, Eq. (43) shows the challenge in simultaneously identifying the parameters Φ_s and θ_s. This is particularly clear when the discount factor, β, is set to 1. Fig. 1 shows the same result where the share of the entry cost and the probability of business failure virtually have the same effect on the steady-state values of services relative price and quantity. This identification issue is difficult to resolve using macro data alone. Considering micro data on business failure should provide some help, although unavailable

[9] Assuming the steady-state relative price of goods equal to one aims to analytically illustrate the sensitivity of some variables at the long run to the entry-sunk cost parameter, Φ_s. It is worth noting that the results remain qualitatively the same if the relative goods prices is endogenously determined at the steady state. Obviously, this assumption is relaxed in the following simulations.

[10] 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

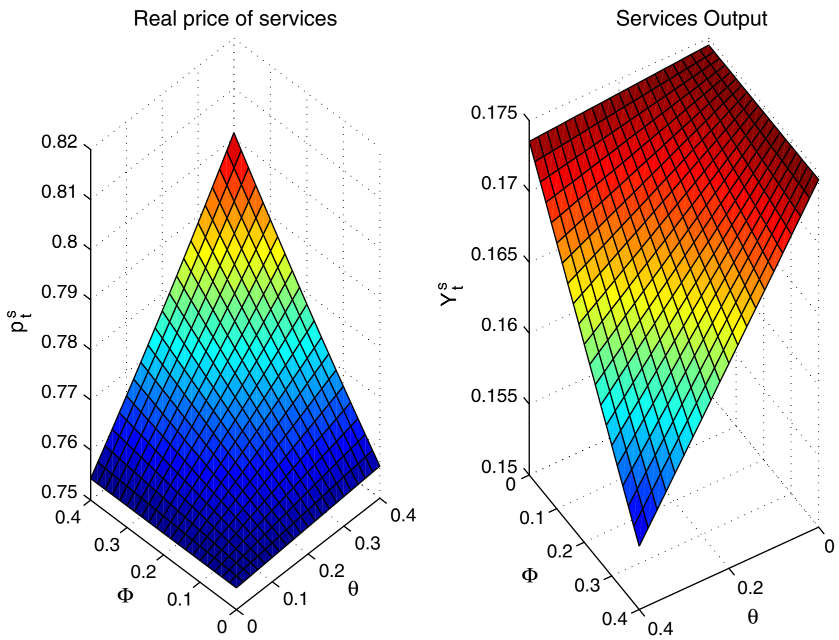

Fig. 1. The steady state: a sensitivity analysis.

in the case of Tunisia. As a consequence, in the following section we solely focus on the identification of the parameter Φ_s; then, we do some sensitivity analysis with respect to the parameter θ_s.

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:

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

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[11]:

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

The model has eight structural shock processes: two sector-specific technology shocks—to the service sector and the good sector; a symmetric labor productivity shock; 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 per capita gross domestic product, real per capita domestic service production, consumer price index inflation, services price index inflation, real per capita 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.[12] To maintain consistency with the theoretical model, which involves stationary variables, we transform all series into growth rates and the same transformation is used with the corresponding variables from the model.It is worth noting that here, as opposed to the welfare evaluation in Section 6, we adopt a first-order approximation of the model's equations around the steady state in the estimation procedure. The rationale is twofold. First, this is a common practice in the literature where the estimation of a DSGE model using the likelihood maximization is adopted. Second, as shown by Schmitt-Grohé and Uribe (2004), the second- or a higher-order moments of the endogenous variables are not sensitive to the approximation order of the model. Obviously, the first-order moments (averages) would be sensitive to the model's order of approximation. As a consequence, adopting a first-order Taylor expansion of the model's equilibrium conditions is sufficient in the context of a maximum likelihood simulation, which by definition minimizes the distance between the observed and model specific moments of second- and higher-orders.

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

[12] 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% 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%. The elasticity of substitution between intermediate labor skills, σ, is set to 6 implying a markup of 20% 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, $\theta_{\{s,g\}}$, we set its prior average value to 10% as in Ghironi and Melitz (2005).[13] 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 the service and good sectors in the Euro Area, with ξ^s and ξ^g equal to 0.10 and 0.19, respectively.

The fourth and fifth 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 decision to enter services and goods markets, Φ_s and Φ_g, exhibit prior means of 0.30 (0.10) and 0.15 (0.10) in Tunisia (Euro Area), respectively. For the purpose of calibrating this parameter for Tunisia, we consider the financial services sector as a proxy. In particular, the level of monetary intermediation in the banking system is estimated to be 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-sunk 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 similar to the adopted values in Smets and Wouters (2003), which are standard.

[13] When included in the set of estimated parameters, θ_s and θ_g exhibit posterior distributions which seem to be virtually the same as the prior distributions implying that observed data do not offer sufficient information on the value of each parameter. However, assuming the same probability in the two sectors, $\theta_s = \theta_g$, turns to be helpful in identifying their common posterior distribution.

4.3. Estimation results

The last six columns of Table 1 show the posterior means of the structural parameters together with their 90% confidence intervals for Tunisia—with and without trade barriers—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 0.469 and 0.001, respectively. Foreign bonds adjustment costs appear to be relatively high but still 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 capital's share in the production functions of services and goods, equal 0.216 and 0.313, respectively. As expected, the service 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 0.474 and 1.572, 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 0.560 and 1.740, respectively. Also, locally produced and imported goods and services tend to exhibit some complementarity.

Concerning the parameters controlling the extent to which the distortion yielded by costly entries and exits in the two sectors are significant. Note that the posterior mean for the entry sunk cost in the service sector, Φ_s, is estimated to a value of 0.376, significantly higher than its equivalent in the good sector, Φ_g, which is equal to 0.195. The size of the sectoral entry-sunk costs is far above the estimated values for developed countries.[14] Thus, substantive welfare gains following the reduction of services trade barriers are expected in view of the estimated high distortion in the service sector. The estimate of the probability of business failure of 0.074 is lower than the prior, but appears in line with microeconometric estimates.

The posterior means of the Calvo parameter on the frequency of wage negotiations, d_w, is equal to 0.617. 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). The estimation results are also 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 money growth rate response to nominal exchange rate fluctuations, ρ_e, is equal to 1.214, which indicates an aggressive exchange rate targeting. The posterior mean of the degree of money growth rate smoothing, ρ_ξ, equal to 0.596 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 service and good sectors due to entry-sunk costs, Φ_s and Φ_g, are 0.098 and 0.099, respectively. These values are considered in our paper as a benchmark for physical entry costs to the two markets, 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).

[14] This parameter takes the value of 0.10 for the United States economy as suggested by Wang and Wen (2011).

Table 1
Estimated parameters.

Parameter	Description	Prior distribution			Posterior distribution					
		Distribution	Mean	Std/df	Tunisia				Euro area	
					With trade barriers		Without trade barriers		Mean	90% interval
					Mean	90% interval	Mean	90% interval		
χ	Capital adjustment cost	Gamma	10	4	0.469	[0.128, 0.777]	0.541	[0.160, 0.896]	1.211	[0.527, 1.948]
φ	Foreign bond adjustment cost	Normal	0.0025	0.0015	0.001	[0.000, 0.002]	0.001	[0.000, 0.003]	0.003	[0.001, 0.006]
α^s	Share of capital in the production of services	Beta	0.25	0.1	0.216	[0.101, 0.337]	0.197	[0.078, 0.303]	0.383	[0.308, 0.463]
α^g	Share of capital in the production of goods	Beta	0.35	0.1	0.313	[0.151, 0.468]	0.309	[0.156, 0.463]	0.279	[0.151, 0.409]
n	Share of services	Beta	0.4	0.1	0.474	[0.414, 0.546]	0.464	[0.396, 0.535]	0.568	[0.500, 0.633]
ϕ	Elasticity between goods and services	Normal	1.25	0.25	1.572	[1.215, 1.890]	1.558	[1.212, 1.892]	1.669	[1.314, 2.039]
m	Share of imports	Beta	0.6	0.1	0.560	[0.504, 0.616]	0.569	[0.511, 0.625]	0.643	[0.589, 0.691]
ν	Elasticity between imports and local products	Normal	1.25	0.25	1.740	[1.402, 2.122]	1.784	[1.403, 2.152]	3.015	[2.094, 3.933]
μ^f	Foreign demand elasticity	Normal	1.25	0.25	1.640	[1.503, 1.770]	1.631	[1.497, 1.766]	2.723	[1.894, 3.561]
Φ_s[a]	Services entry-sunk costs	Beta	0.30/0.10	0.1/0.05	0.376	[0.217, 0.532]	–	–	0.098	[0.057, 0.135]
Φ_g[a]	Goods entry-sunk costs	Beta	0.15/0.10	0.1/0.05	0.195	[0.037, 0.348]	–	–	0.099	[0.060, 0.140]
$\theta_{s,g}$	Probability of exit	Beta	0.1	0.035	0.074	[0.006, 0.133]	–	–	0.095	[0.051, 0.139]
d^w	Degree of wage stickiness	Beta	0.5	0.15	0.617	[0.458, 0.771]	0.625	[0.463, 0.795]	0.651	[0.558, 0.751]
$\rho_{A,s}$	Autocorrelation of services technology	Beta	0.5	0.15	0.733	[0.498, 0.921]	0.689	[0.407, 0.924]	0.090	[0.025, 0.154]
$\rho_{A,g}$	Autocorrelation goods technology	Beta	0.5	0.15	0.944	[0.910, 0.981]	0.948	[0.916, 0.979]	0.473	[0.286, 0.645]
ρ_{ζ}	Autocorrelation of money growth	Beta	0.5	0.15	0.596	[0.361, 0.832]	0.628	[0.400, 0.854]	–	–
ρ_e	Degree of exchange rate stabilization	Beta	0.85	0.15	1.214	[0.489, 1.829]	1.326	[0.578, 1.970]	–	–
ρ_R	Degree of interest rate smoothing	Beta	0.5	0.15	–	–	–	–	0.236	[0.097, 0.370]
ρ_{π}	Policy reaction to inflation gap from a target	Normal	1.5	0.5	–	–	–	–	2.004	[1.654, 2.350]
ρ_y	Policy reaction to output gap	Normal	0.25	0.1	–	–	–	–	0.181	[−0.019, 0.357]
ρ_{y^f}	Autocorrelation of foreign demand	Beta	0.5	0.15	0.704	[0.589, 0.830]	0.736	[0.620, 0.858]	0.416	[0.164, 0.666]
ρ_{π^f}	Autocorrelation of foreign inflation	Beta	0.5	0.15	0.384	[0.135, 0.625]	0.385	[0.167, 0.614]	0.360	[0.178, 0.545]
ρ_{R^f}	Autocorrelation of foreign interest rates	Beta	0.5	0.15	0.549	[0.310, 0.820]	0.652	[0.441, 0.865]	0.352	[0.164, 0.537]
$\sigma_{A,s}$	Std of services technology shocks	Inv-Gamma	0.01	4	0.004	[0.002, 0.007]	0.004	[0.002, 0.006]	0.003	[0.002, 0.004]
$\sigma_{A,g}$	Std goods technology shocks	Inv-Gamma	0.01	4	0.014	[0.011, 0.017]	0.014	[0.011, 0.016]	0.004	[0.002, 0.005]
σ_A	Std of labor productivity shocks	Inv-Gamma	0.01	4	0.011	[0.008, 0.014]	0.011	[0.007, 0.014]	0.005	[0.004, 0.007]
σ_{ζ}	Std of money growth shocks	Inv-Gamma	0.01	4	0.007	[0.002, 0.011]	0.007	[0.002, 0.011]	0.002	[0.002, 0.003]
σ_{y^f}	Std of foreign demand	Inv-Gamma	0.01	4	0.012	[0.009, 0.015]	0.012	[0.009, 0.015]	0.003	[0.002, 0.003]
σ_{π^f}	Std of foreign inflation	Inv-Gamma	0.01	4	0.004	[0.001, 0.006]	0.004	[0.001, 0.006]	0.003	[0.001, 0.004]
σ_{R^f}	Std of foreign interest rates	Inv-Gamma	0.01	4	0.002	[0.001, 0.003]	0.002	[0.001, 0.003]	0.002	[0.001, 0.003]
Marginal log-likelihood					**746.486**		**742.260**		957.074	

[a] 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 4 and 5 correspond to the parameters of the prior distribution for Tunisia (the Euro Area).

We can now assess the hypothesis $\Phi_{\{s,g\}} > 0$ against the alternative $\Phi_{\{s,g\}} = 0$ by computing the posterior odds ratio. The results are reported in the two columns of Table 1 entitled "with trade barriers" and "without trade barriers". The marginal data density of the benchmark model, $\Phi_{\{s,g\}} > 0$, is 4.226 higher on a log-scale, which translates into a posterior odds ratio equal to 68.443. This leads us not to reject the hypothesis of the existence of a substantial entry-sunk cost since the model is largely preferred to its costless entry version.

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 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.

The benchmark model succeeds in reproducing the relative volatility of real exchange and output, predicting a ratio of 3.69 compared with 3.75 in the data thanks to the relatively high degree of monetary policy reaction to nominal exchange rate fluctuations. In contrast, the model has a hard time to produce the correlation between sectoral inflation rates. Adding stickiness in the price setting for the two sectors could help reducing the correlation between the two inflation rates; although, this is expected to complicate the model specification and the interpretation of the final results relative to trade liberalization. A different picture emerges when we look at the correlations between output and sectoral inflation rates, which are very well replicated by the model.

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

Table 2
Second order moments.

Moment	Data	Model
$\frac{std(\Delta log(Y_{s,t}))}{std(\Delta log(Y_t))}$	1.29	1.12 [0.96, 1.39]
$\frac{std(\pi_{s,t})}{std(\pi_t)}$	1.59	1.90 [1.45, 2.67]
$\frac{std(s_t)}{std(\Delta log(Y_t))}$	3.75	3.69 [1.03, 7.66]
$corr(\Delta log(Y_t), \Delta log(Y_{s,t}))$	0.84	0.92 [0.86, 0.96]
$corr(\Delta log(Y_t), \pi_t)$	0.03	0.07 [−0.04, 0.19]
$corr(\Delta log(Y_t), \pi_{s,t})$	0.39	0.35 [0.20, 0.45]
$corr(\Delta log(Y_t), s_t)$	0.19	0.02 [−0.03, 0.06]
$corr(\pi_t,\pi_{s,t})$	0.19	0.80 [0.67, 0.91]
$corr(\pi_t,s_t)$	−0.36	−0.06 [−0.12, −0.01]
$corr(\pi_{s,t},s_t)$	−0.03	−0.07 [−0.13, −0.01]

Table 3
Variance decomposition.

Variable	ε_s	ε_g	ε_A	ε_ζ	ε_{y^f}	ε_{π^f}	ε_{R^f}
Y_t	0.95	24.49	58.51	0.33	10.09	1.22	1.63
	[0.06, 5.05]	[3.62, 63.19]	[23.66, 81.80]	[0.01, 1.20]	[1.63, 29.66]	[0.10, 5.29]	[0.16, 5.15]
$Y_{s,t}$	5.74	14.78	66.82	1.12	2.96	2.69	2.24
	[0.58, 18.82]	[0.26, 60.13]	[25.14, 89.72]	[0.05, 3.52]	[0.33, 12.51]	[0.25, 10.07]	[0.17, 7.70]
$Y_{g,t}$	0.60	30.41	43.24	0.04	22.20	0.41	1.04
	[0.00, 4.38]	[12.46, 58.20]	[19.48, 63.41]	[0.00, 0.19]	[9.80, 42.24]	[0.03, 2.23]	[0.12, 3.45]
Y_t^m	4.93	16.04	29.24	0.08	31.68	3.07	10.66
	[0.14, 18.07]	[3.47, 47.27]	[6.15, 48.70]	[0.00, 0.31]	[15.61, 50.95]	[0.18, 13.52]	[2.31, 27.44]
C_t	0.87	35.17	52.55	0.06	7.04	0.76	1.53
	[0.04, 4.98]	[19.66, 60.12]	[24.90, 70.28]	[0.00, 0.24]	[1.91, 19.32]	[0.07, 3.47]	[0.28, 5.26]
I_t	7.13	22.67	15.40	0.26	46.92	1.25	4.17
	[0.49, 19.77]	[10.35, 40.00]	[4.69, 31.59]	[0.01, 0.95]	[29.69, 63.67]	[0.09, 5.42]	[1.03, 10.96]
π_t	3.61	36.57	10.21	24.22	4.38	16.10	1.17
	[0.13, 12.60]	[4.88, 59.03]	[102, 37.54]	[1.62, 47.52]	[0.91, 12.16]	[2.63, 45.52]	[0.24, 3.27]
s_t	16.26	41.85	22.35	0.68	11.31	0.80	2.40
	[0.13, 47.03]	[8.69, 76.34]	[2.61, 55.16]	[0.02, 2.62]	[0.50, 37.44]	[0.01, 4.64]	[0.10, 9.15]

variance decomposition for the model with their 90% confidence intervals. Entries show that the rest of the world's shocks explain about 15% 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 sector-specific technology shocks and the aggregate technology shock. This result suggests that the service 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 real investment—almost half of the fluctuations—while the contribution of domestic shocks is dominated by technology shocks. These results seem quite consistent with the case of developing small open economies.

5.3. Impulse–response functions

We now examine the dynamic effects of supply and demand shocks changes in the benchmark model. Fig. 2 displays a selection of impulse–response functions to a positive 1% shock on the service sector technology, the good sector technology, the money supply, and the 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 clear illustration of our claim that the two sectors are heterogenous.

The first row in Fig. 2 shows that in reaction to a 1% neutral technology shock in the service 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 declines following the shock owing to higher productivity in the service sector which shifts resources towards the latter. Furthermore, the cost of producing goods decreases given the lower price of services; although, this is not sufficient to overcome the effect of the other factors' productivity gap between the two sectors. 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 Fig. 2 represents the responses to a positive one-period technology shock in the good sector only. As opposed to the previous shock, increased production in the good sector raises demand throughout the economy and therefore increases services and aggregate outputs, as well. Prices in the good 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, an 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 wage 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 first order effect—increase of the aggregate demand— is strong in the short term. Further, the second round effect is stronger in the medium term following the estimation of the model's deep parameters and sectoral output, consumption, and investment moderately decline following the shock. It is noticeable that the response of services production is less negative, reflecting the additional demand effect from the goods service as another propagation channel of the monetary shock.

The foreign demand shock accounts for a significant amount of the cyclical behavior of the endogenous variables, as reported earlier. Following a positive shock, as expected, sectoral producers increase goods and services and the additional revenue serves to finance the desired increase in consumption and investment.[15] As a consequence, real imports increase and the real exchange rate declines reflecting a real appreciation of the local currency.

6. The impact of free trade on welfare and some real variables

6.1. Methodology

In this section, we investigate the consequences of policies that aim to reduce trade barriers—entry-sunk costs—when different objective functions are considered. In particular, we take second-order approximations of the nonlinear model to do formal welfare analysis that

[15] Services decline on impact as a consequence of high entry costs, but increase in the medium term.

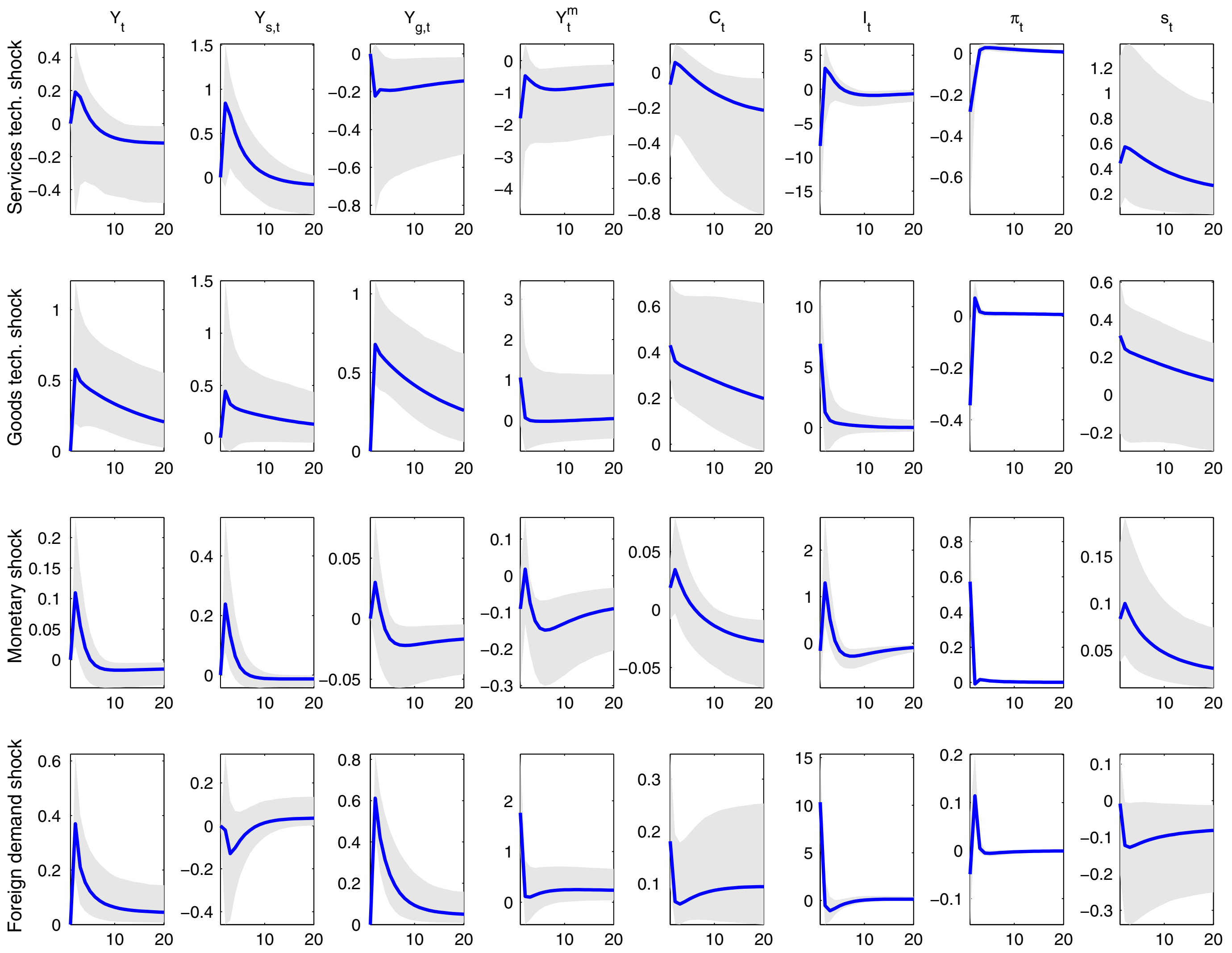

Fig. 2. Impulse–response functions.

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 gain (or loss) by reducing the value of the entry-sunk costs parameter, Φ_s (Φ_g), as far as services (goods) trade liberalization is considered, while taking as a reference the estimated model. This exercise implicitly assumes that the parameters Φ_s and Φ_g are considered as policy choices 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 and 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 and goods is free of those barriers. Namely, for services trade liberalization, this involves bringing down the parameter Φ_s from its historical estimated value in Tunisia to 0.098 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 and goods markets, 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_s and Φ_g —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

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

Finally, the fraction ϵ^c is computed from the solution of the second order approximation to the model equilibrium around the deterministic

Table 4
The effects of eliminating trade barriers.

Percentage gain	Services trade liberalization			Goods trade	Services and goods
	Total	1st order	2nd order	Liberalization	Trade liberalization
Welfare[a]	2.92 [0.41, 7.90]	2.99	−0.07	0.16 [−0.34, 1.06]	3.09 [0.32, 8.38]
Production	2.25 [0.53, 4.87]	2.27	−0.02	0.21 [−0.18, 0.76]	2.44 [0.61, 5.32]
Services production	1.12 [0.22, 2.81]	1.06	0.06	0.23 [−0.21, 0.83]	1.35 [0.24, 3.14]
Goods production	3.04 [0.79, 6.99]	3.03	0.01	0.19 [−0.17, 0.76]	3.23 [0.85, 7.40]
Exports of services	7.22 [1.67, 18.62]	7.14	0.08	−0.41 [−1.46, 0.32]	6.76 [1.38, 17.97]
Exports of goods	3.63 [0.89, 8.67]	3.63	0.00	0.14 [−0.15, 0.58]	3.79 [0.91, 8.92]
Investment	3.71 [0.89, 8.84]	3.74	−0.03	0.53 [−0.43, 1.95]	4.28 [0.95, 9.88]
Service real price	−0.66 [−1.77, −0.14]	−0.58	−0.08	0.30 [−0.24, 1.10]	−0.35 [−1.45, 0.50]

[a] Numbers are compensating variations expressed in percent and reflect the gain resulting when switching from the case with historical values of the structural parameters to the new environment under trade liberalization.

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 rates of growth are considered. The second 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 2.92% of their consumption stream under the optimal policy choice—reducing the entry-sunk cost to only 9.8%—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. Specifically, aggregate output increases by 2.25% in average leading to an average increase of private investment of 3.71%. Curiously, services market inefficiency is particularly distorting the goods market. In particular, imposing Φ_s equal to 9.8%, as in the Euro Area, instead of its estimated value yields an increase of services and goods production by 1.12 and 3.04%, respectively. Hence, growth in the good 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 the service sector is benefiting more to growth in the good 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. Therefore, the higher the capital share in services the bigger output gain would be following the same reduction in entry-sunk costs.[16]

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 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.[17]

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 welfare and growth gains into first and second order effects reveals that the benefit is mainly yielded by a permanent increase in their long-term levels. On the other hand, higher volatilities induce negative second order effects. In particular, entry-sunk costs allow smooth reaction functions of the variables to stochastic shocks. The rationale is simply as follows; 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.

Above we assumed policy that only targets trade barriers in the service sector, conditional to the existence of entry-sunk cost in the good sector ($\Phi_g = 0.195$ in average). Now, we investigate the outcome of a global policy of trade liberalization that applies to all sectors. Results are reported in the last column of Table 4. Implementing the new policy that aims to lower Φ_s and Φ_g to the Euro Area levels, obviously delivers higher gains. As shown by Konan and Maskus (2006), goods trade liberalization increases the revenue by a smaller amount than in the case of services trade liberalization (roughly 23% of total welfare gains are attributed to goods liberalization). Here, we obtain a similar result; namely, the net impact on welfare of the entry-sunk costs reduction in the good service is equivalent to 0.16% permanent increase in households' consumption (6% of the total gains under the full trade liberalization scenario). This simply reflects the facts that the estimated entry-sunk costs in the good sector are moderate and the share of goods as input in the production of services is relatively small.

6.3. Transitional dynamics

We study the short-run impact of service liberalization by shocking the model with an unexpected permanent decline of the entry-sunk cost to the service sector. As regards the new state of the entry-sunk cost we consider a reduction that matches the same level of the same cost in the Euro Area as in the. Fig. 3 illustrates the dynamic adjustments of total production, sectoral outputs, sectoral prices, and the real wage. At time zero the variables are at their initial steady state—consistent with the estimated structural

[16] 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.

[17] Konan and Maskus (2006) find that under the investment liberalization (mode 3) scenario in the service sector yields 4% welfare gains. This roughly represents 75.5% of the total gain if boarder liberalization (mode 1) is also considered.

Table 5
Sensitivity analysis.

Gain criteria	Estimated parameters	High degree of openness	High cost of intermediation	Same share of capital	Without wage stickiness	Symmetric input–output matrix	High probability of failure
		$m = 0.4$	$\varphi = 0.1$	$\alpha^s = \overline{\alpha}^g$	$d^w = 0$	$\xi^g = \xi^s = 0.12$	$\theta = 0.15$
Welfare	2.92	2.89	2.98	3.42	2.94	1.21	6.31
Production	2.25	2.24	2.25	2.69	2.24	0.63	4.41
Services production	1.12	1.04	1.05	1.62	1.12	0.39	2.13
Goods production	3.04	3.00	3.01	3.54	3.04	0.80	6.03
Exports of services	7.21	8.02	7.13	8.53	7.21	−2.58	14.46
Exports of goods	3.63	3.40	3.62	4.23	3.63	3.32	7.25
Investment	3.71	3.70	3.72	4.29	3.73	1.72	7.45
Service real price	−0.66	−0.59	−0.59	−0.70	−0.64	−1.05	−1.15

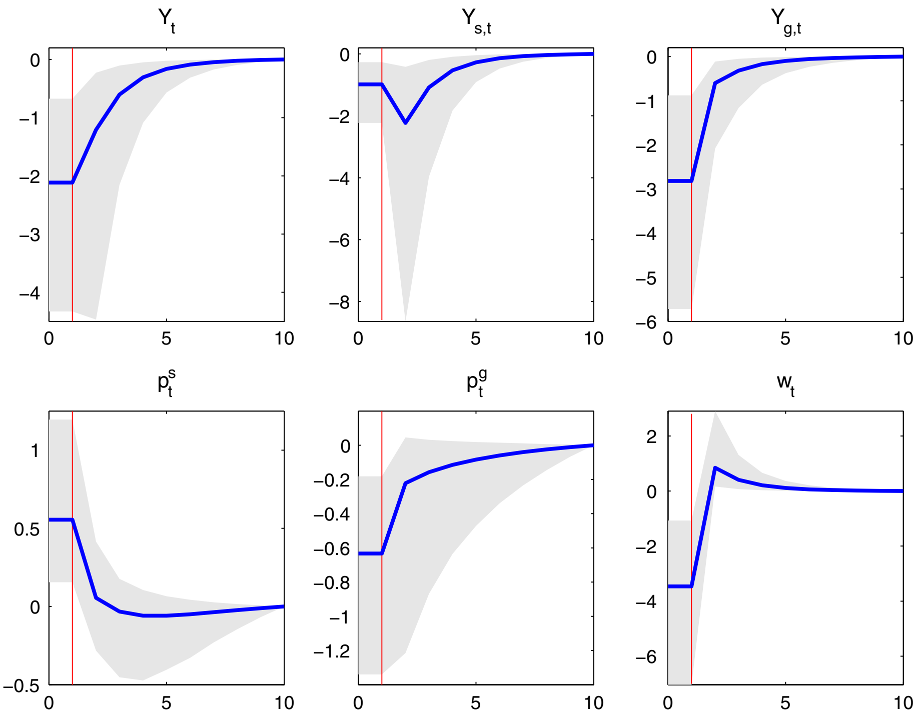

Fig. 3. Transitional dynamics to the new steady-state levels.

parameters. The initial steady-state values for the real quantities are obviously below the new steady state under the counterfactual scenario.[18] The lower panel of Fig. 3 shows an unambiguous decline in the relative price of services reaching its new steady-state value after 5 periods. Inflations rates in different sector fall in response to service trade liberalization, but service sector inflation falls more drastically generating an increase in the relative price of goods.

Fig. 3 further shows that neither aggregate output nor good sector output incur costs during the transitional dynamics until reaching their new steady states. On the other hand, service sector production initially drops (in deviation from new steady state) by about 1% then starts rising in the next periods. Intuitively, following the initial decline in the cost of entering the service sector more firms join the market and prices decrease. As a consequence real wages increase on impact because of the wage stickiness. The impact of a higher labor cost is mostly felt by the producers in the service sector given: (i) the higher share of labor in the production ($\alpha^s < \alpha^g$); and (ii) the decline in the relative price of services (see Eq. (22)). The ratio of the real wages relative to the real price of services, $\frac{w_t}{p_t^s}$, increases sharply on impact yielding a decline in labor and a decline in the production in services which resorbs starting from the second period.

6.4. 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 0.001 to 0.1); and (iii) an increase in the share of capital in the production of services ($\alpha^s = \overline{\alpha}^g$); (iv) a perfect wage flexibility ($d_w = 0$); (v) 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 (vi) a higher probability of business failure (increase of θ from its estimated posterior value to 0.15). The choice of some these parameters is motivated by the fact that liberalization is generally accompanied by a higher degree of openness, a lower cost to

[18] The difference between the two steady states, based on the estimated value of the entry-sunk cost versus matching the degree of service trade liberalization in the Euro Area, is close but not exactly equal to the results in Table 4. Numerical results in Subsection 6.3 includes second order effects tributary to the shocks volatilities; whereas the impulse–response functions are obtained following a permanent decline in the cost of entering the services market assuming all other shocks are unchanged.

borrowing from abroad, free exchange rate 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.[19]

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, the degree of wage rigidity, and the exchange rate regime. The mild impact on welfare gains, however, should be interpreted with caution as these parameters would have obvious effects on the level of welfare. Take the degree of wage rigidity for instance; on the one hand, simulations would clearly show that the highest welfare is attained when $d_w = 0$. On the other hand, wage rigidity does not seem to interact dramatically with entry-sunk costs, which yields a welfare gain from trade liberalization that is relatively stable under different values of d_w.

In the context of the present paper assuming a more open economy in Tunisia than what is observed, 60% 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, the 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 at the second order, which appears to be negligible.

By contrast, the parameter to which liberalization impact is markedly sensitive corresponds to the probability of business failure, θ_s. Increasing its value from the posterior average, 7.4%, to 15%, brings up welfare and aggregate growth gains from 2.92 and 2.25% to 6.31 and 4.41%, 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 result is simply yielded by the fact that entry-sunk costs 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 the service 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 service sector exhibits high entry costs of the magnitude of 37.6% loss in the production. Eliminating the share of these costs related to trade barriers would increase welfare (measured as equivalent variation) by 2.92%; and aggregate output is estimated to further increase by 2.25%. The reason of this gain in aggregate production is mainly yielded by the good-sector production growth evaluated to 3.04%. 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 outcome is proportional to the degree of business failure. More particularly, if the proportion of unsuccessful businesses happens to twice as high as estimated, welfare and output gains increase significantly. Finally, transitional dynamics do not show short term costs during the shift toward the new long term level except for the production in the service sector, which initially drops by 1%.

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 of the structure of the model. Our approach can also be used to understand 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.

Acknowledgments

The authors wish to thank Hafedh Bouakez, Ray Brooks, Dalia Hakura, and Daniel Mirza for helpful comments.

References

Ambler, S., Dib, A., Rebei, N., 2003. Nominal rigidities and exchange rate pass-through in a structural model of a small open economy. Bank of Canada Working Paper No. 03-29.
Bahlous, M., Nabli, M.K., 2003. Financial liberalization and financing constraints on the corporate sector in tunisia. Economic Research Forum for the Arab Countries Working Paper No. 2005.
Basu, S., 1995. Intermediate goods and business cycles: implications for productivity and welfare. American Economic Review 85, 512–531.
Bils, M., Klenow, P., 2004. Some evidence on the importance of sticky prices. Journal of Political Economy 112, 947–985.
Bradford, S., 2003. Paying the price: final goods protection in OECD countries. Review of Economics and Statistics 85, 24–37.
Bradford, S., 2005. The welfare effects of distribution regulations in OECD countries. Economic Inquiry 43, 795–811.
Christiano, L., Eichenbaum, M., Evans, C., 2005. Nominal rigidities and the dynamic effects of a shock to monetary policy. Journal of Political Economy 113, 1–45.
Deardorff, A.V., Stern, R.M., 1998. Measurement of Non-tariff Barriers. University of Michigan Press, Ann Arbor.
Dickens, W., Goette, L., Groshen, E., Holden, S., Messina, J., Schweitzer, M., Turunen, J., Ward, M., 2007. How wages change: micro evidence from the international wage flexibility project. Journal of Economic Perspectives 21, 195–214.
Francois, J., 1999. A Gravity Approach to Measuring Services Protection. (Unpublished) Erasmus University.
Geweke, J.F., 1999. Using simulation methods for Bayesian econometric models: inference, development and communication. Econometric Reviews 18, 1–126.
Ghironi, F., Melitz, M., 2005. International trade and macroeconomic dynamics with heterogeneous firms. Quarterly Journal of Economics 120, 865–915.
Giavazzi, F., Wyplosz, C., 1984. Real exchange rate, the current account and the speed of adjustment. In: Bilson, J.F.O., Marston, R.C. (Eds.), Exchange Rate Theory and Practice. Chicago University Press, Chicago.
Goaied, M., 1999. Financial Liberalization and Financing Constraints on the Corporate Sector in Tunisia (Manuscript).
Hertel, T.W., 2000. Potential Gains from Reducing Trade Barriers in Manufacturing, Services and Agriculture. (Manuscript) Erasmus University.
Jensen, J., Rutherford, T., Tarr, D., 2007. The impact of liberalizing barriers to foreign direct investment in services: the case of Russian accession to the world trade organization. Review of Development Economics 11, 482–506.
Kee, H.L., Nicita, A., Olarreaga, M., 2009. Estimating trade restrictiveness indices. Economic Journal 119, 172–199.
Kim, J., Kim, S.H., 2003. Spurious welfare reversals in international business cycle models. Journal of International Economics 60, 471–500.
Konan, D.E., Maskus, K.E., 2006. Quantifying the impact of services liberalization in a developing country. Journal of Development Economics 81, 142–162.
Schmitt-Grohé, S., Uribe, M., 2003. Closing small open economy models. Journal of International Economics 61, 163–185.
Schmitt-Grohé, S., Uribe, M., 2004. Solving dynamic general equilibrium models using a second-order approximation to the policy function. Journal of Economic Dynamics and Control 28, 755–775.
Schorfheide, F., 2000. Function-based evaluation of dsge models. Journal of Applied Econometrics 15, 645–670.
Smets, F., Wouters, R., 2003. An estimated dynamic stochastic general equilibrium model of the euro area. Journal of the European Economic Association 1, 1123–1175.
Taylor, J., 1993. Discretion versus policy rules in practice. Carnegie-Rochester Conference Series on Public Policy, pp. 195–214.
Wang, P., Wen, Y., 2011. Understanding the effects of technology shocks. Review of Economic Dynamics 14, 705–724.
World-Bank-Staff, 2008. Intégration mondiale de la tunisie. Country Studies Series.World Bank Publications.