Capital Account Liberalization: The Case of Turkey?∗

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Abstract

Following capital account liberalization Turkey has experienced large trade deficits and exchange rate appreciation, which were reversed by trade surpluses and real exchange rate depreciation in crisis years. In this paper, we analyse capital account liberalization experience of Turkey by employing a two-sector dynamic general equilibrium model where a capital poor country with a high population growth rate opens itself to capital flows. The model can account for the observed trade deficits in Turkey. Moreover, we find that Turkish households have a welfare gain because of liberalization. Turkish households would have to give up 26 percent of their lifecycle consumption in the open economy case in order to be as well off in the counterfactual case of the closed economy.

Keywords: Turkey, capital account liberalization, dynamic general equilibrium

JEL Classification: F41, C68

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1 Introduction

Turkey liberalized its capital account in 1989, taking the final step of economic and financial reforms that started in the beginning of 1980s. In what follows, capital inflows and trade deficits increased remarkably, domestic currency, the Turkish lira, entered into an appreciation trend and booms and busts in Turkish economy became closely associated with capital flows. Yet, trade deficits and real exchange rate appreciations following the liberalization were reversed by trade surpluses and real exchange rate depreciations first in 1994 and then in 2001.

The purpose of this paper is to quantitatively account for the features of the Turkish economy in the aftermath of the capital account liberalization, and give a quantitative answer to the question of whether Turkish households are better or worse off due to liberalization. To this aim, we construct a two-sector dynamic general equilibrium model of a small open economy with tradable and nontradable sectors, which is similar to the one presented by Perri and Quadrini (2002). The model is calibrated for Turkey, which we simulate as an economy that suddenly opens up to international capital flows. We find that the model can capture the main dynamics of trade balances in Turkey. These results hinge on two main features of the model: first, at the year of opening to capital flows, Turkey is modeled as a capital poor economy, which has a growing working age population. Turkey starts to borrow when it opens to capital flows because it is capital poor and this borrowing persists over time because of its high population growth rate. Second, two specifications introduced exogenously into the model, the interest rate premium and the remittance flows, determine the shape of trade deficits.

We then investigate the welfare effect of this capital account liberalization compared to what would have happened if the economy had not opened to capital flows. Our results show that Turkish households have a welfare gain because of this opening up. According to our model Turkish households would have to give up 26 percent of their lifecycle consumption in the open economy case in order to have the same level of welfare as in the counterfactual case of the closed economy.

Fernandez de Cordoba and Kehoe (2000) employ a two-sector dependency model to explain capital inflows after Spain’s entry to the European Union where a capital poor country opens itself to capital flows. Bems and Jonsson Hartelius (2006) use the same model by incorporating interest rate risk premium on foreign loans to investigate whether Baltic states’ trade deficits that occurred after their transition will become a problem. Kehoe and Ruhl

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1Perri and Quadrini (2002) uses this model to explain the Great Depression in Italy.
(2009) consider growing working age population to analyze Mexico’s financial opening as well as its sudden stop in 1994. This paper complements Kehoe and Ruhl (2009), the most recent paper among the mentioned studies in this type of literature, by modeling Turkey as a capital poor economy with a high working age population growth rate, which faces interest rate premium while borrowing. In addition to these three features that determine the shape of trade balances, there is one more striking feature pertaining to both Mexico and Turkey, which has not been taken into account by Kehoe and Ruhl (2009): flows of remittances. Considering that Turkey is a major recipient of remittances, we introduce remittances into our model and calibrate it to the data for the Turkish economy.

The remainder of this paper is structured as follows. In section 2 we look at Turkish data after capital account liberalization and identify some developments in Turkish economy that are associated with capital flows. We demonstrate data for trade balance, real exchange rate, real GDP growth rate, and net capital flows. Section 3 and 4 present the model and its calibration. In Section 5 we present the results of our baseline simulations and the results of a simulation exercise, which compares the welfare of the Turkish households after opening up with the counterfactual case of the closed economy. We also demonstrate the results of the sensitivity analysis where we use alternative parameters and initial capital stocks. Section 6 summarizes the basic findings and concludes.

2 Effects of Capital Account Liberalization

In this section, we present the properties of the Turkish economy following capital account liberalization. Net trade in goods and services as a percentage of GDP is presented in Figure 1, which shows an increasing trend in trade deficits after liberalization. Figure 2 plots capital flows and real GDP growth together. We make a brief overview of macroeconomic effects of capital flows following liberalization, specifically focusing on GDP growth, trade deficits, and real exchange rate. To deal with structural weaknesses of the Turkish economy at the onset of capital account liberalization that pave the way for the crises in 1994 and 2001 and in turn capital outflows is beyond the scope of this paper.

Trade balance data is obtained from balance of payments accounts of the Central Bank of Turkey and GDP series is from United Nations National Accounts Main Aggregates Database.

Net capital flows to Turkey data is obtained from the balance of payments accounts of the Central Bank of Turkey and converted to constant dollars by using the producer price index for manufacturing in the USA taken from the Bureau of Labor Statistics.
Capital inflows to Turkey increased steadily after 1989 reaching 13 billion dollars in the period 1992-1993 and giving rise to, predictably, trade deficits. GDP of Turkey grew by more than 4 percent each year in the beginning of the 1990s with sizable capital inflows except 1991, the year of Gulf Crisis, and 1994 when a severe currency crisis led to a contraction in Turkish GDP by almost 5 percent,\(^5\) which simultaneously prompted net capital outflows and a trade surplus of 2.5 percent of GDP. Capital inflows to Turkey rose again after the 1994 currency crisis until the so-called Russian crisis of 1998, when there was a capital outflow from Turkey. Capital flows increased gradually in the 1999-2000 period, yet in 2001 Turkey was hit by a deep economic crisis, which triggered huge amounts of capital outflows where GDP contracted by almost 7 percent.\(^6\) The Turkish economy recovered from the crisis attaining an average annual real GDP growth rate of 6 percent with substantial capital flows and widening trade deficits in the post-crisis period.

The series labeled \(RER\) in Figure 3 shows the change of the bilateral real exchange rate with Germany taking 1989, as the base year. We use nominal exchange rates and consumer price indices obtained from the International Financial Statistics (IFS) database to construct this series. We choose to present the real exchange rate with Germany, because it is the biggest trading partner of Turkey.

We define the real exchange rate for Turkey, vis-a-vis Germany, as

\[
R_{RER,T,G,t} = \frac{p_{C,G,t}}{p_{C,T,t}} \cdot \frac{p_{T,G,t}}{p_{T,t}}
\]

where \(N_{RER,T,G,t}\) is the nominal exchange rate expressed in units of Turkish Lira per DM and \(p_{C,j,t}\) is the price index in country \(j\).

We can rewrite equation (1) as

\[
R_{RER,T,G,t} = \left( \frac{N_{RER,T,G,t}}{N_{RER,T,G,t}} \right) \left( \frac{p_{T,G,t}}{p_{T,t}} \cdot \frac{p_{C,G,t}}{p_{C,T,t}} \right) = R_{RER,T,G,t}^T \cdot R_{RER,N}^T
\]

where \(p_T\) is a price index for tradable goods. In Equation (2) \(R_{RER,T,G,t}^T\) captures the price changes of tradable goods and \(R_{RER,N}^T\) captures the price changes of nontradable goods.

\(^5\)Huge fiscal deficit combined with the effort of the government to supress interest rates while appreciating the real exchange rate led to a loss of the foreign exchange reserves and thus a sharp devaluation of the currency. See Celasun (1998) for a detailed discussion.

\(^6\)The root cause of this crisis was the combination of a fragile banking sector together with a high borrowing requirement of the public sector (Ozkan (2005)).
We assume that law of one price holds for tradable goods, so that

\[ p_{T,t}^T = NER_{T,G,t} p_{G,t}^T. \]  

(3)

Therefore, \( RER_{T,G,t}^T \) in equation (2) becomes 1 and changes in the real exchange rate can only result from movements in the price of nontradable goods across countries. Thus we obtain the following formula for the exchange rate by assuming that equation (3) holds

\[ RER_{T,G,t}^N = \frac{p_{T,t}^T/p_{T,t}}{p_{G,t}^T/p_{G,t}}. \]  

(4)

We will refer to this formula while calculating exchange rate in the model.

Figure 3 plots \( RER^N \) and \( RER \) together. We use producer price indexes for the manufacturing sector for each country. These series are obtained from IFS.

The series labeled \( RER \) in Figure 3 shows that capital inflows to Turkey are associated with the appreciation of the real exchange rate. This association is quite pronounced in the period after 2001. It further indicates that large capital outflows in the crisis years of 1994 and 2001 caused sharp real exchange rate depreciations in Turkey.

Figure 3 reveals, on the other hand, that most of the fluctuations in the real exchange rate can be explained by changes in the relative prices of tradable goods. After capital account liberalization both the real exchange rate and its nontradable components appreciated. Notice that the two series move together: the correlation between the two series is calculated as 0.48. However, changes in nontradable goods can explain only 14 percent of the movement in the real exchange rate between 1989 and 2005. We only expect to account for the changes in the relative price of nontradables in this model.

3 The Model

We present a small open economy that produces two types of goods: one is nontradable and the other is tradable and serves as numeraire. The production of the tradable good can be consumed domestically or exported or used for physical capital investment while the nontradable good can be domestically consumed or used for physical capital investment. Both the tradable and nontradable sectors are perfectly competitive with firms producing homogenous goods. Firms in the tradable sector combine imported intermediate goods with the domestic value added to produce tradable goods. The law of one price holds with respect to tradable goods. The rest of the world
is exogenous to the small open economy. The price of the imported good is assumed to be constant.

### 3.1 Firms

The production of nontradable goods takes place according to constant return-to-scale technologies

\[ y_N^t = A_N^t (k_N^t)^{\alpha^N} (l_N^t)^{1-\alpha^N}, \]  

(5)

where \( k^N \) is capital, \( l^N \) is hours worked, \( A^N \) is total factor productivity (TFP), and \( \alpha^N \) is the share of capital in production for the nontradable sector.

Domestic tradable good producers combine an imported intermediate good \( f \) with a constant price \( p^M = 1 \) and domestic value added \( v \), according to the production function:

\[ y_T^t = \left[ \eta^T \left( v_t \right)^{\frac{\gamma - 1}{\gamma}} + (1 - \eta^T) \left( f_t \right)^{\frac{\gamma - 1}{\gamma}} \right]^{\frac{\gamma}{\gamma - 1}} \]  

(6)

where \( \eta \) is the share of domestic value added and \( \gamma \) is the elasticity of substitution between domestic value added and imported inputs.

Domestic value added is produced using labor and capital as inputs:

\[ v_t = A_T^t (k_T^t)^{\alpha_T} (l_T^t)^{1-\alpha_T}, \]  

(7)

where \( k^T \) is capital, \( l^T \) is hours worked, \( A^T \) is total factor productivity (TFP), and \( \alpha^T \) is the share of capital in production for the production of domestic value added.

Aggregate investment in sector \( j = N, T \) is expressed as a CES index of nontradable investment, \( z^{j,N} \), domestically produced tradable investment, \( z^{j,T} \), and foreign investment, \( z^{j,M} \).

\[ i^j = \left[ (\theta^j)^{\frac{1}{\sigma}} (z^{j,N})^{\frac{\sigma - 1}{\sigma}} + (1 - \theta^j)^{\frac{1}{\rho}} \left( (\mu^j)^{\frac{1}{\rho}} (z^{j,T})^{\frac{\rho - 1}{\rho}} + (1 - \mu^j)^{\frac{1}{\rho}} (z^{j,M})^{\frac{\rho - 1}{\rho}} \right) \right]^{\frac{\sigma}{\sigma - 1}} \]  

(8)

where the parameter \( \theta^j \) and \( \mu^j \) determine the share of investments. The elasticity of substitution between nontradable sector and a composite investment of domestically produced tradable investment and the foreign investment is \( \sigma \). The parameter \( \rho \) is the elasticity of substitution between domestic tradable investment and the foreign investment.

The investment price index in sector \( j = N, T \) is

\[ q^j = \left[ \theta^j (p^N)^{1-\sigma} + (1 - \theta^j) (\mu^j + (1 - \mu^j)(p^M)^{1-\rho})^{\frac{1-\sigma}{1-\rho}} \right]^{\frac{1}{1-\sigma}}. \]  

(8)
where $p^N$ is the price of the nontraded good.

In an optimal investment plan, aggregate investment in sector $j = N, T$ is divided among nontradable investment, domestic tradable investment and foreign investment as

$$z^j_N = \theta^j \left( \frac{p^N}{q^j} \right) ^{-\sigma} \bar{v}^j, \quad (9)$$

$$z^j_T = \mu^j (1 - \theta^j) \left( \frac{1}{q^j} \right) ^{-\sigma} \left( \mu^j + (1 - \mu^j) (p^M)^{1-\rho} \right) ^{\rho-\sigma} \bar{v}^j, \quad (10)$$

$$z^j_M = (1 - \mu^j) (1 - \theta^j) \left( \frac{p^M}{q^j} \right) ^{-\rho} \left( \mu^j + (1 - \mu^j) (p^M)^{1-\rho} \right) ^{\rho-\sigma} \bar{v}^j. \quad (11)$$

Firms face a static optimization problem. The firm in the nontradable sector chooses labor and capital so as to maximize its profits

$$y^N - w^N l^N - q^N r^N k^N.$$ 

The solution to the firm’s problem for the nontradable sector satisfies

$$w^N = p^N (1 - \alpha^N) A^N (k^N)^{\alpha^N} (l^N)^{-\alpha^N}, \quad (12)$$

$$q^N r^N = p^N \alpha^N A^N (k^N)^{\alpha^N-1} (l^N)^{1-\alpha^N}. \quad (13)$$

The firm in the tradable sector chooses labor and capital so as to maximize the following equation

$$y^T - w^T l^T - q^T r^T k^T - p^M f.$$ 

Cost minimization for the tradable sector gives the factor demands:

$$w^T = (1 - \alpha^T) (\eta) ^{\frac{1}{\gamma}} \left( \frac{y^T}{v} \right) ^{\frac{1}{\gamma}} \frac{v}{l^T}, \quad (14)$$

$$q^T r^T = \alpha^T (\eta) ^{\frac{1}{\gamma}} \left( \frac{y^T}{v} \right) ^{\frac{1}{\gamma}} \frac{v}{k^T} \quad (15)$$

$$p^M = (1 - \eta) ^{\frac{1}{\gamma}} \left( \frac{y^T}{f} \right) ^{\frac{1}{\gamma}}. \quad (16)$$

Because of labor and capital mobility across sectors, wage rates and returns to capital are equalized.

$$w^N = w^T = w.$$ 

$$q^T r^T = q^N r^N.$$
3.2 Households

The small open economy model is populated by identical infinitely lived households that value consumption and leisure. The representative household maximizes its lifetime utility

$$\sum_{t=0}^{\infty} \beta^t [\ln c_t + \varphi \ln(1 - l_t)],$$

(17)

where $\beta$ is the intertemporal discount factor, $\varphi$ is the preference for leisure, $l$ is working hours, and $c$ is a composite consumption good, which is a nested CES combination of nontradable goods, $a^N$, domestic tradable goods $a^T$, and imported tradable good, $a^M$.

$$c = \left[ \theta \left( \frac{1}{\sigma} \right) a^N + (1 - \theta) \left( \mu \left( \frac{1}{1-\rho} \right) a^T + (1 - \mu) \left( \frac{1}{1-\rho} \right) a^M \right) \right]^{\frac{1}{\sigma-1}}$$

(18)

where $\theta$ is the preference for the nontradable good and $\mu$ is the preference for the domestic tradable good. The parameter $\sigma$ is the elasticity of substitution between nontradable and tradable goods. The elasticity of substitution between domestically produced tradable good and imported good is $\rho$.

The price index $p^C$ is

$$p^C = \left[ \theta (p^N)^{1-\sigma} + (1 - \theta) \left( \mu + (1 - \mu) (p^M)^{1-\rho} \right) \left( \frac{1}{p^C} \right)^{\frac{1}{1-\sigma}} \right]^{\frac{1}{1-\sigma}}.$$  

(19)

In an optimal consumption plan, total consumption is divided among nontradable good, domestic tradable good, and imported good as

$$a^N = \theta \left( \frac{p^N}{p^C} \right)^{-\sigma} c,$$

(20)

$$a^T = \mu (1 - \theta) \left( \mu + (1 - \mu) (p^M)^{1-\rho} \right) \left( \frac{1}{p^C} \right)^{-\sigma} c,$$

(21)

$$a^M = (1 - \mu) (1 - \theta) \left( \mu + (1 - \mu) (p^M)^{1-\rho} \right) \left( \frac{p^M}{p^C} \right)^{-\sigma} c.$$  

(22)

The representative household maximizes equation (17) subject to
\[ p_t^C c_t + q_t^N i_t^N + q_t^T i_t^T + (1 + n) b_{t+1} = w_t l_t + q_t^N r_t^N k_t^N + q_t^T r_t^T k_t^T + (1 + r_t) b_t + rem_t, \]  
\[ (1 + n) k_{t+1}^N = (1 - \delta) k_t^N + i_t^N - \frac{\psi}{2} \left( \frac{(1 + n) k_{t+1}^N - k_t^N}{k_t^N} - \delta \right)^2 k_t^N \]  
\[ (1 + n) k_{t+1}^T = (1 - \delta) k_t^T + i_t^T - \frac{\psi}{2} \left( \frac{(1 + n) k_{t+1}^T - k_t^T}{k_t^T} - \delta \right)^2 k_t^T \]  
\[ r_t = r_t^* + \omega_t. \]

Equation (23) is the budget constraint equating income to expenditures. Here, \( l_t \) is the endowment of labor, supplied at wage \( w_t \); \( b_{t+1} \) is investment in a bond denominated in units of domestic tradable goods and earning the interest \( r_{t+1} \). If \( b_{t+1} \) is negative, the economy is borrowing from the rest of the world. If \( b_{t+1} \) is positive, the economy is acquiring assets from the rest of the world. Equation (26) shows that the economy can borrow at a higher rate than the world interest rate and \( \omega \) is the interest rate premium. The representative household receives remittances from abroad denoted by \( rem \).

We model the per-capita remittance receipts to Turkey as a lump-sum direct transfer to the Turkish representative household from abroad. Equations (24) and (25) show accumulations of two kinds of capital, with adjustment costs. Adjustment cost parameter, \( \psi \) is set equal for both tradable and non-tradable sectors. Notice that the specification of evolution of capital allows us to have capital adjustment costs at the steady state.

If the economy is closed in period \( t \), there is no borrowing and lending, \( b_{t+1} \) is zero, and equation (26) does not hold. Therefore, the return on investment is endogenously determined in the model. If the economy is open, the interest rate is equal to an exogenously given international rate for net foreign asset position and \( b_{t+1} \) is endogenously determined.

The first order conditions for the consumer maximization problem for sectors \( j = N, T \) are given by

\[
\frac{1}{c_t} q_t^j (1+n) \left( 1 + \psi \left( \frac{(1 + n) k_{t+1}^j - k_t^j}{k_t^j} - \delta \right) \right) = \beta \frac{1}{c_{t+1}^j} q_{t+1}^j \\
\left( r_{t+1}^j + (1 - \delta) + \frac{\psi}{2} (1 + \delta) \left( \frac{(1 + n) k_{t+1}^j - k_t^j}{k_t^j} - \delta \right) \right),
\]  
\] (27)
\[
\frac{1}{p_t^C c_t} = \frac{\varphi}{1 - \ell_t w_t},
\]
\[
\frac{1}{c_t} \frac{1}{p_t^C} (1 + n) = \beta \frac{1}{c_{t+1}} \frac{1}{p_{t+1}^C} (1 + r_{t+1})
\]

plus a transversality condition.

### 3.3 Equilibrium

To close the model, we need to specify the equilibrium conditions. The resource constraints are

\[
y_N^t = a_N^t + z_{T,N}^t + z_{T,N}^t,
\]
\[
y_T^t = a_T^t + z_{N,T}^t + z_{T,T}^t + x_t,
\]
\[
m_t = a_M^t + z_{N,M}^t + z_{T,M}^t + f_t
\]

where \(m\) are total imports and \(x\) are total exports.

The trade balance is given by

\[
b_{t+1} - b_t (1 + r_t) = x_t - p_t^M m_t + rem_t.
\]

### 4 Calibration

In this section, we first discuss the data and the methods used to calibrate the model to Turkey, and then present exogenous processes to simulate the model.

#### 4.1 Calibration of the Household and Production Parameters

In calibrating the model, we would like to match some certain key data in the Turkish input-output matrix for 1989. Since there is no input-out matrix constructed for 1989, we base our calibrations on the input-output table for 1985.

We aggregate the 64 sector input-output matrix compiled by Turkish Institute of Statistics to obtain the two-sector matrix presented in Table 1. We classify each sector of the economy as tradable or nontradable according to the division that is commonly used in the literature (see for instance, Stockman and Tesar (1995) and Bems and Jonsson Hartelius (2006)). In
Receipts | Expenditures
---|---
| 1 | 2 | 3 | 1+2+3 | C+G | I | X | C+G+I+X | Total
---|---|---|---|---|---|---|---|---|---
1 | 16,649 | 3,160 | 0 | 19,809 | 16,997 | 2.239 | 4,839 | 24,075 | 43,885
2 | 3,325 | 1,098 | 0 | 4,423 | 6,394 | 3,519 | 1,079 | 10,992 | 15,415
3 | 0 | 0 | 0 | 0 | 1,788 | 0 | 0 | 0 | 1,788
1+2+3 | 19,974 | 4,258 | 0 | 24,233 | 25,179 | 5,758 | 5,918 | 36,855 | 61,087
wl | 2,543 | 1,773 | 1,673 | 5,988 | 5,988
rk | 12,446 | 7,523 | 19,969 | 19,969
depreciation | 807 | 673 | 115 | 1,596 | 1,596
T | 569 | 839 | 1,408 | 1,408
wl+rk+T | 16,365 | 10,808 | 1,788 | 28,961 | 28,961
M | 7,545 | 348 | 0 | 7,893 | 7,893
Total | 43,885 | 15,415 | 1,788 | 61,087 | 25,179 | 5,758 | 5,918 | 36,855 | 61,087

Source: Turkish Institute of Statistics (http://www.tuik.gov.tr/VeriBilgi.do?tb_id=58&ust_id=16): 1, agriculture, fish, mining, manufacturing and communication (sectors 1-49); 2, energy, construction, wholesale and retail trade, hotel services, finance, real estate and plus services for sale (sectors 50-62); 3, public services and ownership of dwellings (sectors 63-64); wl, remuneration of employees, rk; net business income; T, net direct taxes and transfers including value added tax; M, imports; C+G, private consumption plus government consumption; I, investment plus inventory accumulation; X, exports.

Table 1: Aggregated input output-table for Turkey, 1985 (Billion Turkish Liras)

order to to calibrate the parameters of the model, we use the equilibrium conditions of the model for the autarky steady state and normalize all prices except the rental rates of capital and wage rates to 1 for the initial year. The unit period is the year.

As mentioned above, we can not use input-output table for the last closed year in our calibration. However, relative price changes might occur between the beginning of simulation and the year for which parameter values are calibrated. Hence, we construct GDP deflators for tradable and non-tradable sectors and use them as price indeces to connect the normalized prices of 1989 and with prices of 1985.7

| Nontradable ratios | $\frac{c^N}{y^N} = 0.72$ | $\frac{i^{N,N+X,N}}{y^N} = 0.28$ |
| Tradable ratios | $\frac{c^X}{y^X} = 0.64$ | $\frac{i^{N,X+X,X}}{y^X} = 0.06$ | $\frac{X}{y^X} = 0.25$ |
| Import ratios | $\frac{c^M}{M} = 0.04$ | $\frac{i^{N,M+X,M}}{M} = 0.16$ | $\frac{X^M}{M} = 0.8$ |
| Output ratio | $\frac{y^N}{y^X} = 0.58$ |

Table 2: Aggregate ratios, 1985

Of crucial importance to the dynamic nature of the model is the calibra-

7According to our calculations there is no relative price change between 1985 and 1989.
tion of initial capital stocks. We set the interest rate in Turkey to 0.09 and calibrate initial capital stock values accordingly.

The share parameters $\theta, \mu, \theta^T, \mu^T, \theta^N, \mu^N, \eta$ are calibrated to match the input-output ratios that are constructed from Table 1 and reported in Table 2. Import ratios are taken from imports by commodity groups data of Turkish Institute of Statistics. To pin down the seven share parameters, we set the ratio between the tradable inputs in the production of investment in the tradable and nontradable sectors to 0.6; that is $z^{T,T}/z^{N,T} = 0.6$ as in Bems (2008). In Appendix we explain how we constructed the input-output matrix under the assumption that Turkey was closed to capital flows and how we obtained calibration parameters in more detail.

Following Backus, Kehoe, and Kydland (1994) and other studies in international business cycles we set $\rho$, the elasticity of substitution between domestic tradable goods and imported goods, equal to 1.5. The elasticity of substitution between tradable and nontradable goods in the consumption and the investment index, $\sigma$, is set equal to 0.5, following the empirical estimates in Kravis, Heston, and Summers (1982) and Stockman and Tesar (1995). The elasticity of substitution between imported intermediate good and domestic value added, $\gamma$, is set equal to 0.7 as in Rotemberg and Woodford (1996).

In our model $c$ is conceptually private consumption plus government consumption. Moreover we set imports to be equal to the exports in the initial steady state since we assume Turkey is closed to capital inflows, which implies $b_{1989} = 0$.

Following McGrattan and Prescott (2003), we set $r^* = 0.04$ in the balanced growth path. Requiring this interest rate to be consistent with the balanced growth path implies that $\beta = (1 + n)/(1 + r^*) = 0.976$.

Productivity parameters $A^T$ and $A^N$ are calibrated such that the value added in tradable and nontradable production fits the data in the input-output matrix of 1985. The depreciation rate is calibrated as $\delta = 0.016$.

Preference for leisure term, $\varphi$ is calibrated so that the number of hours worked, $l$, is 0.33 at the autarkic steady state.

We are left with calibrating $\psi$, the capital adjustment cost parameter. In our baseline simulations we set $\psi = 1$, resulting in steady state adjustment cost of 0.03 percent of total output for the tradable sector and 0.04 percent of total output for the nontradable sector. As a sensitivity analysis, we also report the model dynamics of the cases for $\psi = 0.5$ and $\psi = 1.5$ in section 7. The calibration of parameters are presented in Table 3.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b_{1989}$</td>
<td>0</td>
<td>Trade balance</td>
</tr>
<tr>
<td>$k^N_{1989}$</td>
<td>1.79</td>
<td>Real interest rate in Turkey</td>
</tr>
<tr>
<td>$k^T_{1989}$</td>
<td>2.40</td>
<td>Real interest rate in Turkey</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.976</td>
<td>World real interest rate</td>
</tr>
<tr>
<td>$\phi$</td>
<td>1.65</td>
<td>Ratio of hours worked to available hours</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.5</td>
<td>Elasticity of substitution: tradable to nontradable</td>
</tr>
<tr>
<td>$\rho$</td>
<td>1.5</td>
<td>Elasticity of substitution: domestic tradables to imports</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.7</td>
<td>Elasticity of substitution: domestic value added to imports</td>
</tr>
<tr>
<td>$\alpha^T$</td>
<td>0.35</td>
<td>Capital’s share of domestic tradable production</td>
</tr>
<tr>
<td>$\alpha^N$</td>
<td>0.34</td>
<td>Capital’s share of nontradable production</td>
</tr>
<tr>
<td>$\theta$</td>
<td>0.39</td>
<td>Share of nontradable good in consumption</td>
</tr>
<tr>
<td>$\mu$</td>
<td>0.98</td>
<td>Share of domestic tradable good in tradable consumption</td>
</tr>
<tr>
<td>$\theta^T$</td>
<td>0.66</td>
<td>Share of nontradable investment in tradable sector</td>
</tr>
<tr>
<td>$\theta^N$</td>
<td>0.58</td>
<td>Share of nontradable investment in nontradable sector</td>
</tr>
<tr>
<td>$\mu^T$</td>
<td>0.37</td>
<td>Share of domestic tradable investment in tradable sector</td>
</tr>
<tr>
<td>$\mu^N$</td>
<td>0.64</td>
<td>Share of domestic tradable investment in nontradable sector</td>
</tr>
<tr>
<td>$\eta$</td>
<td>0.76</td>
<td>Share of domestic value added</td>
</tr>
<tr>
<td>$A^T$</td>
<td>1.32</td>
<td>Value added in tradable production</td>
</tr>
<tr>
<td>$A^N$</td>
<td>1.37</td>
<td>Value added in nontradable production</td>
</tr>
<tr>
<td>$\psi$</td>
<td>1</td>
<td>Capital adjustment cost parameter</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.016</td>
<td>Autarkic steady state level of $k^X$ and $k^N$</td>
</tr>
</tbody>
</table>

| Time | Trade balance | Real interest rate in Turkey | Real interest rate in Turkey | World real interest rate | Ratio of hours worked to available hours | Elasticity of substitution: tradable to nontradable | Elasticity of substitution: domestic tradables to imports | Elasticity of substitution: domestic value added to imports | Capital’s share of domestic tradable production | Capital’s share of nontradable production | Share of nontradable good in consumption | Share of domestic tradable good in tradable consumption | Share of nontradable investment in tradable sector | Share of nontradable investment in nontradable sector | Share of domestic tradable investment in tradable sector | Share of domestic tradable investment in nontradable sector | Share of domestic value added | Value added in tradable production | Value added in nontradable production | Capital adjustment cost parameter | Autarkic steady state level of $k^X$ and $k^N$ |
|-------|-------------|-----------------------------|-------------------------------|-------------------------|------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| $1989$ | 0           | 1.79                        | 2.40                          | 0.976                   | 1.65                                     | 0.5                                           | 1.5                                           | 0.7                                           | 0.35                                          | 0.34                                          | 0.39                                          | 0.98                                          | 0.66                                          | 0.58                                          | 0.37                                          | 0.64                                          | 0.76                                          | 1.32                                          | 1.37                                          | 1                                              |

Table 3: Calibration of the parameters

4.2 Exogenous Processes

There are three exogenous processes in the model: interest rate premium, population growth rate, and remittances.

4.2.1 Interest Rate Premium

As in Bems and Jonsson Hartelius (2006), we take Germany as the rest of the world. Turkey faces higher real interest rates than Germany, which are regarded as country specific interest rate premium.\(^8\) A country specific interest rate premium can slow down borrowing initially and determine the path of capital flows.

\(^8\)Turkey’s real interest rates are higher than Germany after the opening excluding the exceptional years of 1989 and 1990. The low real interest rates in these years can be attributed to skyrocketing inflation rates during these years.
It is common in the literature to model the interest rate premium of the small open economy as a function of total debt, in line with Schmitt-Grohé and Uribe (2005). Table 4 reports the ratio of total external debt to GNI and interest rate premium together.\(^9\) Afterwards, we will explain the method to calculate the interest rate premium reported in Table 4. A glance at this Table demonstrates that interest rate premium and total external debt are not very correlated. We only see a jump both in the external debt and in the interest rate premium in the crisis years of 1994 and 2001. Other factors that determine the interest rate premium in a country are such as the stability of institutions guaranteeing democracy, the rule of law, and the existence of a functioning market economy (See Eaton, Gersovitz, and Stiglitz (1986) and Hutchison (2002)). We believe that these factors rather than the total debt impact on the determination of the interest rate premium in Turkey. Since we do not model institutional development taking place in Turkey, we choose to introduce the empirically observed interest rate premium exogenously in the model as in Bems and Jonsson Hartelius (2006), Cook and Devereux (2006) and Kehoe and Ruhl (2009). Risk premium is introduced into the model in equation (26).

Since the J.P. Morgan Emerging Market Bond Index spread is not available for the years before 1998, we obtain the comparable data for Turkey and Germany from IFS to construct the interest rate premium, and calculate it as the difference between the real money market interest rates in Turkey and Germany. However, these calculated series turn out to be very high so we follow the calibration strategy of choosing average \(\omega\) to match average of simulated trade deficits between 1989-2005. The households perfectly anticipate the path of interest rate premium to be the same as in the data between 1989-2005. We assume that the interest rate premium in 1989 is the same as in 1990.

4.2.2 Population Growth Rate

When Turkey opens to capital flows, it borrows not only because it is capital poor, but also because it has a growing working age population. A rapidly growing average working age population in Turkey leads to a steady borrowing over time. Hence, calibration of the path for working age population is of crucial importance to the dynamics of the model.

Population growth rate for Turkey is exogenous to the model. Average working age population growth rate is calculated as the difference between Turkish and German working age population growth rates. These growth

---

\(^9\)Total debt includes both private and public external debt. The data for the ratio of total external debt to GNI is obtained from the Global Development Finance database.
<table>
<thead>
<tr>
<th>Year</th>
<th>External Debt GNI ratio (%)</th>
<th>Interest rate premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>34</td>
<td>0.010</td>
</tr>
<tr>
<td>1992</td>
<td>36</td>
<td>0.005</td>
</tr>
<tr>
<td>1993</td>
<td>39</td>
<td>0.006</td>
</tr>
<tr>
<td>1994</td>
<td>52</td>
<td>0.037</td>
</tr>
<tr>
<td>1995</td>
<td>44</td>
<td>0.004</td>
</tr>
<tr>
<td>1996</td>
<td>45</td>
<td>0.010</td>
</tr>
<tr>
<td>1997</td>
<td>45</td>
<td>0.005</td>
</tr>
<tr>
<td>1998</td>
<td>36</td>
<td>0.007</td>
</tr>
<tr>
<td>1999</td>
<td>41</td>
<td>0.014</td>
</tr>
<tr>
<td>2000</td>
<td>44</td>
<td>0.007</td>
</tr>
<tr>
<td>2001</td>
<td>59</td>
<td>0.032</td>
</tr>
<tr>
<td>2002</td>
<td>57</td>
<td>0.007</td>
</tr>
<tr>
<td>2003</td>
<td>49</td>
<td>0.010</td>
</tr>
<tr>
<td>2004</td>
<td>41</td>
<td>0.010</td>
</tr>
<tr>
<td>2005</td>
<td>35</td>
<td>0.004</td>
</tr>
</tbody>
</table>

Table 4: The ratio of Total external debt to GNI and interest rate premium in Turkey (%)

rates are constructed from the observed data for the period 1989-2005 and from population projections made by the United Nations for 2005-2050. We assume that population growth differential between Turkey and Germany becomes zero after 2050.

4.2.3 Remittances

Turkish workers started to migrate, mainly to Western Europe and specifically to the Federal Republic of Germany, in the early 1960s. In 1964 remittances of Turkish migrants started to be recorded in the Turkish balance of payments. Since then, they have gradually grown and become a significant source of external financing for Turkey (Aydas, Metin-Ozcan, and Neyapti (2005)). Remittances of Turkish migrants had been around 2 percent of GDP up until the beginning of 2000s. Thus remittance flows must be accounted for in the model to successfully replicate the data.\(^{10}\)

We pursue a simple way of incorporating remittance flows to the model by

\(^{10}\)Remittances have started to decline in the beginning of 2000s due to the fact that Turkish migrants’ ties with the family members remaining in Turkey weakened with the passage of time (Sayan and Tekin-Koru (forthcoming)).
exogenously introducing remittances in the budget constraint of the household, which we calibrate to the remittance flows that can be observed in the data in the 1990-2005 period. The households perfectly foresee the path of remittances that are the same as in the data.

5 Experiments

In this section we simulate the model presented and calibrated in the previous sections. The economy is closed to capital flows in the initial year, which corresponds to 1989. We set the initial capital stocks in each sector such that they are below their autarkic steady state values in 1989 and open the economy to capital flows in 1990. Consequently, Turkey accumulates capital until it reaches the balanced growth path and population growth rates in Turkey and Germany are equalized. Turkey borrows from international capital markets initially and runs trade deficits to finance consumption and capital accumulation, implying that in steady state, it will run trade surpluses.

5.1 Simulation Results

Simulation results are displayed in Figures 4, 5, 6, 7, and 8. To compare the model results with the data, we include the corresponding Turkish data in the figures.

Figure 4 plots the trade balance. We express the series in terms of the same period GDP and trade balance, since the data series are in current prices. The model is successful to reproduce the shape of the trade balance. There is a strong correlation between the model and the data. It turns negative when the country liberalizes capital flows and fluctuates in line with the path of the interest rate premium. As in the data, trade deficit turns into surplus in 1994 and the country runs higher trade deficits after 2001.

Figure 5 plots the real exchange rate. Notice that the relevant data series for the real exchange rate is $RER$ and not $RER^N$, and we therefore hope to explain only 14 percent of the real exchange rate. To calculate the real exchange rate in the model, we use equation (4) and use price indexes for Germany as in the data. Since households can borrow only tradable good, nontradable good becomes relatively scarce after opening to capital flows and accordingly its relative price increases. Our model captures the appreciation in the real exchange rate in the first years of liberalization. However, it

\footnote{Data for remittances is obtained from the balance of payments accounts of the Central Bank of Turkey.}
predicts a smaller appreciation of the real exchange rate than that in the data. Furthermore, it does not account for either the sharp depreciation in the financial crisis year of 1994 or the appreciation trend after 2004.

Figures 6, 7, and 8 demonstrate the growth rates of output, consumption, and investment respectively. Simulated growth rates of output and investment move in correlation with those in the data. In the case of consumption, there is less correlation between the model and the data. Furthermore, the model underestimates the changes taking place in output, consumption and investment that we see in the data.

Table 5 reports simulated ratios along with the observed ratios constructed from 1998 and 2002 input-output matrices. We demonstrate three representative input-output ratios that are $y^N/y^T$, $x/y^T$, and $a^N/y^N$. The model is successful to predict the direction of the ratios. It only fails to predict the downward movement of $y^N/y^T$ between 1998 and 2002. The ratio of tradable output to exports, $x/y^T$, does increase between 1985 and 1998, but not as much as it does in the data. The model predicts a 4 percent decline in $x/y^T$ between 1998 and 2002, but it decreases by 8 percent in the data. The model does a good job of generating the increase in $a^N/y^N$ both in 1998 and 2002. However, it underpredicts this increase.

<table>
<thead>
<tr>
<th></th>
<th>$x/y^T$</th>
<th>$y^N/y^T$</th>
<th>$c^N/y^N$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>model</td>
<td>data</td>
<td>model</td>
</tr>
<tr>
<td>1985</td>
<td>0.25</td>
<td>0.25</td>
<td>0.58</td>
</tr>
<tr>
<td>1998</td>
<td>0.27</td>
<td>0.39</td>
<td>0.62</td>
</tr>
<tr>
<td>2002</td>
<td>0.23</td>
<td>0.31</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Table 5: Input-Output Ratios

We also consider a model where households anticipate the capital account liberalization in 5 years. The results for output, consumption, exchange rate, and investment show no change both quantitatively and qualitatively. The shape of the trade balances shows no change either. The only change is observed in the quantitative results of the trade balance. Figure 9 shows that the size of the deficits in the model is much closer to that in the data. Since the households anticipate the opening before 1989, they do not perceive the opening as a shock and do not borrow heavily from abroad.
5.2 Welfare Gain?

We now ask a new question: What were the effects on welfare of this financial liberalization compared to what would have happened if the economy had not opened up? To answer this question we need to compare the life-cycle utility after opening with the counterfactual case of no opening. Specifically, we start with the same equilibrium in both cases and simulate the closed economy using the same exogenous processes for remittances and population growth as the open one.

Let $\xi$ denote the welfare loss/gain of opening the economy to capital flows. We measure $\xi$ as the fraction of the consumption process that the household has to give up in the open economy case to be as well off in the closed economy one. Formally, $\xi$ is defined by

$$\sum_{t=0}^{\infty} \beta^t u((1-\xi)c_t, l_t) = \sum_{t=0}^{\infty} \beta^t u(\bar{c}_t, \bar{l}_t)$$

(34)

where $\bar{c}$ is consumption and $\bar{l}$ is leisure in closed economy. If $\xi$ is positive, there is a welfare gain because of opening. Otherwise, there is a welfare loss.

To carry out this exercise, we choose a horizon of 400 periods, the value of the discount rate $\beta^t$ is approximately zero, for $\beta = 0.976$. Then, we compute welfare loss/gain using the following formula

$$\xi = 1 - \exp \left( \frac{\sum_{t=0}^{399} (\bar{u}_t - u_t)}{400} \right)$$

(35)

where $\bar{u}$ is the utility of the household, the one Turkish households would have enjoyed if there had been no capital account liberalization. We get $\xi > 0$, meaning that Turkish households have a welfare gain because of financial opening according to our model. Turkish households would have to give up 26.21 percent of their lifecycle consumption in the open economy case in order to have the same level of welfare as in the counterfactual case of the closed economy.

5.3 Sensitivity Analysis

Table 6 reports the results of the model under alternative initial capital stocks and parameter values. We recalibrate the other parameters of the model when required. We demonstrate maximum simulated trade deficit as well as the initial trade deficit in 1990. We also carry the welfare gain exercise for each alternative experiment.
Experiments | Trade deficit (% of GDP) | Welfare gain |
--- | --- | --- |
Benchmark | 4.13 | 7.42 | 26.21 |
0.9$k^T$, 0.9$k^N$ | 6.38 | 7.41 | 26.11 |
1.1$k^T$, 1.1$k^N$ | 2.11 | 7.45 | 26.30 |
$\sigma=0.1$ | 4.17 | 7.41 | 26.22 |
$\sigma=0.9$ | 4.09 | 7.41 | 26.22 |
$\rho=1$, $\rho=2$ | 4.13 | 7.42 | 26.21 |
$\gamma=0.5$, $\gamma=0.9$ | 4.13 | 7.42 | 26.21 |
$\psi=0.5$ | 8.78 | 7.50 | 27.26 |
$\psi=1.5$ | 1.86 | 7.40 | 25.32 |

Table 6: Sensitivity analysis

Choosing initial capital stock values is of crucial importance to the dynamics of the model. When Turkey liberalizes capital flows, it starts borrowing because it is modeled as a capital poor economy. Not surprisingly changing the initial capital stock values has considerable effects on the magnitude of these trade deficits. A 10 percent increase in the initial capital stock values leads to a 2.02 percent decline in the 1990 trade deficit whereas a 10 percent decrease raises the 1990 trade deficit by 2.25 percent. Yet, the higher the initial capital stock values are, the higher the welfare gain is.

We also vary the elasticities of substitution, which are governed by $\sigma$, $\rho$, and $\gamma$ in both directions. Welfare gain is insensitive to the change in elasticities of substitution. The magnitude of the trade deficits changes slightly as $\sigma$, the elasticity of substitution between tradables and nontradables, varies, whereas it is insensitive to varying two other elasticities.

Table 6 reveals that the capital adjustment cost parameter is important for the results of the model. A lower value of adjustment cost parameter induces larger trade deficits. This is not a surprising result as Fernandez de Cordoba and Kehoe (2000) and Bems and Jonsson Hartelius (2006) show that adjustment costs are crucial in matching the model dynamics to the data. Obviously a lower value of adjustment cost parameter leads to a higher welfare gain.\(^\text{12}\)

\(^{12}\)In an exercise not shown in the text, we considered a model where households anticipate interest rate premium shocks one period in advance. Trade balance dynamics of that experiment move mostly opposite to the data.
6 Conclusion

In this paper we have constructed a two-sector dynamic general equilibrium model and calibrated it to Turkey. The model can account for much of the trade balances in Turkey after capital account liberalization. When Turkey opened to capital flows, it started to borrow, not only because it was capital poor, but also it had a rapidly growing working age population. Furthermore, the specifications of interest rate premium and remittance flows determine the path of trade balances. We also found that Turkish households have a welfare gain because of this opening up. Turkish households would have to give up 26 percent of their lifecycle consumption in the open economy case in order to have the same level of welfare as in the counterfactual case of the closed economy.

On a negative note, our model fails to explain interest rate differentials between Turkey and Germany. We assume that real interest rate is constant at 4 percent in Germany and it starts from 9 percent in Turkey. However, the real interest rate in Turkey in 1989 and 1990 was lower than that in Germany, due to very high inflation rates in Turkey during these years and our model fails to demonstrate this.
References


Figures

Figure 1: Trade Balance (percent of GDP)
Figure 2: Capital Flows and GDP Growth
Figure 3: Real Exchange Rate
Figure 4: Simulation Results for Trade Balance (percent of GDP)
Figure 5: Simulation Results for the Real Exchange Rate
Figure 6: Simulation Results for the GDP growth rate
Figure 7: Simulation Results for consumption
Figure 8: Simulation Results for investment
Appendix

We aggregate the 64 sector input-output matrix to obtain the two sector matrix presented in Table 1. Notice that, in this matrix, the value of domestic tradable good production, \( z \), is 16,365 and the value of nontradable good production, \( y^N \), is 10,808.

We begin by calibrating capital shares and employ the method used by Fernandez de Cordoba and Kehoe (2000). The capital share in the tradable sector is

\[
\alpha^T = \frac{12,446}{12,446 + 2,453} = 0.83.
\]

The figure for \( \alpha^N \) is obtained analogously. Aggregate capital share turns out to be

\[
\alpha = (\alpha^T z + \alpha^N y^N)/(z + y^N) = 0.82.
\]

This number is too high because of including income of the self-employed workers in capital income. Therefore we assume a flat capital share of 0.35
as do Bosworth and Collins (2003) and make an adjustment for the capital shares in each sector. Because of lack of information to make this adjustment separately, we do it proportionately, obtaining $\alpha^T=0.35$ and $\alpha^N=0.34$.

Because imported input into nontradable investment is the only component of nontradable imports, we set $z^{N,M}=348$. According to the data obtained from the Turkish Institute of Statistics, the ratio of investment goods in imports is 0.161. This would imply that $z^{T,M}$ is 922. Notice that in the input-output matrix, the sum of investments into tradable investment, $z^{N,T}$, $z^{T,T}$, and $z^{T,M}$, is 2,239. Subtracting $z^{T,M}$ from the total leaves us with $z^{N,T}+z^{T,T}=1,316$. The sum of $z^{N,N}$ and $z^{T,N}$, and $a^T$ are calculated analogously. Finally, we find tradable good production ($y^T$) by employing the equilibrium condition given by equation (31) and take it to be equal to the sum of intermediate imported goods ($f$) and domestic value added in tradable good production ($v$). Since the share of imported intermediate inputs is 0.8 according to the data obtained from the Turkish Institute of Statistics, $f$ is calculated as $0.8 \times 7,893=6,314$. Subtracting this amount from $y^T$ gives $v$. As the value we find for $v$ is different from the one in the input-output matrix, we have adjusted the values of $v$ and $y^N$ proportionately in the matrix to match the value of $v$ we have derived. Hence, we have the aggregate ratios for 1985 demonstrated in Table 2.