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Terms of Trade and Economic Fluctuations

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TERMS OF TRADE AND ECONOMIC FLUCTUATIONS

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Abstract

This paper aims at analyzing the existence of the Harberger-Laursen-Metzler hypothesis for Turkey. The hypothesis states that an improvement in the terms of trade improves a country's real income level and, since part of that increase will fall on saving, the improvement in the terms of trade improves the trade balance. The models within the intertemporal optimizing framework, however, assert that the relation between the terms of trade and trade balance depends on the relative importance of consumption-smoothing and consumption-tilting motives that are governed by the intertemporal elasticity of substitutions. When there are nontradable goods the intratemporal elasticity of substitution also plays and important role. In this paper, we provide the estimates of these elasticities using a variation of the models employed in the real business cycle literature. We also compare the data obtained from the artifical economy with those of the actual data to see if a model based on intertemporal considerations is capable of replicating the characteristics of actual data on Turkey.

I. INTRODUCTION

It is well recognized that changes in the terms of trade have important consequences for the economic performance of a country. One consequence, according to Keynesian theory, is that they affect the saving decisions in an economy by altering a country's real income. There has been extensive research in the literature aiming at analyzing the link among the terms of trade and the savings (which are equal to the trade balance when there is no investment and government sector). One of the results of this literature is known as the Harberger-Laursen-Metzler (HLM) hypothesis. According to this

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hypothesis an improvement in the terms of trade improves a country's real income level and, since part of that increase will fall on saving, the improvement in the terms of trade improves the trade balance.

For almost three decades the HLM hypothesis was the dominant view. Along with the oil price shocks in the beginning of the 1970's interest on the relation between the terms of trade and trade balance reemerged. During that period theoretical studies based on between periods (intertemporal) utility maximization have cast some doubt on the validity of the HLM effect. Some examples to the early studies questioning the HLM effect are by Obstfeld (1982), Svensson and Razin (1983), and Persson and Svensson (1985). The central finding in this literature is that the linkage between the terms of trade changes and the trade balance depends on the nature of the shock to the terms of trade.

When the shock to terms of trade is in permanent nature, then there will be no effect of the change in the terms of trade on the trade balance. The reason is that with a permanent change (say, deterioration) in the terms of trade, both real income and real spending are likely to fall by similar amounts, since the agents would revise their estimate of the permanent income downward in proportion to the decreased purchasing power of their income today. Under the assumption that marginal propensity to consume out of permanent income is unity there will be no change in saving and hence no effect on trade balance. This is contrary to what the HLM hypothesis foresees.

In contrast, a temporary deterioration in the terms of trade has an ambiguous impact on the current account. On the one hand, the "consumption-smoothing" motive dictates that agents will maintain spending in the face of a temporary decline in real income. This force favors a worsening in the current account position if the temporary deterioration in the terms of trade occurs in the current period. On the other hand, a temporary current deterioration in the terms of trade raises the cost of current consumption in terms of future consumption. This "consumption-tilting" motive results in the reduction of current consumption, implying an improvement in the saving and hence in the trade balance. Thus, the net effect on the trade balance resulting from a temporary change in the terms of trade depends on which of these influences - the consumption-smoothing or the consumption-tilting motive - is stronger. The parameter that determines the magnitude of the consumption-tilting motive is the elasticity of intertemporal substitution. The larger this elasticity, the greater is the increase in saving in response to transitory adverse terms of shock.

The literature mentioned above based on the existence of two goods (exportable and import-substituting), and disregarded the role of the nontradable goods. In general, a change in the terms trade alters both the level and the composition of aggregate real spending. Part of this spending falls on nontradable goods. Ostry (1988) and Edwards (1989) take into account this shortcoming and introduce the nontradable goods into the analysis. When there are nontraded goods a deterioration in the terms of trade causes the consumers to substitute nontradable (home) goods for more expensive import-substitutes. The resulting increase in the relative price of nontradable goods makes the current goods more expensive relative to the future goods. The result is an increase in the saving. The parameter that gains importance in this process is the within period (intratemporal) elasticity of substitution. The larger this elasticity the greater will be the substitution towards nontraded goods away from the import-substitutes. The resulting increase in the relative price of the nontraded goods will be higher, and a result of the mechanism above the increase in saving will be higher.

In this study, we aim at to estimate the intertemporal and intratemporal elasticity of substitution parameters governing the relationship between the terms of trade and trade balance within a simple optimizing framework employing a variation of the models used in the real business cycle literature. Also making use of the model, we compare the data obtained from our artificial economy with those of actual data to see if a model based on intertemporal considerations is capable of mimicking the characteristics of the actual data on Turkey.

The methodology employed for this experiment consists of finding a solution to the optimal control problem of the representative agent as the welfare maximizing solution, since there are no distortions in the economy, in the first step. Then, using numerical methods, we compute the optimal decision rules of the representative agent as a second step. In the third step, using these decision rules, we shall construct time series from the artificial economy. Finally, we compare the statistical properties of the series obtained from the artificial economy with those of actual series.

II. THE MODEL

Consider an economy comprised of identical, infinitely-lived households or alternatively by a single representative consumer. The representative consumer derives utility from the consumption of tradable and nontradable, {n}, goods. Tradable goods are the composite of exportable, {x}, and import-competing,{m}, goods.

The nontradable goods consist of all services plus construction components of the national accounts. The commodities produced in the remaining sectors of the economy constitute the tradable goods. For the classification of the tradable goods as exportable and import-competing goods, the criterion that we have used was to see which sectors have been net exporters. In using this criterion we have defined the net exports as the difference between sectoral exports and imports in US dollar terms. Commodities produced in agriculture and in the food, beverage and tobacco (sector 31), and textile, wearing apparel and leather (sector 32) sub-sectors of the manufacturing sector of the economy turned out to be exportable goods. Non-manufacturing industry and manufacturing industry exluding sub-sectors 31 and 32 form the import-competing goods.

The objective of the representative consumer is to maximize expected value of its utility function that takes the form of:

$$E_0 \sum_{t=0}^{\infty} \beta^t U\left(x_t, m_t, n_t\right) = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{\left(\left[\gamma\left(x_t^{\alpha} m_t^{1-\alpha}\right)^{-\rho} + (1-\gamma) n_t^{-\rho}\right]^{-\frac{1}{\rho}}\right)^{1-\psi}}{1-\psi} \right\} \quad (1)$$

$1 > \beta > 0$, $1 > \gamma > 0$, $1 \geq \alpha \geq 0$, $\rho > -1$, $\psi > 0$ and $\psi \neq 1$.

In the utility function, $E_t(.)$ denotes an expectation conditioned on the period t information set, and β is the subjective discount factor. The distribution parameter (γ) reflects the relative importance of the tradable and the nontradable goods in the aggregate consumption. The parameter, (α) gives the share of exportable goods in total expenditure on tradable. The elasticity of substitution between tradable and nontradable goods depends on the substitution parameter, ρ, and equals 1/(1+ρ). The parameter, ψ, determines the intertemporal elasticity of substitution that equals to the inverse of this parameter.

It is assumed that the consumer can trade bonds expressed in terms of the exportable good, {b}, which pay a stochastic real interest rate, {r}, in international financial markets.

There are fixed endowments of exportable, $\{Y_x\}$, import-competing, $\{Y_m\}$, and nontradable, $\{Y_n\}$, goods. The endowment of the exportable goods is subject to stochastic disturbances:

$$Y_{xt}(\lambda_{xt}) = \exp(\lambda_{xt})\bar{Y}_x \qquad (2)$$

where the parameter, λ_x, denote the stochastic disturbances to the endowment of the exportable goods. We shall explain its characteristics shortly

The overall resource constraint for this economy can be written as:

$$\begin{aligned} x_t + \exp(p_{mt})m_t + \exp(p_{nt})n_t + b_t \leq \exp(\lambda_x)\bar{Y}_x \\ + \exp(p_{mt})\bar{Y}_m + \exp(P_{nt})\bar{Y}_n + (1+r_t)b_{t-1} \end{aligned} \qquad (3)$$

The resource constraint states that consumption of each type of goods, and the purchases (sales) of international bonds must be financed by the sales of the endowments of the goods and principal and interest on the bonds carried over previous period.

In (3), p_{mt} is the logarithm of the exogenous relative price of the import-competing goods, and p_{nt} is the logarithm of the endogenous relative price of nontradable goods both in terms of the exportable goods.

For the laws of motion of the exogenous variables real interest rate and the logarithm of the relative price of the import-competing goods, we assume the following VAR representation:

$$\begin{aligned} P_{mt+1} &= C_1 + P_{11}(L)P_{mt} + P_{12}(L)r_t + \zeta_{1t+1} \\ r_{t+1} &= C_2 + P_{21}(L)p_{mt} + P_{22}(L)r_t + \zeta_{2t+1} \end{aligned} \tag{4}$$

where C_1 and C_2 are constants; P_{ij}, i,j,=1,2 are infinite polynomials in the lag operator; and $\zeta_{ij}, i, j = 1,2,$ are random shocks from a normal distribution with a time independent covariance matrix Ξ.

The law of motion for the exogenous shocks to the endowment of the exportable goods is assumed to follow an AR(1) process:

$$\lambda_{xt+1} = \varpi_x \lambda_{xt} + \varepsilon_{xt+1} \tag{5}$$

where ε_{xt} are normally distributed random shocks. They are assumed to be independent over time.

Equilibrium of this economy is characterized as a solution to the representative consumer's intertemporal optimization problem. The problem takes the form of maximizing the expected value of the lifetime utility function, $U(x_t,m_t,n_t)$, subject to the feasibility constrain (3). The choice variables are x_t,m_t,n_t and b_t,,

The equilibrium conditions are:

$$\frac{U_m(.t)}{U_x(.t)} = \exp(p_{mt}) \qquad (6)$$

$$\frac{U_n(.t)}{U_x(.t)} = \exp(p_{nt}) \qquad (7)$$

$$\frac{U_x(.t)}{\beta E_t\left[U_x(.t+1)\right]} = (1+r_t) \qquad (8)$$

Condition (6) implies that within each period the consumer chooses the consumption of the goods so as to set the marginal rate of substitution between import-competing and exportable goods equal to the price of import-competing goods in terms of the price of exportable goods. In the same manner, equation (7), states that the consumer chooses the consumption of the exportable and non-traded goods such that the ratio of marginal utilities obtained from their consumption is equal to the price of nontradable goods relative to that of exportable goods. Condition (8) governs the consumption of exportable goods between periods. According to the condition (8) the marginal rate of substitution between periods in the consumption of exportable goods is equal to its intertemporal price, $(1+r_t)$.

III. DATA ISSUES AND THLE SELECTION OF PARAMETERS

Before explaining the method in choosing the parameter values, we would like to mention briefly about the data we have used. The time period covered is from the first quarter of 1988 to the third quarter of 1995. Data availability was the main reason in deciding the time period. The GNP data is from national accounts and deflated by using the export prices. Export and import price series obtained from the price indexes constructed at the Central Bank of Turkey. Terms of trade are defined as the ratio of import prices to that of exports.

In constructing the consumption series we have proceed as follows. First, we have constructed the production series for exportables, import-competing goods, and nontradables from the national accounts. Second, we converted the series into real terms using the export prices. Third, to obtain the consumption of exportables we have added the imports in the corresponding sectors forming the exportable goods sectors and subtracted their exports (both are deflated using the export prices) to the production of exportables. The same procedure is applied to arrive at the consumption of import-competing goods. Lastly, we have obtained the consumption of nontradables as the difference between the total consumption and the consumption of exportable plus import-competing goods.

As for the selection of the parameters of the most criticized features of the models used in the real business cycle literature is that the exploitation of the calibration techniques in obtaining the numerical solutions to the model. To avoid this critique we have preferred to recourse the data itself to obtain the parameters of the model. The parameters of the model fall into one of the three categories: (i) preference parameters; (ii) technology parameters; (iii) parameters governing the system of prices (4).

Table 1 presents the parameter values used in the solution of the model. In the following subsections we explain how we have obtained these parameters.

Table 1
Parameters of the model

α	β	ρ	γ	ω	$\sigma^2_{\omega\lambda x}$	$\sigma^2_{\zeta,p}$	$\sigma^2_{\zeta,r}$	$\sigma^2_{r,pm}$
0.486	0.960	0.604	1.011	0.99	0.0067	0.050	0.019	-0.0019

III.1. Preference Parameters

There are five preference parameters. Within this group the value of the subjective discount factor, ß, is pinned down by the economic theory. For the existence of the steady-state, as can be seen from the equilibrium condition (8), the subjective discount factor, ß, has to be equal to the reciprocal of the steady-state value of the real interest rate plus one; namely,the condition ß=1/(1+r) must hold. This determines the value of the ß parameter. For the steady-state value of the real interest rate, r, we have used the average value of the real interest rate from the first quarter of 1988 to the third quarter of 1995. In obtaining the real interest rates, we have deflated the national nominal interest rates with the export prices. For the nominal interest rates we have used the 3-month T-bill rate. The value for the distribution parameter, γ, has been determined by taking the average value of the share of nontradable goods in total consumption for 1988:Q1-1995:Q3 period. For the third preference parameter, α, we have used the share of the consumption of exportable goods in the total consumption of tradable goods. Then, we have proceeded by forming the consumption series and obtaining the distribution parameter, γ, and the parameter, α, from these series.

The remaining two preference parameters are important. These are within period substitution parameter, ρ, and between periods substitution parameter ψ. They influence the movement of various aggregates such as the saving decisions in the economy as explained in the introduction.

Concerning the intertemporal elasticity of substitution parameter there are two alternatives. One alternative is to obtain a value from other studies. There are several studies concerning the value of the risk aversion parameter ψ. Stockman and Tesar (1990) and Mendoza (1991) are some examples. The other alternative is to estimate this parameter by Generalized Method of Moments (GMM) method. We have used the GMM method, and estimated the intertemporal substitution parameter (ψ). For the intratemporal substitution parameter (ρ), the method that is usually used in the literature is to obtain an estimate by regressing logged relative expenditures on logged relative prices for traded and non-traded goods. In this study, we have also used the GMM method to obtain an estimate of within period substitution parameter, ρ.

III.1.1. Estimation of the Substitution Parameters by the GMM Method

We have estimated the preference parameters using the model given in section 2. The model gives rise to the following set of first order and orthogonality conditions after some manipulation:[2]

$$p_{mt} = \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{x_t}{m_t}\right) \tag{9}$$

$$p_{nt} = \left[\frac{1-\gamma}{\alpha\gamma}\right]\left[\frac{1}{x_t^{\alpha-1} m_t^{1-\alpha}}\right]\left[\frac{n_t}{x_t^{\alpha} m_t^{1-\alpha}}\right]^{-\rho-1} \tag{10}$$

$$E_0\left\{\left[\frac{\gamma(x_{t+1}^{\alpha} m_{t+1}^{(1-\alpha)})^{-\rho} + (1-\gamma)n_{t+1}^{-\rho}}{\gamma(x_t^{\alpha} m_t^{(1-\alpha)})^{-\rho} + (1-\gamma)n_t^{-\rho}}\right]^{\frac{\psi-\rho-1}{\rho}}\left[\frac{x_t}{x_{t+1}}\right]\left[(1+r_{t+1})\right]\left[\frac{x_{t+1}^{\alpha} m_{t+1}^{(1-\alpha)}}{x_t^{\alpha} m_t^{(1-\alpha)}}\right]^{-\rho}\right\} = \frac{1}{\beta} \tag{11}$$

$$E_0\left\{\left[\frac{\gamma(x_{t+1}^{\alpha} m_{t+1}^{(1-\alpha)})^{-\rho} + (1-\gamma)n_{t+1}^{-\rho}}{\gamma(x_t^{\alpha} m_t^{(1-\alpha)})^{-\rho} + (1-\gamma)n_t^{-\rho}}\right]^{\frac{\psi-\rho-1}{\rho}}\left[\frac{m_t}{m_{t+1}}\right]\left[\frac{p_{mt}}{p_{mt+1}}\left(1+r_{t+1}\right)\right]\left[\frac{x_{t+1}^{\alpha} m_{t+1}^{(1-\alpha)}}{x_t^{\alpha} m_t^{(1-\alpha)}}\right]^{-\rho}\right\} = \frac{1}{\beta} \tag{12}$$

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[2] In equations (9) through (13) the symbols for the relative prices of the import-competing goods and nontradable goods refer to the exponential of those prices.

$$E_0\left\{\left[\frac{\gamma(x_{t+1}^{\alpha}m_{t+1}^{(1-\alpha)})^{-\rho}+(1-\gamma)n_{t+1}^{-\rho}}{\gamma(x_t^{\alpha}m_t^{(1-\alpha)})^{-\rho}+(1-\gamma)n_t^{-\rho}}\right]^{\frac{\psi-\rho-1}{\rho}}\left[\frac{n_t}{n_{t+1}}\right]\left[\frac{p_{nt}}{p_{nt+1}}\left(1+r_{t+1}\right)\right]\left[\frac{n_{t+1}}{n_t}\right]^{-\rho}\right\}=\frac{1}{\beta} \quad (13)$$

Combining the equations (9) and (10) gives a condition that equates the relative price ratio between the import-competing goods and the nontradables to their intratemporal marginal rate of substitution. Equation (11) is the between periods Euler equation for the consumption of exportable goods. This equation states that marginal utility of consuming a unit of exportable good at time (t) should be equal to the marginal utility of consuming a unit of the same good at time (t+1). Equations (12) and (13) express the same idea for the consumption of import-competing and nontradable goods. Since the first two first order conditions must hold identically in the absence of measurement error and when this is the case the three orthogonality conditions are not independent of each other we have used the equation (11) in the estimation. In the estimation procedure we have defined the disturbance term as:

$$u_t=\left\{\left[\frac{\gamma(x_{t+1}^{\alpha}m_{t+1}^{(1-\alpha)})^{-\rho}+(1-\gamma)n_{t+1}^{-\rho}}{\gamma(x_t^{\alpha}m_t^{(1-\alpha)})^{-\rho}+(1-\gamma)n_t^{-\rho}}\right]^{\frac{\psi-\rho-1}{\rho}}\left[\frac{x_t}{x_{t+1}}\right]\left[\left(1+r_{t+1}\right)\right]\left[\frac{x_{t+1}^{\alpha}m_{t+1}^{(1-\alpha)}}{x_t^{\alpha}m_t^{(1-\alpha)}}\right]^{-\rho}\right\}-\frac{1}{\beta} \quad (14)$$

We estimate the within and between periods substitution parameters, ρ and γ, by fitting the first order condition given in equation (14). Following a common practice in the literature we took the lagged values of the variables as instruments. Neither instrument set includes variables dated (t) to avoid the possible correlation with the error terms. Also to be able to make comparisons among the results we have used two sets of instrument.

The vector of the first set of instruments is:

$$\left\{ cons\tan t, \frac{x_{t-1}^{\alpha} m_{t-1}^{1-\alpha}}{n_{t-1}}, \frac{x_{t-1}^{\alpha} m_{t-1}^{1-\alpha}}{x_{t-2}^{\alpha} m_{t-2}^{1-\alpha}}, \frac{x_{t-2}}{x_{t-1}}(1+r_{t-1}) \right\}$$

The vector of the second set of instruments consists of the one more lagged values of the instruments in the first vector of instruments.

Table 2 presents the estimation results for both set of instruments.[3] The estimates are similar for both sets of instruments and economically meaningful. The elasticity of substitution parameter between periods, (ψ), ranges between 0.77 and 1.01 for both set of instruments implying values in the range of 0.99 and 1.29 for the intertemporal elasticity of substitution. These values are somewhat different from the values used in other studies. For example, Stockman and Tesar (1990), use a value of 0.5 for the intertempyoral elasticity of substitution. Mendoza (1992) referring to other studies concludes that values between 1 and 2 for the elasticity of substitution parameter between periods, (ψ), (corresponding to the between the elasticity of substitution in the range of 0.5 and 1) are useful to mimic key stylized facts. We should note, however, that these studies have been conducted mainly on developed countries.

Table 2
Estimates of the model

	ρ	(ψ)	J-statistics
Instrument set I	0.594	0.771	2.148
	(0.171)	(0.676)	
Instrument set II	0.604	1.011	3.833
	(0.159)	(0.441)	

Table 2 also report standard errors of the estimates along with the minimized value of the objective function, J-statistics. J-statistics

[3] The parameter values given in Table 2 refers to seasonally adjusted data on instruments. The reason being the very high seasonality observed in the original data. In order to make use of the seasonality we had to use at least four lags. The estimate for the intertemporal elasticity of substitution was close to the estimate obtained from the adjusted data and statistically meaningful, but the estimate for the intertemporal elasticity of substitution parameter (was around 0.60) was not. Considering the reduction in the sample size when we use four lags we have preferred to use the adjusted data.

is used for the validity of the overidentifying restrictions, that are the excess of instruments over estimable parameters. The first set of instruments includes five instruments that implies three overidentifying restrictions with two parameters to be estimated. For the second set of instruments there are five overidentifying restrictions. The J-statistics indicates that the parameters satisfy the orthogonality conditions for both set of instruments.

Table 2 reveals that the standard errors of the parameter estimates are smaller for the second set of instruments. For this reason, we have used the parameter estimates obtained from the second set of instruments.

III.2. Technology Parameters

There are two parameters in the group of technology parameters. These are the parameters that (ϖ_x and ε_x) govern the evolution of the random disturbances to the endowment of the exportable goods. The parameter ϖ_x was set at 0.99. We have set the variance of random disturbances to the exportable goods endowment ε_x as close as possible to the variability of the output in the corresponding sector.[4]

[4] In setting the variance of the random disturbance to the endowment of the exportable good, we have exploited the law of motions for the random disturbances. Specifically, ignoring the covariance terms, we have proceeded as follows:

$$Ln(Y_x) = \exp(\lambda_x) + Ln(\overline{Y}_x) \Rightarrow \sigma^2_{\lambda x} = \sigma^2_{Ln(yx)}$$

$$\lambda_{x,t+1}\varpi_x\lambda_{x,t} + \varepsilon_{x,t+1} \Rightarrow \sigma^2_{\lambda x} = \varpi^2_x\sigma^2_{\lambda x} + \sigma^2_{\varepsilon x} \Rightarrow \sigma^2_x = (1-\varpi^2_x)\sigma^2_{\lambda x}$$

III.3. Parameters of the Price Block

In determining the parameters of the pirce block (coefficients of the price system given in equation) we have proceeded as follows: First, we have decided the optimal lag structure by using Akaike Information Criteria (AIC). Second, we have performed the causality tests at the lag length indicated by the AIC. Third, based on the causality test results we have estimated the system of equations (4). Finally, we have corrected the constant term (C_2) in the second equation of the price system (4) so as to make it consistent with the steady-state value of the real interest rate. This transformation is justifiable since changing the constant term in a regression does not change the value of slope coefficients. In performing the procedure above we have used the ratio of the import prices to export prices for the terms-of-trade series.

Both the AIC and SC resulted in two lags as optimum both for the relative price of import-competing goods and the real interest rate. Based on this criteria the causality test performed implicated that there is a causality in the Granger sense from the real interest rate to the relative price ofimport-competing goods. There was no evidence for the causality from the relative price of the import-competing goods to the real interest rate. Therefore, we have used a second-order autoregressive model for the relative price of import-competing goods.

Concerning the random shocks in disturbances to prices, we estimate the covariance matrix Ξ from the residuals of the ordinary regression and decompose it to use later in the solution procedure as;

$$\Xi = \begin{bmatrix} \sigma_{pm,pm}, \sigma_{p\ m,r} \\ \sigma_{r,r} \end{bmatrix} \quad (15)$$

where Ξ=Ξ'Ξ.

Before concluding this section we should mention about an adjustment in one of the parameters of the model. Specifically, we have adjusted the steady-state level of internationally traded bonds is due to the necessity that the rate of time preference, β, should be equal to the reciprocal of (1+r) for the existence of the steady state solution.

When this is the case, however, the steady-state level of bonds is left undetermined. In other words, if β, equals the reciprocal of (1+r), there is infinite set of possible values for the steady-state level of bonds, for which a steady-state solution exists. Therefore we have chosen to pick a steady-state value for bonds that gives the ratio of the foreign debt to GNP.

IV. SOLUTION METHOD AND SIMULATION RESULTS

Once we have decided the parameters of the model we have performed an experiment to have an idea about the success of the model in replicating the characteristics of the actual data. For the experiment we generated time series at length of 91 observations in 60 simulations and used the last 31 observations to match the size of the actual data. Then, we have compared the moments of the data with the actual data. In constructing the series we have filtered them to obtain stationary and used the difference between the original and filtered series.

In obtaining the data from the artificial economy, we have solved the problem described above using the linear-quadratic approximation method. The method involves using a quadratic objective function and linear constraints. The quadratic objective function is found by taking a second-order Taylor expansion of the corresponding nonlinear function around the steady-state of the system. The resulting system is then solved numerically using the dynamic programming techniques. McGrattan (1990) gives a detailed explanation of the technique.

In applying the approach described above to our problem we have taken the following steps. First, we have used the condition that in equilibrium the market for nontradables must clear domestically, i.e., $n_t = Y_n$, in the budget constraint (3). Second we have solved the budget constraint (3) for exportable goods, $\{x_t\}$. Then, we have substituted the resulting expression along with the condition $n_t = Y_n$ into the utility function (1). Then the problem is transformed to maximizing

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left\{ \left[(\exp(\lambda_x)\bar{Y}_x + \exp(p_{mt})\bar{Y}_m - (b_t - b_{t-1}) + r_t b_{t-1} - \exp(p_{mt}) m_t)^{\alpha} m_t^{1-\alpha} \right]^{-\rho} \left[\bar{Y}_n \right]^{-\rho} \right\}^{-\frac{(1-\psi)}{\rho}}}{1-\psi} \quad (16)$$

subject to the laws of motion for prices (4) and the law of motion for the random disturbance to the exportables' endowment (5), given and b_{t-1}.

In applying the solution procedure we have chosen m_t, and (b_t-b_{t-1}) as the control variables of the system, $\{u_t\}$. The vector of state variables, $\{x_t\}$, consist of 1, λ_{xt} ρ_{mt} , ρ_{mt-1} r_t,. r_{t-1}, b_{t-1}.

V. CONCLUSIONS

When we examine the correlation between the trade balance and the terms of trade for Turkey, an interesting conclusion emerges. It concerns the sign of this correlation that is positive implying the non-existence of the HLM effect. This situation is contrary to the case for many countries, Mendoza (1992). The sign of the correlation is robust to the usage of alternative series for terms of trade. In the light of previous discussions, however, one might infer that the magnitude of the intertemporal elasticity of substitution might be a reason for this phenomenon, among other factors. In every instance, we have found the intertemporal elasticity of substitution for Turkey is greater than one, although not very much, implying that the consumption-tilting motive dominates the consumption-smoothing motive. Therefore, it is expected that the increase in saving in response to adverse terms of trade shock will be higher causing a positive correlation between the terms of trade and the trade balance.

Another result is the success of the model in replicating the correlation structure between the terms of trade and the trade balance. This correlation has turned out to be 0.161 in the actual data. What we have got from the data obtained using the model is 0.125 with a standard error of 0.253. The magnitude of the correlation is very close to that of actual data when one considers its standard error. However, other statistics that we have not reported here because of their irrelevance, make us cautious about the success of the model. Despite the contradictory results, we should stress, that this point should not be taken as an argument against the success of this type of models. We believe that some extensions to the model, such as a more detailed production structure, inclusion of investment, labor-leisure choice, could greatly improve the results from the model.

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