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Modeling the Impacts of Macroeconomic and Trade Policies on the Iranian Agricultural Sector

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Abstract: A structural econometric model was applied to determine the impacts of changes in macroeconomic and trade policies on the agricultural sector. Because of the simultaneous nature of the equations in the model, Two Stage Least Squares (TSLS) technique was used. The study used the time series data between 1959 -2005 which was derived from statistics center of Iran. The results show that 10 percent reduction in import tariffs will lead to 0.35 percent increase in the degree of openness of the Iranian economy. Results also show that 10 percent increase in terms of trade (FOB/CIF), real exchange rate for exports increase 2.16 percent. On the other hand 10 percent increase in real exchange rate for exports and 10 percent reduction in money supply as a proportion of total income (GDP) and GDP will lead to, 0.42, 0.62 and 2 percent increase respectively in relative agricultural domestic prices.

Key words: Government expenditure · Real exchange rate · Degree of openness · Relative prices of agriculture · Terms of trade

INTRODUCTION

After Iranian revolution in 1979, the economy has been subject to a number of major upheavals, disruptions and shocks, both internal and external in nature. the initial effects of the disruptions as are due to the revolution itself, the eight-year war with Iraq, the ongoing economic and financial embargoes by the United States and on occasions by some of the European countries, the volatile international crude oil prices and the uncertainties surrounding the conduct of the monetary, foreign exchange and trade policies with abrupt switches between fixed and floating exchange rate regimes, open and closed foreign trade policies and private-owned and government-controlled enterprises[1].

Iran economy depends on oil incomes and its abundant swings that encountered and will encounter the Iran economy with crisis. Helping other economic sectors, particularly agricultural sector, has abundant advantages in this case. Prerequisite of a mature economic sector formation in long term is to adopt suitable policy and; these policies cannot operate without recognition of important ingredient [2].

Added value of agricultural sector on 1997 stable prices during 2002-2004 has increased from 49.818 to 58.381 Billion Rials. Custom value of agricultural commodities export was increased from 1603 million dollar in 2001 to 2148 in 2005. Considering prior and subsequent relations between agricultural sector and other economic sectors and also Iran?s advantages in some agricultural products, this sector was found to be important in Iran economy and foreign trade [3].

However, macroeconomic and trade policies are exogenous to the agricultural sector and the agricultural sector has to adapt to changes in the macroeconomic and trade policies [4]. According to Johnson [5] when policies are inappropriate, farmers find themselves at an enormous disadvantage in making effective use of their natural and human resources. Moreover, Rausser *et al.* [6] mentioned that, "if macroeconomic policies were appropriately designed, there would be no need for sector-specific policies". Macroeconomic and trade variables such as: government expenditure, money supply, exchange rate and import tariffs are recognized to have an effect on the agricultural performance.

The objective of this paper is two folds. The first objective is to design an appropriate structural framework that draws heavily on economic theory and allows investigating the linkages between macro-economy and agriculture in Iran. The second objective is to use the econometric model to analyze the importance of macroeconomic and trade policy impacts on the

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agricultural sector, which is important for economic analysts and policy makers. Most of the previous studies analyzing the impacts on the agricultural sector have mainly focused on internal factors such as the size of research and development investment, farm size and efficiency and land tenure systems. In addition, there is a considerable lack of empirical evidence investigating the implications of the macroeconomic environment on agricultural performance in developing countries where economic growth and development depend heavily on agriculture and where agriculture is in need of more coordinated policies [5-7].

The macroeconomics of agriculture involves the relationship between the general domestic economy and the agricultural sector and the world economy and the domestic agricultural sector [7]. This definition of macroeconomics of agriculture clearly demonstrates that the agricultural sector is integrated with other sectors in the domestic economy as much as it is with rest of the world [4]. Furthermore, Schuh [8] observed that significant structural change in economic environment and the dramatic integration with world markets indicate that the agricultural sector should no longer be treated as a closed sector.

To emphasize the linkage between world economy and agriculture, Penson and Gardener [9] mentioned that there are two main channels linking the international (world) economy to agriculture. The first channel is through international commodity markets, where international economic conditions influence the demand for exports and supply of imports (current account). The second is through international capital markets, where the demand for and supply of investment funds observed in the nation's capital account influences interest rate and exchange rates (financial and capital account).

Fiscal, monetary and exchange rate policies as well as trade policy affect not only farmers' income in real and relative terms with respect to other sectors of the economy, but also the terms of trade between agricultural and non-agricultural sectors[4]. According to Penson and Gardener [9] and Knutson *et al.* [7] domestic macroeconomic variables that are most important for agriculture are the rate of inflation, real rate of growth in gross national product, interest rate and exchange rate. However, Knutson *et al* [7] mentioned that the implications of macro conditions are transmitted to agriculture through four variables: income growth; inflation rate; interest rate; and value of the currency (exchange rate). However, the exchange rate is the variable commonly used to capture the developments taking place in the international financial markets.

Schuh [8] started whole body of research on the effects of exchange rates of agricultural sector by addressing the effects of exchange rates on the U.S. agricultural sector. In addition, Lachaal and Womack [10] concluded that the exchange rate of currency is the primary variable linking international economy to domestic agricultural sector and that exchange rates are an important determinant of commodity prices and trade flows).

MATERIALS AND METHODS

In developing the conceptual framework for this study, assumptions are made that macroeconomic and trade policies influence output price, which in turn affect sectoral productivity and production. The standard analysis divides the economy into two sectors: tradable sector and non-tradable sector [4].

The relative price of the tradable in terms of non-tradable is known as the real exchange rate (RER) and it is through this "relative price" that macro-policies affect sectoral performance. A rise in the RER means that the price ratio improves in favor of tradable goods and vice-versa, the decline in RER means that the price ratio improves in favor of non-tradable goods. Under the hypothesis that inter-sectoral resources flows follow relative price changes, movements in the RER would tend to affect resource allocation between different sectors of the economy. More specifically, an increase in RER would shift resources out of non-tradable sector into tradable sector and reduce incentives to produce non-tradable goods and vice-versa is true[4].

In order to measure the impacts of policies on exports and imports separately, the economy is further decomposed into three markets: the exportable (x), the importable (m) and home goods (h). the trade components of The model for two traded goods allow domestic supply and demand for these goods to be different. However, this is not true for home goods for which the market needs to clarify domestically to meet the equilibrium conditions, which are fulfilled through adjustments in relative prices of traded goods in terms of home goods [11].

In this study the supply of home goods is defined, denoted by Sh, as a function of the relative prices of exportable and importable in terms of home goods and by resource endowment and technology [4]:

$$S_h = (\frac{P_x}{P_h}, \frac{P_m}{P_h}, K, L, t) \quad (1)$$

Where Px, Pm, Ph are domestic prices of exportable, importable and home goods, respectively, K and L represent capital and labor and τ denotes technology. Sh is negatively related to relative prices of both traded goods. Higher prices for the exportable and the importable would shift resources out of the non-traded sector to the traded sectors and consequently reduce the production of home goods [4].

Likewise, we specify the demand for home goods, Ph, as a function of the relative prices of two traded goods measured in terms of home goods and income (denoted by Y). In symbols [4],

$$D_h = D_h(\frac{P_x}{P_h}, \frac{P_m}{P_h}, Y) \tag{2}$$

The increase in the prices of the exportable and the importable will reduce their demand and thereby increase the demand for home goods. The increase in domestic income will cause domestic consumers demand more than the exportable and the importable and less than home goods [12].

In order to measure the incidence of commercial policy on traded goods, comparative static is needed for analysis of price effects. For this aim, we assume K, L, τ and Y to be constant. Hence, the differentiation of equation (to evaluate the incidence of trade policy logarithmically) (1) yields [4]:

$$dS_h = \frac{\partial S_h}{\partial (P_x/P_h)} d(P_x \Big/ P_h) + \frac{\partial S_h}{\partial (P_m/P_h)} d(P_m/P_h) \tag{3}$$

From (3) the results are:

$$\hat{S}_h = \eta_x(\hat{P}_x - \hat{P}_h) + \eta_m(\hat{P}_m - \hat{P}_h) \tag{4}$$

Where, Πx and Πm are supply elasticity of home goods with respect to the relative prices of the exportable and the importable, respectively, the hat (^) denotes a proportionate change in a variable. Similarly, from the demand function this is obtained:

$$\hat{D}_h = \varepsilon_h(\hat{P}_x - \hat{P}_h) + \varepsilon_m(\hat{P}_m - \hat{P}_h) \tag{5}$$

Where ex and em are the demand elasticity of home goods with respect to the relative prices of the exportable and the importable, respectively. By equating (4) and (5), to examine the comparative static properties of the model, this is found [4]:

$$\Delta_x(\hat{P}_x - \hat{P}_h) + \Delta_m(\hat{P}_m - \hat{P}_h) = 0 \tag{6}$$

Where $\Delta_j = (\varepsilon_j - \eta_j)$, j = m, x. defining the incidence parameter, equation (6) can be rearranged as:

$$\hat{P}_x - \hat{P}_h = \omega(\hat{P}_x - \hat{P}_m) \tag{7}$$

Or,

$$\hat{P}_h = (1-\omega)\hat{P}_x + \omega\hat{P}_m \tag{8}$$

By assuming w to be constant and integrating equation (8), the real exchange rate for exports is derived as [4]:

$$\ln\left[\frac{P_x}{P_h}\right] = a + \omega \ln\left[\frac{P_x}{P_m}\right] \tag{9}$$

Equation (9) provides a framework for investigating the impacts of trade and exchange rate policies on the export sector. However, this framework does not allow for the effects of quantitative restriction on trade. For example, consider the case of an effective import quota. A binding import quota results in higher prices of importable goods in the domestic market and hence, this sector will attract more resources. The increased demand for resources by the importing sector will alter their prices, causing a change in the price of home goods. These movements in prices will in turn affect the RER and resource allocation. For this reason, the degree of commercial openness (DCO) of the economy is introduced in the model, as both an explanatory variable and as well as endogenous variable [4].

The next component of the model defines the mechanism channels through which the impacts of trade and macroeconomic policies are transmitted to agriculture. Mechanically, first macro-policies are linked to agricultural prices and then production function for the agricultural sector is specified. It is through this production function that the relative prices and, therefore, macroeconomic and trade variables influence agricultural performance. Higher output prices are expected to increase productivity, as the increased profitability would make firms allocate more resources to innovative activities and increase their investments in new technologies. Considering agricultural products at the same time exportable, importable and home goods, then an aggregate price index for the sector, denoted by Pa, would be computed as an average of Px, Pm, Ph. using the geometric aggregation method we obtain[4],

$$P_a = P_x^{a_1} P_m^{a_2} P_h^{(1-a_1-a_2)} \quad (10)$$

a1 and a2 represent the shares of exportable and importable agricultural products, respectively, in total agricultural output.

Some macro-variables will be included in equation (10) as the share of exportable agriculture (a1) depends on economic variables that determine demand and supply and on the degree of commercial openness (DCO) of the economy. Furthermore, agricultural prices depend on macroeconomic policies that affect the demand for home goods and consequently sectoral output. The last component of the model is the agricultural sector production function. The specification adopted the concept of endogenous technology introduced by Mundlak [13], which postulates that prices are technology-changing variables. This approach assumes that prices not only determine the position of a producer across different curves. The hypothesis here is that economic agents choose innovations and adopt new innovations in harmony with their incentives and constraints. Empirically, this is achieved by defining a variable-parameter production function. These parameters are specified as functions of some state variables representing the structure of incentives and constraints facing firms [13].

This study uses Cobb-Douglas specification with time varying parameters and n inputs to represent the agricultural production function. Algebraically, this specification takes the following functional form [4]:

$$y(x;\beta) = A\prod_{i=1}^{n} x_i^{\beta_i} \quad (11)$$

Where,

$$\ln A = a_0 + \sum_{k=1}^{m} a_k s_k + u_0 \quad (12)$$

$$\beta_i = b_{i0} + \sum_{k=1}^{m} b_{ik} s_k + u_i \quad (13)$$

Y is the maximum level of output that cane be produced from any given set or combination of input x = (x1, x2,…, xn). S = (s1, s2 …, sm) is a vector of state variables and u's are error terms. The above specification is very flexible in that in that it allows us to include as many as many state variables as possible.

Empirical Model: The econometric model used to analyze the impacts of trade and macroeconomic policies on the agricultural sector in Iran consists of a system of three equations. The endogenous variable is the real exchange rate (RER), the degree of openness (DCO) and relative agricultural domestic prices (Pa/Ph). The exogenous variables are import prices (Pm), prices of home goods (Ph), export tax rate (tx), import tariff rate (tm), the share of government expenditures (G) and the share of money supply (M) in the total income (y) [4].

The empirical model is described by following set of equation [4]:

$$RER = F(P_x/P_m, DCO, G, M^s)$$
$$DCO = F((1-t_x/1+t_m), G, M^s$$
$$P_a/P_h = F(P_x/P_h, DCO, G, M^s)$$

The codes used in the estimation process are [4]:

- Degree of openness (DCO) that is calculated by Total trade / total income.
- Trade barriers (BARS) that is calculated by (1-x)/ (1+Tm) Where Tx and Tm are export and import tariffs; and export tariffs are assumed zero.
- Government expenditure as a proportion of total income (GDP) (GEXPTI).
- Money supply as a proportion of total income (GDP) (MOSPTI).
- Real exchange rate for exports (RER) that is calculated by FOREXP / CPI, Where: Forexp – foreign price of export, fob. CPI - Consumer price index (price for non-traded goods).
- Terms of trade (RELEXR) which ist calculated by Forexp / Forimp, Where Forimp is Price of imports, cif.
- Relative agricultural domestic prices (RELAT) which is calculated by PPIAGR / CPI, Where PPIAGR is index of agricultural product price.

Data: This study will use secondary data between 1960 and 2004 to estimate the impacts of trade and macroeconomic policies on Iran agricultural sector.

Estimation Procedure and Simulation Results: The structural econometric model (as in this study) cannot be estimated to use ordinary least square (OLS) because ordinary least square (OLS) yields biased and inconsistent estimators when estimating simultaneous equations or cross - equations. Therefore, this study will use the Two Stage Least Squares (TSLS) because TSLS yields unbiased and consistent estimators.

Table 1: The Estimated Results of the Impact on Ln DCO

Variables	Coefficient	t statistic	R2
C	-0.24	-0.58	0.9
Ln BARS	0.35	11.57	
Ln GEXPTI	0.22	2.84	
DUM	-0.71	-8.54	

Table 2: The Estimated Results of the Impact on Ln RER

Variables	Coefficient	t statistic	R2
C	5.13	4.94	0.72
Ln RELEXR	2.16	5.25	
Ln GEXPTI	0.24	1.59	

Table 3: The Estimated Results of the Impact on Ln RELAT

Variables	Coefficient	T statistic	R2
C	61.49	4.04	0.96
Ln RER	0.42	6.14	
Ln MOSPTI	-0.62	3.07	
Ln GDP	-2	-4.17	
Ln DCO	0.14	0.7	

The above results show the impact of macroeconomic and trade policies on the domestic degree of openness. The results indicate that 1 percent increase in BARS variable (an increase in BARS variable implies that import tariff decrease) leads to 0.35 percent increase in the degree of openness in Iran. In contrast, the increase of 1 percent in government expenditure will lead to increase 0.22 percent in degree of openness. However, the dummy variable indicates the years in Iran between 1979 and 1989 have been decreasing. The degree of openness has decreased 0.71 percent from 1979 to 1999 for the agricultural sector and for the whole economy.

The results presented at table 2 indicate that 1 percent increase in the terms of trade will lead to increase of 2.16 percent in the real exchange rate in Iran. This implies that as Iran terms of trade rises, the value of the Rial will increase against the U.S. dollar. Furthermore, the results indicate that 1 percent increase in government expenditure will lead to an increase of 0.24 percent in the real exchange rate. Under the hypothesis that resource flow follow change in the price of the exportable, the importable and home goods, rise in government expenditure implies there will be more domestic investment, hence more consumption of home goods. Total income and money supply variables were dropped from the equation because they have very low t-statistics.

The results in table3 indicate that real exchange rate, money supply as a proportion of total income (GDP) and total income variables are variables that have significant effect on the relative price of agriculture. Degree of openness does not have significant effect on relative prices of agriculture in Iran.

The results show that an increase of 1 percent in real exchange rate will lead to an increase of 0.42 percent in relative prices of agriculture. Also a decrease of 1 percent in money supply as a proportion of total income (GDP) and total income will lead to an increase of 0.62 and 2 percent, respectively in relative prices of agriculture.

CONCLUSIONS

An increase in real exchange rate for export, has a meaningful and positive effect on relative prices of agriculture that can improve the agricultural status in Iran. Money supply as a proportion of total income affects negatively relative prices of agriculture. the improvement in the agriculture status must prevent from every increase in money supply. Decreasing import tariff has a meaningful and positive effect on degree of openness. Thus, an effective way to trade growth is reduction in import tariff. An increase in the terms of trade will lead to increase in the real exchange rate that affects indirectly relative prices of agriculture [10-15].

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