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Empirical Analysis of Sri Lanka's Agriculture in Relation to Policy Reforms with General Equilibrium Growth Accounting Approach (1970-1996)

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Abstract

The chief motivation of this research is to evaluate the impact of Structural Adjustment Policy (SAP) Program on the Sri Lanka's agricultural sector with special reference to the domestic food sector. Due to various problems arise from earlier models, this paper attempted to use the Two Sector General Equilibrium model with Growth Accounting Approach. Growth Rate Multiplier approach, combination of effect and contribution, was combined with this two sector General Equilibrium Model in order to measure the impact of the policy variables as the result of the new policy reforms on the Sri Lanka's economy. It is quite different from these earlier studies that introduced policy changes are favourable to the overall agricultural development though their impact on the domestic food sector is negative. Further our study clearly indicates that the fertilizer prices that change under the policy adjustments tremendously effect the agricultural production and it was further negatively effect the domestic food production. Food imports are open under the new policy reforms and these food imports make considerably large impact on the domestic food production. The Push-Pull effect of technical changes of agriculture and non-agriculture is also evident from this study as expected under this policy package.

KEY WORDS: Structural Adjustment Policy (SAP); Sri Lanka's agricultural sector; General Equilibrium Growth Accounting; Push-Pull effect of technical changes

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1. Introduction

Sri Lanka is a tropical country located in the Indian Ocean. Since independence, all governments came to power periodically, have invested substantial amounts of resources on the agriculture and irrigation infrastructures as well as to facilitate agricultural production and particularly food production associated with the rural agricultural economy. In the Sri Lanka's rural agricultural economy, the use of poor seed, adherence to age old cultural practices, insufficient use of fertilizers and pesticides, lack of production-credits etc., added up to a low rate of productivity; characterized the small holder and subsistence level farming. The lack of sources of fair priced production inputs as well as the insufficiency and the inadequacy of well-organized producer oriented marketing facilities further aggravated this problem. Any increase in the agricultural production would contribute significantly both to increasing the employment potential and raising income levels at rural areas. At the same time, with rice and other subsidiary food stuffs accounting for a major part in imports, any reduction thereof could not only help in redressing the foreign exchange imbalance but could also release foreign exchange resources for import of capital goods for much needed development activities. Therefore, development of domestic agriculture has been a major policy of successive governments since independence.

The majority of the people in the South Asian countries are involved in agriculture and allied vocations. The majority of them live in the rural agricultural areas and employment opportunities of the majority of these people are provided by agriculture only. Similarly, these countries are not developed in non-agricultural sectors so as to compete with the developed countries. As a result, in times of food-scarcity, famine or any other disaster the people of these countries become immediate victims to many catastrophes and hardships (S. Amarasiri, 1998). In this regard, FAO's agricultural production index in 1996 shows the kind of challenge that Sri Lanka has to face and overcome in order to increase food production to a reasonably satisfactory level. The agricultural sector, the cornerstone for socio-economic development of Sri Lanka is unfortunately saddled with declining productivity and is the lowest in the SAARC region. According to FAO, Sri Lanka's agricultural productivity had slumped from 108.3 in 1985 to 96.3 in 1995. Let us see the major

policy reform, which took place in the 1977 called *structural adjustment policies (SAP)*, and estimate the effect of SAP on Sri Lanka's Agriculture.

2. Conceptual Problems in Monitoring SAP and the relevance of SAP to Sri Lanka's Agriculture

(1) Conceptual Problems in Monitoring SAP: In general, most adjustment programs arise from an existing or anticipated deterioration in the external balance, due to factors not likely to be reversed easily or quickly and because the external deficit is not sustainable in the medium term and necessitates reduced development objectives. Further, adjustments entail the realignment of domestic demand with available resources and changing supply and the production structure to eliminate the external deficit. Since demand can be curtailed more easily and faster through changes in public expenditures and money supply, it tends to be the focus of the first attempts at correcting disequilibria, hence, the association of short-term stabilization efforts with demand reductions. Changes on the supply side, however, are more difficult and slower to implement and therefore tend to be associated with medium term structural adjustment efforts. As the elimination of the external disequilibria is the primary focus of adjustment, trade policies figure prominently in all adjustment programs. Trade policies usually comprise two sets of measures, one aimed at export promotion and other at import liberalization. Under export promotion, which is one of major objectives of SAPs, the following aspects are considered.

Adjustment programs in many countries have caused considerable internal controversy. The reason is that they provide a visible and easily identifiable scapegoat upon which to blame all ills that befall the economy. Then advocates of reforms overstate their case by crediting any good outcomes to the program. This situation clearly makes monitoring more difficult as several interpretations can be made of the same trends. The first issue is whether the program of reforms as outlined in agreement between the government and the financing institutions really takes place. Given that some reforms have taken place the major question concerning monitoring is whether the observed outcomes or changes are due to the policy changes or would have occurred anyway. Such a question brings out the issue of counterfactual analysis. This type of approach consists of constructing a scenario for the economy that would have prevailed in the absence of the SAP. Such

a scenario should include controls for exogenous shocks unrelated to the policy reforms. Comparison of the observed and the counterfactual values of the economic variables would then indicate the differential impact of the Sap on the economy. The problem is that the estimation of a detailed counterfactual path cannot be done in the absence of a consistent multisectoral general equilibrium model. The construction of such a model is rather difficult and time-consuming task without proper and comprehensive data (Sarris, 1987).

(2) Relevance of SAP to Sri Lanka's Agriculture Sri Lanka was one of the first among the developing countries which implemented a far reaching program of economic policy reforms as early as 1977, mainly under the structural adjustment policy packages designed and introduced by the World Bank and the International monetary Fund. Consequently the major economic policy reforms implemented in Sri Lanka includes following aspects such as reduction of protection provided to the import competing sectors, provision of incentives to export oriented sectors, exchange rate adjustments, fiscal and monetary reforms, liberalization of domestic factor and product markets from Government intervention thus allowing free play of market forces and privatization of Government owned enterprises (Central Bank of Sri Lanka Annual Reports, Various Years). Athukorala and Jayasuriya in 1994, Bandara and Gunawardana in 1989 and Edwards in 1993 mainly studied the historical process of economic reforms in Sri Lanka, particularly in relation to macroeconomic effects. The impact of such policy reforms on the domestic food sector was not evaluated having understood its importance in terms of contribution to the national income and employment. It is also important to study the relevant periods in which various economic policy packages were implemented.

Pre-Reform conditions (1970-1977)

In this period Sri Lanka followed a closed economic policy under which foreign exchange limitation and restrictions on imports of food and agricultural inputs took place. The Government adopted a policy of food self-sufficiency under increased Government interventions in domestic factor and product markets. Many private business ventures were taken into Government control and management while large tracks of land cultivated with tea, rubber and coconut were

nationalized under land reform program³.

The First Approach of Economic Policy Reforms (1978-1988)

The new Government in 1977 implemented various policy reforms in order to achieve a number of declared objectives such as accelerate economic growth, create employment opportunities, increase capacity utilization, stimulate savings and investment, improve the balance of payments and achieve international competitiveness (Athukorala and Jayasuriya, 1994). To attain these objectives, following measures were taken by the then Government. Tariffication was introduced in place of non tariff measures, the exchange rate was unified and allowed to be market determined, exchange controls were removed, Sri Lanka currency (Rupee) was devalued substantially, massive public sector investment programs were introduced and export processing zones were also introduced. Trade liberalization was major component of the policy reform package. Introduction of this open economy policy also led to the elimination of most of the controls. Major fiscal policy reforms included the replacement of generic food subsidies with targeted food stamp scheme in 1978 and the reduction of fertilizer subsidies. Government concessions on agricultural credit were reduced (Lakshman, 1994).

The Second Approach of Policy reforms (1989-1994)

Under the changed leadership in 1989, the same Government implemented second wave of policy reforms for several reasons. Macroeconomic stability, compounded government mismanagement of the domestic economy, mounting ethnic violence and insurgency put a halt to the initial waver of incomplete reforms and liberalization during 1977-1983 (Dunham and Kelegama, 1994). The first wave of reforms caused hardships to the certain sections of the community. The social cost of the adjustment also forced the government to implement converted version of policy under second phase which involved two types of policy reforms and initiatives such as technically important but low profile adjustments and high profile projects. This high profile projects include privatization of further number of public institutions, new emphasis placed on export-oriented industrialization under more liberalized trade regime and the major program

³ See Gunawardana, 1981.

for poverty alleviation. Also the private sector was allowed to carry out the fertilizer imports and the fertilizer prices were aligned with world markets. Interest rates on rural credit scheme were increased⁴.

3. An Analytical framework and the Model

Here we considered a two sector General Equilibrium Growth Accounting model to analyze the above trend. Many development countries in Asia and Africa region have adopted SAPs to resuscitate their economy as discussed in the previous sections. Hence the suitability of this model to analyze the above trends in the Sri Lankan Agricultural sector has been firstly tested. Accordingly, Sarris (1990) made a very good basic framework of a model in 1990 but our model in this paper has been converted and extended much more to suit the structure of the economy of Sri Lanka. First, Sarris did not show what were the endogenous variables and what were the solving equations as a whole. Therefore, he did not solve the equation. In other words, he did not specify the way to solve the equations in order to capture the impact (effects) of the exogenous variables on endogenous variables fully. Second, Sarris model did not also specify anything about nonagricultural sector. For example, his model did not contain nonagricultural production function. Also, his model did not contain the equation for intersectoral flow of labor. Third, he neglected the domestic consumption of exportable goods which is not true in reality. In our model these drawbacks have been rectified. First, we showed clearly 21 equations and 21 endogenous variables. Therefore, we can solve the equation. Second, it has been modified with inclusion of nonagricultural variables, such as technical change in both agricultural (T_A) and nonagricultural (T_N) sectors and nonagricultural labor force (L_N). We introduced the Growth Rate Multiplier (GRM) approach (as we would see it later) to solve the model to capture the effects of the exogenous variables on endogenous variables. Therefore, Sarris model has been converted and further extended. Third, we included the domestic consumption of exportable goods in our model. Though we have constructed four converted versions of the model, in this paper we discuss only final

⁴ See Dunham and Kelegama, 1994 for detailed description of second wave policy reforms.

version⁵ of the converted version of the model. In concrete, we added completely new equations (5), (7), (19), (20) and (21) in Table 1, which were not included in Sarris model, and extended equations of (1), (6), (12) and (15) in Table 1. Here the model uses the growth accounting approach to find the impact of 11 exogenous variables on 21 endogenous variables many studies have been done with the General Equilibrium Growth Accounting Approaches⁶ to evaluate the policy impacts.

There were many studies dealing with adjustment policy effects on economy in Sri Lanka. The two notable works are Bandara (1989) and Cooray (1998). Though their models deal with domestic food sector through CGE approach, they failed to discuss the effects of the policy changes in the sub-sectors of the domestic food sector. Also the important aspects of technical changes were also not discussed along with nonagricultural determinants like P_N and L_N . In our model, we have rectified these changes with three sector model with GRM approach to find the effects. In this model the economy is composed of two sectors such as agriculture and nonagriculture and the behavior of the nonagricultural sector will be exogenous to the model. Further the agricultural sector has been divided into three sub-sectors. The following assumptions are made in this model. (1) Agriculture will produce three products (or sectors) such as exportable (sector 1), import substitute (sector 2) and the final one is both domestically produced and consumed (sector 3). That is the agricultural sector has been categorized into 3 sub-sectors as stipulated above. (2) Aggregate

⁵ Version 1 of the model is the first step conversion of Sarris model with the conversion only in the consumption from Sector one. Sarris argued that Sector one's output (X_1) is totally exportable (E_1) as $X_1=E_1$. But in the case of Sri Lanka, some portion from Sector 1 is also consumed (C_1) but not as food. So the relevant change is $X_1=E_1+C_1$ where $C_1=0.2X_1$. In this Version 2, this consumption is assumed as function of per capita income (E) and the price of this product (P_1). Version 3 deals with Agriculture labor force (L_A) and Technical Change in Agriculture (T_A) and nonagriculture (T_N) sector along with the total labor force (L) in order to catch the push-pull effect. The dynamic form of this relationship is

$\hat{L}_A = \gamma_1 \hat{T}_A + \gamma_2 \hat{T}_N + \gamma_3 \hat{L}$. In Version 4, more nonagricultural sector variables (e.g., nonagricultural Labor L_N) are also included in the model to see the impact on non-agriculture side such as $\hat{L} = l_1 \hat{L}_A + l_2 \hat{L}_N$ and $\hat{X}_N = \hat{T}_N + \zeta \hat{L}_N$.

⁶ Papers among these studies are Yamaguchi and Binswanger (1975), Yamaguchi (1982) & Yamaguchi and Kennedy (1983).

agricultural production will depend on factors that are fixed in the short term such as land and capital as well as variable factors such as labor and imported input fertilizer. The price of the fertilizer is given for agriculture and will change under adjustment. (3) The price of the nonagricultural sector will be determined by factors largely outside agriculture in order to see the effect of it on 21 endogenous variables.

Now, we start to explain our model which is a wide extension of Sarris model. Let X_A : an output index of the agricultural sector. X_N : an output index for nonagricultural sector. P_A : Price index for the agricultural sector. P_N : Price index for the non-agricultural sector. The Aggregate production function for agriculture will be of the form

$$X_A = T_A L_A^a X_F^b \quad a, b > 0 \quad a + b < 1 \quad \text{-----}(1)$$

where X_F is the quantity of fertilizer used by agriculture. L_A is total agricultural labor force and T_A is technical change in agriculture which includes the constant that summarizes all the fixed factors such as land and capital.

The aggregate supply of agriculture will be given by maximization of agricultural value added V_A

$$\text{Max } V_A = P_A X_A - P_F X_F \quad \text{-----}(2)$$

The solution for the demand of fertilizer X_F is given by equation (3)

$$X_F = (T_A L_A^a)^{1/1-b} (P_A / P_F)^{1/1-b} b^{1/1-b} \quad \text{-----}(3)$$

The aggregate agricultural supply is given by equation (4)

$$X_A = (T_A L_A^a)^{1/1-b} (P_A / P_F)^{b/1-b} b^{b/1-b} \quad \text{-----}(4)$$

Hence the Agricultural value added is given by equation (5)

$$V_A = (T_A L_A^a)^{1/1-b} P_A^{1/1-b} P_F^{(1-b)/b} (1-b) b^{1/1-b} \quad \text{-----}(5)$$

Let us assume that the agricultural sector produces three products. Then the allocation of X_A to these must be specified. In order to do this, let us specify X_A as CET⁷ index of the quantities X_1 , X_2 and X_3 of the three produced products and it is given as follows.

$$X_A = \left(\sum_{i=1}^3 \alpha_i^{-\tau} X_i^{(1-\tau)/\tau} \right)^{\tau/(1-\tau)} \quad \text{-----}(6)$$

⁷ For further analysis on CET function, refer Powell and Gruen, 1968.

where τ is the positive elasticity of transformation and α_i are positive parameters. Given the prices P_i of three agricultural sub-sectors, allocation of X_A to the three sectors is done by maximizing the total value of agricultural output.

$$\text{Max } \sum_{i=1}^3 P_i X_i \quad \text{-----}(7)$$

The above maximization yields the following allocation functions.

$$X_i = \alpha_i^{-\tau} X_A (P_i / P_A)^\tau \quad i = 1, 2, 3 \quad \text{-----}(8)$$

where the price index P_A turns out to be the following

$$P_A = \left(\sum_{i=1}^3 \alpha_i^{-\tau} P_i^{1+\tau} \right)^{1/(1+\tau)} \quad \text{-----}(9)$$

The supply utilization accounts (namely the commodity balance equations) for the three agricultural products are given as follows.

$$X_1 = E_1 + C_1 \quad \text{-----}(10)$$

$$X_2 + M_2 = C_2 \quad \text{-----}(11)$$

$$X_3 = C_3 \quad \text{-----}(12)$$

where E_1 denotes the exports of agricultural sector 1 and some percentages (C_1) are consumed locally. M_2 denotes the imports of basic cereals that are perfect or near perfect substitutes for locally produced cereals. C_2 and C_3 denote the quantities of the two different types of food that are demanded domestically. The equations (10), (11) and (12) are the equilibrium relations in the model.

We define an index of a consumed commodity to be called food that a CES function of the quantities of the two domestically consumed agricultural food products and it is given by the following equation.

$$C_f = (\beta_2 C_2^{(\sigma-1)/\sigma} + \beta_3 C_3^{(\sigma-1)/\sigma})^{\sigma/(\sigma-1)} \quad \text{-----}(13)$$

where σ is the elasticity of substitution β_i are positive parameters. $i = 2, 3$

Given C_f the quantities of C_2 and C_3 will be found as if consumers act by minimizing the cost of purchasing the given quantity.

$$\text{Min } (P_2 C_2 + P_3 C_3) \text{-----(14)}$$

Based on equations (13) and (14), the allocation functions will be as follows.

$$C_i = C_f \beta_i^\sigma (P_i / P_f)^{-\sigma} \quad i=2,3 \text{-----(15)}$$

where P_f is the domestic food price index and given as follows.

$$P_f = \left(\sum_{i=2}^3 \beta_i^\sigma P_i^{1-\sigma} \right)^{1/(1-\sigma)} \text{-----(16)}$$

The quantity of total domestically consumed food C_f is found as a function of domestic income, and the prices of food and non-food products.

$$C_f = f(N, Y, P_f, P_N) = eN(Y/P_N)^\eta (P_f/P_N)^{-\varepsilon} \quad (e: \text{demand shifter}) \text{-----(17)}$$

Y is the domestic nominal income and the sources of this are from both agriculture and nonagriculture and given as follows.

$$Y = (P_A X_A - P_F X_F) + P_N X_N \Rightarrow Y = V_A + P_N X_N \text{-----(18)}$$

Please note that from (17) & (18) that we have abstracted from the savings behaviour of income earners as well as taxation. This is done for simplicity and to focus on the agricultural sector only. The assumption on supply side link between agriculture and nonagriculture is that the available agricultural labor L_A is a negative function of the quantity of non-agricultural production.

$$L_A = g(T_A, T_N, L) = L_{A0} T_A^{\gamma_1} T_N^{\gamma_2} L^{\gamma_3} \quad \gamma_1, \gamma_2 < 0 \quad \gamma_3 > 0 \text{-----(19)}$$

$$L = L_A + L_N \text{-----(20)}$$

$$X_N = T_N L_N^\xi \text{-----(21)}$$

$$C_1 = dNP^n E^q \quad (d: \text{demand shifter}) \text{-----(22)}$$

$$E = GDP / N \text{-----(23)}$$

Equation (19) comes from the push effect of agricultural technical change and the pull effect of nonagricultural technical change (Yamaguchi and Kennedy (1984)). Equation (20) is the equation of sectoral allocation of labor, and equation (21) is the production function of nonagricultural sector. Equation (22) is the domestic demand function of exportable goods. Finally, Equation (23) is the definition of per capita income. This relation is based on the assumption as appears in the many developing countries that the domestic labor market, which comprises both agriculture and

nonagriculture, is connected and some people those are released from nonagriculture go back to agricultural production and do not just stay unemployed. Also an expansion of the nonagricultural sector tends to draw labor from agriculture even in the short term.

Government is implicit throughout, as it affects national income directly through X_N as well as somewhat through P_N , and it also affects prices of exportable agricultural products. It is also assumed that government determines M_2 , the quantity of food imports while the effective prices are determined by supply and demand. In addition, agricultural exports, imports, fertilizer imports are included in the above model and the agricultural trade balance can be explicitly analyzed. Having stated the above model, impact of various exogenous but adjustment related variables on various endogenous variables could be obtained. In order to do this, the above static form of the model should be converted to the dynamic log differential form. If X denotes the log-derivative, namely the quantity dX/X (Growth Rate $\hat{X}$), all variables will be expressed in this way throughout the analysis. The following equations in Table 1 are derived from earlier equations from (1) to (23) after changing them into log derivative form.

After this transformation, the model has the general form $Ax=b$ as indicated in the matrix form (Table 2) where A is a matrix of order (21 X 21) of structural parameters, x is the column vector of rates of change of 21 endogenous variables ($X_1, X_2, \dots, L_N$) and b is the column vector of rates of change of 11 exogenous variables ($E_1, M_2, d, e, T_A, T_N, P_F, P_N, L, N, L_{A0}$). The inverse of A

displays the **Growth Rate Multipliers (GRM)**⁸. As an example, $(A^{-1})_{8,2}$ element is $\frac{\partial \hat{C}_f}{\partial \hat{M}_2}$

(We write this as $C_f M_2$) which indicates by how much the rate of change of aggregate consumption of food C_f changes (effects) due to an increase or decrease in the growth rate of import substitute M_2 . Similarly we could attribute to other exogenous variables. As said earlier GRMs are obtained by calculating the inverse of above matrix of structural parameters. Then the multiplication of these GRMs with the relevant exogenous variables gives the corresponding effect of that exogenous

⁸ For further details of the application of GRM, see Yamaguchi (1982), Yamaguchi and Kennedy (1984), Yamaguchi and Binswanger (1975).

Table 1: Dynamic Form of the Model

Equation Number	Equations
(1) from equation 10	$\hat{X}_1 = (1 - S_1)\hat{E}_1 + S_1\hat{C}_1$ where $S_1 = X_1/C_1$
(2) from equation 11	$S_2\hat{X}_2 + (1 - S_2)\hat{M}_2 = \hat{C}_2$ where $S_1 = X_2/C_2$
(3) from equation 12	$\hat{X}_3 = \hat{C}_3$
(4) from equations 8, 9	$\hat{P}_A = \sum_{i=1}^3 \nu_i \hat{P}_i$ where $\nu_i = P_i X_i / (P_1 X_1 + P_2 X_2 + P_3 X_3)$
(5) from equation 22	$\hat{C}_1 = -n\hat{P}_1 + q\hat{E} + \hat{N} + \hat{d}$
(6) from equation 4	$\hat{X}_A = \frac{1}{1-b}\hat{T}_A + \frac{a}{1-b}\hat{L}_A + \frac{b}{1-b}(\hat{P}_A - \hat{P}_F)$
(7) from equation 19	$\hat{L}_A = \gamma_1\hat{T}_A + \gamma_2\hat{T}_N + \gamma_3\hat{L} + \hat{L}_{A0}$
(8) from equation 15	$\hat{C}_2 = \hat{C}_f - \sigma(\hat{P}_2 - \hat{P}_f)$
(9) from equation 15	$\hat{C}_3 = \hat{C}_f - \sigma(\hat{P}_3 - \hat{P}_f)$
(10) from equations 13, 16	$\hat{P}_f = \lambda_2\hat{P}_2 + (1 - \lambda_2)\hat{P}_3$ where, $\lambda_2 = P_2 X_2 / (P_2 X_2 + P_3 X_3)$
(11) from equation 17	$\hat{C}_f = \eta(\hat{Y} - \hat{P}_N) - \varepsilon(\hat{P}_f - \hat{P}_N) + \hat{N} + \hat{e}$
(12) from equations 5, 18	$\hat{Y} = \mu_A \left[\frac{1}{1-b}\hat{T}_A + \frac{a}{1-b}\hat{L}_A + \frac{1}{1-b}\hat{P}_A - \frac{b}{1-b}\hat{P}_F \right] + (1 - \mu_A)(\hat{P}_N + \hat{X}_N)$
where μ_A = share of agriculture in GDP	
(13)	$\hat{CPI} = \nu_f \hat{P}_f + (1 - \nu_f)\hat{P}_N$
(14)	$\hat{DEF} = \mu_A \hat{P}_A + (1 - \mu_A)\hat{P}_N$
(15) from (6), (20) of Table 1	$\hat{GDP} = \mu_A \left[\frac{1}{1-b}\hat{T}_A + \frac{a}{1-b}\hat{L}_A + \frac{b}{1-b}(\hat{P}_A - \hat{P}_F) \right] + (1 - \mu_A)\hat{X}_N$
(16) from equation 8	$\hat{X}_1 = \hat{X}_A + \tau(\hat{P}_1 - \hat{P}_A)$
(17) from equation 8	$\hat{X}_2 = \hat{X}_A + \tau(\hat{P}_2 - \hat{P}_A)$
(18) from equation 8	$\hat{X}_3 = \hat{X}_A + \tau(\hat{P}_3 - \hat{P}_A)$
(19) from equation 23	$E = GDP/N \rightarrow \hat{GDP} - \hat{E} = \hat{N}$
(20) from equation 21	$\hat{X}_N = \hat{T}_N + \xi\hat{L}_N$
(21) from equation 20	$\hat{L} = l_A \hat{L}_A + l_N \hat{L}_N$ where $l_A = L_A/L$, $l_N = L_N/L$

Table 2: Matrix form of the Model

	X1	X2	X3	XA	C1	C2	C3	Cf	P1	P2	P3	Pf	PA	CP	DEF	LA	Y	GDP	E	XN	LN		
(1)	1	0	0	0	(-s1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\hat{X}_1$	$(1-s)\hat{E}$
(2)	0	s2	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\hat{X}_2$	$(s_2 - 1)\hat{M}_2$
(3)	0	0	1	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\hat{X}_3$	0
(4)	0	0	0	0	0	0	0	0	v1	v2	v3	0	-1	0	0	0	0	0	0	0	0	$\hat{X}_A$	0
(5)	0	0	0	0	1	0	0	0	(n)	0	0	0	0	0	0	0	0	0	(-q)	0	0	$\hat{C}_1$	$\hat{d} + \hat{N}$
(6)	0	0	0	-1	0	0	0	0	0	0	0	0	b/1-b	0	0	a/1-b	0	0	0	0	0	$\hat{C}_2$	$\frac{1}{b-1}\hat{T}_A + (b/1-b)\hat{P}_F$
(7)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	$\hat{C}_3$	$\gamma_1\hat{T}_A + \gamma_2\hat{T}_N + \gamma_3\hat{L} + \hat{L}_{A0}$
(8)	0	0	0	0	0	1	0	-1	0	σ	0	(-o)	0	0	0	0	0	0	0	0	0	$\hat{C}_f$	0
(9)	0	0	0	0	0	0	1	-1	0	0	σ	(-o)	0	0	0	0	0	0	0	0	0	$\hat{P}_1$	0
(10)	0	0	0	0	0	0	0	0	0	λ_2	$1-\lambda_2$	-1	0	0	0	0	0	0	0	0	0	$\hat{P}_2$	0
(11)	0	0	0	0	0	0	0	-1	0	0	0	(-e)	0	0	0	0	η	0	0	0	0	$\hat{P}_3$	$\eta\hat{P}_N - \varepsilon\hat{P}_N - e - \hat{N}$
(12)	0	0	0	0	0	0	0	0	0	0	0	0	$\mu_A/1-b$	0	0	$a\mu_A/1-b$	-1	0	0	$1-\mu'$	0	$\hat{P}_f$	$\frac{\mu_A}{b-1}\hat{T}_A + (b\mu_A/1-b)\hat{P}_f + (\mu_A-1)\hat{P}_N$
(13)	0	0	0	0	0	0	0	0	0	0	0	μ_f	0	-1	0	0	0	0	0	0	0	$\hat{P}_A$	$(\mu_f-1)\hat{P}_N$
(14)	0	0	0	0	0	0	0	0	0	0	0	0	μ_A	0	-1	0	0	0	0	0	0	$\hat{CP}$	$(\mu_A-1)\hat{P}_N$
(15)	0	0	0	0	0	0	0	0	0	0	0	0	$b\mu_A/1-b$	0	0	$a\mu_A/1-b$	0	-1	0	$1-\mu'$	0	$\hat{DEF}$	$\frac{\mu_A}{b-1}\hat{T}_A + (b\mu_A/1-b)\hat{P}_f$
(16)	-1	0	0	1	0	0	0	0	τ	0	0	0	(-r)	0	0	0	0	0	0	0	0	$\hat{L}_A$	0
(17)	0	-1	0	1	0	0	0	0	0	τ	0	0	(-r)	0	0	0	0	0	0	0	0	$\hat{Y}$	0
(18)	0	0	-1	1	0	0	0	0	0	0	τ	0	(-r)	0	0	0	0	0	0	0	0	$\hat{GDP}$	0
(19)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-1	0	0	$\hat{E}$	$\hat{N}$
(20)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	$-\zeta$	$\hat{X}_N$	$\hat{T}_N$
(21)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	l_1	0	0	0	0	l_2	$\hat{L}_N$	$\hat{L}$

variable on the endogenous variable. These effect values are given in the Appendix Table 1. This is followed by graphs, which depict these effects and trends diagrammatically for better understanding.

Data⁹ used here to obtain parametric values are from secondary sources such as Central Bank of Sri Lanka, Department of Census and Statistics, Customs Department and Department of Agriculture for the period starting from 1970 to 1996. The parameters of the model are not assumed to be constant and were obtained for every five-year period starting from 1970 to 1996. This allows us to trace structural changes in the economy and to measure how the effect of the exogenous variables has changed over time for growth accounting by using the structural changes

⁹ Due to space limitations, the data set is not included here and could be obtained from the authors by request.

in each period. Further these GRMs will be used to find the influence of the exogenous variables on endogenous. In addition the contribution of exogenous variables to the endogenous variables could be calculated by multiplying the GRM of each year interval by the corresponding rates of change of the exogenous variables. For example, $CX_1M_2 = (\frac{\partial \hat{X}_1}{\partial \hat{M}_2}) \hat{M}_2$, where CX_1M_2 is the contribution of the agricultural food imports M_2 to the agricultural production for exports X_1 , and $(\frac{\partial \hat{X}_1}{\partial \hat{M}_2})$ $= (X_1M_2)$ is the relevant GRM. The calculated values of these contributions are given in the Appendix Table 2. Now let us see the results of this analysis and impact evaluation as explained by the Table and Graphs given in Appendix.

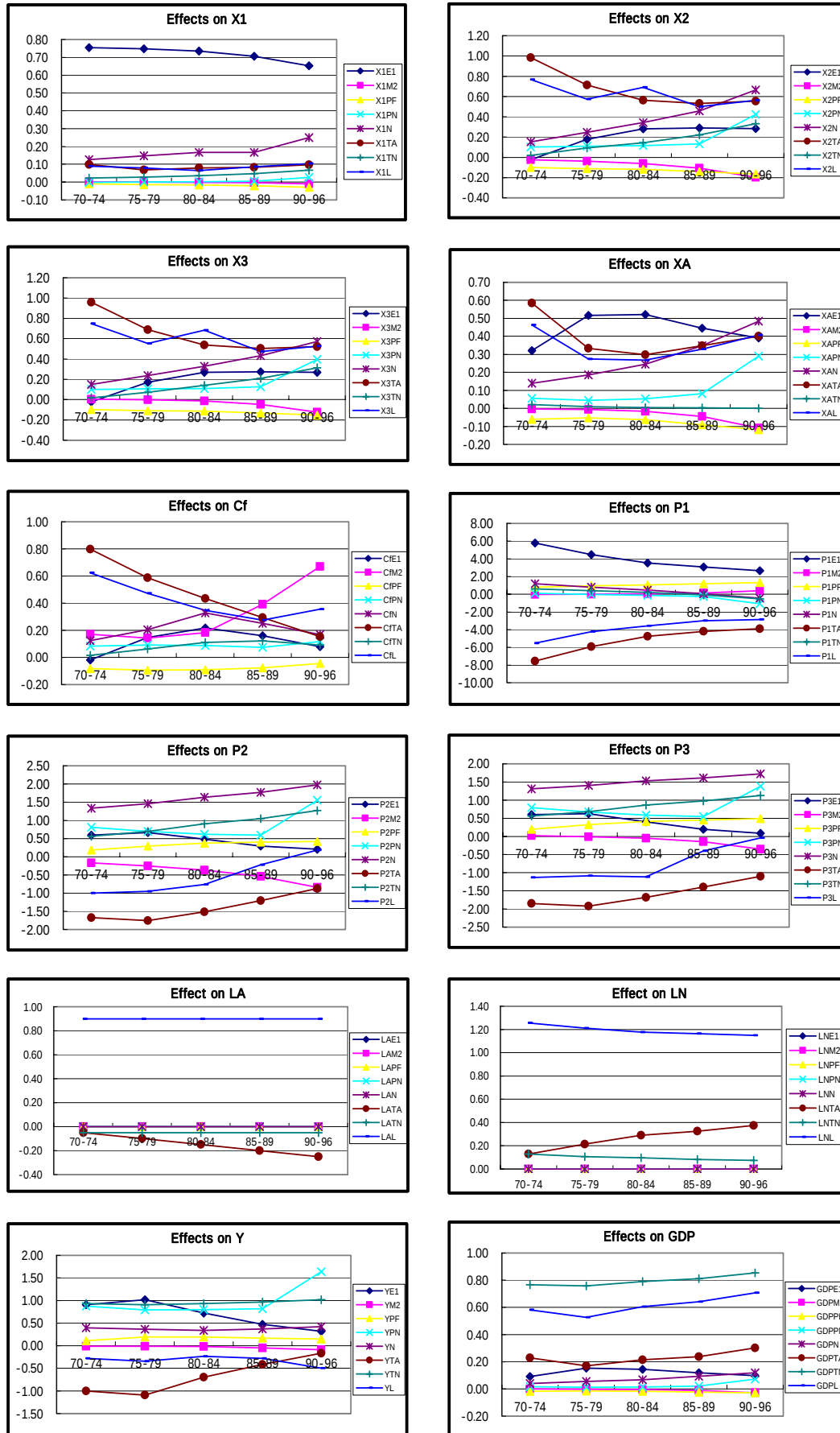
4. Empirical Results of the Model

Now let us see the results of this analysis and impact evaluation as explained in the previous sections. Further, effects and contributions of exogenous variables to endogenous variables are given in Figure 1, Appendix Tables 1 and 2.

4.1 Inference on Effects

The Effects based on the GRMs are given in Figure 1 (See Appendix Table 1 in detail) in relation to this model, which has 21 endogenous variables and 11 exogenous variables providing 168 Effects in total in one period. Hence, it is extremely complicated to describe the performance of the entire Effects but only the principal effects, which clearly describe the policy effects, are discussed here. It is quite evident to see the trend of agricultural exports (E_1) had made notable impact on the agricultural production both exportable and domestically produced and consumed items (X_1 , X_2 and X_3). The effect on X_1 by E_1 (X_1E_1 in Figure 1 and Appendix Table 1) is quite large comparatively to other two sectors X_2 (X_2E_1) and X_3 . (X_3E_1). This is expected under SAP but the effect of E_1 on X_2 is a little bit larger than that of X_3 . Though these two effects are negative before 1975, the larger positive effects on X_2 and X_3 after 1975 clearly show that both sectors of import substitute and domestic food production are affected by agricultural exports after the policy

Figure 1 Graphical Effect of Exogenous Variable on Endogenous Variables (Values of GRM)



reforms since 1978.

Nevertheless, the overall agricultural production X_A ($X_A E_1$) shows positive increasing trend of effects since 1975-79 to 1980-84 and again a declining trend until 1996. This clearly shows the initial shift in the production by agricultural exports soon after the policy reforms and the decline in the later stages of the reforms due to various other exogenous factors affecting the exports and the production. Since the opening of trade allowed the food imports M_2 , the negative effect is felt in the domestic food production as well as on the overall agricultural production ($X_1 M_2$, $X_2 M_2$, $X_3 M_2$, $X_A M_2 < 0$). It can also be seen that the effect of fertilizer prices is much severe on the domestic food sector ($X_2 P_F < 0$ and $X_3 P_F < 0$) then on X_1 ($X_1 P_F < 0$) due to its usage pattern. For example, 100% increase of fertilizer prices would bring down production of X_1 , X_2 and X_3 by 1.02%, 10.2% and 9.92% in 1970-1974 to 2.83%, 16.41% and 15.4% in 1990-1996 respectively. It clearly shows the effect of fertilizer and the price increase under SAP.

It is also noteworthy to mention that the nonagricultural production and price (X_N and P_N) decreased the agriculture exportable's production ($X_1 P_N < 0$) in the pre-reform period but after the policy reforms, X_N and P_N helped the production from sector 1 X_1 ($X_1 P_N > 0$). Positive effects could be observed in the case of import substitute and domestic food sectors ($X_2 P_N > 0$, $X_3 P_N > 0$). Overall X_N and P_N tend to increase the production of aggregate agriculture X_A ($X_A P_N > 0$). Though this effect was small in the beginning of the policy reform stages in 1970-1979 it increased in the 1990-1996 period. Hence we could conclude that the expansion of the nonagricultural sector does not adversely affect the agricultural sector.

Now let us shed light on the side of consumption although we showed only C_f in Figure 1 and Appendix Table1 because of the space restriction. The effect of E_1 is not contributing a positive effect on the consumption from this sector ($C_1 E_1 < 0$, e.g., -0.36 in 1970-74). Although this effect is negative in the pre-reform period, but then became positive with increasing trend in the post reform periods in relation to food consumption from sectors 2 and 3 (C_2 and C_3 and then the aggregated food consumption C_f . For example, see $C_i E_1 < 0$ in 70-74 but positive later). It is interesting to note that the effect of food imports M_2 considerably affect the domestic food sectors of

sectors 2 and 3. As understood, the effect of M_2 is negligible on consumption from sector 1 (C_1M_2 is very small) but it increases the consumption from the sector 2 ($C_2M_2 = 0.13$ in 70-74, but increases to 0.22 in 90-96) as this sector serves as the import substitutable food production. The effect of this M_2 is negative in the sector 3 as the food imports reduce the consumption from the sector 3 of domestically produced and consumed items (e.g., $C_3M_2 = -0.12$ in 90-96). This is the notable effect due to the policy reforms. But the overall food consumption increases due to the food imports since the sector 2 holds the majority of the food consumption in Sri Lanka. In other words, although there is a negative effect of these imports on the sector 3, overall consumption increases as food imports increase. It was nearly 0.17% increase in the pre-reform period per 1% increase of food imports and it increase to 0.67% in the period of 1990-1996 (See C_fM_2). Also nonagricultural price P_N increase and the labor force increase also positively affected on the consumption ($C_fP_N > 0$ and $C_fL > 0$).

It is also of paramount importance to look at the side of prices of agricultural products in relation to the other exogenous variables. Our study reveals that the prices of agricultural commodity from sectors 1, 2 and 3 are considerably affected by the important policy variables of fertilizer prices P_F , nonagricultural price P_N and food imports M_2 . As expected, the import of foods M_2 reduces the prices of products from food sector 2 and 3 ($P_2M_2 < 0$, $P_3M_2 < 0$). Also the exports from sector 1 (E_1) increase the production of sector 1 considerably ($X_1E_1 > 0$). This is the positive side of the policy reform in relation to agricultural exports. But interestingly, this increase also raises the prices food products from sectors 2 and 3 ($P_2E_1 > 0$, $P_3E_1 > 0$). It could be due to the commodity balance under the general equilibrium. Hence we could conclude that the increase of exports from sector one increase the prices of the domestic food production after the policy reforms. But the imports of food items reduce the prices P_2 and P_3 ($P_2M_2 < 0$, $P_3M_2 < 0$), thus harming the local small-scale producers. The changing pattern of fertilizer prices always affects the prices of agricultural products from all the three sectors (P_1P_F , P_2P_F , $P_3P_F > 0$). Under the SAP the fertilizer prices increased due to the reduction and removal of subsidies, which in turn negatively affected the production (X_1P_F , X_2P_F , $X_3P_F < 0$), thus increases the prices agricultural products. It severely

affected the agriculture after the policy reforms. Changing pattern of price indices of agriculture clearly show this argument registering an alarming increase in 1990-1996 in comparison to that of in 1970-1974 (e.g., P_2P_F increases from about 0.18 to 0.42). Hence it could be concluded from here that the severe effect is felt on the agricultural production and prices due to the change in fertilizer prices.

Agricultural labor is clearly characterized by the changes of technical changes in agriculture and nonagriculture (T_A and T_N). The changing pattern shows the **push** effect ($L_A T_A < 0$ and $L_N T_A > 0$) and **pull** effect ($L_A T_N < 0$ and $L_N T_N > 0$) from the starting of the policy reforms (See Yamaguchi and Binswanger (1975) in detail). Decrease of the agricultural labor L_A is due to the development of the nonagricultural sector and this is the expected phenomenon under SAP in a developing country like Sri Lanka. But the interesting point is the declining trend of the labor force. It suggests that the earlier period of the policy reform tend to pull the agricultural labor to the nonagricultural sector and it is expected to maintain the trend, but in Sri Lanka, the later stages of the policy reforms show that the nonagricultural sector could not absorb the influx of agricultural labor so much (i.e., $L_N T_N$ decreases from 0.12857 to 0.07500) due to the economic pattern in Sri Lanka. Hence, the policy option here is to retain the returning labor force in agriculture and to turn this to contribute positively.

The overall effect could be seen from the effect trend of GDP (In fact, real GDP). The ultimate objective of SAP is to re-structure the economy to register a positive economic growth through the increase of GDP. This could be seen from the trends of effects in relation to GDP. As expected under the policy reforms, exports tend to increase the GDP ($GDPE_1 > 0$) and it is quite evident after the reforms in 1977-1978. Further food imports and the increase of fertilizer prices tend to decrease the GDP growth ($GDPM_2, GDPP_F < 0$) Though the import effects are negative, the positive effects from the exports negate these negative effects thus registering a positive growth of GDP. The same pattern could be observed from the effects on per capita due to the changes on the above-analyzed exogenous variables. Further changes on these effects could be clearly understood from analyzing the results of contributions of the exogenous variables to endogenous variables as stipulated in the

Appendix Table 2. The highlighted values are found to be most important to the conclusion of this study.

4.2 Inference on Contributions

Here the contributions provide the percentage of amount of contribution of the exogenous variable to the endogenous variable. The highlighted values give the most important policy changes and the pattern of the effect due to these policy changes. The most important values in relation to agricultural output X_A is given by the E_1 , M_2 and P_F . According to the values in the Appendix Table 2, the biggest contribution of exportable to agricultural output (CX_AE_1) is in the 1975-1979 just the beginning of the policy reform. And the production is affected positively by the biggest contribution from exports with almost 100% ($CX_AE_1=98.19\%$) contribution to the growth of X_A . It further shows clearly a decrease in the period of 1985-1989 due to the civil conflict and the decrease of the exports due to this fact have 142.02% of contribution to the decrease of the output. Similarly the fertilizer and the food imports have also contributed significantly to the agricultural output negatively and positively. The fertilizer has about 235% of contribution in the decrease of the agricultural output ($CX_AP_F=-234.78\%$) in 1980-1994.

As we have argued above, agricultural exports helped to increase the GDP and the contribution of this ($CGDPE_1$) is nearly 65.15% in the beginning of the policy reforms in 1975-79. Further the decrease of the growth rate of GDP was also evidenced here in the period of 1985-89 following to that of 1980-84 and the contribution of decrease of agricultural exports in the decreased GDP is evident here with 48.20%. Also fertilizer price increase negatively contributed to the GDP growth ($CGDPP_F < 0$) and the maximum contribution is in the year of 1985-89 with -47.99%. Technical change in agriculture also positively contributed with increasing percentage of contribution to GDP ($CGDPT_A$ = about 22% in 1970-74 to 44% in 1990-96).

The contribution of these policy variables is also felt in the prices of the agricultural outputs. It is quite evident that the contribution of fertilizer prices on the prices of products of all the three sections (CP_1P_F , CP_2P_F , CP_3P_F) is very high reaching the highest of 98.14% in the sector 2 during 1985-89. Mostly the contribution from the fertilizer prices is negative in the beginning of the policy

reform endorsing the import benefits announced under SAP but tend to increase later on thus increasing the prices. Since the small-scale farmers are often affected by this increase, the policy option here should be the rationalizing the fertilizer subsidy based on the cultivation size. Further the contribution from the exports E_1 to P_1 (CP_1E_1) is also high in the beginning of the policy reform at about 742.92% but it negatively contributed in the later stages at about 106.48 and 18.83 % thus indicating the unfavorable trend to the production of exportable. Further the prices of products from sector 2 and 3 (P_2 and P_3) are also considerably affected by the prices of nonagricultural price (P_N) as the contribution from this is quite strong thus indicating the strongest influence (CP_2P_N and CP_3P_N are very large). This trend further endorses that the development of nonagricultural sector tend increase its prices and this is positively affected the agricultural products too ($CX_AP_N > 0$ in almost all periods).

The technical change in agricultural sector pulled the labor force as the contribution of T_A to L_A is high ($CL_AT_A = -579.39\%$) during 1990-96. Also technical change of nonagricultural sector T_N pulled the labor force. This is quite a good example for the push-pull effect due to the technical changes. The contribution table (Appendix Table 2) with respect to the agricultural and nonagricultural labor force clearly shows this trend. Hence the calculation of contribution further enriched the understanding of the performance of endogenous variables in relation to the effects of exogenous variables on the endogenous variables. As specified elsewhere in this paper, calculation of contribution helped to capture the inter-sectoral effects and only important contributions were discussed here though the calculation was made for every possible one.

5. Conclusion

After the first wave of policy reforms in Sri Lanka, the foreign exchange constraint that prevailed during the pre-reform period eased with increased foreign aid and loans under SAP. Exchange rate reforms and export incentives encouraged the manufacturing and agricultural exports. GRMs in this regard and the effect of E_1 on various other endogenous variables of domestic food sector clearly showed this effect. Thus the first wave of policy reforms helped the export agriculture while making little or no positive effect on domestic food sector. This situation

was further aggravated with the escalating fertilizer prices (P_F) as the fertilizer subsidies under SAP were progressively removed. This has caused increase in food prices thus effecting the domestic consumption. GRMs in this regard also point out a minus effect along with decreasing trend of effects with regard to P_F .

A second period of policy reforms was implemented after 1989, by which the private sector was given a greater role in economic development, trade was also liberalized and export promotion and diversification were encouraged. This also allowed more food imports into the country. But according to our calculation and relevant GRMs, the increase in imports (M_2) has made negative impact on domestic food production X_2 and X_3 especially after second wave of policy reforms. Agricultural labor L_A , continued to show a declining trend as this is related only to nonagricultural output X_N in the model equation which was connected to technical changes in agriculture (T_A) and nonagriculture (T_N) in the model. This declining trend is attributed to the internal out-migration phenomenon in the agricultural sector in many of the developing countries due to imbalanced categorization of agricultural and nonagricultural economies.

Effects on prices of agricultural outputs (Sectors 1, 2 and 3 respectively) are also pointed out and they have a negative impact (i.e., increase of price) from both export agriculture (only one exception is sector 1) and fertilizer prices, and positive impact (reduction of prices) from food imports. Nevertheless this import effects are negative in relation to domestic production. Relevant GRMs and trend graph showed this aspect clearly. Having seen the major impact on the agricultural sector through above GRM approach, we could say that there is a need for national agricultural planning and policy framework with clearly defined objectives and priorities. It is unavoidable that the economic development in developing countries much depend on nonagricultural sector rather than subsistence agricultural sector meanwhile it is important to ensure that the traditional agricultural economy should not be revitalized. It is also important to consider the agricultural trade in the analysis within the perspectives of SAPTA (South Asian Preferential Trade Arrangement) implementation. According to our analysis, major hardships in domestic food sector were caused due to escalating fertilizer prices and outmigration of

agricultural labor force. Hence remedial measures in this regard should be considered.

It is quite evident from the above sections of this study that the Structural Adjustment Policies have made considerable impact on the economy with the special reference to the agricultural sector. In the beginning of the SAP implementation, the export agricultural sector was registering a positive growth and during the second wave of the policy changes, this increasing trend started to decline. Further, due to the various changes in the policy, the domestic agriculture was affected considerably. Due to the removal of various agricultural related subsidy schemes including important fertilizer subsidy, the production of domestic agriculture was affected with the increase of cost of production. Also, the rate of increase of the producer price in relation to that of the fertilizer price was not proportional and biased towards the fertilizer price increase. It was evident from the Tables in relation to GRM effects and contributions.

Further it was evident from various statistics and the above historical readings that Sri Lanka's socio-economic structure was the one of the best among the developing nations but these indices in the pre-reform periods strongly supported for the policy reform in order to resuscitate the economy with special reforms to the agricultural sector. But these changes registered success in the initial periods from 1978 and the latter part of 1980s were not in favor of the satisfactory trend. It was evident from the above analysis that the large-scale farmer benefited by these policy reform packages and the small holder are still struggling to improve against the influence of the policy impact. Due to the considerable increase in the development of nonagricultural sector since 1978, there was a labor migration pattern from the rural to urban. Though this migration affected agricultural sector, especially the domestic food sector, in the long run this effect has become positive to the agriculture with the technical change effects.

It is quite evident from this study is that SAPs are favorable to the overall agricultural development though their impact on the domestic food sector is negative. Since the revenue from the export earnings compensate the negative impact on the domestic food sector, the overall impact of agriculture is favorable for the development. Further our study clearly indicates that the fertilizer prices that change under the policy adjustments tremendously effect the agricultural

production and it was further negatively effect the domestic food production. Food imports are open under the SAP and these food imports make considerably large impact on the domestic food production thus creating an outward migration of agricultural labor. The Push-Pull effect of technical changes of agriculture and nonagriculture is also evident from this study as expected under SAP. Further our study specifies that the impact of nonagricultural sector on agriculture is not affecting the overall economy though the latter experienced negative impact in the initial period of the policy reforms as the nonagricultural sector recorded rapid growth.

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Appendix Table 1: Effects of Exogenous Variables on Endogenous Variables

Effect on X1	70-74	75-79	80-84	85-89	90-96
X1E1	0.75452	0.74739	0.73564	0.70555	0.65333
X1M2	0.00006	-0.00017	-0.00074	-0.00303	-0.00992
X1PF	-0.01016	-0.01348	-0.01635	-0.02119	-0.02833
X1PN	-0.00085	0.00108	0.00255	0.00557	0.02632
X1N	0.12730	0.14714	0.16739	0.16660	0.24960
X1TA	0.09984	0.06841	0.07999	0.08319	0.09824
X1TN	0.02365	0.02863	0.03607	0.04703	0.06722
X1L	0.08952	0.07991	0.06467	0.08536	0.10464

Effect on X3	70-74	75-79	80-84	85-89	90-96
X3E1	-0.02236	0.17109	0.26891	0.27388	0.26701
X3M2	0.00400	-0.00231	-0.01358	-0.04690	-0.12344
X3PF	-0.09923	-0.10963	-0.11420	-0.13248	-0.15399
X3PN	0.09956	0.10706	0.10916	0.12651	0.39565
X3N	0.14755	0.23790	0.32773	0.43293	0.57315
X3TA	0.95739	0.68930	0.53858	0.50387	0.52024
X3TN	0.01911	0.07102	0.13925	0.20799	0.31201
X3L	0.74804	0.55343	0.68214	0.47195	0.52786

Effect on Cf	70-74	75-79	80-84	85-89	90-96
CfE1	-0.01864	0.14632	0.21659	0.15904	0.07837
CfM2	0.16962	0.14280	0.18366	0.39208	0.67027
CfPF	-0.08273	-0.09376	-0.09198	-0.07693	-0.04520
CfPN	0.08301	0.09156	0.08792	0.07346	0.11612
CfN	0.12302	0.20345	0.32773	0.25140	0.16822
CfTA	0.79818	0.58779	0.43378	0.29259	0.15269
CfTN	0.01426	0.06073	0.11054	0.12078	0.09157
CfL	0.62365	0.47330	0.34670	0.27406	0.35493

Effect on P2	70-74	75-79	80-84	85-89	90-96
P2E1	0.59286	0.66653	0.48800	0.29747	0.20504
P2M2	-0.16272	-0.25289	-0.36118	-0.54048	-0.84331
P2PF	0.17901	0.29266	0.37140	0.40096	0.41907
P2PN	0.81231	0.69536	0.61944	0.59193	1.55699
P2N	1.33594	1.45882	1.63243	1.77095	1.97412
P2TA	-1.67778	-1.75005	-1.51464	-1.20906	-0.87076
P2TN	0.56403	0.69460	0.90704	1.04938	1.26599
P2L	-0.99822	-0.94984	-0.76101	-0.22349	0.18475

Effect on LA	70-74	75-79	80-84	85-89	90-96
LAE1	0.00000	0.00000	0.00000	0.00000	0.00000
LAM2	0.00000	0.00000	0.00000	0.00000	0.00000
LAPF	0.00000	0.00000	0.00000	0.00000	0.00000
LAPN	0.00000	0.00000	0.00000	0.00000	0.00000
LAN	0.00000	0.00000	0.00000	0.00000	0.00000
LATA	-0.05000	-0.10000	-0.15000	-0.20000	-0.25000
LATN	-0.05000	-0.05000	-0.05000	-0.05000	-0.05000
LAL	0.90000	0.90000	0.90000	0.90000	0.90000

Effect on Y	70-74	75-79	80-84	85-89	90-96
YE1	0.90928	1.01408	0.72085	0.47566	0.32130
YM2	-0.01080	-0.01367	-0.02141	-0.04736	-0.08975
YPF	0.11203	0.18991	0.18985	0.16948	0.15052
YPN	0.87468	0.79256	0.79663	0.81970	1.63433
YN	0.39682	0.36409	0.33940	0.37242	0.41999
YTA	-1.00186	-1.09180	-0.69229	-0.41288	-0.16790
YTN	0.93250	0.90852	0.93188	0.96510	1.01694
YL	-0.28249	-0.34325	-0.23616	-0.27985	-0.49731

Effect on X2	70-74	75-79	80-84	85-89	90-96
X2E1	-0.02297	0.17735	0.28133	0.28919	0.28459
X2M2	-0.02308	-0.03898	-0.06036	-0.10542	-0.19740
X2PF	-0.10192	-0.11364	-0.11948	-0.13988	-0.16413
X2PN	0.10227	0.11098	0.11420	0.13358	0.42170
X2N	0.15156	0.24661	0.34286	0.45714	0.66405
X2TA	0.98342	0.71245	0.56344	0.53203	0.55448
X2TN	0.01757	0.09361	0.14358	0.21961	0.33255
X2L	0.76838	0.57367	0.69055	0.49833	0.56261

Effect on XA	70-74	75-79	80-84	85-89	90-96
XAE1	0.31971	0.51577	0.52031	0.44467	0.39051
XAM2	-0.00380	-0.00695	-0.01545	-0.04427	-0.10908
XAPF	-0.06060	-0.05294	-0.06296	-0.09123	-0.11822
XAPN	0.05594	0.04449	0.05321	0.08145	0.28946
XAN	0.13953	0.18518	0.24498	0.34816	0.48426
XATA	0.58547	0.33302	0.29847	0.34799	0.40015
XATN	0.02156	0.01016	0.00560	0.00379	0.00086
XAL	0.46252	0.27432	0.26800	0.32883	0.40754

Effect on P1	70-74	75-79	80-84	85-89	90-96
P1E1	5.77612	4.46685	3.51678	3.07323	2.66334
P1M2	-0.00847	0.00582	0.03627	0.14217	0.40657
P1PF	0.79078	0.96042	1.05891	1.19224	1.32439
P1PN	0.12482	-0.03728	-0.12487	-0.26153	-1.07888
P1N	1.17418	0.79574	0.46260	0.04691	-0.43444
P1TA	-7.56928	-5.92367	-4.73973	-4.20140	-3.91235
P1TN	0.60452	0.39473	0.19031	-0.10117	-0.50283
P1L	-5.52398	-4.24158	-3.56245	-2.97661	-2.86837

Effect on P3	70-74	75-79	80-84	85-89	90-96
P3E1	0.59692	0.62481	0.40526	0.19540	0.08786
P3M2	0.01782	-0.00842	-0.04931	-0.15033	-0.35027
P3PF	0.19700	0.31940	0.40654	0.45033	0.48665
P3PN	0.79426	0.66925	0.58586	0.54478	1.38335
P3N	1.30919	1.40079	1.53159	1.60961	1.72258
P3TA	-1.85133	-1.91769	-1.68035	-1.39683	-1.09907
P3TN	0.56092	0.67728	0.86481	0.97186	1.12906
P3L	-1.13382	-1.08482	-1.11705	-0.39937	-0.04692

Effect on LN	70-74	75-79	80-84	85-89	90-96
LNE1	0.00000	0.00000	0.00000	0.00000	0.00000
LNM2	0.00000	0.00000	0.00000	0.00000	0.00000
LNPF	0.00000	0.00000	0.00000	0.00000	0.00000
LNPN	0.00000	0.00000	0.00000	0.00000	0.00000
LNN	0.00000	0.00000	0.00000	0.00000	0.00000
LNTA	0.12857	0.21250	0.29118	0.32632	0.37500
LNTN	0.12857	0.10625	0.09706	0.08158	0.07500
LNL	1.25714	1.21250	1.17706	1.16316	1.15000

Effect on GDP	70-74	75-79	80-84	85-89	90-96
GDPE1	0.09093	0.15211	0.14417	0.11891	0.09639
GDPM2	-0.00108	-0.00205	-0.00428	-0.01184	-0.02692
GDPPF	-0.01724	-0.01575	-0.01745	-0.02449	-0.02847
GDPPN	0.01591	0.01312	0.01474	0.02178	0.07145
GDPN	0.03968	0.05462	0.06788	0.09311	0.11953
GDPTA	0.22984	0.17033	0.21367	0.23856	0.30101
GDPTN	0.76731	0.75765	0.78981	0.81115	0.85257
GDPL	0.58135	0.52545	0.60420	0.64180	0.70689

Note: Highlighted values provide the expected trend correctly.

Appendix Table 2: Contribution of Exogenous Variables to the Endogenous Variables

Percentage Contribution of Exogenous Variables to Value of Production of Exportable Commodities (X1)

Year	GR(X1)	GR(X1) (%)	CX1E1	CX1E1 (%)	CX1M2	CX1M2 (%)	CX1PF	CX1PF (%)	CX1PN	CX1PN (%)	CX1N	CX1N (%)	CX1TA	CX1TA (%)	CX1TN	CX1TN (%)	CX1L	CX1L (%)
1970-1974	0.43	100.00	0.23	53.89	-0.00	-0.16	-0.06	-13.55	-0.01	-3.30	0.21	48.84	0.02	3.67	0.01	2.01	0.32	74.79
1975-1979	2.26	100.00	2.01	89.09	0.00	0.05	0.05	2.04	0.01	0.62	0.24	10.62	0.91	40.06	-0.01	-0.32	0.18	8.05
1980-1984	-0.53	100.00	0.07	-12.46	0.02	-3.62	-0.27	51.76	0.07	-13.05	0.25	-47.17	-0.43	81.86	-0.00	0.40	-0.05	9.38
1985-1989	-4.93	100.00	-5.21	105.58	-0.03	0.66	-0.22	4.48	0.09	-1.88	0.25	-5.07	-0.33	6.76	0.01	-0.27	0.30	-6.07
1990-1996	-1.11	100.00	-1.89	170.34	0.02	-1.80	0.17	-15.42	0.63	-56.77	0.30	-27.03	0.52	-46.97	0.00	-0.01	0.15	-13.95

Percentage Contribution of Exogenous Variables to Value of Production of Import Substitute Food Commodity (X2)

Year	GR(X2)	GR(X2) (%)	CX2E1	CX2E1 (%)	CX2M2	CX2M2 (%)	CX2PF	CX2PF (%)	CX2PN	CX2PN (%)	CX2N	CX2N (%)	CX2TA	CX2TA (%)	CX2TN	CX2TN (%)	CX2L	CX2L (%)
1970-1974	4.02	100.00	-0.01	-0.18	0.27	6.71	-0.58	-14.55	1.70	42.34	0.25	6.22	0.16	3.87	0.01	0.16	2.76	68.72
1975-1979	8.72	100.00	4.78	54.79	0.27	3.10	0.39	4.47	1.44	16.52	0.40	4.59	4.43	50.78	-0.02	-0.27	1.31	14.97
1980-1984	2.89	100.00	0.04	0.87	1.56	54.07	-2.00	-69.37	3.10	107.13	0.52	17.99	-0.01	-0.30	-0.01	-0.29	-0.53	-18.37
1985-1989	-0.92	100.00	-2.13	231.90	-1.13	123.32	-1.46	158.54	2.22	-241.74	0.70	-76.09	-0.10	11.18	0.06	-6.63	1.75	-189.77
1990-1996	10.45	100.00	-0.82	-7.88	0.40	3.81	0.99	9.49	10.10	96.63	0.80	7.66	2.94	28.16	0.00	0.01	0.83	7.97

Percentage Contribution of Exogenous Variables to Value of Production of Domestically Produced and Consumed Food Commodity (X3)

Year	GR(X3)	GR(X3) (%)	CX3E1	CX3E1 (%)	CX3M2	CX3M2 (%)	CX3PF	CX3PF (%)	CX3PN	CX3PN (%)	CX3N	CX3N (%)	CX3TA	CX3TA (%)	CX3TN	CX3TN (%)	CX3L	CX3L (%)
1970-1974	3.76	100.00	-0.01	-0.18	-0.05	-1.24	-0.57	-15.13	1.66	44.03	0.24	6.38	0.15	4.02	0.01	0.19	2.69	71.47
1975-1979	6.89	100.00	4.61	66.89	0.02	0.23	0.38	5.46	1.39	20.17	0.38	5.52	2.12	30.79	-0.02	-0.26	1.26	18.28
1980-1984	1.12	100.00	0.02	2.16	0.35	31.38	-1.92	-171.10	2.96	264.24	0.50	44.64	-0.23	-20.37	-0.01	-0.72	-0.52	-46.82
1985-1989	0.78	100.00	-2.02	-259.04	-0.50	-64.71	-1.38	-177.09	2.11	270.03	0.66	84.62	-1.02	-130.77	0.06	7.63	1.65	211.98
1990-1996	8.73	100.00	-0.77	-8.85	0.25	2.85	0.93	10.65	9.47	108.53	0.69	7.90	1.86	21.32	0.00	-0.01	0.78	8.95

Percentage Contribution of Exogenous Variables to Agricultural Output(XA)

Year	GR(XA)	GR(XA) (%)	CXAE1	CXAE1 (%)	CXAM2	CXAM2 (%)	CXAPF	CXAPF (%)	CXAPN	CXAPN (%)	CXAN	CXAN (%)	CXATA	CXATA (%)	CXATN	CXATN (%)	CXAL	CXAL (%)
1970-1974	2.52	100.00	0.10	3.90	0.04	1.76	-0.35	-13.79	0.93	36.91	0.23	9.13	0.09	3.67	0.01	0.31	1.66	65.94
1975-1979	14.15	100.00	13.89	98.19	0.05	0.34	0.18	1.28	0.58	4.08	0.30	2.12	1.41	9.94	-0.00	-0.02	0.62	4.41
1980-1984	0.45	100.00	0.05	10.38	0.40	88.89	-1.06	-234.78	1.44	320.55	0.37	82.22	-0.13	-28.09	-0.00	-0.07	-0.21	-45.79
1985-1989	-2.31	100.00	-3.28	142.02	-0.48	20.63	-0.95	41.18	1.36	-58.70	0.53	-22.94	-1.10	47.41	0.00	-0.05	1.15	-49.87
1990-1996	7.35	100.00	-1.13	-15.38	0.22	3.00	0.71	9.71	6.93	94.31	0.59	8.03	2.12	28.89	0.00	0.00	0.60	8.21

Percentage Contribution of Exogenous Variables to Food Consumption (CF)

Year	GR(CF)	GR(CF) (%)	CCFE1	CCFE1 (%)	CCFM2	CCFM2 (%)	CCFPF	CCFPF (%)	CCFPN	CCFPN (%)	CCFN	CCFN (%)	CCFTA	CCFTA (%)	CCFTN	CCFTN (%)	CCFL	CCFL (%)
1970-1974	1.35	100.00	-0.01	-0.42	-1.98	-146.75	-0.47	-35.14	1.38	102.25	0.20	14.81	0.13	9.33	0.01	0.39	2.24	165.96
1975-1979	4.23	100.00	3.94	93.18	-0.99	-23.42	0.32	7.69	1.19	28.10	0.33	7.80	0.92	21.70	-0.02	-5.09	1.08	25.46
1980-1984	-4.01	100.00	0.02	-0.48	-4.75	118.56	-1.54	38.49	2.38	-59.44	0.50	-12.47	-0.18	4.58	-0.01	0.16	-0.27	6.65
1985-1989	5.87	100.00	-1.17	-19.99	4.22	71.88	-0.80	-13.66	1.22	20.84	0.38	6.47	-0.07	-1.24	0.13	2.29	0.96	16.36
1990-1996	2.45	100.00	-0.23	-9.26	-1.35	-55.23	0.27	11.14	2.78	113.50	0.20	8.16	0.81	33.07	0.00	0.07	0.53	21.44

Percentage Contribution of Exogenous Variables to Average Price of Export Agricultural Output(P1)

Year	GR(P1)	GR(P1) (%)	CP1E1	CP1E1 (%)	CP1M2	CP1M2 (%)	CP1PF	CP1PF (%)	CP1PN	CP1PN (%)	CP1N	CP1N (%)	CP1TA	CP1TA (%)	CP1TN	CP1TN (%)	CP1L	CP1L (%)
1970-1974	-11.61	100.00	1.77	-15.28	0.10	-0.85	4.53	-39.05	2.08	-17.88	1.90	-16.37	-1.20	-10.29	0.22	-1.90	-19.84	170.93
1975-1979	1.66	100.00	12.83	742.92	-0.04	-2.43	-3.29	-198.38	-0.48	-29.16	1.27	76.51	-3.39	-203.96	-0.10	-6.05	9.65	-581.45
1980-1984	17.79	100.00	0.32	1.77	-0.94	-5.28	17.77	99.88	-3.39	-19.03	0.70	3.93	2.01	11.29	-0.01	-0.06	2.74	15.39
1985-1989	-2.51	100.00	-2.67	106.48	1.53	-60.95	12.43	-495.27	-4.35	173.47	0.07	-2.79	0.44	-17.66	-0.03	1.15	-10.43	415.48
1990-1996	-40.93	100.00	-7.71	18.83	-0.82	2.01	-8.00	19.54	-25.84	63.12	0.53	-1.29	-8.76	21.41	-0.00	0.00	-4.25	10.37

Percentage Contribution of Exogenous Variables to Average Price of Import Substitute Food Commodity (P2)

Year	GR(P2)	GR(P2) (%)	CP2E1	CP2E1 (%)	CP2M2	CP2M2 (%)	CP2PF	CP2PF (%)	CP2PN	CP2PN (%)	CP2N	CP2N (%)	CP2TA	CP2TA (%)	CP2TN	CP2TN (%)	CP2L	CP2L (%)
1970-1974	12.01	100.00	0.18	1.52	1.90	15.82	1.03	8.55	13.51	112.48	2.16	17.99	-0.26	-2.21	0.21	1.71	-3.59	-29.86
1975-1979	14.24	100.00	7.96	55.87	1.75	12.32	-1.00	-7.05	9.03	63.40	2.33	16.36	-2.06	-14.45	-0.18	-1.24	-2.16	-15.18
1980-1984	30.72	100.00	0.04	0.14	9.35	30.44	6.23	20.29	16.79	54.67	2.48	8.07	0.64	2.09	-0.05	-0.17	0.59	1.90
1985-1989	4.26	100.00	-2.19	-51.52	-5.82	-136.53	4.18	98.14	9.85	231.33	2.69	63.15	0.85	19.88	0.30	7.05	-0.78	-18.38
1990-1996	32.61	100.00	-0.59	-1.82	1.70	5.22	-2.53	-7.76	37.28	114.33	2.39	7.33	-4.62	-14.17	0.00	0.01	0.27	0.84

Percentage Contribution of Exogenous Variables to Average Price of Domestically Produced and Consumed Food Commodity (P3)

Year	GR(P3)	GR(P3) (%)	CP3E1	CP3E1 (%)	CP3M2	CP3M2 (%)	CP3PF	CP3PF (%)	CP3PN	CP3PN (%)	CP3N	CP3N (%)	CP3TA	CP3TA (%)	CP3TN	CP3TN (%)	CP3L	CP3L (%)
1970-1974	10.92	100.00	0.18	1.68	-0.21	-1.91	1.13	10.34	13.21	120.96	2.12	19.41	-0.29	-2.68	0.20	1.87	-4.07	-37.30
1975-1979	20.67	100.00	16.83	81.43	0.06	0.28	-1.10	-5.30	8.69	42.04	2.24	10.84	-2.38	-11.50	-0.17	-0.83	-2.47	-11.94
1980-1984	22.34	100.00	0.04	0.16	1.28	5.71	6.82	30.54	15.88	71.10	2.33	10.43	0.71	3.19	-0.05	-0.23	0.86	3.84
1985-1989	9.45	100.00	-1.44	-15.25	-1.62	-17.12	4.70	49.69	9.07	95.98	2.45	25.93	2.20	23.28	0.28	2.94	-1.40	-14.81
1990-1996	27.52	100.00	-0.25	-0.92	0.71	2.57	-2.94	-10.68	33.13	120.37	2.08	7.56	-2.83	-10.29	0.00	-0.01	-0.07	-0.25

Percentage Contribution of Exogenous Variables to Average Agriculture Labour Force (LA)

Year	GR(LA)	GR(LA) (%)	CLAE1	CLAE1 (%)	CLAM2	CLAM2 (%)	CLAPF	CLAPF (%)	CLAPN	CLAPN (%)	CLAN	CLAN (%)	CLATA	CLATA (%)	CLATN	CLATN (%)	CLAL	CLAL (%)
1970-1974	3.01	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.26	-0.02	-0.61	3.23	107.41
1975-1979	1.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.02	-102.33	0.01	1.27	2.05	204.80
1980-1984	-1.98	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16	-58.76	0.00	-0.15	-0.69	34.94
1985-1989	2.91	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	10.37	-0.01	-0.49	3.15	108.35
1990-1996	0.21	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.22	-579.39	-0.10	-47.62	1.33	634.29

Percentage Contribution of Exogenous Variables to Average Non-Agriculture Labour Force (LN)

Year	GR(LN)	GR(LN) (%)	CLNE1	CLNE1 (%)	CLNM2	CLNM2 (%)	CLNPF	CLNPF (%)	CLNPN	CLNPN (%)	CLNN	CLNN (%)	CLNTA	CLNTA (%)	CLNTN	CLNTN (%)	CLNL	CLNL (%)
1970-1974	5.01	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	18.37	0.05	0.94	4.52	90.14
1975-1979	5.72	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.81	49.16	-0.03	-0.47	2.76	48.24
1980-1984	1.11	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.12	-191.29	-0.01	-0.51	-0.90	-81.52
1985-1989	4.36	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.11	-25.42	0.02	0.54	4.08	93.47
1990-1996	3.76	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.99	52.93	0.00	0.00	1.70	45.27

Percentage Contribution of Exogenous Variables to GDP