

THE EFFECTS OF FOREIGN CAPITAL INFLOWS ON THE TURKISH ECONOMY

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Abstract

The role and effects of foreign aid in the economic development of developing countries have been controversial issues. Some economic studies of foreign aid suggest that it is successful, as the other studies find no relationship between foreign aid and growth rate of output, and suggest that it also retards economic growth in developing countries by leading to the structural distortions of the economy. This study has examined empirically the effectiveness and impact of foreign aid on the economic development of Turkey from 1963 to 1990. A simultaneous equations model was developed and Three Stage Least Squares method was used to assess both direct and indirect effects of foreign aid on economic development of Turkey. The empirical results have made an important contribution to understanding the role of foreign aid as a determinant of the behaviour of savings, growth, investment, etc. in the Turkish economy. The basic conclusion in this study is that foreign aid was successful and made a positive contribution to the economic development efforts of Turkey over the period 1963-1990.

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Özet

Yabancı Sermaye Girişinin Türkiye Ekonomisi Üzerindeki Etkileri

Dış yardımların, gelişmekte olan ülkelerin ekonomik kalkınmaları üzerindeki etkileri ve rolü tartışmalı bir konudur. Bazı ekonomik çalışmalar, dış yardımların faydalı olduğunu ileri sürerken, diğer bazı çalışmalar dış yardımlarla büyüme hızı arasında bir ilişki olmadığını ve hatta dış yardımın ekonominin yapısını bozarak ekonomik gerilemeye neden olduğunu ileri sürmüşlerdir. Bu çalışma, ampirik olarak dış yardımların 1963-90 yılları arasında Türkiye ekonomisinin kalkınmasındaki etkilerini incelemeye çalışmaktadır. Analiz için eş zamanlı denklem sistemi geliştirilmiş ve 3 aşamalı en küçük kareler yöntemi kullanılarak dış yardımların kalkınma üzerindeki doğrudan ve dolaylı etkileri ölçülmeye çalışılmıştır. Çalışma sonuçları dış yardımların Türkiye ekonomisi üzerinde olumlu bir etkiye sahip olduklarını göstermektedir.

I: Introduction:

We should specify here that cross section results have dominated the literature to date, but that these have suggested that the impact of aid is not constant across all countries; sometimes it appears to generate growth and sometimes it appears not to generate growth. Thus, a survey of the academic literature can leave us unsure about the answer to the question of whether aid makes contribution to economic development of developing countries. The present study is an individual country time series study for the case of Turkey. Time series analysis applied to specific countries can shed further light on these issues of foreign aid, but we have made the assumption that the impact of aid on the Turkish Economy, and more generally, the structure of the equations has been unchanged throughout the sample period (1963-1990). This is, a somewhat heroic assumption, we do not have sufficient data to test it adequately, but it does characterise much of time series research.

We developed the simultaneous equations model and examined the direct and indirect effects of foreign aid and other components of foreign capital inflows on the economic development of Turkey by using a simultaneous equation approach and also path analysis. Precedence parts

present the results of statistical analyses of the effects of foreign aid inflows on the Turkish economy. Later, we used results obtained from path analysis, which is a technique borrowed from sociology but which is a useful method of summarising the linkages within a simultaneous equations model. It has not been used widely in economics, and thus this represents a genuine empirical contribution to the modelling literature.

II: Review of Previous Empirical Research:

The role of foreign capital as a determinant of growth in the developing countries is a controversial subject. The controversy has sometimes been focused on its components, particularly on foreign aid, and thus there is little agreement on the impact of foreign assistance inflows on LDC's or developing countries. For example, according to the orthodox economists like Rosenstein-Rodan (1961) and Chenery and Strout (1966), all capital inflows make net additions to an LDC's productive resources, thus increasing their growth rate. The channel of this effect was sometimes in the spirit of the well-known Harrod-Domar model and at other times in terms of the 'two-gap' models, -where these inflows facilitated and accelerated growth by removing foreign exchange and/or domestic savings gaps. The radical economists like Griffin and Enos (1970) and Weisskopf (1972b) challenged this orthodox position. According to their line of argument foreign capital inflows exercised a depressing effect on the savings propensities of the developing countries, thus leading to a reduction of the domestic saving rates and lower rates of capital formation and consequently lower rates of growth. Thus, unlike the orthodox position, they took the view that foreign capital, in particular, foreign aid was a substitute and not a complement to domestic savings.

The existing differences vary from several factors mentioned previously. First, there is a disagreement on the definition of foreign capital or foreign aid. Almost all studies use the different components of foreign capital as independent variables to measure the effectiveness of foreign aid.

Second, most studies consist of a cross-sectional analysis over a number of countries. The number of countries in these studies vary from seven to ninety one. Some of the researchers attempt to overcome the

statistical problems of studying a limited number of countries by using data at different time points. The most common problem with cross-sectional study is the instability of either dependent or independent variables. If the year (or few years) chosen prove to be unusual, then the obtained results will be inaccurate or will not reflect the true characteristics of the sought after relationships. Differences in size and economic structure of the LDC's, and the scale of the economic key variables may also exhibit high variability, and therefore the danger of heteroscedasticity¹ can be present.

Third, some of the studies use stock measures while others use flow variables. Measures employing flows look at inflows of foreign aid or capital on current account, while those which employ stocks try to measure the total amount of accumulated foreign aid in a country. Then, flow measures are the value of new foreign aid coming into a country within a limited time period, while stock measures describe the accumulated amount that exists in a country.

It is argued that current flows of foreign capital and aid have a positive short-run effect on growth whereas stocks of foreign investment and aid have had the cumulative, long term effect of decreasing the relative rate of economic growth of countries.

There is a variety of evidence in the studies to support such a proposition. Stoneman(1975) uses both stock and flow measures in the same analysis; he finds that the flow measures are consistently positive while the stock measures are consistently negative. Bornschier, Chase-Dunn, and Rubinson (1978) stated that these results in the studies of the effects of foreign investment and aid on economic growth tend to confirm the hypothesis that current inflows of foreign aid cause short term increases in growth due to the contribution to capital formation available in a country and demand, while the long-run structural distortions of the national economy and high stock of foreign investment means that a large portion of the resources and productive capacity of a country is controlled

¹ Heteroscedasticity refers to the case in which the variance of the error term is not constant for all values of the independent variable. This problem occurs primarily in cross-sectional data rather than time-series data and leads to unbiased but inefficient estimators of the parameters. For heteroscedasticity, see Haines, B., (1978), p.87-88 and 102. For more information, see Gujarati, D., (1978), Chapter: 10, P.193-218.

by foreign corporations, and the exporting of profits tend to produce negative effects over time.

Recent studies on the effects of stocks and flows, and direction of effects are shown in Table I. Seven of the eleven studies which employ measure of stocks, find negative effects on growth. Four of the six studies which employ the measure of flows, find positive effects. This pattern of findings is the same for the effects of both foreign investment and aid. The finding of Griffin and Enos (1970) for foreign aid and of Stevenson (1972) for foreign investment are the only studies of flows which do not fit this pattern.

Table I : Studies of the Effects of Foreign Aid and Investment on Economic Growth by Type of Measurements and Direction of Effects.

MEASUREMENT OF FOREIGN INV. AND AID	DIRECTION OF EFFECTS	
	<u>POSITIVE</u>	<u>NEGATIVE</u>
STOCKS	Kaufman et al. McGowan and Smith Ray and Webster Szymanski	Alschuler Bornschie(1975) Bornschie and Ballmer-Cao Chase-Dunn(1975a) Evans Rubinson(1977) Stoneman Gobalet, Diamond(1979)
FLOWS	Kaufman et al. Papenek(1973) Ray and Webster Stoneman Jackman(1982) Dolan and Tomlin(1980)	Griffin and Enos Stevenson

Source: V. Bornschie, C. Chase-Dunn and R. Rubinson, (1978).

Most of these studies did not use time lagged analysis. Rothgeb (1984), through the usage of time lags of 5, 10, and 15 years, showed that total stocks were negatively related to overall growth in the long-run. Stocks reflect investments made over a long period of time and thus are responsive to long term trends in government attitudes towards foreign investment and aid, whereas the flow of investment or aid over a period is likely to be responsive to changes in the current attitude rather than the longer term policy of the government.

Stoneman (1975) found that the flow of foreign investment and aid had a positive effect on growth while the impact of the stock was negative. He proposed reducing the stock in order to grow faster. But as Gupta (1983) pointed out, a country cannot reduce the stock without reducing its flow.

III: Single and Multi Equations:

The role of foreign aid as an instrument of economic development has remained controversial and is fraught with disagreements in the last three decades. That is why its various dimensions, particularly its association with savings and growth has come under intensive scrutiny. On the one side there are the proponents of conventional wisdom who argued that foreign aid has indeed helped to promote growth and structural transformation in many developing countries. In the 1960's, Rosenstein-Rodan (1961), Chenery and Strout (1966) considered foreign aid purely as an exogenous net increment for developing countries' capital stocks. On this approach a developing country, growing at a rate of " $g=s/v$ " where " s " is marginal propensity to save and " v " is incremental capital-output ratio, would experience an increase in its growth rate from " s/v " to " $s+a/v$ " as a result of being given an amount of foreign aid whose value (as a fraction of GNP) was " a ".

On the other side, some other economists in the 1970's (Griffin (1970), Griffin and Enos (1970), Weisskopf (1972a)) have argued that foreign aid does not promote faster growth, but also may in fact retard it by substituting for, rather than supplementing domestic saving and investment. They emphasized that much aid did not act as an increment to the capital stock, but was used for consumption purposes, and that, in addition, much aid might have the effect of raising the capital-output ratio.

Griffin (1970) contends that foreign capital inflows represent a transfer of resources or purchasing power from one nation to another and therefore, increases the possible magnitude of domestic resources. However, how these additional resources will be utilised cannot be determined. There is every likelihood that some fraction of these additional resources might be diverted towards consumption. Griffin (1970) argued that the possibility of diverting foreign aid towards

consumption can be demonstrated with the help of a plausible utility function balancing immediate benefits derived from the current consumption and future benefits to be derived from investment. He demonstrated that in theory one ought to expect foreign capital inflows to reduce domestic savings. He studied a cross-section analysis of 32 developing countries and showed that there is a negative relationship between foreign savings (Capital) and domestic savings. His estimated statistical relationship is;

$$S/Y = 11.2 - 0.73A/Y; R^2 = 0.54$$

where S/Y is gross domestic savings as a per cent of GDP, and A/Y is foreign savings as a per cent of GDP².

Griffin and Enos (1970) tested their hypothesis that there may be an inverse relationship between foreign aid and growth, using the data from Latin America over the years 1957-64 for the twelve countries. They found that it is inversely related to the ratio of foreign aid to GNP. Their regression equation is,

$$\dot{Y}/Y = 42.97 - 6.78A/Y; R^2 = 0.13;$$

where \dot{Y}/Y is average rate of growth of GNP, A/Y is ratio of foreign aid to GNP.

Papenek (1973), and Gubta and Islam (1983) found that foreign aid and foreign private investment has a negative effect on savings but a positive effect on GDP. Papenek used a single equation regression model which is different from that of Griffin and Enos (1970) in terms of explanatory variables included and numbers of observation used for estimation. He has suggested growth rates on savings and foreign capital inflows disaggregated into foreign aid, foreign private investment and other foreign inflows. The equation is below,

$$g = a_1 + b_1 y + c_1 N + d_1 s + e_1 A + f_1 I + g_1 OFI + u,$$

where; g = Growth rate, y = Per capita real income, N = Population, s = Saving rate, A = Foreign aid, I = Foreign private investment, OFI = Other foreign inflows.

² See, Griffin, K.B. (1970), p.105.

Papenek's (1973) study provided some quantitative evidence on the relationships between savings, foreign resource inflows and growth in less developed countries by using cross-country analysis. He reached the conclusion that savings and the components of foreign inflows (aid, private investment, and other inflows) explain over a third of growth rate and foreign aid, which goes disproportionately to countries with low saving rates, and serious balance of payments problems has a more significant effect on growth than savings. He also pointed out that the correlation between aid and the other forms of inflows is not high, and the coefficients for savings, aid, foreign private investment and other inflows are substantially higher and really significant especially in the Asian and Mediterranean countries.

Mosley (1980) questioned the validity of OLS estimation of parameters used by Papenek (1972, 1973), Over (1975) and others. Firstly, Mosley's objection is that these studies invariably assume an instantaneous effect of foreign aid on growth of income, and thereby rules out the existence of "lag structure relating the independent variables (foreign inflows) and dependent variables (indices of development)" (Mosley, 1980, p.79). According to Mosley (1980), OLS technique, which is used by Papenek and others in the single equation model, is inappropriate if the right hand side of the equation contains endogenous variables, instead of being extraneously determined, as he believes that political and strategic benefits ensure that foreign aid is allocated among countries on the basis of their needs. To be more specific, foreign aid is related to and is influenced by the recipient countries' income level. The hypothesis is that foreign aid influences growth of income and in conjunction with the above proposition make both income and foreign aid interdependent. Such an interdependence entails the use of Two Stage Least Squares (TSLS) as an appropriate estimation technique as the use of OLS is likely to bring forth biased estimation of parameters.

The equations Mosley (1980) has estimated contain all the explanatory variables used by Papenek plus "aid lagged five years" as explanatory variables. Using the TSLS method the two significant results which he has obtained suggest that aid lagged five years is positively related with growth in the case of 35 poor countries, and that UK donated aid, particularly to poor African countries, showed significant positive

contributions to growth. Thus he concludes that "the positive and significant relationship between growth and aid noted by Papenek in the 1960's appears to have collapsed as applied to the less developed countries as a whole" (Mosley, 1980, p.90), but the relationship between foreign aid and growth is still positive for the poorest countries³.

One of the several attempts at measuring the impact of both domestic and foreign resources on the actual growth performance of the developing countries has been made by Gupta (1975) and Gupta and Islam (1983). He pointed out that the above studies only allowed for the direct effects of foreign capital inflows on growth, and did not properly specify the indirect effects through savings. Therefore he tried to specify and estimate a model which allows for both the direct and the indirect effects of dependency rates and foreign capital inflows on savings rates.

Gupta and Islam (1983) involved demographic factors in the form of dependency rates in their model to partly explain the lower saving rate of the LDC's, and used a simultaneous equation model. They treated the components of foreign capital (Foreign aid, foreign private investment and other foreign inflows) as an exogenous variable and both the growth of GNP and savings as endogenous variables. They have found that the domestic savings as well as foreign capital make a positive contribution to growth, and they reached the point that foreign capital has some positive role to play and that foreign capital will still continue to play a crucial role in the relations between the developed and developing countries in the near future. Using the single equation estimates in their model, it can be seen clearly that foreign aid is more productive than private investment, and in most cases the coefficient of foreign private investment is not significant. Thus, on the basis of strong evidence in favour of foreign aid against foreign private investment from single equation results, foreign aid seems to be more useful than foreign private investment.

According to Mosley, Hudson and Horrell (1987), multiple linear regression equation which relates growth in the recipient country as an independent variable, to a cluster of possible casual influences, including aid as independent variables, is a simple model which implies that aid has

³ See, Mosley, P., (1980), p.90.

some kind of leverage on growth. Thus they considered the apparent effectiveness of foreign aid in the light of a model which decomposes the impact of foreign aid into three different component parts. These are "the direct effects of the aid disbursement", "indirect effects on the spending pattern of the public sector of the recipient country", and lastly the effect of foreign aid on the prices of some goods, which "raises the prices of some goods, depresses the price of some others and hence has side effects on the private sector of the recipient economy through the price system" (Mosley, Hudson and Horrell, 1987, p.616-617).

It has been argued particularly by Papenek (1972), that not only is the economic performance of a country influenced by aid inflows, but inflows are also influenced by economic performance, and in particular are stimulated by balance of payment crises and natural disasters in recipient countries. Whereas these crises are not necessarily correlated in any way with the growth of GNP, the possibility of simultaneous causation obviously exists. Therefore, Mosley, Hudson, and Horrell (1987) consider this simultaneity problem, and they used a simultaneous equations system to overcome this matter. In their model, foreign aid is expressed as a function of various indicators of recipient need, including growth of GNP, the level of per capita GNP, and overall mortality as a measure of welfare. In addition, the member countries of the Arab League and OPEC were included as dummy variables to account for a number of the cases of abnormal foreign aid flows during the 1970s. Mortality is taken itself as an endogenous variable, and therefore the system consists of the following three relationships:

"Growth = f (foreign aid, other financial flows, savings, growth of literacy rate, growth of export.)

Foreign aid = F (Per capita GNP at the beginning of period, mortality at the beginning of period, growth rate of GNP, OPEC and Arab league dummies.)

Change in Mortality = f (foreign aid, per capita GNP at beginning of the period, growth rate of GNP") (Mosley, Hudson and Horrell, 1987, p.632).

IV: The Model:

In this study a simultaneous equations model was developed to assess both direct and indirect effects of foreign aid on the economic development of Turkey. The impact of foreign inflows and particularly foreign aid on a Keynesian multi equation demand system were traced through the consumers' expenditure, investment, government expenditure, exports and imports.

IV.1: The System of Simultaneous Equations.

The structural model we used consists of five equations: Each has an independent meaning and identifies a behavioural relationship in the system. All the equations in this model are expressed in linear form-both in variables and parameters. The equations contained in the model are stochastic in nature, because each equation has an error term e , in addition to the explanatory variables, to account for omitted variables and other factors affecting the relationships.

In this paper, foreign aid inflows were evaluated in terms of foreign capital together with foreign direct investment, travel and tourism flows, and other foreign capital. Furthermore, foreign aid was appraised in two groups: 1) Net official foreign aid and; 2) Military aid. Travel and tourism flows are also investigated as a net travel and tourism revenue by taking differences between travel and tourism inflows and travel and tourism outflows. Travel and tourism inflows refer to foreign exchange earnings from international visitors and travel and tourism outflows are the monetary loss occurred by the travelling abroad of Turkish residents.

Foreign direct investment figures do not show the repatriation of profits by foreign firms, since data for such profit transfers are not available. In this study, the flows of foreign direct investment were used. However, the flows of foreign direct investment have been very low in comparison with foreign aid.

In this study, we have first tried to regress the changes in the left hand side variables divided by national income (Y_t) on the changes in all the right hand side variables divided by national income (Y_t). Foreign capital inflow (Foreign aid, Other foreign Inflows, etc.) variables enter as

they are, rather than as $FA_t - FA_{t-1}$. For example, Consumers' expenditure in this approach is as follows;

$$(C_t - C_{t-1})/Y_t = a_0 + a_1(Y_t - Y_{t-1})/Y_t + a_2(C_{t-1} - C_{t-2})/Y_t + a_3 FA_t/Y_t + a_4 OFI_t/Y_t.$$

This consumption function had to link changes in consumers' expenditure (deflated by Y_t) to foreign aid. However, this did not work and we finally reverted the equation system to the following:

IV.2: Equations:

$$C_t = a_0 + a_1 Y_t + a_2 C_{t-1} + a_3 FA_t + a_6 OFI_{t-1} + a_7 OP_t + U_1$$

$$I_t = b_0 + b_1 Y_t + b_2 Y_{t-1} + b_3 FA_t + b_5 FI_t + b_6 OFI_t + (TI_t - TO_t) + u_2$$

$$GEX_t = c_0 + c_1 Y_t + c_2 M_t + c_3 FA_t + c_4 OFI_t + c_5 MA_t + u_3$$

$$X_t = d_0 + d_1 RY_t + d_2 ER_t + d_3 FA_t + d_4 OFI_t + d_5 (TI_t - TO_t) + u_4$$

$$M_t = e_0 + e_1 Y_t + e_2 ER_t + e_3 FA_t + e_4 OFI_t + e_5 C_t + e_6 OP_t + u_5$$

together with the identity:

$$Y_t = C_t + I_t + GEX_t + (X_t - M_t)$$

Below is the list of variables:

Endogenous Variables:

C_t = Consumers expenditure

I_t = Gross Domestic Investment

GEX_t = Government expenditure

X_t = Exports

M_t = Imports

Exogenous Variables:

Y_t = National Income

Y_{t-1} = National Income 1 Year Lagged

OFI_t = Other Foreign Inflows

FI_t = Foreign Investment

FA_t = Foreign Aid

MA_t = Military Aid

$(TI_t - TO_t)$ = Travel and Tourism Flows

TO = Travel and Tourism Outflows

ER_t = Effective Foreign Exchange Rate

OP_t = Oil Price

C_{t-1} = Consumption 1 Year Lagged

RY_t = OECD Output

Let us consider the equations one by one:

IV.2.1: Consumers' Expenditure Equation:

$$C_t = a_0 + a_1 Y_t + a_2 C_{t-1} + a_3 FA_t + a_6 OFI_{t-1} + a_7 OP_t + U_1$$

In this first equation, consumers' expenditure is a function of consumption habits in the past, national income, foreign aid inflows and other foreign inflows. This is a standard consumption function. C_{t-1} represents the impact of lagged consumption, alternatively it is proxying permanent income (as in Friedman's permanent income hypothesis). Its inclusion means that a change in any of the right hand side variables will have short and long run impacts. For example a change in Y_t of one unit will increase consumption by a_1 immediately. In the longer term, the full impact will be $a_1 / (1 - a_2)$ (i.e. divide the coefficient by 1 minus the coefficient on the lagged dependent variable). Foreign capital inflow variables are there to capture any positive direct effects of foreign aid and other foreign inflows on consumers' expenditure, (i.e. any negative impact on savings). Expectations are that $a_1 > 0$, $a_2 > 0$, $a_3 < 0$, $a_4 < 0$ and the remaining signs can be either positive or negative. If $a_3 > 0$ and significant, then foreign aid is increasing consumers' expenditure which is equivalent to it reducing savings.

IV.2.2: Investment Equation:

$$I_t = b_0 + b_1 Y_t + b_2 Y_{t-1} + b_3 FA_t + b_5 FI_t + b_6 OFI_t + (TI_t - TO_t) + u_2$$

In this second equation, investments are determined by the national income and the foreign capital inflows, foreign aid, foreign investment,

other foreign inflows. In this linear form of investment function, investment is a function of foreign capital inflows as an external income as well as national income, as proposed in Haavelmo's hypothesis. It is generally accepted that investment is to be determined by the availability of funds to investors. In investment equation, b_1 is the marginal propensity to invest, as the ratio of a change in investment to a change in national income. The marginal propensity to invest implies that some portion of any increased income will be directed toward investment expenditure. The inclusion of Y_t and Y_{t-1} in investment equation is equivalent to the accelerator model of investment. Accelerator theory of investment links systematic fluctuations in national income to systematic fluctuations in investment expenditure. Foreign capital inflows, (foreign aid, foreign direct investment and other foreign inflows) represent the external income and there to capture any direct effects of foreign inflows on investment expenditure. Expectations are that $b_1 > 0$, $b_2 < 0$ and remaining signs of foreign inflows are expected to be positive.

IV.2.3: Government Expenditure Equation:

$$GEX_t = c_0 + c_1 Y_t + c_2 M_t + c_3 FA_t + c_4 OFI_t + c_5 MA_t + u_3$$

In this equation, government expenditure is regressed on national income, imports, foreign aid, other foreign inflows and military aid. This is a standard government expenditure function, and government expenditure is a function of governments' revenues. National income (Y_t) is there, representing tax revenue which feeds through to government expenditure. Imports (M_t) is there, as typically developing countries' governments receive considerable income from import duties. Foreign aid (FA_t) and Military aid (MA_t) are there to capture any direct effects of aid on government expenditure, since aid refers to transfer of resources from governments or public institutions of developed countries to governments in developing countries, and they are able to shift the foreign aid funds designated for projects or programmes to their current non-productive expenditure. This is known as fungibility of aid. If $c_3 > 0$ and significant, then there is evidence for fungibility of aid. In other words, a significant positive coefficient of the foreign aid variable indicates a diversion of development aid to recurrent government expenditure, and a change in FA_t of one unit will increase government expenditure by c_3 directly. Similar argument is also valid for military aid

(MA_t). Expectations are that $c_1 > 0$, $c_2 > 0$ and the remaining signs can be either positive or negative.

IV.2.4: Exports Equation:

$$X_t = d_0 + d_1 RY_t + d_2 ER_t + d_3 FA_t + d_4 OFI_t + d_5 (TI_t - TO_t) + u_4$$

In the fourth equation, export earnings are regressed on the total output of OECD countries, foreign exchange rate and foreign capital inflows -being foreign aid, other foreign inflows, tourism flows. In this equation, exports earnings are a function of foreign exchange rate and the demand for Turkey's exports. RY_t stands for total output of OECD countries as a measure of demand for Turkey's exports. ER_t is effective exchange rate. One of the main purposes of foreign aid has been the promotion of a viable export sector, therefore foreign aid and other foreign inflows variables are there to capture any positive direct effects of external inflows on exports. Expectations are positive for all coefficients of variables.

IV.2.5: Imports Equation:

$$M_t = e_0 + e_1 Y_t + e_2 ER_t + e_3 FA_t + e_4 OFI_t + e_5 C_t + e_6 OP_t + u_5$$

In this equation, imports of Turkey are regressed on national income, foreign exchange rate, foreign aid, other foreign inflows, consumption and oil prices. More generally, imports is a function of national income. e_1 is the marginal propensity to imports and simply say that the fraction of national income goes to expenditures on imports. Foreign aid and other foreign inflows are external resources which provide additional foreign exchange to finance imports. Also one of the motives of foreign aid for donors is commercial, and tied aid by source has to be spent on the purchase of donor country's goods and services, which means that foreign aid affects imports of recipient country. Oil prices are thought to be positively associated with imports, because Turkey produces almost no oil and has to import from abroad. All coefficients are expected to be positive except Coefficient of exchange rate ($e_2 < 0$).

As addition to the structure of the model above, we simply construct a second aid variable equal to $FA_{t-1} + FA_{t-2}$ and it is included in the regressions along with FA_t whenever aid (FA_t) appears in an equation, in order to represent the longer term impact of foreign aid. The inclusion of this second aid variable enables us to see the differences between the immediate impact of aid and long term impact.

All the equations in this model are expressed in linear form, both in variables and parameters. Each equation has an independent meaning and identifies a behavioural relationship in the system. In this model, we are not estimating national income (Y_t) directly, but indirectly through its components.

V: The Estimates of the Simultaneous Equations Model:

The simultaneous equations model specified in the previous section was estimated for 28 years between 1963 and 1990. Estimates were obtained by using both the Two Stage Least Squares (2SLS) and the Three Stage Least Squares (3SLS) methods. However, we found that there are slight differences on the basis of usual statistical criteria; the differences are only on the basis of quantitative criteria. Therefore, here we report only 3SLS results which is given in Table II.

Table II. :The Summary of Simultaneous Equation Model: 3SLS Estimates

$C_t = -5.2087 + 0.570 Y_t + 0.263 C_{t-1} - 0.0055 FA_t - 0.0013 FA2_t$ <p>(-1.397) (5.403) (1.752) (-3.0693) (-1.1706)</p> $- 0.002 OFI_t + 0.0274 OP_t$ <p>(-2.865) (1.4292)</p>	$(R^2 = 0.99)$ $(DW=2.24)$
$I_t = -6.512 + 0.765 Y_t - 0.578 Y_{t-1} + 0.0055 FA_t + 0.0021 FA2_t$ <p>(-1.559) (3.098) (-2.260) (2.948) (0.777)</p> $0.001 OFI_t + 0.015 FI_t - 0.006 (TI_t - TO_t)$ <p>(2.027) (0.902) (-1.150)</p>	$(R^2 = 0.97)$ $(DW=1.64)$
$G_t = 0.291 + 0.233 Y_t + 0.0022 M_t - 0.0015 FA_t - 0.0021 FA2_t$ <p>(0.039) (4.091) (1.815) (-0.833) (-1.867)</p> $- 0.0012 OFI_t - 0.027 MA_t.$ <p>(-0.909) (-1.916)</p>	$(R^2 = 0.94)$ $(DW=1.23)$
$X_t = -1.754 + 0.854 RY_t + 0.228 ER_t + 1.213 FA_t + 0.550 FA2_t$ <p>(-0.208) (0.548) (2.002) (3.277) (1.774)</p> $+ 0.365 OFI_t - 0.764 (TI_t - TO_t).$ <p>(2.254) (-0.476)</p>	$(R^2 = 0.90)$ $(DW=1.22)$
$M_t = -17.949 + 0.370 Y_t + 0.335 ER_t + 0.279 FA_t - 0.557 FA2_t$ <p>(-2.603) (0.939) (6.855) (1.761) (-2.193)</p> $+ 0.510 OFI_t + 0.200 C_t + 21.868 OP_t.$ <p>(4.544) (1.763) (4.670)</p>	$(R^2 = 0.98)$ $(DW=1.80)$

In table II, the t-values are given in parentheses. DW stands for the Durbin-Watson statistic. $FA2_t$ represents the foreign aid of the previous period for the sake of detecting long term impact.

VI: Discussion of Estimates:

In this section, we examine the results of each equation that take place in Table II separately.

VI.1: Consumers' Expenditure:

The consumers' expenditure equation shows that the direction of the effect of foreign aid on consumers' expenditure is negative as other foreign capital components. However, we are, here, talking about the direct effects of variables, and we see that all types of foreign capital inflows have a negative direct effect on consumers' expenditure. The national income has a positive effect on consumers' expenditure together with lagged consumption as expected.

As can be seen from the consumers' expenditure equation, the coefficient of national income (0.570) represents the marginal response of consumers' expenditure to a unit change in the level of national income. In other words, one percent increase in national income (Y_t) will increase consumers' expenditure by 0.570 percent immediately. The inclusion of lagged consumption variable enables us to capture long term impact. Thus, in the longer term, full impact of income (Y_t) will be 0.773. Current foreign aid inflows has a significant negative direct effect on consumers' expenditure, while second foreign aid has also negative but insignificant effect. A change in FA_t of one unit will decrease consumers' expenditure by 0.0055 immediately. In the longer term, full impact will be -0.0075. The other foreign inflows have a significant negative direct effect on consumers' expenditure and a one percent increase in other foreign inflows will cause the consumers' expenditure to decrease by 0.002 percent in the short term and by 0.0027 in the long term.

The negative direct effects of foreign aid and other foreign inflows on consumers' expenditure imply that there is a positive impact on savings. This result supports the view of Rosentein-Rodan (1961), Chenery and Strout (1966) and others, that foreign capital inflows, especially foreign aid supplements the domestic savings (not substitute) of developing countries and make contribution to the economic development. The channel of this effect comes from Harrod-Domar economic development model and foreign aid inflows were expected to have positive effects on savings, since aid inflows would cause an

increase in investment and this would generate a subsequent increase in income, and thus in turn raise domestic savings. In other words, our result does not support the argument of Griffin and Enos (1970), Weisskopf (1972) and others, that foreign aid was substitute, not a complement to domestic savings, and a large fraction of aid is used to increase consumption rather than investment.

When we look at the statistical significance of variable on consumers' expenditure, we see that current foreign aid and other foreign inflows have almost the same effect in qualitative terms while they differ in quantitative terms. All variables have expected sign with the exception of the oil prices which is insignificant from zero. The coefficients of income, foreign aid, other foreign inflows are significant at the 5 percent level, while the coefficient of lagged consumption is significant at 10 percent level. Second aid variable and oil prices are insignificant from zero at 10 percent level.

The problem of autocorrelation is common in time series analysis and leads to downward-biased standard errors, thus to incorrect statistical test. Autocorrelation refers to case in which the error term in one time period is correlated with the error term in any other time period. The presence of autocorrelation is tested by the Durbin-Watson statistic. In consumers' expenditure equation, the DW statistic is close to 2 and indicates that the test shows no autocorrelation at the 1 percent probability level and is inconclusive at the 5 percent probability level. It should be noted here that when the lagged dependent variable appears as an explanatory variable in the regression, the DW statistic is biased toward 2. The value of the R^2 is quite high and indicates that this equation can explain 99 percent of total variations in consumers' expenditure over the period 1963-90 in Turkey. Hence, all explanatory variables make a significant and necessary contribution to explaining the dependent variable consumers' expenditure.

VI.2: Investment Equation:

The impact of foreign aid inflows on the investment is assessed by this investment equation which allows for the accelerator model of investment. Investment is regressed on national income, one year lagged income and the components of foreign capital inflows. The result of the

investment equation shows that all the estimated coefficients in the equation satisfy the expectation of sign with the exception of $(TI_t - TO_t)$ which is insignificant from zero. There is a positive and significant correlation between national income and investment while lagged income has negative significant effect on investment as expected. The current foreign aid and other foreign inflows has positive significant impact, but foreign direct investment and the second foreign aid variable (for long term impact) shows insignificant impact although they have the expected sign.

As can be seen from the investment equation, the coefficient of national income (0.765), which is the marginal propensity to invest, represents the marginal response of investment to a unit change in the level of national income. In other words, one percent increase in national income (Y_t) will increase investment by 0.765 percent immediately. However, marginal response of investment to a unit change in the level of the previous year income is negative and one percent increase in lagged income will lead to a decrease of 0.578 percent in investment. The current inflows of foreign aid has a significant positive direct effect on investment, while second foreign aid has also positive but insignificant effect. A change in FA, of one unit will increase the investment by 0.0055 immediately. In the longer term, foreign aid will have no impact on investment. The other foreign inflows have a significant positive direct effect on investment and a one percent increase in other foreign inflows will cause the investment to increase by 0.001 percent immediately. Foreign direct investment and net travel and tourism revenue have no significant impact on investment.

The investment equation shows that foreign aid and other foreign inflows make a significant contribution to domestic investment in Turkey in the short-run. Positive direct effects of foreign aid and other foreign inflows on investment imply that these inflows make net additions to investable resources of Turkey. This result supports the view of Rosentein-Rodan (1961), Chenery and Strout (1966), that they considered foreign capital inflows, especially foreign aid purely as an exogenous net increment for developing countries' capital stocks. On this approach a developing country, growing at a rate of " $g=s/v$ " where s is marginal propensity to save and v is incremental capital-output ratio would experience an increase in its growth rate from " s/v " to " $s+a/v$ " as a result

of having been given an amount of foreign aid whose value was "a". In other words, our result does not support the argument of Griffin and Enos (1970), Weisskopf (1972) and others, that foreign aid was substitute, not a complement to domestic savings, and a large fraction of aid is used to increase consumption rather than investment. Our result is also in parallel with results of Gupta and Islam (1983) in magnitude and direction of foreign capital inflows. It can be seen clearly that foreign aid is more productive than other foreign inflows and foreign direct investment, thus it can be said that foreign aid inflows, among the other foreign resources, is more productive for investment in Turkey.

When we look at the statistical significance of all foreign capital inflows variable on investment, we observe that different components of foreign capital inflows have different effects both in qualitative terms and in quantitative terms. All variables have expected signs with the exception of the travel and tourism flows which is insignificant from zero. The coefficients of income, lagged income, foreign aid and other foreign inflows are significant at the 5 percent level while the coefficient of foreign direct investment, the travel and tourism flow and second aid variable are insignificant from zero at 10 percent level.

In investment expenditure equation, the DW statistic indicates that the test shows no autocorrelation at the 1 percent probability level and is inconclusive at the 5 percent probability level. The value of the R^2 is quite high and indicates that this equation can explain 97 percent of total variations in investment over the period 1963-90 in Turkey. Hence, all explanatory variables make a significant and necessary contribution upon explaining the dependent variable investment.

VI.3: Government Expenditure Equation:

In this equation, government expenditure is regressed on national income, imports, foreign aid, other foreign inflows and military aid. This is a standard government expenditure function and government expenditure is a function of government's revenues. The result of the government expenditure equation shows that all the estimated coefficients in the equation satisfy the expectation of sign. National income (Y_t) is there, representing tax revenue which feeds through to government expenditure, and Imports M_t is there as typically developing countries' governments receive considerable income from import duties.

As can be seen from the coefficients of Y_t and M_t , there is a positive and significant correlation between government revenues and government expenditure as expected.

Foreign aid (FA_t) and Military aid (MA_t) are there, to capture any direct effects of aid on government expenditure, since aid refers to transfer of resources from governments or public institutions of developed countries to governments in developing countries, and they are able to shift the foreign aid funds designated for projects or programmes to their current non-productive expenditure. This is known as fungibility of aid. However, current inflows of foreign aid and other foreign inflows have no positive impact on government expenditure, while foreign aid inflows in the long term and military aid have negative significant impact on government expenditure. Thus, there is no evidence for fungibility of aid. In other words, a negative coefficient of the foreign aid variables indicate no diversion of development aid to recurrent government expenditure.

As can be seen from the government expenditure equation, the coefficient of national income (0.233) represents the marginal response of government expenditure to a unit change in the level of national income. In other words, one percent increase in national income (Y_t) will increase government expenditure by 0.233 percent. Marginal response of government expenditure to a unit change in the imports is also positive and one percent increase in imports will lead to an increase of 0.0022 percent in government expenditure. The current inflows of foreign aid does not show any significant direct impact on government expenditure, while second foreign aid has significant negative effect in the longer term. A change in previous year foreign aid ($FA_{2,t}$) of one unit will decrease government expenditure by 0.0021. This negative effect could be partly because of relaxation on tax effort and partly because of foreign debt repayment since the large portion of foreign aid comes in by credits rather than grants and it is to be paid. These repayments reduce the government income to be spent. The military aid has also a significant negative direct effect on government expenditure and a one percent increase in military aid will cause the government expenditure to decrease by 0.027 percent. Other foreign inflows has no significant impact on government expenditure.

Our result on current foreign aid and other foreign inflows are insignificant at the 10 percent level. This implies that current foreign aid and other foreign inflows do not have any statistically significant effect on government expenditure. On the other hand, domestic resources are used to finance such consumption. Thus, it may be true that foreign resources, foreign aid, other foreign inflows, etc., are used to finance development projects and not used for recurrent budget. The proposition indicated by Mosley (1980) and Mosley, Hudson and Horrel (1987) that in some countries reluctance to raise taxes, or to collect the taxes that are due, forces governments of these countries to drain some overseas aid into the recurrent budget, is not valid for Turkey. This is not in contrast with the findings of H. Pack and J.R. Pack (1990) that they found no diversion from development purposes to current expenditure but they found positive and significant impact of aid on the categories of development expenditures. These results also support the findings of Gang and Khan (1991).

When we look at the statistical significance of all foreign capital inflows variable on government expenditure, we observe that different components of foreign capital inflows have different effects both in qualitative terms and in quantitative terms. All variables have expected signs. The coefficients of income is significant at the 5 percent level, while imports, second foreign aid and military aid are significant at the 10 percent level but the coefficient of current foreign aid and other foreign inflows are insignificant from zero at 10 percent level.

In government expenditure equation, the DW statistic indicates that the test is inconclusive at the 5 percent probability level and it is just at the edge of lower border. The value of the R^2 is high and indicates that this equation can explain 94 percent of total variations in government expenditure over the period 1963-90 in Turkey. Hence, all explanatory variables make a significant and necessary contribution to explain the dependent variable investment.

VI.4: Exports Equation:

In exports equation, real export earnings are regressed on the income of OECD countries, effective foreign exchange rate and foreign capital inflows: foreign aid, other foreign inflows, and the travel and

tourism flows. The result of the exports equation shows that all the estimated coefficients in the equation satisfy the expectation from signs with the exception of $(TI_t - TO_t)$ which is insignificant from zero. The foreign exchange rate has a positive and significant direct effect on export earnings as expected while foreign demand for exports shows no impact. There is a positive and significant correlation between the all foreign capital inflows and exports, except $(TI_t - TO_t)$ which is insignificant and has a wrong sign. Foreign aid has positive and significant impact on exports both in short term and in long term. The other foreign inflows have also positive and significant direct effect on exports.

As can be seen from the exports/ equation, the coefficient of effective foreign exchange rate (0.228) represents the marginal response of exports to a unit change in the foreign exchange rate. In other words, one percent increase in foreign exchange rate (ER_t) (Devaluation) will increase export earnings by 0.228 percent. Exports are the most important source of foreign exchange earnings, and Turkey has started looking at exports as a major source of income after a long battle against foreign exchange bottle-necks. The reforms of government in 1980 changed the traditional Turkish trade policy of import substitution with that of export-oriented growth and as part of this new foreign trade policy, government started to the daily adjustment of foreign exchange rate to stimulate the exports of Turkey. Our finding proved that foreign exchange rate policy is used to increase of exports earnings.

Marginal response of Turkish exports to a unit change in foreign aid is positive, and one percent increase in foreign aid will lead to an increase of 1.213 percent in exports in short term. Foreign aid has also a significant positive direct effect in the long term and an increase in previous year's foreign aid ($FA_{2,t}$) of one unit will increase exports by 0.550 and full impact of foreign aid on exports will be 1.763 unit. The other foreign inflows has also a significant positive direct effect on exports and a one percent increase in other foreign inflows will cause the export earnings to increase by 0.365 percent .

As can be seen from the exports equation, devaluation of the Turkish currency is positively associated with exports. Devaluation makes Turkish goods and services less expensive in terms of other currencies, and this increases the foreign exchange earnings from exports.

It is also very clear that foreign aid both in current and in long term, and foreign other inflows have significant positive impact on exports of Turkey. This implies that foreign capital inflows, particularly foreign aid is used for developmental purposes and does not go to consumption which is also proved by consumers' expenditure equation. Foreign aid makes positive contribution to national income by increasing the capital formation, and this creates an important base for Turkish exports.

When we look at the statistical significance of all foreign capital inflows variable on export earnings, we observe that different components of foreign capital inflows have different effects both in qualitative terms and in quantitative terms. All variables have expected signs. The coefficients of foreign exchange rate, foreign aid and other foreign inflows are significant at the 5 percent level while second foreign aid variable is significant at the 10 percent level. The coefficient of OECD income and the travel and tourism flows are insignificant from zero at 10 percent level.

In exports equation, the DW statistic indicates that the test is inconclusive at the 5 percent probability level and close to the lower border. The value of the R^2 is considerably high and indicates that this equation can explain 90 percent of total variations in export earnings over the period 1963-90 in Turkey. Hence, all explanatory variables make a significant and necessary contribution in explaining the dependent variable investment.

VI.5: Imports Equation:

In import equation, the imports of Turkey are regressed for national income, foreign exchange rate, foreign aid, other foreign inflows and oil prices. The result of the imports equation shows that all the estimated coefficients in the equation satisfy the expectation of sign with the exception of foreign exchange rate. The foreign exchange rate has a positive and significant direct effect on imports although it is expected to have a negative effect on imports. It could be because of the composition of Turkey's imports. A large portion of Turkish imports are intermediate goods, and investment goods and only a small portion of imports (about 5 percent) are consumption goods. Turkey has to import necessary raw or intermediate goods and services such as oil, and investment goods

without looking at their prices. Thus, despite devaluation making imported goods and services more expensive, it raises the cost of imports.

There is a positive but significant correlation between foreign aid and imports in the short term, despite the fact that it has a significant negative impact in the long term. The results of import equation also indicate that other foreign inflows, consumption and oil prices have significant positive effects on imports.

As can be seen from the imports equation, marginal response of Turkish imports to a unit change in exchange rate is positive, and one percent increase in exchange rate will lead to an increase of 0.335 percent in imports.

The coefficient of foreign aid /on imports is positive and significant in current terms, although it has negative and significant effect in long term and an increase in foreign aid of one unit will increase imports by 0.279 immediately and decrease by 0.557 in the long term. This negative long term effect of foreign aid could be because of repayment, since the most of foreign aid comes in the form of concessional credit and it must be paid back. This repayment leads to a decrease in sum of foreign exchange available for imports of goods and services. The other foreign inflows have also a significant positive direct effect on imports. The coefficient of other foreign inflows represents the marginal response of Turkish imports to a unit change in the level of other foreign inflows and a one percent increase in other foreign inflows will cause the imports to increase by 0.510 percent. The relationship between other foreign inflows and imports can be explained by the fact that increasing other foreign inflows, especially in a time of currency shortages, enabled Turkey to import necessary goods and services for its economic development.

The coefficient of consumption (0.200) represents the marginal response of imports to a unit change in the other foreign inflows. In other words, one percent increase in other foreign inflows will increase imports by 0.200 percent.

The oil price coefficient indicates that a one percent increase in oil prices will increase imports by 21.868 percent. Turkey has very little oil of her own and is using most of its export earnings to pay the oil bill. The total imported oil consumption of Turkey rose from 2,269,022 metric

tons in 1962 to 20,061,974 metric tons in 1990⁴. Within the total energy consumption of Turkey, commercial-energy consumption such as coal, lignite, oil, and hydro-electric power increased at a faster rate. However, the rise in energy consumption was not spread evenly over the different forms of energy. In fact, most of the increase was accounted for by oil. This increasing degree of oil dependency had serious effects on the Turkish balance of payments. Domestic oil production was around 3.6 million tons in 1969, fell back to an average of 2.7 million tons per year between 1976 and 1978 and decreased further to an average of 2.4 million tons between 1985 and 1988, then rose sharply to 3.7 million tons in 1990. On the other hand, consumption of oil rose from 7.1 million tons in 1969 to 15.2 million tons in 1978, and to 23.8 million tons in 1990, reducing the proportion met by domestic production from 51 to 15.5 percent in 1990. Turkey's oil bill rose to around \$3.5 million in 1990. The finding of a significant positive association between oil prices and imports was expected.

There are some economic and commercial motives of developed countries for giving aid as they procure economic benefits as result of their aid programmes. Some of foreign aid is tied aid by source and in this case, loans or grants have to be spent on the purchase of donor countries' goods and services which are in this case imports of Turkey. It is also stated by Chenery and Strout (1966) and others that foreign aid could play a vital role in promoting economic development of developing countries by resulting in an increase of investment and imports; that is explained in terms of two-gap (the savings gap and the foreign exchange gap) model. Foreign aid could contribute to economic development by relieving bottle-necks of economy, when it is limited by a few bottle-necks such as a shortage of skills, a shortage of savings and a shortage of foreign exchange receipts. Our findings imply that foreign aid helps Turkey to overcome the shortage of foreign exchange in the short run and provides funds to imports of necessary goods and services needed for economy.

When we look at the statistical significance of all foreign capital inflows variable on imports, we perceive that different components of

⁴ Data received from Hazine ve Dış Ticaret Müsteşarlığı, (Undersecretariat of Treasury and Foreign Trade), Ankara, Turkey.

foreign capital inflows have different effects both in qualitative terms and in quantitative terms. All variables have expected signs with the exception of foreign exchange rate. The coefficients of foreign exchange rate, second foreign aid, other foreign inflows and oil prices are significant at the 5 percent level while current foreign aid and consumption variables are significant at the 10 percent level. The coefficient of national income is insignificant from zero at 10 percent level.

In imports equation, the DW statistic indicates that the test shows no autocorrelation at the 1 percent probability level and is inconclusive at the 5 percent probability level. The value of the R^2 is quite high and indicates that this equation can explain 98 percent of total variations in imports over the period 1963-90 in Turkey. Hence, all explanatory variables make a significant and necessary contribution in explaining the dependent variable investment.

VII: Conclusion:

In this study, we have developed a model in order to assess the direct and indirect effects of foreign capital on the Turkish economy, and the impact of foreign capital inflows was investigated through consumers' expenditure, investment, government expenditure, exports and imports. The results provided some insights into the relationship between Turkey and foreign capital inflows.

On the basis of our results from the simultaneous equations model, we have found that the components of foreign capital inflows, foreign aid, other foreign inflows as well as domestic resources make a positive contribution to the economic development efforts of Turkey in different ways over the period 1963-1990. From our analysis in this paper, we can say that foreign assistance is successful and has some positive role to play in promoting economic development.

Our observation that foreign aid and other foreign capital as a foreign capital inflow have some positive role to play in Turkish economy is in contrast to Griffin and Enos (1970), Weisskopf (1972), Bauer (1976) etc. who argued that foreign capital inflows reduce domestic savings and are used in part to increase consumption, since there are the possibilities of leakages of aid into non-productive public

expenditure and of negative effect on the private sector through the price mechanism. However, results of this study are in line with Chenery and Strout (1966) and Rosenstein-Rodan (1961) who underlined the importance of foreign aid in the economic growth of developing countries and were convinced that all capital inflows constitute net additions to a developing country's productive resources.

The analysis has shown that the different types of foreign capital inflows have different effects on the Turkish economy in terms of magnitude as well as in the statistical significance of the coefficient estimates. Using the simultaneous equation estimates, we found that the impact of foreign aid is more productive than other foreign inflows on investment while the coefficient of foreign direct investment is not significantly different from zero. This is similar to the findings of Gupta and Islam (1983). In consumers' expenditure and imports, foreign aid inflows have a greater impact than other foreign inflows.

This study has also shown that foreign aid is not used directly to meet government expenditure, as foreign aid in previous years has shown a negative impact. This means that there is no evidence for fungibility of aid. It indicates that governments in Turkey are not able to use foreign aid to finance their current expenditure. Mosley (1980) and Mosley, Hudson and Horrel (1987) indicate that in some countries reluctance to raise taxes, or to collect taxes that are due, forces governments of these countries to drain some of foreign aid inflows into the recurrent budget, but Turkey is not one of those countries. However, White (1993) stated that there is the possibility that foreign aid will lead to an increase in taxes and an increase in government expenditure. In our case, despite foreign aid and other foreign inflows have no direct impact on government expenditure, they have positive indirect impact through imports.

This shows that foreign direct investment has no significant impact on investment. This could be the result of the fact that the capital markets in Turkey historically have not played an important role in the economy and only a small amount of foreign investment was accumulated by the early 1980s.

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