The Causality Analysis of External Debt Service and GNP: The Case of Turkey

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Abstract

It is argued that debt service burden has a negative impact on investment and capital accumulation. The main reason is that the greater percentage of reserves (foreign currency) goes to meet debt service and there will be a reduction in external capital because of a decrease in creditworthiness. This paper extends the model of Cunningham (1992) and uses multivariate cointegration techniques to develop a vector error correction model useful for investigating the long-run effects of external debt service on GNP level. Moreover, the information on cointegration (Johansen ,1988 and Johansen &Juselius ,1990) in variables are taken into consideration in specifying the correct model. We apply our methodology to Turkey and show how external debt service is having a negative short -run impact on economic growth. The results also show that there is a uni-directional causal relationship between debt service and GNP level.

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1.1. Introduction

The poor investment and growth performance of the highly indebted countries in the past few years is frequently attributed, at least to some extent, to the debt burden of their foreign debt, a phenomenon which has been defined by the debt overhang. The economic literature has indicated several direct and indirect channels through which a large foreign debt affects investment and finally negatively output:

i- the debt overhang effect, which refers to the reduced incentives to invest;

ii- the high domestic real interest rates due to the impaired access to international credit;

iii- the low profitability due to the downturn in economic activity; the decrease in public investment that is complementary to private investment.

Basically, the debt overhang hypothesis indicates that the accumulated debt act as a tax on future output, discouraging productive investment plans of the private sector and adjustment efforts on the part of governments. In a sense, foreign debt acts like a tax when the debt situation is such that an improvement in the economic performance of the indebted country has the side product of higher debt repayments; i.e. creditors receive part of the fruits of increased production or exports by the debtor country. This study will examine the relationship between the external debt burden and economic growth relationship in Turkey by using cointegration analysis. This study is encouraged by the lack of country studies on the external debt-economic growth relationship within the existing literature. No actual empirical estimates of the impact of the debt problem on indicators economic growth have been provided for Turkey. However, studies generally analyse the debt effect for developing countries and they concentrate on the impact on investment or saving levels rather than on economic growth. It is very important to examine how the external debt burden affects the economic growth in Turkey.

This paper proceeds as follows: In the next section, there is a brief description of theoretical survey of external debt and economic growth relationship in second section. Section 1.3 is divided by the estimation model. The section 1.4 is about the theoretical expectations and hypothesis. In section 1.5, the empirical results and their analyses were discussed. The section 1.6 presents cointegration analysis. Short-run analysis and causality are discussed in section 1.7. Last section is about concluding remarks.

1.2. The Theory of External Debt and Economic Growth

The relationship between foreign debt and economic growth is not simple. Due to the reduction in economic growth via investment, namely debt overhang[1], this subject attracts the interest of highly developing countries. It argued that debt overhang is a significant factor influencing slowdown in investment. Debt overhang theory is based on the premise that if debt will exceed the country's repayment ability with some probability in the future, expected debt service is likely to be an increasing function of the country's output level. Thus some of the returns from investing in the domestic economy are effectively taxed away by existing foreign creditors and investment by domestic and new foreign investor is discouraged. Debt servicing, including interest payments and repayments, may also be a real linkage from an indebted country. It takes large benefit from the domestic economy to transfer to the foreign economy. Therefore, the country foregoes some spectacular multiplier-accelerator effects. This decreases the domestic country's ability to grow its economy and raises its dependence on foreign debt (Metwally and Tamaschke, 1994).

Sachs (1990) and Kenen (1990) argue that external debt overhang plays an important role in the heavily indebted countries. Debt overhang is the main reason for slowing economic growth in indebted countries. Because of large debt overhang private investments are discouraged and the payments of the debt service of some countries are so large that the prospects for a return to growth paths are dim, even if the governments were to apply hard adjustment programmes. It is argued that a debt overhang creates adverse incentive effects on the economic growth in the long run.

The scope of debt overhang is much wider in that the effects of debt do not only affect investment in physical capital but any activity that involves incurring costs up-front for the sake of increased output in the future. Such activities include investment in human capital and in technology acquisition whose effects on growth may be even stronger over time. How a debt overhang discourages private investment depends on

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[1]Borenzstein (1990) defines debt overhang as follows:
"The debt overhang arises in a situation in which the debtor country benefits very little from the return to any additional investment because of debt service obligations. When foreign obligations cannot be fully met existing resources and actual debt payments are determined by some negotiation process between the debtor country and its creditors, the amount of payments can become linked to the economic performance of the debtor country, with the consequence that at least part of the return to any increase in production would in fact be devoted to debt servicing. This creates a disincentive to investment from the point of view of the global interest of the debtor country"*(1990:316).*

how the government is expected to raise the resources needed to finance external debt service and whether private and public investment are complementary. For example, if a government resorts to inflation tax or to a capital levy, private investment is likely to be discouraged.

Other channels through which the need to service a large amount of external obligations can affect economic performance include the crowding out effect, due to high real interest rates, terms of trade of over borrowed country's worsens and shut-off from foreign credit markets, it is expected that investments would have declined because of the decreasing in available resources for financing investment and macroeconomic conditions. Moreover, because of the expected higher taxes and deteriorated domestic policies that will effect real returns on investment. Since the debtors' country has to pay their debt obligations. This has led to a decrease through decreasing growth rates in investment. Moreover foreign borrowing affects future growth through the effect on interest payments obligations. This causes a higher stock of outstanding debt. This means that external borrowing increases future debt service obligations because the foreign exchange constraint is tightened in the future (Kamin *et al.,* 1989). In the crowding out effect, a reduction in the debt service should lead to an increase in investment for any given level of future indebtedness. If a grater portion of foreign resources are used to service external debt, very little is available for investment and growth.

In summary, the debt overhang hypothesis, external debt causes a negative effect on investment. The debtor country cannot benefit fully from an increase in production (economic growth). A part of the production goes to creditor countries to pay the debt service and this point is a consideration for investment and production decisions.

1.3. Estimation of External Debt Burden And Economic Growth

The bulk of previous studies that estimated long-run economic growth elasticities employed standard econometric techniques. However, the failure of these techniques to take into account the non-stationary behaviour of macroeconomic time series resulted in what has become known as "spurious regressions". In the literature, the development of cointegration techniques for modelling non-stationary variables, estimation of debt overhang has been receiving renewed attention.

Although an enormous body of literature exists on economic growth-debt relationship in cross-sectional analysis, less effort has been made to understand

economic growth-debt service relationship in time series. Most studies about external debt and economic growth association have employed cross country studies. Our study is different from previous studies in several respects:

i- Cross country analysis is not easy and has some difficulties. Developing countries in aggregate differ significantly in terms of their economic and political environment, organisations and institutions. The vast majority of studies have employed OLS method to investigate external debt and economic growth relationship in sample countries, where the sample countries are at different stages of development and have different debt burden. Hofman and Reisen (1991) argued that (IMF,1989) picks group of middle income debtor countries to consider as indebted countries. These countries are arbitrary and classified as indebted countries and also have not faced serious debt servicing problem. It is clear that the effect of debt burden may vary across these countries.

ii- However, previous studies that have not employed cointegrating modelling techniques to examine the external debt and economic growth association in developing countries. We used longer and more recent data for the estimation of external debt burden and GNP level using the cointegration analysis. Still, previous studies generally concentrate more particularly on how external debt influences investment or saving levels rather than GNP or GDP level (e.g Hoffman and Reisen,1991;Savvides,1992; Faini and DeMelo,1990). Moreover, while a drag on investment rates will reduce economic growth, external debt could also affect the productivity of production factors in economic growth. External debt may still affect output growth even if investment levels are unaffected (Fosu, 1999). Even though some studies have used the Engle-Granger two step procedure, this method makes the implicit assumption that the cointegrating vector is unique, which means that we are bound to end with a model that is a linear combination of independent cointegrating vectors. In particular, the assumption is made that the cointegrating vector is unique, this may not however be the case, and the two-step procedure provides no framework for addressing this question. Moreover, the test procedures do not have well defined limiting distributions and as a result testing for cointegration is not a straightforward procedure. Another disadvantage of the Engle and Granger two-step procedure is that it examines only the dominant cointegrating vector between series. It is difficult to draw a general conclusion from findings of these studies as to which determinants they provide important information on external debt and economic growth association in individual countries.

iii- An apparent reason is the insufficient amount of usable time-series data apart from the possibility for a few industrialised countries. Nevertheless, they may be useful for acquiring broad indications. Such cross section models imply strong parametric restrictions across countries with different economic structures. Thus, it would be useful to consider evidence based on time series data for as many countries as possible (Ram, 1986).

iv- Most of the studies reviewed are cross-sectional in nature. While the findings are quite revealing, there is need for case by case studies in view of each country's unique characteristics. This is particularly important given the stringent conditionalities for debt relief initiatives (Were, 2001). In spite of that very few empirical studies on Turkey's external debt exist and, even then, they do not focus on the analysis of external debt and output level. This study attempts to fill this gap.

v- Single country data may give more reliable results than studies of the cross-country or specific areas of the world. Due to a lack of individual country studies and problems with cross-sectional studies, time series analysis for a single country is more reliable than cross section analyses (Sezgin, 1997).

Turkey is a developing country and it has a high economic growth and is also paying too much for external debt service. Another important thing is that there was a oil shock in 1973, which had spectacular effects on the world economy. It makes sense to measure what is the effect the oil shock had on the Turkish economy. On the other hand, since 1980 Turkey had started new strategy from import-substitution strategy to export oriented strategy. This strategy gave Turkish economy the incentive to grow. Moreover, with export oriented strategy, Turkish economy has been opened to the world economy. Turkey has competed with the other developed countries. Developed countries have began to invest in Turkey. This has given an incentive to the foreign investor to lend to the Turkish government and the Turkish economy in general. It is important to investigate what has been done with that borrowing.

1.3.1. The Model and Specification: Extension of Export-Growth Model

This study focuses on the relationship between the debt burden and GNP in Turkey and employed a standard production function model. Cunningham (1993) has investigated the association between economic growth and debt burden in heavily indebted countries during the period 1971-1986 with the following model. In recent

years, several studies have focussed on the export and economic growth with the framework of export-growth model on vrious aspects of the relationship between export and economic growth.

The model is as follows:

$$Y = (K, LF, DS) \quad (1)$$

Where Y, K, LF and DS are the measure of GNP, K capital stock, labour force and debt service respectively. Cunningham (1993) noted that the debt burden can be considered as debate in the production function due to its effects on the productivity of labour and capital in a manner similar to the inclusion of exports in the production function. In as much as a nation has significant debt burden, the need to service its' debt will affect how labour and capital will be employed in the production function. More specifically, if the gains of the productivity increase are to foreign creditors and not domestic agents, there is little motivation to increase the productivity of capital or labour. This means that an increase in debt burden will decrease economic growth.

The main shortcoming of the Cunningham (1993) model is that it presumes that the production function only consists of physical capital and labour. The model clearly assumes that there is no human capital. Romer (1996) indicates that physical capital is important for the production but that human capital is vital. To investigate the relationship between Turkey's debt burden and GNP, human capital, H, is included as a new variable in the production function since human capital consists of the abilities, skills, and knowledge of particular workers. Therefore, like traditional economic goods, human capital is rival and excludable. and adding human capital to our models raises the output effects of changes in the resources devoted to capital accumulation.

As we include human capital as a new variable, our model will be:

$$Y = (K, LF, H, DS) \quad (2)$$

Where Y, K, LF, H and DS are the measure of GNP, capital stock, labour force, human capital and debt service respectively. This makes the standard assumption in equation (2) that the input elasticities of output are constant, and that technical change is neutral. Cuningham (1993) states that when a nation has a substantial debt burden, the manner in which labour and capital will be exploited in the production precess is bound to be influenced by the need to service that debt. More specifically, if foreign creditors rather than domestic agents benefit from the rise in productivity, the latter are discouraged from increasing capital or labour.

Following Cunningham (1993), it is possible to treat external debt service as separate inputs in a neoclassical production function, i.e , economic growth for Turkey (in natural logs, L) is specified as follows:

$$LY = \rho_0 + \rho_1 LK + \rho_2 LLF + \rho_3 LH + \rho_4 LDS + \varepsilon \quad (3)$$

1.3.2. Data and Problems

It is difficult to have a reliable data from less developed countries (LDS), where most data are not used for time series analyses. Sezgin (1997) claims that data series are not in a chain for time series analysis in Turkey because of the high inflation. It is obvious that the proper deflators may not be used. We collect the data from several different resources. All financial data were deflated to 1987 millions Turkish liras using GNP deflators of SIS (The State Institute Statistics Turkey). The external debt service data are obtained from the UT (the Undersecretariat of Treasury, Turkey) and SPO (State Planning Organisation Turkey). Data about external debt service for 1955-1964 are taken from SPO Turkey, *Economic and Social Indicators*, 1950-1998. External debt indicates public and publicly guaranteed external debt. External debt service is including interest payments and repayments of long and short run term. We construct the capital stock for Turkey. Since physical capital depreciates during the process of production, a part of new investment is always used to replace the worn out capital. However, it is difficult to estimate the amount of new investment needed to replace the worn out capital in aggregate. This is because the process of capital depreciation is not directly observable or measurable. Therefore, it must be approximated based on some arbitrary assumptions on the life-length of various physical assets and on the way the services they provide are spread over this life (Levy, 1995). The capital stock is approximated by using the gross domestic investment and constant annual depreciation rate of 0.10. Our results show that the estimation results are not substantially changed as the depreciation rate vary between 0.05 and 0.15.

The labour force data extracted from the OECD labour force statistics from 1960-1996. The data between 1955-1959 are not available neither from the OECD nor SIS Turkey, so it was developed from the population using labour force/population ratio. Population data were taken from SIS Turkey. Labour force is proxied by the employed labour force. Although Turkey has high population growth rate, we used labour force as a proxy in our estimation instead of population growth rate. Despite the high rate of population growth in Turkey, the high rate of employed labour force,

especially skilled labour force, may give an incentive to the Turkish economy. Therefore, labour force is assumed to foster the economic growth**.** The rate of population growth is used as a proxy variable in place of the rate of increase in labour input in several studies. On the other hand, we used education expenditures as a proxy for human capital. We used education expenditures as a proxy variable in our estimation. Human capital is difficult to measure. As a proxy this study used the educational expenditures in the government budget. Education expenditures are taken from the Ministry of Finance Turkey.

1.4. Theoretical Expectations and Hypothesis

Hypothesis 1;

The capital stock is defined as the value of the existing supply of physical goods that are used in the production process at a given point (in time) and includes such thing as buildings, machinery, equipment and inventory. There are points of view that capital stock is generally believed to be of critical importance, not only as a component of final aggregate demand, but also in terms of the impact of capital stock on the economy's growth and employment opportunities (Ghali, 1998). Hence we expect that capital stock should have a positive coefficient.

Hypothesis 2;

In this study, the labour force is defined as the employed labour force. Since the rate of utilisation of the labour force is important in production, employed labour force is used rather than the full labour force. We expect a positive relationship between economic growth and labour force.

Hypothesis 3;

Gungor (1997) notes that human capital which describes the knowledge and skills embodied in individuals is an important source of economic growth. Human capital accumulation (the acquisition of knowledge and skills that improves the ability of individuals to solve problems and to think critically) is believed to promote higher growth by improving labour force which will be more productive on the job by requiring less supervision and possessing greater initative in handling job-related problems. The human capital variable which serves as a measure of the quality of work force is often proxied by government education expenditures.

Hypothesis 4;

The external debt service is assumed to have negative effect on economic growth. Rockerbie (1996), Afxentiou (1993) and Cunnigham (1993) state that when a nation has a substantial debt burden, the manner in which labour and capital will be exploited in the production precess is bound to be influenced by the need to service that debt. More specifically, if foreign creditors rather than domestic agents benefit from the rise in productivity, the latter are discouraged from increasing capital or labour.

The assumptions are that excessive debt appears to affect the economic development in some ways. Firstly, the large debt service requirements dry up foreign exchange and capital and foreign exchange and capital are transferred to principal and interest payments. Secondly, when the debtor countries are unable to meet their debt services promptly, they face bad credit standing and will have difficulties in borrowing. Therefore, debtor countries pay too much to get new credit. Thirdly, the accumulation of debt causes to reduce the countries' efficiency, since it is difficult to adjust efficaciously to some shocks and international financial fluctuations. Fourthly, to obtain more foreign exchange to meet debt obligations, many debtor countries reduced imports and trade. This leads to poor trade performance. Furthermore, the intra country analysis shows that the marginal effects of debt burden on the economy decreases when the debt burden increases. Even though there are important variations in the model from country to country, some factors affect economic development in each of the countries in a similar way and account for the different reactions to the debt burden.

1.5. Empirical Results

In order to examine the relationship between the GNP (Y) and external debt service (DS), a five equation VAR model is examined. The variables used are; GNP (Y), external debt service (DS), capital stock (K), labour force (LF) and human capital (H). All variables are in logarithmic forms. Dornik and Hendry (1994) state that the trend should enter into the cointegration space, as otherwise it would induce a quadratic trend in levels, for which there is no evidence. From an economic point of view, on the other hand, the time trend may pick up the effects of other determinants of economic growth, which are missing in the model.

Before modelling the relationship between the economic variables, their univariate time series proportion are established. The tests that are used to investigate the

existence of unit roots in the level variables as well as in their first differences are the augmented Dickey Fuller (ADF) (1979). ADF test can be performed using variates of the following regression.

$$\Delta Y_t = constant + \partial Y_{t-1} + \_T + \sum_{s=1}^{n} \partial_1 \Delta Y_{t-s} + \varepsilon_t \qquad (4)$$

where Y_t is the relevant time series, ε_t is the residual term and T is a time trend. This is performed on the level variables as well as on their differences. The null hypothesis is that the variable under investigation has a unit rot, against the alternative that it does not.

The visual inspection of the variables in hand (i.e. LY, LK, LLF, LH ,LDS,) shows that they are all non stationary in levels, but stationary in first differences. We then apply the augmented Dickey-Fuller test for unit roots as formal test. Table 1.1 presents the results for the unit root test for level data. The results show that the hypothesis of unit roots in LY, LK, LLF, LH, LDS cannot be rejected at 1% and 5% significance level. ADF test for unit roots (see Table 1.1) confirms that all variables are integrated of order one in levels**.**

The hypotheses of a unit root in ΔLY, ΔLK, ΔLLF, ΔLH and ΔLDS are rejected at 1% and 5% significance level. Table 1.1 shows that all the variables in first differences integrated of order zero (i.e. stationary) in first differences denoted as Δ LY~ I(1), Δ LK~I(1), Δ LLF~I(1), Δ LH~I(1),Δ LDS~I(1),.[2]

Table 1.1
Unit Root Tests Results for Levels

Variables	*ADF Test*	*First difference(Δ) ADF Test*
	Calculated	***Calculated***
LY	-1.754	-4.931**
LK	-1.094	-4.712**
LLF	-1.274	-4.009*
LH	-2.245	-7.264**
LDS	-2.716	-5.51**

Note: The reported critical values are obtained from PC-Give 8 version and correspond to 40 observations. For calculated values of levels intercept and trend are included in the ADF equations. On the other hand, for calculated values of first difference intercept is included in the ADF equations.
Critical values of ADF statistic for levels at 1% and 5% significance are -4.202**,** -3.525 (with trend) respectively**.**
Critical values of ADF statistic for first difference at 1% and 5% significance are -4.209**,** -3.528 (without trend) respectively**.**

[2] Econometric computations in this study have been carried out by PC-Give 8.0 version.

Table 1.2
Unrestricted VAR Estimates

	Y_{t-1}	K_{t-1}	LF_{t-1}	H_{t-1}	DS_{t-1}	σ
URF Equation for Y	0.57835 (3.558)	0.011905 (0.278)	-0.43838 (-2.469)	-0.015954 (-0.782)	-0.021486 (-1.763)	0.03
URF Equation for K	1.9784 (5.143)	0.18627 (1.840)	-1.7825 (-4.242)	0.023541 (0.488)	0.0010069 (0.035)	0.07
URF Equation for LF	0.11635 (1.195)	-0.019202 (-0.749)	0.85508 (8.038)	-0.018245 (-1.492)	0.00316 (0.433)	0.01
URF Equation for H	1.7044 (1.332)	-0.083866 (-0.249)	-1.1301 (-0.809)	0.44229 (2.754)	-0.016995 (-0.177)	0.24
URF Equation for DS	-2.7542 (-1.330)	0.42776 (0.785)	4.1285 (1.825)	0.38476 (1.480)	0.53044 (3.416)	0.39

Note: t- ratios are in the parentheses and σ denotes equation standard deviations.

After investigating their univariate time series properties, we can now start modelling the system. The vector of variables in the joint density comprises:

$$(Y_t, K_t, LF_t, H_t, DS_t) \tag{5}$$

In addition to the these five stochastic variables, the system includes a constant and a time variable. Our estimation is carried over 1956-1996. The first step to modelling is determination of the lag length of the VAR model to simplify the specification of the system at hand. Generally, a practical solution will be started from the highest possible lag-length then reduce it one lag at a time and perform the likelihood ratio test at each step. In doing so, empirical analysis begins with two lags of each variable and the results are obtained using Pc Fiml version 8.00 (see Doornik and Hendry (1994), then the lag-length is reduced by one at a time. Table 1.3 shows the F -approximation of the likelihood ratio test and Schwarz and Hannan-Quinn criteria statistics.

Table 1.3
Specifications Test

Model	***Lag-Length***	***Hanan-Quin***	***Schwarz Test***	***Model Reduction***	***F -test F=(25,90)***
1	2	-22.6	-24.21	1→2	1.1524
2	1	-23.6	-24.54		(0.0774)

Note: * indicates significant at the 5% level and P probabilities are in parentheses.

In Table 1.3, Schwarz and Hannan-Quinn criteria have a minimum for model 2, indicating a one lag system. Moreover, the F-form of the likelihood ratio tests show the

reduction 25 parameters for eliminating lag-length 2 are acceptable on the overall F-test and reduces the cost as measured by the model selection criteria.

Table 1.4
Correlations of URF Residuals

	Y	K	LF	H	DS
Y	1				
K	0.51	1			
LF	0.16	-0.2286	1		
H	0.16	-0.03	-0.26	1	
DS	-0.2	0.06	-0.47	–0.03	1

The residual cross-correlations are presented in Table 1.4. It appears that there is a large positive correlation between GNP and investment and a negative residual correlation between GNP and debt service.

Table 1.5
Diagnostic Tests Results

	Y	***K***	***LF***	***H***	***DS***	***SYSTEM***
F_{Ar} -2.32	0.61032 (0.5494)	2.935 (0.0676)	0.407 (0.6690)	0.32221 (0.7269)	0.14607 (0.8647)	
F_{Arc} -132	0.00715 (0.9331)	1.3557 (0.2529)	0.50278 (0.4834)	0.085725 (0.7716)	0.078443 (0.7812)	
F_{Het} -1221	1.3183 (0.2794)	1.7972 (0.1156)	3.2456** (0.0089)	0.90134 (0.5604)	0.54744 (0.8587)	
F_{Nor} -2	9.0765* (0.0107)	0.77124 (0.6800)	15.037** (0.0005)	15.649** (0.004)	1.2767 (0.5282)	
Fv_{Ar} ***-5089***						0.84404 (0.7425)
Fv_{Het} -21060						0.83459 (0.8457)
Fv_{Nor} -10						47.818** (0.000)

** denotes significant at 1% level, and t values are in the parenthesis.

Table 1.5 shows that statistical information about the unrestricted VAR reported by PcFiml. F_{Ar} denotes the null hypothesis of no autocorrelation, which would be rejected if the test statistic is very high. F_{Arc} indicates autoregressive conditional heteroscedasticity (ARCH). The statistical results show that the null hypothesis of no ARCH is not to be rejected at any level of significance. F_{Het} denotes for heteroscedasticity. There is no indication of a problem of heteroscedasticity. F_{Nor} indicates the normality test. The system, however, fails to pass the multivariate normality test at the 5% level. Ozmen (1998) states that the residual non-normality is probably caused by outliers. Fv_{Ar} denotes the vector error autocorrelation, Fv_{Het} is vector heteroscedasticity and Fv_{Nor} is vector normality.

1.6. Cointegration Analysis

To test cointegration among these five variables (Y, K, LF, H, DS), a procedure developed by Johansen (1988) and applied by Johansen and Juselius (1990) is used. The procedure suggested by Johansen (1988) basically depends on direct investigation of cointegration in the vector autoregressive (VAR) representation. This analysis yields maximum likelihood estimators of the unconstrained cointegration vectors, but it allows one to explicitly test for number of cointegration vectors so that the weaknesses of Engle- Granger(1987) two step procedure are overcome. Engle and Granger (1987) provide a two-step cointegration technique that enables determination of whether a long-run relationship exist among two or more non-stationary variables, by examining the stability deviations from the relationship using the coefficients estimated by fitting static regression. However, the test based on this procedure suffers from a number of short comings. This method makes the implicit assumption that the cointegrating vector is unique, which means that we are bound to end with a model that is a linear combination of independent cointegrating vectors. Furthermore, when the cointegrating vector is not unique, two-step procedure provides no framework for addressing this situation. Moreover, the test procedures do not have well defined limiting distributions and as a result testing for cointegration is not a straightforward procedure. Another disadvantage of the Engle and Granger two-step procedure is that it examines only the dominant cointegrating vector between series.

A pth -order vector autoregression, denoted VAR (p) can be explained as:

$$X_t = c + \pi_1 X_{t-1} + \pi_2 X_{t-2} + \ldots\ldots\ldots \pi_p X_{t-p} + \Lambda Q_t + \varepsilon_t \qquad (6)$$

Where X_t =nx1 vector of variables (Y, K, LF, H, DS), c= nx1 vector of constants (5x1 in our case), π_i =nxn matrices of autoregressive coefficients for i= 1,2...p, and Q_t denotes the deterministic conditioning variables. To distinguish between stationarity by linear combinations and differencing, a reparametrisation of equation (6) is needed. Thus the system is equation (6) can be rewritten equivalently as:

$$\Delta X_t = c + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots\ldots\ldots \Gamma_{p-1} \Delta X_{t-p+1} + \prod X_{t-1} + \Lambda Q_t + \varepsilon_t \qquad (7)$$

Where

$$\Gamma_i = -(I - \pi_1 + \ldots\ldots \pi_i)(i = 1\ldots., p - 1) \qquad (8)$$

and

$$\prod = -(I - \prod_1 - \ldots - \prod_p) \qquad (9)$$

The only difference between equation (7) and a standard VAR in differences is the error- correction term, ΠX_{t-p}. The system represented in equation (7) also contains information on both the short and long-run adjustment to changes in X_t, via the estimates of Γ_i and Π respectively. The transformation of a VAR model for I(1) variables into equation (7) can be called a cointegrating transformation. The rank of the long-run matrix, Π, in this transformation has a particular importance. Since there are n variables which constitute the X_t vector, the dimensions of Π can be at most equal to n, that is the total number of variables explained in the VAR model. In that case all the variables in X_t are integrated of zero, that is the vector process X_t is stationary. But if the rank of the matrix is Π equal to r<n, then there are r stationary relations among the non-stationary variables of X_t in the long run.

The non stationary component Π can also be factorised to test the null hypothesis r of reduced rank or equivalently, the number of cointegrating relationships, that is

$$H_0 : \Pi = \alpha\beta' \quad rank(\Pi) = r < n \tag{10}$$

Where β' is an (rxn) matrix and α is an (nxr) matrix. Matrix β is called the cointegrating matrix and has the property that $\beta' X_t \sim$ I(0), while $X_t \sim$I(1). The variables X_t are cointegrated, with the cointegrating vectors $\beta_1, \beta_2, ..., \beta_r$ being the particular column of the cointegrating matrix β. Hence, in a VAR model explaining n variables there can be at most r=n-1 cointegrating vectors, which can also be interpreted as long-run parameters. On the other hand, the elements of α indicate the speed of adjustment of particular variables with respect to a disturbance in the equilibrium relation. If an adjustment of coefficient of a particular cointegrating vector is large, it implies that the average speed of adjustment toward the estimated equilibrium state is fast, whereas a small coefficient indicates a slow adjustment.

Table 1.6
Cointegration Analysis

r	(λ Max)	95%	(λ Trace)	95%
r=1	67.15**	37.5	121.1**	87.3
r=2	20.46	31.5	53.95	63
r=3	15.73	25.5	33.49	42.4
r=4	13.58	19	17.46	25.3
r=5	4.175	12.3	4.175	12.3

(λ Max), (λ Trace) indicates the maximum eigenvalue test and the trace test respectively.

Two test statistics are reported for the number of cointegrating vectors. The first one is the maximum eigenvalue test. The maximum eigenvalue test shows the null

hypothesis r=0 against the alternative r=1 only at the first step from Table 1.6. The second test is trace statistics test. The trace test allows us to evaluate the null hypothesis that there r=0 against the alternative r>0 at the first row from the Table 1.6. Looking both at the maximum eigenvalue and the trace statistics show that there is a one cointegrating relationship. The results of Table 1.6 show strong evidence that there is a long-run relationship among the variables Y, K, LF, H, DS, which implies that market forces push a series back to the long-run equilibrium after a drift apart due to a temporary shock. In other words, these variables do not diverge from each other in the long-run. Therefore a policy of stabilising any one among the six variables is likely to stabilise the long-run levels of the other variables.

Table 1.7
Eigenvectors β'

	Y	K	LF	H	DS	Trend
Y	1	-0.3026	-0.4929	0.0037	0.019	-0.02158
K	-0.4733	1	7.129	-0.2904	0.01916	-0.1519
LF	0.4068	-0.0814	1	0.1178	-0.0479	-0.02758
H	7.247	2.129	15.45	1	1.997	-0.9654
DS	94.5	2.751	14.49	-17.99	1	-3.597

The eigenvectors presented in Table 1.7 are normalised by GNP (Y) for the first, by investment for second, by labour force for the third, by human capital for the fourth and finally by debt service for the fifth. When we interpret the evidence, from the first row of β',only the first cointegrating vector represents Y equation, with positive effects from investment, labour force, human capital, and trend whares a negative effect from debt service. However, the long-run debt service effect is quite small with expected sign. The coefficients in this equation represent the elasticities of Y to K, LF, H, DS.

Thus,

$$Y = 0.3026K + 0.4929LF - 0.0037H - 0.0190DS + 0.02158Trend$$

From the long-run relationship between the variables given by the cointegration equation, we can see that, in the long run, debt service has a negative effect on Y. This result is labelled the debt overhang hypothesis. Debt overhang hypothesis argues that when foreign debt becomes excessive; actual payments to creditors become linked to the economic performance of the debtor country. Therefore potential increases in debt payments depress the returns to productive investment and discourage capital formation. In such circumstances, the debtor country shares only partially in any increase in output and may be exports because a fraction of that increase is used to service the foreign debt. This may weaken incentives to invest from the point of view

of the debtor country as a whole, because the effective return to investment is reduced. The main reason is that the greater percentage of reserves (foreign currency) goes to meet debt service and there will be a reduction in external capital because of a decrease in creditworthiness. All of these make it difficult to continue large infrastructure, new projects and old investments. The most important reason is the lack of a foreign currency barrier, necessary capital goods and raw materials. There are several studies in the literature to test whether indebtedness impacts on the economic activity of developing countries. It is argued that if foreign loans are converted into capital and other necessary inputs, development will occur. On the other hand, if the borrower countries mis allocate resources or waste them on consumption, then economic development is negatively affected (Afxentiou and Serletis, 1996a).

The first oil shock devastated Turkey very strongly, resulting in the quadrupling of oil prices. Due to the heavy reliance of domestic energy necessities on imported oil, this cause a sharp deterioration in the terms of trade and accumulation of external debt. When we examine this period, it is clear that the increasing in external debt came from some external shocks and domestic policies implications. The economic embargo, which was imposed by USA and first oil crises of 1973 had negative effect on the external balance which inevitably caused Turkey to reschedule its debt with consecutive agreements signed, with OECD countries in 1978 ,1979 and 1980. International borrowing has two faces. It gives incentives for economy to enlarge beyond its domestic limits, it also causes a high degree of unsteadiness into the system. The high and variable interest rates with limited repayments term, getting the borrowing money from the Eurocurrency markets, caused to a substantial accumulation of external debts (Onis and Ozmucur,1991). The World Bank Country (1990) indicates that short term borrowing affected Turkish economy during the 1970s. Because of the abundant increasing in the short term borrowing, which was costly and increased the external debt burden. The external debt burden caused to a loss in credit-worthiness and then to fall scale payments crisis in 1977. Then, Turkey had to adjust to some new conditions, which were started by the first oil shock.

After facing a balance of payments crisis, Turkey had to reschedule external debt between 1978 and 1982 and borrow further credits to finance the requirements of the current account. Though, further borrowing was only possible by rising future debt service obligations prerequired by investors that in turn led to increasing transfers and higher gross capital inflow. It can be said that the aim to increase the transfer capacity is usually a prerequisite for and complementary to the aim to increase capital flow.

When investors had demonstrated their cautiousness through the rescheduling, which conditioned that future debt service obligations would not exceed the capacity to the service debt, the country had to adjust to transfer more resources abroad.

Table 1.8
Adjustment Coefficients α

	Y	K	LF	H	DS
Y	-0.1069	-0.00359	-0.2202	-0.01433	0.001305
K	2.554	-0.00932	-0.153	-0.02588	0.0002103
LF	0.03835	0.002619	-0.04236	-0.0001	-0.000256
H	0.7792	0.05262	-1.086	-0.05274	0.002359
DS	-2.968	-0.01356	3.812	-0.1139	-0.1139

Table 1.8 shows the adjustment coefficients. The adjustment coefficients α , which are represents loadings, show that the main effect of first cointegrating vector is on Y. They can be interpreted as the weights with which cointegration vector enter the five equation systems. They indicate the average speed of adjustment through the estimated equilibrium state. In doing so, a small coefficient represents a slow adjustment. The first column of the adjustment matrix α can be evaluated as the weights with which the GNP enters into the five equations of the system.

Table 1.9
Long-Run Matrix ro =αβ 'rank 5

	Y	*K*	*LF*	*H*	*DS*	*Trend*
Y	-0.4216	0.01119	-0.4384	-0.01595	-0.021	0.02756
K	1.978	-0.8137	-1.782	0.02354	0.001	-0.01537
LF	0.1163	-0.0192	-0.1449	-0.01824	0.003	-0.001
H	1.704	-0.0839	-1.13	-0.5577	-0.017	-0.02345
DS	-2.754	0.4278	4.128	0.3848	-0.4696	0.07202

1.7. Short -Run

Engle and Granger (1987) state that if there is an equilibrium or cointegration relationship between non stationary variables, there must exist an error correction representation of the data. Engle and Granger (1987) show that if a cointegration relationship exist, then a simple ordinary least squares static regression affords consistent estimates of the long-run equilibrium parameters. It is then straightforward to introduce the parameters from the first-stage estimates in the full, dynamic, second-stage estimator of the error correction term. A precondition for the existence of cointegration is that all the relevant variables are integrated of the same order. If this is established then the residuals from the long-run estimates can be used as the error correction term (ECT) to explain the short-run dynamics.

The second stage of the two-step Engle-Granger (1987) cointegration methodology is to establish the stationary condition of the residuals which would be an indication of the existence of a long-run equilibrium relationship between the variables in equation (1.6). Kollias (1995) states that the error-correction variable in a short- term dynamic relationship indicates the proportion of the disequilibrium from one period that is adjusted in the next period. The assumption is that the disequilibrium errors are sloped to move to their mean value. It means that the dependent variable does not permanently drift away from what is specified by the long-run determinants.

In the next step of the cointegration methodology employed here the residuals from the cointegration regression are used as the ECT variable in the short-run dynamic tests. In these tests a number of other explanatory variables are used which may affect the adjustment process of real GNP from the one time period to the next.

1.7.1. Granger Causality Test

Thus, given the foregone discussion, there are four possible outcomes when the determination of the causal ordering between GNP and external debt service is the task at hand, namely uni-directional causality from external debt servicing to growth or vice versa: bi-directional causality between the two variables and finally lack of any causal ordering.

Madalla (1998) indicates that if two variables are cointegrated, there must be at least one direction causality between investigated variables. Our objective is to investigate whether observations of a variable like debt service is potentially useful for anticipating future movements in GNP. In context of Granger causality, it is hypothesised that debt service (represented by LDS) causes GNP (LY) with respect to a given information set that includes the relevant variables (i.e LDS and LY), if GNP is better predicted by adding the past time series for debt service than by using the past LYseries alone.

Following Engle and Granger(1987) the error-correction representation for ΔLY_t and ΔLDS_t variables in the cointegrating regression can be formulated as follows:

$$\Delta LY_t = \theta_0 + \Sigma\theta_1 \Delta LY_{t-i} + \Sigma\theta_2 \Delta LDS_{t-i} + \Sigma\theta_3 \Delta LK_{t-i} + \Sigma\theta_4 \Delta LF_{t-i} + \Sigma\theta_4 \Delta LH_{t-i} + \theta_5 DUM + \theta_6 ECT_{t-1} \quad (11)$$

$$\Delta LDS_t = \phi_0 + \Sigma\phi_1 \Delta LY_{t-i} + \Sigma\phi_2 \Delta LDS_{t-i} + \Sigma\phi_3 \Delta LK_{t-i} + \Sigma\phi_4 \Delta DLLF_{t-i} + \Sigma\phi_5 \Delta DLH_{t-i} + \phi_5 DUM + \phi_6 ECT_{t-1} \quad (12)$$

ECT is a vector of stationary residuals from cointegration regression and DUM is a dummy variable which captures the 1977 payment crisis. It takes the value one for 1977 and zero otherwise. All other variables are as previously defined.

i-) Equation 11 is used to test causality runs from debt service to GNP, If debt service Granger-causes GNP the null hypothesis that the sum of the coefficients θ_i (i=1...n) equal to zero is rejected.

ii-) Equation 12 used to test causality from GNP to debt service, if GNP Granger-causes debt service then the null hypothesis that the sum of the coefficients ϕ_i (i=1...q) equal to zero is rejected.

iii-) Feedback or bilateral causality is suggested when the sets of DS and Y coefficients are statistically significant different from zero on both regressions.

iv-) Moreover, if DS and Y are causally independent, all the coefficients of DS in equation 11 and of Y in equation 12 should be statically insignificant. Both DS and Y may grow, or even appear to move together, but neither influencing the other and changes in both occur due to other independent factors.

Table 1.10
Estimates of the Error Correction Model

Variables	ΔLY_t	ΔLDS_t
Constant	0.023924 (1.526)	0.054379 (0.408)
ΔLY_{t-1}	0.60515** (2.233)	-1.8324 (-0.952)
ΔLDS_{t-1}	-0.030021** (-2.078)	0.82764** (2.875)
ΔLK_{t-1}	0.019666 (0.457)	0.35045 (0.638)
ΔLLF_{t-1}	-0.44542 (-1.216)	3.2424 (0.731)
ΔLH_{t-1}	-0.0064524 (-0.334)	0.38351 (1.612)
DUM	0.052442 (1.428)	-0.72809 (-1.679)
ECT_{t-1}	-1.1839 *** (-3.481)	-1.2986*** (-4.069)
R^2 0.36		R^2 0.43
F(7,31)= 2.5657 (0.0330)	DW=2.01	F(7,31)=3.3424 (0.0090) DW=1.89
AR 1-2F(2,29)= 0.30792 (0.7373)		**AR 1-2F(2,29)**= 2.2825 (0.1201)
ARCH1 F(1,29) = 0.0048727 (0.9448)		**ARCH1 F(1,29)** = 0.00035221 (0.9852)
$Nor\,X^2 =$ 10.491** (0.0053)		$Nor\,X^2 =$ 1.6078 (0.4476)
Het F(13,17)= 0.39468 (0.9524)		**Het F(13,17)**= 1.0294 (0.4689)

***,**,* denotes the 1%, 5% and 10% percent significance level respectively.

The process includes regressing the first difference of lnY on the lag values of the first differences of each of the explanatory variables in cointegration equations, one period lagged residuals from cointegration equation. All the variables in the regression

equation are consequently stationary. First we estimated the error correction equation with one lag for each variable. Accordingly, ECT, with one lag of each dependent variable were estimated. From the ΔLY equation in Table 1.10 we can see that debt service has a significant negative effect on GNP (ΔLY) with a one year lag. This means that debt service reacts negatively to changes in GNP with one time lag. Hence, we conclude that in Turkey, debt service is having a debt overhang effect on GNP. This result is consistent with Bauerfreund's (1989) findings. Bauerfreund (1989) shows that external debt payments obligations reduce investment levels and finally output in Turkey.

Estimates of the error correction model are presented in Table 1.10. The results from the Y equations are more satisfactory. Several diagnostic tests are conducted to check for the validity of the assumption of the regression model. At the 5 percent significant level, these test do not reject the null hypotheses of nonnormality (Nor),no serial autocorrelation, no ARCH effects, and no heteroscedasticity. The error correction term, which is negative and statically significant indicates the speed with which deviations from log-run equilibrium will be corrected. This would take place quite fast, with over100 percent of the deviation is being eliminated after per annum. The significant coefficients for the error correction term are indicating that neglecting the cointegratedness of the variables could introduce a serious misspecification in the dynamic relationship.

F- test was carried out to determine if the direction of causality between debt service and economic growth could be detected. Debt service can theoretically impact on output through a variety of avenues. On the one hand, if converted into capital and other domestically unavailable inputs, which are productively used, the development benefits will soon manifest themselves. If, on the other hand, the borrowed resources are misallocated or wasted on consumption the negative effects on productivity will, in time, haunt the economy (Asxentiou and Serletis, 1996a). Debt burden has an output retarding effect through investment crowding out, and reduction of available public expenditure funds in areas such as education, health and infrastructural work all which have an output promoting impact.

Geiger (1990, p.186)) states that some of the ways that excessive debt appears to effect economic development are :

1- Large debt service requirements divert foreign exchange and capital from internal investment to principal and interest payments.

2- The inability of developing country to service the debt promptly affects its credit, and if the problem persists, the nation will eventually have difficulty borrowing for new projects . . . The scissors effect of declining capital inflows along with increasing debt service payments obviously creates problems for the developing nations.

3- The accumulation of debt reduces the countries' efficiency, inasmuch it makes it more difficult for the country to adjust officiously to major shocks and international financial fluctuations.

4- As a result of the increased pressure to obtain more foreign exchange to service the debt, many indebted nations restricted imports and reduce trade.

Table 1.11

Test Results for Granger-Causality

Equations	Direction	Wald Type F- Statics	Causality
Equation 1.11	*ΔLDS→ ΔLY*	*F(1,231)= 4.3184 {0.0461}***	*Yes*
Equation 1.12	*ΔLY→ ΔLDS*	*F(1,31)= 0.90585 {0.3486}*	*No*

** and * indicates the 5 %and 10% significance level.
This results are carried out by PC-Give 8 version. See Doornik, A. J. and Hendry, F. D. (1995)

Results of the causality test are in Table 1.11 where we the computed F-statistics are presented. To test for example whether ΔLDS causes ΔLY in the Granger sense, we proceed in the following way. In order to test for Granger inference, we impose the zero restriction on polynomial coefficients of the explanatory variables which are not the lag series of the dependent variables. We report results for Granger causality from equation 1.11 and 1.12, which is causality from debt service to GNP and causality from GNP to debt service respectively.

Based on the estimates, causality does run from debt service to GNP but causality does not run from GNP to debt service. Causal relationships from the debt service to GNP is statically determined by the t-values reported in Table 1.11. The t-value is statistically significant at 5 percent level of significance. This means that the hypothesis of causality from debt service to economic is not rejected at the 5 percent level of significance as shown in Table 1.11. On the other hand, based on the estimates, causality does not run from GNP to debt service. Causal relationships from the GNP to debt service is statically determined by the t-values reported in Table 1.11. The t-value is statistically insignificant at 5 percent level of significance. This means that the hypothesis of causality from GNP to debt service is rejected at the 5 percent level of significance as shown in Table 1.11.

The main conclusion of the short run causality test indicates that debt service is the cause of output in Turkey. There is a uni-direction causality between two variables. The burning issue is the impact of debt service on GNP in Turkey during the period 1956-1996. This result, coupled with the comprehensive coverage of our investigation, suggest that debt overhang is an important factor for Turkey. Our test indicates that debt service is a deciding determinant of GNP and the existence of causality in debt-service output relationship may be due to the borrowed resources being mis allocated or wasted on consumption. The negative effects on productivity will haunt the economy as it agonizes over debt servicing in the future.

1.8. Conclusion

In this paper we have investigated the long-run economic growth in the Turkish economy during the 1956-1996. Estimates of the long-run economic growth elasticities were obtained by employing Johansen and Juselious maximum likelihood cointegration technique to analyses data for the period 1956-1996. The VAR estimates of the initial system showed that there is a one way cointegrating relationship in the long-run. This cointegration relationship measures the GNP as a function of investment, labour force, human capital and external debt service.

Debt service is an effective policy variable, as it is negatively related to GNP in the long-run and short-run. The coefficients in this equation represent the elasticities of Y to DS. This consistent with to our expectations, though it has a small elasticity, which is (0.01). Human capital does seem to have long-run equilibrium relationship with Y during the sample period, the error correction model estimates clearly shows that human capital is not an important determinant of Y in the short term. Education expenditure is may not be a good proxy for human capital. Employing Granger causality in a sample of Turkey we found uni-direction negative causal relation from debt service to GNP. Granger causality indicates that debt service is an important factor of GNP. The existence of causality in debt service and GNP relationship may be due to the fact that borrowed resources are mis allocated or wasted on consumption. The negative effects on productivity will haunt the economy as it agonizes over debt servicing in the future.

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