View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Bilkent University Institutional Repository

Application of the Twin-Deficits Hypothesis to the Turkish Case

A thesis
submitted to the Department of Economics
and the Institute of Economics and Social Sciences of
Bilkent University
in Partial fulfillment of the requirements
for the degree of

Master of Arts in Economics

by

Alper YILMAZ

October 1993

Thesis
HF
1014
.Y45
1993

Application of the Twin-Deficits Hypothesis to the Turkish Case

A thesis
submitted to the Department of Economics
and the Institute of Economics and Social Sciences of
Bilkent University
in partial fulfillment of the requirements
for the degree of

Master of Arts in Economics

by

Alper Yılmaz
October 1993

Alper Yılmaz
tarafından bağışlanmıştır

HF
1014
.Y45
1993

B023226

I certify that I have read this thesis and in my opinion it is fully adequate, in scope and in quality, as a thesis for the Master of Arts in Economics.

Prof. Dr. Orhan Güvenen

I certify that I have read this thesis and in my opinion it is fully adequate, in scope and in quality, as a thesis for the Master of Arts in Economics.

Assoc. Prof. Dr. A. Erinç Yeldan

I certify that I have read this thesis and in my opinion it is fully adequate, in scope and in quality, as a thesis for the Master of Arts in Economics.

Assist. Prof. Dr. Bahri Yılmaz

Approved by the Institute of Economics and Social Sciences

Director:

Abstract

Application of the Twin-Deficits Hypothesis to the Turkish Case

Alper Yılmaz
MA in Economics
Supervisor: Prof. Dr. Orhan Güvenen
59 pages
October 1993

This study detects the *twin-deficits* hypothesis, the mutual effects of government budget deficits and merchandise trade deficits on each other through real interest rates and real effective exchange rates, in the Turkish economy. One-sided Granger causality analysis and Ordinary Least Squares (OLS) regressions for multivariate analysis for each are used for 1987-92 monthly data. The government budget deficits are found to affect trade deficits not directly, but through the mechanism over real interest rates and real effective exchange rates. Nevertheless, the merchandise trade deficits seem to affect budget deficits directly.

Key words: Twin-deficits hypothesis, consolidated budget deficits, merchandise trade deficits, real interest rates, real effective exchange rates, unit roots, Granger causality, Ordinary Least Squares

Özet

İkiz-Açıklar Hipotezinin Türkiye Örneğine Uygulanması

Alper Yılmaz
Yüksek Lisans Tezi, İktisat Bölümü
Tez Yöneticisi: Prof. Dr. Orhan Güvenen
59 sayfa
Ekim 1993

Bu çalışma, Türkiye ekonomisinde, reel faiz oranları ve reel efektif döviz kurları yoluyla merkezi hükümet bütçe açıkları ile ticaret açıklarının birbirleri üzerindeki etkileri anlamına gelen *ikiz-açıklar* hipotezinin varlığını araştırmaktadır. Bunun için 1987-92 aylık verileri üzerine tek taraflı Granger nedensellik analizi ve çok yönlü analiz için OLS regresyon kullanılmıştır. Hükümet bütçe açıklarının ticaret açıklarını direk olarak etkilemediği, ancak reel faiz oranları ve reel efektif döviz kurları üzerinden bir mekanizma yoluyla etkili olduğu belirlenmiştir. Bununla beraber, ticaret açıklarının bütçe açıklarını doğrudan etkilediği görülmüştür.

Anahtar Kelimeler: İkiz-açıklar hipotezi, konsolide bütçe açıkları, ticaret açıkları, reel faiz oranları, reel efektif döviz kurları, Granger nedensellik analizi, OLS

Acknowledgments

I would like to express my gratitude to Prof. Dr. Orhan Güvenen for his close supervision and suggestions during the preparation of this thesis. I would also like to thank to Assoc. Prof. Dr. A. Erinç Yeldan for his valuable comments, for being *more* than a supervisor and, most important, for his friendship. I also thank to Assist. Prof. Dr. Bahri Yılmaz for his valuable suggestions and for being a participant in my thesis jury.

Dr. Serdar Sayan is one of the most important people in the preparation of this study, *at least* for suggesting the *topic*; Dr. Kıvılcım Metin and Dr. Faruk Selçuk are the other two without whom I could not succeed in the application of econometric theory.

I would also like to thank to all close friends (Nazende Özkaramete, Emre Özdenören, Tunç Erkan and Tolga Tüfekçi) for their help.

My family must not be forgotten for being so patient with a *man* who has all sorts caprice, complaints and problems during the preparation of such work. Thanks to them for providing me all the things I need for years and years!

And one last gratitude is to my *dearest* Aslıhan, without whom this study cannot be completed.

Alper Yılmaz
October 1993

Table of Contents

List of Tables

List of Boxes

1 Introduction

Deficit spending is usually seen as both desirable and necessary to offset cyclical fluctuations in economic activity. It is known that increased government deficits put upward pressure on interest rates in order to finance the deficit. For open economies which are large enough to effect world markets, this induces capital inflows that appreciate the real value of the currency, which erodes competitiveness and, after a time lag, causes increased trade deficits. For small economies, the mechanism works in a similar way, excluding the capital inflows.

The purpose of this study is to detect whether the above-mentioned story, so called as the *twin deficits* hypothesis which is of debate for the US, applies to the Turkish case or not. The model used is an extension of the model developed by Caines, et al. (1981) and applied by Darrat (1988) to the US economy. A distinguishing feature of this study from the latter one is that it uses two independent single-equation ordinary least squares (*OLS*) regressions rather than the full information maximum likelihood (*FIML*) methodology.

The study makes use of univariate Granger-causality analysis. For a complete analysis, augmented Dickey-Fuller test as a unit root test is applied to the time-series to check for stationarity. In the model setting phase, the Final Prediction Error (*FPE*) criterion is used. The data is collected monthly and covered a 72-month period starting from January 1987 ending at December 1992.

In the coming chapter, the economic theory on which this study is based is provided. The theories of determination of interest rates and exchange rates are handled in detail in the last two sections of that chapter. Thus, the pertaining literature survey is covered in the second chapter. The third chapter mainly focuses on the econometric theory which is required to carry on the study. Starting from the issue of stationarity, which is necessary for the application of causality analysis, the chapter deals with a particular unit root test, the augmented Dickey-Fuller, and the model formation methodology developed by Caines, et al. (1981). Causality inferences, especially Granger-causality, is also handled in this chapter.

The fourth chapter is devoted to the empirical analysis and application of twin deficits story to the Turkish case. Based on the economic theory discussed in Chapter 2 and econometric grounds discussed in Chapter 3, this chapter makes use of the econometric techniques to analyze the theory. In the last part, there are some conclusive remarks pertaining to the study.

2 Economic Theory

2.1 The Concept of Twin Deficits

The term, *twin deficits*, is used to designate a parallel movement between two distinct variables. It is believed by many economists that the *twin deficits* concept aptly summarizes the recent relationship between fiscal policy and the US trade balance (Rosensweig and Tallman, 1991). In this study, this concept is tried to be assimilated to the Turkish case. It is, therefore, proper to use this term, within the context of this study, in such a way to reflect a parallel movement between the budget deficits and trade deficits of Turkey. To be consistent with the structure of existing data, a parallel movement between consolidated budget deficits and merchandise trade deficits is examined.

Budget deficits which inevitably put an upward pressure on real interest rates, causes an increase in the attractiveness of the economy to make investments, resulting in an inflow of capital, particularly for an *open* economy *large* enough to influence the whole world, like that of the USA. Foreign capital flows increase the value of the currency, giving rise to an increase of purchasing power of the domestic economy and a decrease of the same parity in external economies. This inevitably results in an increase of trade deficits. The whole thing may be summarized for a smaller and controlled economy in the following way: a higher budget deficit makes the interest rates rise; this results in appreciation of the exchange rate; an increase in the foreign exchange rate reduces net exports, hence gives rise to an increased trade deficit. This mechanism will partially be handled in detail in the coming sections.

2.2 Empirical Evidence from the US Economy

There is a conventional argument in the US that high federal budget deficits have been the prime *cause* of the escalating US trade deficits, particularly during 1980s (Darrat, 1988). Among a number of studies on US empirical evidence, Miller and Russek (1989) found evidence of a secular relationship between budget and trade deficits under two of the three statistical techniques that they have employed, whilst Bernheim (1988) estimated that the government deficit is a prime determinant of US trade deficits. Similarly, Rosensweig and Tallman (1991) showed that the evidence provided stronger and significant support for the twin deficits story. They ended up with a result suggesting that government deficits might have contributed to the large US trade deficits, particularly in 1980s and beyond.

Contrary to the results developed by Miller and Russek, Bernheim, and Rosensweig and Tallman, Dewald and Ulan (1990) asserted that there was no systematic association between the current account and budget balances when both were adjusted for inflation. In other words, there was no significant linkage between fiscal and current account balances. Evans (1989), and Lee and Enders (1990) found no such causal impact of fiscal deficits on merchandise trade deficits, either.

Darrat (1988), using a two-equation approach rather than a single-equation model in contrast to many other previous studies, found evidence of budget-to-trade deficit causality as well as a stronger evidence of trade-to-budget deficit causality. Abell (1990) also displayed somewhat mixed results.

2.3 The Theory of Interest Rates

2.3.1 The Determination of Interest Rates

Interest rates are determined in a theoretical framework which is mainly based on the IS-LM model, which can be regarded as the amalgamation of the theories of loanable funds and liquidity preference.

According to classical loanable funds theory, the rate of interest can be determined only by real forces, hence leaving no way to the monetary policy to be influenced. The productivity of capital and labour determines the demand for investment goods and hence the demand for loanable funds, whereas the savings rate in the economy provides the supply of loanable funds. The intersection of these supply and demand schedules determines the interest rate (Green, 1991).

In contrast, liquidity preference theory suggests that the rate of interest is determined by the supply and demand for money and can be directly influenced by monetary policy. While it can be argued that liquidity preference and loanable funds each constitute a complete theory of the rate of interest, these theories are *not* deemed to be complete as they do not take the influence of income on savings and on the demand for money into account (Green, 1991). Allowing for these influences yields the IS-LM model: the IS curve shows the locus of combinations of income and the rate of interest consistent with equilibrium in the market for loanable funds, and the LM curve depicts the combinations of the same variables that assure equality between the demand and supply for real balances, the production function and marginal condition for employment assumed to be satisfied (Sargent, 1979). In short, the LM curve gives the money market equilibrium conditions. The rate of interest and the aggregate income are determined as a result of the simultaneous equilibrium in these markets.

Basically, the IS curve may be represented by

$$I(r) = S(Y, W) \tag{2.1}$$

and, the LM curve by

$$M / P = L(Y, r, W) \tag{2.2}$$

where $W = M / P + D / r$ is private wealth, r is the real rate of interest, Y is the real income, P is the price level, M is the quantity of money and D is the number of bonds in existence. If these equations are solved for the interest rate under classical assumptions, i.e., income is fixed, one can end up with

$$\frac{dr}{dM} = 0 \tag{2.3}$$

and

$$\frac{dr}{dD} = \frac{S_w}{r\left[S_w D / r^2 + (1 - L_w)L_r - S_w L_r\right]} > 0 \tag{2.4}$$

where subscripts denote the variables with respect to which derivatives would be taken. Since $dr / dD \neq 0$, an open market operation can change the rate of interest because it alters portfolio balance, and hence the margin at which money and bonds are held.

The IS-LM equilibrium can be one with non-zero investment, a government budget surplus or deficit and a balance of payments current account surplus or deficit. Over time, the flows implied by these surpluses or deficits will accumulate respectively into changes in the capital stock, changes in the outstanding amount of government debt and changes in net foreign debt. The central features introduced by allowing for the cumulation of flows into stocks are the impact of increased wealth on aggregate demand and on the demand for money, and any increases in supply of interest-bearing assets. In general, these factors push up interest rates in the long run. Factors which reduce interest rates in the long run include any increases in the supply of money and the effect of higher wealth in increasing the demand for interest-bearing assets.

In general, given stable prices, monetized government deficits are associated with lower interest rates than non-monetized deficits. The underlying assumption in this assertion is that government bonds are counted as part of net private wealth.[1] When positive inflation rates are introduced into the analysis, outcomes are more complex to work out, but it remains true that changes in financing policies have permanent effects on interest rates.

---

1 See Barro (1974).

A related issue concerns the interaction between interest rates and the sustainability of a budget deficit. Given the deficit, if the authorities finance with bonds, they are committed to increased future interest payments which may rise as the rate of interest rises. This in turn makes it more difficult to reduce the size of the budget deficit in the future as interest payments swallow up part of the deficit reduction effort. Sargent and Wallace (1986) handle the sustainability issue by expecting a higher future inflation due to a current tight monetary policy, through the increase in debt payments which follow from bond financing, and because of a ceiling on the private sector's debt-to-income ratio.

Determinants of real interest rates can be divided into two main categories: shocks, from whatever source, which work solely by changing inflation expectations and shocks which work independently of changes of inflation expectations. The main sources of exogenous shocks are monetary and fiscal policies, portfolio (LM) shifts and shocks to aggregate demand (IS) and supply.

2.3.2 Empirical Work on Interest Rate Determination[2]

Empirical research on the level of interest rates has mostly involved either the construction of large-scale macromodels or the estimation of reduced forms. Small-scale structural models have been more widely used to study the structure of interest rates (Green, 1991).

Evans (1985) used a reduced form of a linear and purely contemporaneous relationship, in which nominal interest rates were designated as a function of government spending, deficit, money stock -all in real terms- and expected inflation rate. In his study for three different periods during which the federal deficit has exceeded 10 percent of national income, in contrast to standard macroeconomic theory, he found no evidence of an appreciable rise in interest rates for the US case. That analysis was extended back to 1858. Many other studies have supported Evans' work, whereas some others have had

---

2 See Green (1991) for a detailed survey of empirical work.

contradictory results (Tran and Sawhney, 1988; Cebula and Koch, 1989).

Cebula and Koch (1989)[3], criticizing previous studies for dealing with closed economic systems, added a real net capital inflow term to their reduced-form equation to determine the nominal long-term rate of interest. They obtained a result providing strong empirical evidence that federal budget deficits in the United States exercised a positive and significant influence over longer-term interest rates, in both of the analysis one of which neglected the capital inflow term whereas the other took care of it.

Tanzi and Lutz (1991) reached, among a number of conclusions, that growth in fiscal debt to GDP ratios would raise interest rates thus also reducing private sector investment.

2.4 Exchange Rate Determination

2.4.1 Some Definitions

The *exchange rate* is simply the price of foreign currency which clears the foreign exchange market (MacDonald and Taylor, 1991). Copeland (1989) refers to the exchange rate simply as a *price*. Briefly, it is the domestic currency price of foreign currency. Within the context of this definition, Copeland, denoting the exchange rate *S*, says

> ... a rise in *S* means a rise in the price of foreign exchange, hence a relative cheapening of the domestic currency, or a **depreciation**. Conversely, a fall in *S* implies a reduction in the number of units of

---

[3] Cebula and Koch (1989), as well as Green (1991), summarize many empirical studies on interest rates, particularly those related to the US case. In order to avoid being distracted from the topics that are central to my objectives, I am not dealing with the US in this study; only the methodology and structure of modelling is important in this frame. Therefore, one can refer to the papers in the bibliographies of the above-mentioned literature in order to have a detailed opinion on the US case of interest rate determination.

> domestic currency required to buy a unit of foreign exchange, that is, a rise in the relative value of the home country's money, or an **appreciation.** (1989: p. 4)

In the same text, he defines the *effective* or *trade-weighted exchange rate* of currency *A* as

> ... a weighted average of its exchange rate against currencies *B*, *C*, *D*, *E*... and so on. The weights used are usually the proportion of country *A*'s trade which involves *B*, *C*, *D*, *E*... respectively. (1989: p. 7)

If the level of the exchange rate is determined by the underlying balance of supply and demand for the currencies involved, with no outside intervention, it is called a *completely flexible* or *floating exchange rate* (Copeland, 1989).

2.4.2 Theories of Exchange Rate Determination

Based on the definition by MacDonald and Taylor (1991), it is quite obvious to make an assertion that theories of exchange rate determination differ only in their different specifications of the supply of and demand for foreign exchange. In this section, three models of exchange rate determination will be simply reviewed, namely, the monetary model, the Mundell-Fleming model, and the Dornbusch model.

2.4.2.1 The Monetary Model

The monetary model, employing a vertical aggregate supply curve, assumes that the demand for real balances is a stable function of only a few domestic macroeconomic variables, say simply the real national income and domestic price level, giving rise to the use of Cambridge quantity equation in the form

$$M^d = kPy \qquad k > 0 \qquad (2.5)$$

where y is the real national income and k is a positive parameter. With an additional assumption of all-times-obtains purchasing power parity, the equilibrium is obtained at a level of S at which

$$S = \frac{M_0^s}{kP^* y} \tag{2.6}$$

where M_0^s is the given money stock, and P^* is the foreign price level. In this frame, the exchange rate is the ratio of the money stock to the demand, measured at the foreign price level. Therefore, under a floating exchange regime, an increase in the domestic money supply leads to a depreciation of the same proportion in the value of the domestic currency, whereas a rise in either the domestic real income or in the foreign price level lead to an appreciation (Copeland, 1989).

If the role of interest rates is included in the analysis, it will be seen that the demand for real balances will be lower, at any given level of income, the higher are interest rates. It is, therefore, proper to propound that a rise in interest rates, *ceteris paribus*, will be associated with a depreciation in the domestic currency, given nominal money stocks and real incomes.

2.4.2.2 The Mundell-Fleming Model

The Mundell-Fleming model of exchange rate determination was that net excess demand for foreign exchange is just the overall balance of payments. Under a free float, this must be equal to zero in equilibrium. Combining this equilibrium condition with standard equilibrium conditions for the goods market (the IS curve) and the money market (the LM curve) then allows us to solve for the exchange rate and to determine the comparative static effects of fiscal and monetary policy.

Along with an assumption of a flat aggregate supply curve, the Mundell-Fleming model assumes that the purchasing power parity does not hold, that the exchange rate expectations are static, and that capital mobility is less than perfect (Copeland, 1989). This last assumption is a major innovation of the Mundell-Fleming model, integrating asset markets and capital mobility into open economy macroeconomics.

The effect of a fiscal expansion on the exchange rates in the Mundell-Fleming model is

$$\frac{de_t}{dG} = \frac{1-a^g}{(1+\bar{r}_f)B^p_{f,t-1} - \overline{D}^*}, \text{ for } dT_t = 0, \tag{2.7}$$

and

$$\frac{de_t}{dG} = \frac{-a^g}{(1+\bar{r}_f)B^p_{f,t-1} - \overline{D}^*}, \text{ for } dT_t = dG. \tag{2.8}$$

In this frame, $\overline{D}^*$ is the domestic currency value of the exogenously given foreign demand, $B^p_{f,t-1}$ is the level of initial debt, $\bar{r}_f$ is the world rate of interest, G is the government spending, e_t is the exchange rate and T_t is the tax collection.[4]

Since the price level is fixed by the flat aggregate supply curve, the increase in the nominal money stock is equivalent to a rise in the real money stock. Hence, a money supply increase in this model results in a depreciation in the exchange rate and a fall in the interest rate, provided capital is not completely mobile. A more relevant result to this study is that a fiscal expansion causes an appreciation in the exchange rate and a rise in the interest rate, under a floating exchange regime.

2.4.2.3 The Dornbusch Model

In the Dornbusch (1976) model, IS-LM model is assumed to prevail in the determination of aggregate demand. Moreover, financial markets adjust instantaneously. A third and the most important assumption is the stickiness of the price level, implying a horizontal aggregate supply curve in the immediate impact phase, which is increasingly steep in the adjustment phase, and ultimately vertical in long-run equilibrium.

The full set of equations, under these assumptions, in the simplified form by MacDonald and Taylor (1991) are

---

[4] In order to avoid being distracted from the topics that are central to the objectives of this study, no more emphasis is given to the issue and no more detail is provided in this text. For a more detailed analysis of the Mundell-Fleming model, see Frenkel and Rasin (1988).

$$\dot{s} = r - r^*$$ (2.9)

$$m - p = \phi \bar{y} - \lambda r$$ (2.10)

$$\dot{p} = \pi[\alpha + \delta(s - p) - \sigma r - \bar{y}],$$ (2.11)

the first equation reflecting the uncovered interest parity[5] condition, the second reflecting the condition for money market equilibrium and the third representing a Phillips curve, which relates the rate of change of prices to the excess demand over output supply. Demand is assumed to be a function of an autonomous component α, the real exchange rate and interest rates.

The long-run equilibrium requires that the rate of depreciation is zero, hence the long-run money market equilibrium is presented by

$$m - \bar{p} = \phi \bar{y} - \lambda r^*.$$ (2.12)

Subtracting the LM curve equation from this one,

$$p - \bar{p} = \lambda(r - r^*)$$ (2.13)

is obtained. Combining this with the UIRP condition, one can end up with

$$\dot{s} = \frac{1}{\lambda}(p - \bar{p}).$$ (2.14)

Concerning the goods market side, solving the LM curve and substituting into the Phillips curve yields

$$\dot{p} = \pi\left[\alpha + \delta(s - p) + \frac{\sigma}{\lambda}(m - p) - \left(1 + \frac{\sigma\phi}{\lambda}\right)\bar{y}\right]$$ (2.15)

or, in long-run zero inflation equilibrium

---

[5] Uncovered interest rate parity (UIRP) condition is stated in words by Copeland (1989) as follows:

> The domestic interest rate must be higher (lower) than the foreign interest rate by an amount equal to the expected depreciation (appreciation) of the domestic currency. (p. 86)

$$0 = \pi\left[\alpha + \delta(\bar{s} - \bar{p}) + \frac{\sigma}{\lambda}(m - \bar{p}) - \left(1 + \frac{\sigma\phi}{\lambda}\right)\bar{y}\right]. \qquad (2.16)$$

The combination of these two equations gives us

$$\dot{p} = \pi\delta(s - \bar{s}) - \pi\left(\delta + \frac{\sigma}{\lambda}\right)(p - \bar{p}). \qquad (2.17)$$

The Dornbusch model, in short, may be characterized by the assertion that a monetary expansion results in a domestic currency whose value is appreciating, but at a diminishing rate, a decreasing current account surplus, decelerating inflation and relatively low but rising interest rates (Copeland, 1989).

3 Econometric Grounds

3.1 Analysis of Time-Series

3.1.1 Stationarity

The precision of a time-series analysis heavily depends on the pre-examination of the stochastic properties of the available data in order not to cause some falsifying effects in future interpretation (Selçuk, 1993a; Selçuk, 1993b).

In a causality analysis, which will be discussed in coming sections, all series are assumed to be stationary (Darrat, 1988). A stochastic process is said to be *stationary*, if the joint and conditional probability distributions of the process are unchanged if displaced in time (Charemza and Deadman, 1992). Nevertheless, it is more practical to deal with the *weak sense* of stationarity, restricting attention to the means, variances and covariances of the process. In other words, a weakly stationary series has a constant mean and constant, finite variance (Cuthbertson et al., 1992). Mathematically, a stochastic process $\{X_t\}$ is said to be stationary if

$$E(X_t) = \text{constant} = \mu;$$

$$Var(X_t) = \text{constant} = \sigma^2;$$

and

$$Cov(X_t X_{t+j}) = \sigma_j.$$

In general, the statistical properties of regression analysis using non-stationary time series are dubious. If series are non-stationary, one is likely to finish up with a model showing promising diagnostic test statistics even in the case where there is no sense in the regression analysis (Charemza and Deadman, 1992). In this respect, a time-series must be checked up before use for whether it is stationary or not, and must be converted into a stationary process, if not. One way of converting a non-stationary series into a stationary one is to take difference (Cuthbertson et al., 1992). If the difference operator is to be shown by Δ, we can define the operation as

$$\Delta x_t = x_t - x_{t-1}. \tag{3.1}$$

3.1.2 Unit Roots and Orders of Integration

Cuthbertson et al. (1992) defines the order of integration in the following way:

> If a series must be differenced d times before it becomes stationary, then it is said to be integrated of order d, denoted $I(d)$. Thus, a series x_t is $I(d)$ if x_t is non-stationary but $\Delta^d x_t$ is stationary, where $\Delta x_t = x_t - x_{t-1}$, and $\Delta^2 = \Delta(\Delta x_t)$ etc. (p. 130)

The series then can be written as

$$(1-L)^d \phi(L) x_t = \theta(L) e_t \tag{3.2}$$

where L is the lag operator, $\phi(L)$ and $\theta(L)$ are polynomials in the lag operator and e_t is stationary process.

An appropriate method of testing the order of integration of a particular time-series is proposed by Dickey and Fuller (1979), which is called the *DF* test. This is called as the *unit root test* and is a test of the hypothesis that $\rho = 1$ in an equation

$$\Delta x_t = (1+\delta) x_{t-1} + \varepsilon_t \tag{3.3}$$

where $\rho = \delta + 1$. Rejection of the null hypothesis: $\delta = 0$ in favour of the alternative: $\delta < 0$ implies that $\rho < 1$ and that x_t is integrated of order zero.

A weakness of the Dickey-Fuller test is that it does not consider the autocorrelation in the error process (Charemza and Deadman, 1992), which may be falsifying in the analysis of a series of data. In order to overcome this problem, Dickey and Fuller (1981) have improved upon their own test technique and developed a new test, called as the *Augmented Dickey-Fuller* (*ADF*) test.

Considering the autoregressive representation of a variable x_t with a white noise, stationary error term in the form

$$x_t = \lambda_0 + \lambda_1 x_{t-1} + \lambda_2 x_{t-2} + \ldots + \lambda_{n+1} x_{t-n-1} + u_t \qquad (3.4)$$

along with the regression[6]

$$\Delta x_t = \beta_0 + \beta_1 x_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta x_{t-i} + u_t, \qquad (3.5)$$

we require $\beta_1 < 0$ for stationarity. If $\beta_1 = 0$ and the sum of autoregressive parameters λ_i is unity, the x_t is non-stationary.

Hence, testing for non-stationarity would be to estimate such a regression and to test the null hypothesis

$$H_o\colon \beta_1 = 0.$$

This could be done using the *t*-ratio of the term, which is called as the *Augmented Dickey-Fuller* statistic (*ADF*). Nevertheless, since the distribution of the *ADF* is not Student's *t* under the hypothesis of non-stationarity, Fuller's (1976; p. 373) approximate critical values, which are calculated by Monte Carlo methods, are used in the analysis.

At the second stage of analysis for the order of integration, one must also consider the regression

$$\Delta^2 x_t = \gamma_0 + \gamma_1 \Delta x_{t-1} + \sum_{i=1}^{n-1} \Psi_i \Delta^2 x_{t-i} + u_t, \qquad (3.6)$$

unless the data proves to be stationary. In order that $x_t \sim I(1)$, we should be able to reject the hypothesis $\gamma_1 = 0$ against the alternative $\gamma_1 < 0$.

This testing process is carried on, until the appropriate order of integration is obtained.

[6] It is possible to add a trend term to the equation depending on the existence of a trend in the time-series.

3.2 Model Selection Criteria[7]

One major problem confronted in the determination of the order of integration is to choose an appropriate lag length for regressions. In order to determine such a lag length for not causing misleading results, several criteria have been set forward.

3.2.1 The Coefficient of Determination

The coefficient of determination, adjusted for the number of explanatory variables is written as

$$\overline{R}^2 = 1 - \frac{T-1}{T-k} \cdot (1 - R^2). \tag{3.7}$$

Here, R^2 is the coefficient of determination, T is the number of observations and k is the number of explanatory variables (Charemza and Deadman, 1992: p. 293). The run among a number of regressions that gives the highest value of the adjusted coefficient of determination is chosen to be appropriate lag. In most of the studies, this criterion is no more used.

3.2.2 The Akaike Information Criterion (*AIC*)

This criteria is computed as

$$AIC = \frac{(-2 \cdot \ln L(\bullet) + 2 \cdot k)}{T} \tag{3.8}$$

where the "ln" term is the loglikelihood function of the estimated model. Other parameters remain the same as in the adjusted coefficient of determination. The idea behind the *AIC* criterion is to select the model which has the minimal loss of information (Charemza and Deadman, 1992: p. 293). In other words, the run that gives the smallest *AIC* is chosen among a number of regressions.

---

7 For a more detailed analysis of model selection criteria, see Judge, et al. (1988)

3.2.3 The Schwarz Bayesian Criterion (*SC*)

The Schwarz Criterion is

$$SC = \ln \hat{\sigma}^2 + \frac{k \cdot \ln T}{T} \tag{3.9}$$

where the first term is an unbiased estimate of the residual variance. Model selection is on the basis of choosing the model with the smallest *SC* value (Charemza and Deadman, 1992: p. 294).

3.2.4 The Final Prediction Error (*FPE*) Criterion

The *FPE* is based on forecasts made using actual rather than estimated values of explanatory variables for forecast periods and using parameter estimates for the entire sample, including that of the forecast period. It can be written as

$$FPE = \frac{T+k}{T-k} \cdot \hat{\sigma}^2. \tag{3.10}$$

Model selection is again on the basis of choosing the model with the smallest *FPE* value (Charemza and Deadman, 1992: p. 294).

3.2.5 Approach of Campbell and Perron

A different approach to the appropriate lag selection is rather a heuristic one developed by Campbell and Perron (1991). In this heuristic approach, an upper limit for the maximum number of lags is determined, say, $n = n_{max}$, and the regression is run with n_{max}. If the last included lag is significant, the appropriate lag length is determined to be n_{max}. Otherwise, the number of lags is reduced one-by-one until a significant lag coefficient is reached.

3.3 Development of a Model

As the appropriate lags are selected and unit root tests are applied accordingly, the time-series are transformed into covariance stationary processes by differencing up to a required order. At this stage, the model is started to be established.

In general, there are two practical approaches in setting up a model of more than one variables. The first one is a general-to-simple approach, that is, all variables with their lags are included in a huge model. After each run of regressions, the lag seeming to be the most insignificant is deleted from the model. This process is continued until ending up with a model comprising significant lags. One major question associated with this technique is that there may be a high *degrees of freedom* problem as there are a large number of variables using a limited number of observations (Caines, et al., 1981).

Hence, a second approach, a simple-to-general one, is used in some studies, which is also the method used in this analysis. In this method, each of the dependent variables are regressed on its own lags to determine the appropriate lag order. The equation may be written as

$$x_t = a_0 + a_1^h(L)x_t + e_t \qquad (3.11)$$

where L is the lag operator, $a_1(L)$ is a distributed lag polynomial in L and, h is the order of the lag, and e is the associated error term (Darrat, 1988).

The appropriate lag length is determined in accordance with one or a combination of more than one of the criteria described in the previous section. After the appropriate lag for the dependent variable itself is determined, bivariate regressions are estimated comprising the appropriate own lag, and the lags of each of the remaining variables considered separately. As the appropriate lags are determined for each of the variables, including the pre-determined appropriate lag length for the dependent variable, one of the variables is taken into the structural model with respect to the *specific gravity* criterion of Caines, et al. (1981).[8]

This process is continued until all the variables are included in the final equation, each with its appropriate lag selection (Darrat, 1988).

---

[8] Caines, et al. (1981: p. 278) describes the specific gravity of y^i with respect to X as the reciprocal of MFPE (X, y^i), where MFPE (X, y^i) is the multiple prediction error of the bivariate AR model for X and y^i. Then the causal variables variables y^i are ranked in the order of decreasing specific gravity.

All the remaining econometric analysis is performed on this model in accordance with the particular methodology that will be used.

3.4 Causality Inference

The general vector autoregression (*VAR*) model containing a large number of estimated coefficients can usually be reduced in size by eliminating those coefficients for which the hypothesis that they are jointly equal to zero cannot be rejected. In some situations, testing for zero coefficients can lead to economically significant results. Testing restrictions in a *VAR* model is made within the context of *causality analysis* (Charemza and Deadman, 1992).

The notion of causality is deemed to be a philosophical matter rather than a pure mathematical one (Simon, 1970; Charemza and Deadman, 1992). Nevertheless, only the mathematical aspect of this notion will be handled here.

Contemporary notions of causality comprise three major features (Charemza and Deadman, 1992):

- There is always a time difference between independent actions. Basing the assertion on this, one can say that there is no *instantaneous causation.*
- Because of the above-mentioned time difference, there is no *simultaneous causation*, either.
- The past and present may *cause* the future, but it is impossible that the future can *cause* the present.

Granger (1969), who has handled the issue in quite an operational way and who has also gave a role for *instantaneous causation*, provided a definition such that x is a *cause* of y, if present y can be predicted with better accuracy by using past values of x rather than by not doing so, other information being identical. Mathematically, if

$$\sigma^2\left(X|U\right) < \sigma^2\left(X|\overline{U-Y}\right), \tag{3.12}$$

Y is said to cause X, and denoted by $Y_t \Rightarrow X_t$ where U_t is all the information in the universe accumulated since time $t-1$ (Granger, 1969: p. 428).

Unfortunately, there is no generally accepted procedure accepted for testing for causality, partially because of a lack of a definition of this concept that is universally liked (Granger, 1980: p. 329).

In this study, Granger's definition and methodology for testing for causality will be used. Suppose that X_t and Y_t are two stationary time series with zero means. The causal model is

$$X_t = \gamma_0 D_t + \sum_{j=1}^{m} \alpha_j X_{t-j} + \sum_{j=1}^{m} \beta_j Y_{t-j} + \varepsilon_t \qquad (3.13)$$

where $\gamma_0 D_t$ denotes the deterministic part of the equation such as intercept, deterministic trend or seasonals.

It is possible to add up a new term and look for instantaneous causality in Granger's analysis. Then, the above equation takes the form

$$X_t + \beta_0 Y_t = \gamma_0 D_t + \sum_{j=1}^{m} \alpha_j X_{t-j} + \sum_{j=1}^{m} \beta_j Y_{t-j} + \varepsilon_t . \qquad (3.14)$$

If $\beta_1 = \beta_2 = \ldots = \beta_k = 0$ in equation (3.13), then Y does not Granger cause X. A test for testing this restriction would be an F test or the Lagrange Multiplier LM test. For Lagrange Multiplier test, two different test statistics may be used. The first one is

$$LM = T \cdot R_0^2, \qquad (3.15)$$

which under the null has a $\chi^2(k)$ distribution, or:

$$LMF = \frac{T-h}{k} \cdot \frac{R_0^2}{1-R_0^2}, \qquad (3.16)$$

which under the null hypothesis has an $F(k,(T-h))$ distribution (Charemza and Deadman, 1992). Here T is the sample size and h is the number of variables in (3.13) including those for the variable D_t.

4 Empirical Analysis for Twin Deficits Hypothesis in Turkey

4.1 Some Empirical Evidence from the Turkish Economy

In 1980s, Turkey has undergone a reword structural adjustment. An average annual growth rate of 6.06 % for 1986-90 era was accompanied with several interrelated constraints in the economy, particularly under the economic conditions prevailing in 1987. Celâsun (1990) explains these constraints pertaining

> ... mainly to firstly, persistantly large fiscal deficits, which are increasingly financed by high-yield government securities, and secondly, excessively high interest rates, which threaten stability in the financial system, and inhibit new private investment in export-oriented activities, such as manufacturing, which relied on improved rates of capacity utilization in the 1980-87 period. (p.38)

This view is supported by Anand et al. (1990) for 1980-1986; that is, large fiscal deficits were paid by maintaining high real rates of interest restraining private consumption and private investment expenditure, creating more room for fiscal deficits for any external balance target. Indeed, some like Rodrik (1990) have gone further to classify this fiscal imbalance being the weakest aspect of Turkish macroeconomic management in the 1980s.

The overall adjustment in the 1980s started with large price corrections to reduce the deficits of the State Economic Entreprises, promote exports and stimulate financial savings. After a steep initial devaluation and switch to positive real interest rates for time deposits, flexible exchange rate and industrial price policies were adopted.

However, large fiscal deficits, exchange rate adjustments, and non-competitive pricing in industrial and financial markets appear to be the major underlying factors for persistent inflationary pressures (Celâsun, 1990).

After 1980, adoption of an actively managed, flexible exchange rate system was put into use under the trade liberalization program. Real depreciation of Turkish lira has considerably conributed to the increased exports and restrained import demand, particularly in 1980-86 period (Baysan and Blitzer, 1990). Nevertheless, 1987-92 period witnessed a 9.36 per cent real appreciation, starting from 80.49 at the end of December 1986, reaching a peak level of 96.19 in January 1991 and ending at 88.02 at the end of December 1992 (Selçuk, 1993c).

Given the observed strength of domestic demand growth in 1986, the authorities planned to reduce the public sector borrowing requirement (PSBR) from 4.7 per cent of GNP in that year to 4.1 per cent of GNP in 1987. They were not successful in this; the PSBR, instead of falling, rose to 7.8 per cent of GNP, the highest since 1980, due to the financial burden of a series of elections. Meanwhile, fast expenditure growth and lagging revenue receipts, the so-called consolidated budget government deficit rose from 3.6 per cent of GNP in 1986 to 4.2 per cent in 1987. It was financed by directly Central Bank credit and the net issue of Treasury bills and bonds.

Economic policies in 1988 and 1989 aimed at achieving the national plan target of real GNP growth of 5 per cent and a marked reduction of inflation. A reduction of the PSBR was planned from 7. 8 per cent in 1987 to 6 per cent in 1988 and to 5 per cent in 1989. The 1988 target was, to a great extent, reached with 6.2 per cent, whereas the target for 1989 was 7.2 per cent of the GNP, due to an increase in the consolidated budget and extra-budgetary funds including State economic entreprises in the process of privatisation. For 1990, the target was 5 per cent of GNP, which was then revised to 6 per cent. However, the actual value was 10.5 per cent of the GNP. The government aimed at reducing the PSBR to 7.5 per cent in 1991, far below an actual value of 14.4 per cent. 1992 estimate was 12.6 per cent, significantly higher than the planned 8.8 per cent. The public sector borrowing requirements for the period of study are presented in Table 4.1.

Table 4.1

Public Sector Borrowing Requirements

	1986	1987	1988	1989	1990	1991	1992[1]
Public sector deficit/GNP	-4.7	-7.8	-6.2	-7.2	-10.5	-14.4	-12.6
General government	-1.3	-3.6	-3.4	-4.6	-5.2	-10.0	-9.7
Central government	-3.6	-4.5	-4.0	-4.5	-4.2	-7.4	-7.3
Local administrations	0.3	-0.6	-0.5	-0.3	-0.3	-0.6	-0.4
Revolving funds	0.4	0.8	0.3	0.5	0.4	-0.2	-0.3
Extra-budgetary funds[2]	2.2	0.7	0.7	-0.3	-1.2	-1.8	-1.7
SEEs	-3.4	-4.2	-2.8	-2.6	-5.3	-4.4	-3.0

Notes: 1. Estimate made in October 1992.
2. Including State economic entreprises in the process of privatisation

Sources: OECD Economic Surveys: Turkey 1987/1988; 1989/1990; 1990/1991; 1991/1992; 1993.

1987 was a year when Turkish export markets remained subdued on average. The merchandise exports rose 29 per cent in real terms, with 52 per cent increase in manufactured exports, due to the increase in export incentives via tax rebates, concessional credits and a real effective devaluation of the lira by 2.26 per cent. But briefly, the export performance may have depended on support from other incentives, apart from a depreciating real exchange rate, which tend to lower costs in the domestic currency (OECD, 1988).

Due to differential growth of exports and imports and improvement of the terms of trade, the trade deficit fell substantially, from $3.2 billion in 1987 to $1.8 billion in 1988 due to the near-stagnation of imports as a consequence of fiscal tightening (OECD, 1990). However, the improvement in the trade balance was temporary until the domestic demand began to grow more strongly. For 1990, the trade deficit appears to have increased to a level more than $9 billion, after a $4.2 billion in 1989 (OECD, 1991).

Growth of merchandise exports in volume terms was little more than 2 per cent in 1990, after its stagnation in 1989. But in 1991, growth of exports again slowed down. Much of this disappointing performance of exports may be related to the real affective exchange rate appreciation. The real appreciation reflected the combined effect of a high nominal interest rate differential between Turkey and abroad and capital market liberalisation, which encouraged short-term capital inflows (OECD, 1992; p.29).

1992 export value seems to be significantly greater than 1991 value, helped by the real depreciation of the Turkish lira since mid-1991. During this period, exports of manufactured goods are estimated to have increased by about 16 per cent in volume (OECD, 1993).

The exports and imports are presented in Table 4.2, as well as the trade balance and exports/imports ratio.

Table 4.2

Exports and Imports (million $)

	1986	1987	1988	1989	1990	1991	1992[1]
Trade balance	-3081	-3229	-1800	-4219	-9555	-7326	-7144
Exports (fob)[2]	7583	10322	11846	11780	13026	13672	13359
Imports (cif)[2]	-10664	-13551	-13646	15999	-22581	-20998	-20503
Exports/Imports (%)	71.1	76.2	86.8	73.6	57.7	65.1	65.2

Notes: 1. November 1992 figures.
2. Including transit trade.

Sources: OECD Economic Surveys: Turkey 1987/1988; 1989/1990; 1990/1991; 1991/1992; 1993.

4.2 Variables Used in the Model and Data Sources

There are mainly five variables used in this study, namely, *BUDGET*, *TRADE*, *TWIN*, *MIPI* and *RIR*.

BUDGET represents the monthly consolidated budget deficit of Turkey. Since the remaining part of the total budget deficit is formed by the finance of the losses of State Economic Enterprises, funds and local governments and since data pertaining these items are collected annually, consolidated budget deficit is chosen proper to be used in the analysis. But rather than using net consolidated budget deficit (monthly collections of consolidated budget revenues less monthly expenditures of consolidated budget), the ratio of these two items are taken, that is, the variable *BUDGET* shows to what extent the monthly collections of consolidated budget revenue meet the monthly expenditures of consolidated budget. Briefly,

$$BUDGET = \frac{\text{monthly collections of consolidated budget revenues}}{\text{monthly expenditures of consolidated budget}}$$

where the data was collected from January 1990, January 1992 and August 1993 issues of the *Main Economic Indicators, Turkey* published by T. R. Prime Ministry State Planning Organization.

Using the same reasoning, *TRADE* represents the ratio of monthly total exports in *FOB* values to monthly imports in *CIF* values. Briefly,

$$TRADE = \frac{\text{exports (FOB)}}{\text{imports (CIF)}}$$

where the data was obtained directly from T. R. Central Bank, Research, Planning and Training Department.

TWIN represents a trade-weighted real exchange rate calculated by Selçuk (1993c). The data is converted into natural logarithmic form before usage in the analysis.

MIPI is the monthly industry producer index. Since GNP data is collected quarterly, and since industrial production forms a highly significant share of total GNP, *MIPI* is preferred to be used. It is obtained directly from the T. R. Prime Ministry State Institute of Statistics (SIS), Press and Information Department. The data is converted into natural logarithmic form before usage in the analysis.

RIR is the real interest rate calculated as

$$RIR = \frac{IR - WSPI}{1 + WSPI}$$

where *IR* is the 1-year domestic debt average interest rate obtained from March 1993 issue of the *Main Economic Indicators, Turkey* published by the T. R. Treasury and Foreign Trade Undersecretary, and *WSPI* is the wholesale price indices percentage change over the same month of previous year index calculated by the State Institute of Statistics. It is obtained from January 1990 and February 1993 issues of the *Main Economic Indicators, Turkey* published by T. R. Prime Ministry State Planning Organization.

The complete set of data comprises the period starting from January 1987 and ending at December 1992, making a total of 72 samples. The reason for not going back far is the controlled structure of interest rates before 1987. For *WSPI* data, the index 1981=100 is used for years 1987 and 1988, whilst for the rest of the period, 1987=100 is used because of lack of a complete time-series calculated using one particular base year. This will make negligible difference in the analysis.

4.3 Stochastic Properties of the Time-Series

In order to determine the order of integrations of the time series, unit root tests are used in the way explained in Section 3.1.2. For the determination of appropriate lag lengths, the Schwarz Bayesian criterion (*SC*), the Final Prediction Error (*FPE*) criterion and the approach by Campbell and Perron are used in a combinatory fashion. In most of the regressions these three criteria gave significantly different results. In such cases, the heuristic approach by Campbell and Perron is preferred. Reason for using *SC* and *FPE* rather than two other afore-mentioned methods is that the computer package *PC-GIVE Version 6.01* (Hendry, 1989) provides only these two statistics.

The appropriate lags for the unit root tests are found to be 11 for *BUDGET* in 12 regressions of the relevant equation with a constant, 7 for *TRADE* for an equation with a constant, 1 for *TWIN* for an equation with a constant, 12 for *MIPI* for an equation with a constant and a trend, and 8 for *RIR* for an equation with a constant. Relevant *SC*, *FPE* and *t*-values which are significant are presented in Appendix-A.

Using equations (3.5) and (3.6), all variables except *RIR* are found to be integrated of order 1. *RIR* is found to be integrated of order 2. The results of the unit root tests are presented in Table 4.3. The *t*-values are compared to -3.58, -2.93 and -2.60 for a sample size of 50, and to -3.51, -2.89 and -2.58 for a sample size of 100 at 0.01, 0.05 and 0.10 significance levels, respectively (Fuller, 1986: p. 373).

Table 4.3

Unit Root (Augmented Dickey-Fuller) Test Results

Variables	***I*(0)**		***I*(1)**	
	β_1	**ADF**	γ_1	**ADF**
BUDGET	-0.59856	-1.33583	-8.18488	-3.55968
TRADE	-0.23402	-1.52387	-3.16021	-5.02120
TWIN	-0.06070	-1.87868	-0.63922	-4.58117
MIPI	-0.77317	-1.81388	-6.59256	-3.61029
RIR	-0.11840	-1.59971	-1.44719	-2.73421

Source: Fuller (1986) and own calculations

As would easily be seen from Table 4.3, *RIR* is integrated of order 1, if a significance level of 0.10 is used. However, for convenience, an integration of order 2 is preferred, since the difference of a stationary time-series is also stationary.

As a brief remark for this section, one can say that all series except *RIR* are stationary at their first differences, whilst *RIR* is stationary at its second difference. Therefore, before using the available time-series, the first differences of the variables *BUDGET*, *TRADE*, *TWIN* and *MIPI* are taken, whereas the second difference of the variable *RIR* is taken.

4.4 Causality Tests for Two-Variable Models

Twin deficits story tries to set up a relation between the budget deficits and merchandise trade deficits. Therefore, there may be a two-sided causality between these two variables. The aim of this study is to detect a mutual causality between the budget deficits and trade deficits in Turkey. Nevertheless, in this section, a possible causality only starting from the budget deficits towards the trade deficits is handled within the context.

Considering all these aspects, various combinations of variables are regressed on each other to detect causality between them, in this section. The analysis is to end at trade deficits, and aims at linking up each stage of the twin deficits mechanism.

Based on the theory explained in Section 2.3.1, the budget deficits are supposed to have a considerable effect on interest rates. Similarly, the theory on exchange rate determination suggests a positive correlation between fiscal expansion and real exchange rates. Meanwhile, trade deficits may simply be affected by changes in budget deficits, real interest rates and total industrial production as well as by real exchange rates.

In order to detect such causality inferences between any two variables, equation (3.13) with 12 lags and the *LMF* criterion stated in equation (3.16) are used. At 0.05 significance level, all of the six hypotheses that all coefficients of the lags of the causing variable are zero are rejected. Nevertheless, at 0.01 level, *BUDGET* seems to Granger-cause *RIR*, and *TWIN* and *MIPI* can be said to Granger-cause *TRADE*. At this level of significance, other causality inferences fail to be rejected, i.e.,

$$\beta_1 = \beta_2 = ... = \beta_k = 0.$$

The test results are summarized in Table 4.4. The detailed results of each of the autoregressive-distributed lag models are presented in Appendix-B.

As a result of the causality analysis presented in this section, a significant causality between the consolidated budget deficits and real interest rates, starting from the former towards the latter, has been found. With a *LMF* value of 7.59, the hypothesis is rejected for both 0.05 and 0.01 significance levels. This shows a parallel movement between the budget deficits and real interest rates, which is consistent with the afore-mentioned theory, i.e., in case of an increased budget deficit, real interest rates must be increased to such an attractive level that the deficit can be financed by either foreign or domestic debt. This is also consistent with the findings of Celâsun (1990), Anand et al. (1990) and Rodrik (1990).

Table 4.4

One-Sided Causality Inferences

Causality	*LMF*	Tabulated *F*-ratio		Inference	
		$\alpha = 0.05$	$\alpha = 0.01$	$\alpha = 0.05$	$\alpha = 0.01$
BUDGET ⇒ *RIR*	7.59	2.07	2.80	R.	R.
BUDGET ⇒ *TWIN*	2.09	2.06	2.78	R.	F. to R.
BUDGET ⇒ *TRADE*	2.66	2.06	2.78	R.	F. to R.
RIR ⇒ *TRADE*	2.42	2.07	2.80	R.	F. to R.
TWIN ⇒ *TRADE*	2.88	2.06	2.78	R.	R.
MIPI ⇒ *TRADE*	3.30	2.06	2.78	R.	R.

Note: R. - reject, F. to R. - fail to reject

Source: Charemza and Deadman (1992) and own calculations

Closing the deficit by foreign debt is common in Turkey, but not through high interest rates; in other words, higher real interest rates are not the main reason for foreign capital inflows. Capital inflows, mostly in the form of foreign direct investment, have increased during 1980s because of the incentives and new regulations by the government under the structural adjustment programs, but not by high interest rates as in the case of US (SPO, 1987). The above-mentioned regulations have abandoned the restrictive and discriminative applications (Treasury, 1990). Among these are:

- An inflow of foreign capital with a minimum level of $50000 is left free,
- There is no percentage limit on the share of the foreign shareholder,
- The foreign investor is free to transfer his/her divident, the dues on his/her share and the cash amount in case of shut-down to a foreign country,
- It is possible to employ foreign personnel during the investment and management stages.

The regulations in 1990 contributed to foreign capital inflow by loosing the limit of transfer that is subject to the consent of Council of Ministers (from 50 million $ to 150 million $).

The causality between budget deficits and real exchange rates seems not to be that strong as it is in the previous case. Even at 0.05 significance level, this causality is of debate, with a critical *LMF* value of 2.09 in comparison to a tabulated value of 2.06. Analyzing at this significance level, government budget deficits can be said to have an effect in the determination of the real exchange rates.

Coming to the causality between real interest rates and merchandise trade deficits, a similar outcome is reached, that is, real interest rates affect trade deficits only at 0.05 significance level, with a *LMF* value of 2.42 greater than a tabulated value of 2.07.

The results suggest that both real exchange rates and manufacturing industry producer index affect trade deficits even at 0.01 significance level, which is an expected outcome consistent with the theory.

The Granger-causality analysis, in this frame, suggests that the mechanism in the twin-deficits hypothesis starting from the consolidated budget deficits ending at merchandise trade deficits through real interest rates, real exchange rates and total production in the economy (approximated by the manufacturing industry producer index here) is completed. In other words, at 0.05 significance level, an increased consolidated budget deficit *indirectly* affects the trade deficits through its effects on real interest rates and real effective exchange rates.

These one-sided causality inferences do not provide detailed information about the correlations, except the existence of a possible one. Briefly, simultaneous effects of different variables on any one of the variables, either budget deficits or trade deficits, are not handled in this section. Rather, it is the purpose of the following two sections to examine the causality in such a detailed fashion.

4.5 Construction of the *Complete Model*

At this stage of the study, the aim is the construction of a complete model of trade deficits (exports/imports) and budget deficits (revenues/expenses) such that all variables are included. The first attempt is to regress the variable *TRADE* on its own lags in order to determine the appropriate lag. This autoregressive model is of the form:

$$TRADE_t = a_0 + a_1^h(L)TRADE + e_t \qquad (4.1)$$

where L is the lag operator, $a_1(L)$ is a distributed lag polynomial in L, h is the order of the lag and e is the associated error term. *BUDGET* is regressed on its own lags in the same way. Varying h from 1 to 12 (assuming the highest lag order to be 12 months), a series of autoregressions are estimated and the appropriate lag is selected using the *FPE* criterion, i.e., the lag giving the smallest *FPE* value is chosen. For *TRADE*, the appropriate lag is found to be 7.

Once the appropriate lag for *TRADE* is determined, bivariate regressions are estimated comprising the own lag, 7, and the lags of each of the remaining variables considered separately. Determining the appropriate lag specifications by the previous methodology, the variable which has the minimum *FPE* value (specific gravity criterion) at its appropriate lag is taken into the *TRADE* equation first. In this study, the first variable to enter the equation is *MIPI* with 4 lags.

At this stage, trivariate regressions are estimated in order to determine which variable will be taken into the equation with what lag next. The methodology used is the same. As a result, the following equation is obtained for *TRADE*:

$$\begin{aligned} TRADE_t = a_0 + a_1^7(L)TRADE &+ a_2^4(L)MIPI \\ &+ a_3^1(L)RIR + a_4^2(L)TWIN \\ &+ a_5^2(L)BUDGET + e_t \end{aligned} \tag{4.2}$$

where the superscripts in the coefficients of variables show the number of lags of the related variable that would be used in the complete equation. Explicitly, the coefficient of the variable *TWIN* implies that the first two lags of the real exchange rates would be used in the *TRADE* equation.

The appropriate lag selection procedures for *TRADE* are explicitly shown in Appendix-C.

In the same way, the equation for *BUDGET* is determined in the following form:

$$\begin{aligned} BUDGET_t = b_0 + b_1^{11}(L)BUDGET &+ b_2^9(L)RIR \\ &+ b_3^2(L)TRADE + b_4^1(L)MIPI \\ &+ b_5^1(L)TWIN + u_t \end{aligned} \tag{4.3}$$

4.6 Solution of the Models and Some Inferences

In order to determine the effects of each variable on *TRADE* and *BUDGET*, equations (4.2) and (4.3) are estimated independently by simple regression, *OLS*.

For equation (4.2), the *TRADE* equation, it is easy to observe that the first, third, fourth and seventh own lags are significant. Among the 4 lags of *MIPI* included in the regression, only the last one is significant. The one and only lag of *RIR* seems to be insignificant, whilst the second lag of *TWIN* is significant, a satisfactory result compatible with the theory. *BUDGET* seems not to be a significant variable in explaining *TRADE*.

Box 4.1

The *TRADE* Equation

TRADE =	- .364 *TRADE*1 (.13071)	- .144 *TRADE*2 (.13149)	- .245 *TRADE*3 (.13342)
	- .222 *TRADE*4 (.12995)	- .146 *TRADE*5 (.13835)	- .193 *TRADE*6 (.13889)
	- .231 *TRADE*7 (.12452)	+ .070 *MIPI*1 (.14900)	- .207 *MIPI*2 (.16660)
	+ .233 *MIPI*3 (.15751)	+ .292 *MIPI*4 (.14390)	- .321 *RIR*1 (.26670)
	+ .515 *TWIN*1 (.54034)	- .965 *TWIN*2 (.55587)	+ .044 *BUDGET*1 (.05660)
	+ .079 *BUDGET*2 (.05604)	- .006 (.01093)	

R^2 = .4536738, σ = .0854796,
F(16, 47) = 2.44 [.0091], DW = 2.192
RSS = .3434177591 for 17 Variables and 64 Observations.

For equation (4.3), the *BUDGET* equation, the first 6 lags as well as the eleventh lag of *BUDGET* itself are significant. *RIR* also presents significant lags except the second and the fourth. An interesting result is that *TRADE* behaves as an explanatory variable for *BUDGET* in its second lag. *MIPI* and *TWIN* have insignificant explanatory power in the whole model.

The final form of the estimations are presented in Boxes 4.1 and 4.2. The numbers in parentheses represent the standard error terms.

4.7 Results and Some Interpretations

In the previous section, the analysis is made so as to detect a two-sided causality. For this reason, two different equations, namely

TRADE and *BUDGET*, are regressed on the variables defined in Section 4.2.

The *TRADE* equation provides results consistent with the theory. The only significant lag of the variable *MIPI*, manufacturing industry producer index, with a positive coefficient of 0.292, tells that an increase in total production results in an increase in the exports/imports ratio with a 4-month lag.

Box 4.2

The *BUDGET* Equation

BUDGET =	- 1.091 *BUDGET*1	- 1.362 *BUDGET*2	- 1.141 *BUDGET*3
	(.14292)	(.20898)	(.24222)
	- .996 *BUDGET*4	- .694 *BUDGET*5	- .497 *BUDGET*6
	(.25882)	(.27884)	(.28765)
	- .464 *BUDGET*7	- .349 *BUDGET*8	- .119 *BUDGET*9
	(.28792)	(.28192)	(.23872)
	- .244 *BUDGET*10	- .301 *BUDGET*11	+ 1.675 *RIR*1
	(.17435)	(.10812)	(.56964)
	+ .886 *RIR*2	+ 1.920 *RIR*3	+ 1.261 *RIR*4
	(.79519)	(.85517)	(.86967)
	+ 2.497 *RIR*5	+ 2.485 *RIR*6	+ 3.533 *RIR*7
	(.97299)	(.95408)	(.98551)
	+ 2.365 *RIR*8	+ 1.184 *RIR*9	- .216 *TRADE*1
	(.82961)	(.60695)	(.21769)
	- .431 *TRADE*2	- .084 *MIPI*1	- .100 *TWIN*1
	(.22400)	(.23401)	(.80963)
	- .014		
	(.01511)		

R^2 = .8609099, σ = .1119758

F(24, 35) = 9.03 [.0000], DW = 1.987

RSS = .4388499544 for 25 Variables and 60 Observations

Real interest rates have no significant effect on trade balance, which also seems to be reasonable. As already mentioned, in an economy like that of the US, an increase in real interest rates attracts foreign capital, hence resulting in a capital inflow. This increases the demand for the domestic currency and, therefore, the currency appreciates. The common result of this is an increase in exports and decrease in imports. However, it is impossible to set such a linkage in the Turkish economy, i.e., the foreign capital does not flow to Turkey for the sake of high real interest rates. In this respect, real interest rates and trade balance can be said to be not related directly.

The most important result that would be derived from this equation is the effect of real exchange rates on the trade deficit. As would be seen from the equation, the second lag of the variable *TWIN* is significant with a negative coefficient. This means that an increase in the real effective exchange rate, simply an appreciation, results in a decrease in exports/imports ratio with a 2-month lag, or visa versa. In all these respects, it is seen that the 9.49 per cent appreciation of the real exchange rate in 1987-92 period has resulted in the slight deterioration of the exports/imports ratio.

The equation implies that there is no direct significant effect of budget deficit on trade deficit, since none of the coefficients of the variable *BUDGET* are significant. But rather, it has some effect through other variables as mentioned in Section 4.4.

All four significant own lags of the *TRADE* equation have negative effects on the current trade deficit. An econometric interpretation would be that a unit increase in the exports/imports ratio of the last month causes 0.36 units decrease in the current trade deficit.

The *BUDGET* equation may be interpreted similarly. While the real exchange rates and manufacturing industry producer index as an approximation to the total production in the economy have no significant effect on the budget deficit, seven different lags of the real interest rates have significant effect on it. The pertaining interpretation to this may be that the government expenditures, given the tax revenues, are increased in order to compensate the decrease in the aggregate demand originated from the decreases in consumption and investments due to higher real interest rates, or visa versa.

According to the regression of the *BUDGET* equation, the second lag of *TRADE* seems to affect the budget deficit, i.e., a unit increase in the exports/imports ratio is accompanied, two months later, by a decrease in the revenues/expenditures with a coefficient of 0.431. This seems not to be a valid result, if we would like to think in terms of the relationship between trade balance and domestic production. More briefly, a larger trade deficit may harm the domestic manufacturing industries leading to unemployment and losses in foreign market share. Moreover, the agricultural sector may be facing a serious financial crisis due to the weak trade performance and high credit interest costs. The financial burden of these two may be consciously overtaken by the government and may result in a significant fiscal expansion. However, the only reasonable explanation for the negative correlation between the two variables may be that a relatively higher increase in imports in comparison to exports may increase government revenues in the form of tariffs more significantly, whereas less significant effect due to a change in total exports is felt.

5 Concluding Remarks and Suggestions for Further Research

The purpose of this thesis was to examine possible existence of a causality between the Turkish consolidated budget deficit in the form of *to what extent revenue collections meet expenses* and the merchandise trade balance in the form *to what extent exports meet imports*. Evidence was obtained through causality testing that the twin deficits are connected through the transmission mechanisms of interest rates and exchange rates.

Using vectorautoregressive model, support is found for the notion that budget deficits influence trade deficits indirectly rather than directly. The univariate Granger-causality tests have shown that budget deficits have influence on both real interest rates and real exchange rates. It is also evident that the real exchange rates have a significant effect on the trade deficits, a consistent result with the theoretical propositions. However, the multivariate analysis does not provide any factual inference that budget deficits directly causes trade deficits.

Meanwhile, trade deficits seem to have a direct influence on budget deficits. A reasonable explanation given in the literature for this is that large trade deficits may harm domestic manufacturing industries leading to unemployment and losses in foreign market share. Moreover, the agricultural sector may be facing with serious financial crisis due to the weak trade performance. The financial burden of this may be consciously overtaken by the government and may result in a significant fiscal expansion. However, the negative sign of this correlation is not in favour of this view.

The shortness of the data period used in this analysis may be falsifying. Although there are enough number of observations (72) which do not create any degrees of freedom problem within the context of an econometric analysis, the total period covered may be short for a detailed macroeconomic analysis. However, the whole period had to be only 6 years, since the only way to increase the number of observations is to use monthly data. Therefore, yearly fluctuations in the series could not be examined. It is, unfortunately, impossible to move the analysis to older periods since there are strict jumps in real interest rates before 1987, which will inevitably produce meaningless outcomes. As the number of years increases, this study will give more accurate results.

A more detailed analysis may be done by using numerous techniques of econometrics in addition to the ones used in this study. A better approach may be using Full Information Likelihood (*FIML*) technique, which enables one to examine the two equations for *TRADE* and *BUDGET* simultaneously taking simultaneity biases into consideration. Another approach may be developing a new model starting from sophisticated cointegration techniques.

References

ABELL, JOHN D. "Twin Deficits during the 1980s: An Empirical Investigation," *Journal of Macroeconomics*, Winter 1990, *12*(1), pp. 81-96.

ANAND, RITU, CHHIBBER, AJAY AND VAN WIJNBERGEN, SWEDER. "External Balance and Growth in Turkey: Can They Be Reconciled?" in *The Political Economy of Turkey: Debt, Adjustment and Sustainability*. Eds.: TOSUN ARICANLI AND DANI RODRIK. London: Macmillan, 1990, pp. 157-82.

BARRO, ROBERT J. "Are Government Bonds Net Wealth?" *Journal of Political Economy*, 1974, *82*(6), pp. 1095-1117.

BAYSAN, TERCAN AND BLITZER, CHARLES. "Turkey's Trade Liberalization in the 1980s and Prospects for its Sustainability," in *The Political Economy of Turkey: Debt, Adjustment and Sustainability*. Eds.: TOSUN ARICANLI AND DANI RODRIK. London: Macmillan, 1990, pp. 9-36.

BERNHEIM, B. DOUGLAS. "Budget Deficits and the Balance of Trade," in *Tax Policy and the Economy*. Ed.: LAWRENCE H. SUMMERS. Cambridge, MA: MIT Press, 1988.

CAINES, P. E., KENG, C. W. AND SETHI, S. P. "Causality Analysis and Multivariate Autoregressive Modelling with an Application to Supermarket Sales Analysis," *Journal of Economic Dynamics and Control*, August 1981, *3*, pp. 267-98.

CAMPBELL, JOHN Y. AND PERRON, PIERRE. "Pitfalls and Opportunities: What Macroeconomists Should Know About Unit Roots," in *NBER Macroeconomics Annual 1991*. Cambridge, MA: MIT Press, 1991.

CEBULA, RICHARD J. AND KOCH, JAMEŞ V. "An Empirical Note on Deficits, Interest Rates, and International Capital Flows," *Quarterly Review of Economics and Business*, Autumn 1989, *29*(3), pp. 121-27.

CELÂSUN, MERİH. "Fiscal Aspects of Adjustment in the 1980s," in *The Political Economy of Turkey: Debt, Adjustment and Sustainability*. Eds.: TOSUN ARICANLI AND DANI RODRIK. London: Macmillan, 1990, pp. 37-59.

CHAREMZA, WOJCIECH W. AND DEADMAN, DEREK F. *New Directions in Econometric Practice*. Worcester: Edward Elgar, 1992.

COPELAND, LAURENCE S. *Exchange Rates and International Finance*. Wokingham: Addison-Wesley, 1989.

CUTHBERTSON, KEITH, HALL, STEPHEN G. AND TAYLOR, MARK P. *Applied Econometric Techniques*. New York: Philip Allan, 1992.

DARRAT, ALI F. "Have Large Budget Deficits Caused Rising Trade Deficits?" *Southern Economic Journal*, Apr. 1988, *54*, pp. 879-87.

DEWALD, WILLIAM G. AND ULAN, MICHAEL. "The Twin-Deficit Illusion," *Cato Journal*, Winter 1990, *9*(3), pp. 689-707.

DICKEY, DAVID A. AND FULLER, WAYNE A. "Distributions of the Estimators for Autoregressive Time Series with a Unit Root," *Journal of the American Statistical Association*, 1979, *74*, pp. 427-31.

_____. AND ______. "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root," *Econometrica*, July 1981, *49*(4), pp. 1057-72.

DORNBUSCH, RUDIGER. "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, 1976, *84*(6), pp. 1161-76.

EVANS, PAUL. "Do Large Deficits Produce High Interest Rates?" *American Economic Review*, March 1985, *75*(1), pp. 68-87.

_____. "Do Budget Deficits Affect the Current Account?" Working Paper. Columbus, Ohio: Ohio State University, July 1989.

FELDERER, BERNHARD AND HOMBURG, STEFAN. *Macroeconomics and New Macroeconomics*. Berlin, Heidelberg: Springer-Verlag, 1987.

FRENKEL, JACOB A. AND RAZIN, ASSAF. "The Mundell-Fleming Model a Quarter Century Later: A Unified Exposition," *IMF Staff Papers*, 1988, ..., pp. 567-620.

FULLER, WAYNE A. *Introduction to Statistical Time Series*. New York: John Wiley and Sons, 1976.

GRANGER, C. W. J. "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," *Econometrica*, July 1969, *37*(3), pp. 424-38.

______. "Testing for Causality-A Personal Viewpoint," *Journal of Economic Dynamics and Control*, 1980, *2*, pp. 329-52.

GREEN, CHRISTOPHER J. "The Determination of Interest Rates and Asset Prices: A Survey of Theory and Evidence," in *Surveys in Monetary Economics*. Eds.: CHRISTOPHER J. GREEN AND D. T. LLEWELLYN. Oxford: Basil Blackwell, 1991, ch. 2, pp. 74-149.

HENDRY, DAVID F. *PC-GIVE: An Interactive Econometric Modelling System*. Institute of Economics and Statistics and Nuffield College: University of Oxford, 1989.

JUDGE, GEORGE G., HILL, R. CARTER, GRIFFITHS, WILLIAM E., LÜTKEPOHL, HELMUT AND LEE, TSOUNG-CHAO. *Introduction to the Theory and Practice of Econometrics*, Second Edition. New York: John Wiley and Sons, 1988.

LEE, BONG-SOO AND ENDERS, WALTER. "Current Account and Budget Deficits: Twins or Distant Cousins?" *The Review of Economics and Statistics*, August 1990, *72*(3), pp. 373-381.

MACDONALD, RONALD AND TAYLOR, MARK P. "Exchange Rate Economics," in *Surveys in Monetary Economics*. Eds.: CHRISTOPHER J. GREEN AND D. T. LLEWELLYN. Oxford: Basil Blackwell, 1991, ch. 3, pp. 150-224.

MILLER, STEPHEN M. AND RUSSEK, FRANK S. "Are the Deficits Really Related?" *Contemporary Policy Issues*, 1989, *7*(4), pp. 91-115.

OECD. *OECD Economic Surveys: Turkey 1987/1988*. Paris: OECD, 1988.

______. *OECD Economic Surveys: Turkey 1989/1990*. Paris: OECD, 1990.

______. *OECD Economic Surveys: Turkey 1990/1991*. Paris: OECD, 1991.

______. *OECD Economic Surveys: Turkey 1991/1992*. Paris: OECD, 1992.

______. *OECD Economic Surveys: Turkey 1993*. Paris: OECD, 1993.

RODRIK, DANI. "Some Policy Dilemmas in Turkish Macroecenomic Management," in *The Political Economy of Turkey: Debt, Adjustment and Sustainability*. Eds.: TOSUN ARICANLI AND DANI RODRIK. London: Macmillan, 1990, pp. 183-98.

ROSENWEIG, JEFFREY A. AND TALLMAN, ELLIS W. "Fiscal Policy and Trade Adjustment: Are the Deficits Really Twins?," Working Paper 91-2. Atlanta, Georgia: Federal Reserve Bank of Atlanta, March 1991.

SARGENT, THOMAS J. *Macroeconomic Theory*. New York: Academic Press, 1979.

______ AND WALLACE, NEIL. "Some Unpleasant Monetarist Arithmetic," in *Rational Expectations and Inflation*. Ed.: THOMAS J. SARGENT. New York: Harper and Row, 1986, ch. 5, pp. 158-90.

SELÇUK, FARUK. "Testing for Unit Roots: Bayesian Approach versus Classical Tests," *METU Studies in Development*, 1993a, forthcoming.

______. "Currency Substitution in Turkey," mimeographed, 1993b.

______. "Monetary Shocks and Real Exchange Rates in Turkey," mimeographed, 1993c.

SIMON, J. L. "The Concept of Causality in Economics," *Kyklos*, 1970, *23*, pp. 226-52.

TANZI, VITO AND LUTZ, MARK S. "Interest Rates and Government Debt: Are the Linkages Global Rather than National?" Working Paper 91-6. IMF, January 1991.

T.R. PRIME MINISTRY STATE PLANNING ORGANIZATION. *Report on Foreign Capital (1983-1986)*. April 1987.

______. *Main Economic Indicators, Turkey*. January 1990, pp. 72, 101.

______. *Main Economic Indicators, Turkey*. January 1992, p. 72.

______. *Main Economic Indicators, Turkey*. February 1993, p. 101.
______. *Main Economic Indicators, Turkey*. August 1993, p. 72.
T.R. PRIME MINISTRY TREASURY AND FOREIGN TRADE SECRETARY. *Foreign Capital*. unpublished manuscript, 1990.
______. *Main Economic Indicators, Turkey*. March 1993, p. 19.
TRAN, DANG T. AND SAWHNEY, BANSI L. "Government Deficits, Capital Flows, and Interest Rates," *Applied Economics*, 1988, *20*, pp. 753-65.

Appendix-A

Appropriate Lag Selection for Unit Root Tests

TABLE A1. Selection of Lag for *BUDGET*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)	t-value*
12	-3.247292	0.023968	
11	-3.298921	0.023619	-1.82532
10	-3.185577	0.027443	
9	-3.202023	0.027998	
8	-3.234963	0.028087	
7	-3.286092	0.020568	
6	-3.270498	0.029105	
5	-3.321417	0.028643	
4	-3.359232	0.028547	
3	-3.432766	0.027441	
2	-3.446876	0.027980	
1	-3.521449	0.026843	

* Provided for the highest significant lag at 95% significance level (t =1.671).

TABLE A2. Selection of Lag for *TRADE.*

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)	t-value*
12	-4.156913	0.009651	
11	-4.141409	0.010171	
10	-4.210668	0.009846	
9	-4.287839	0.009453	
8	-4.360368	0.009115	
7	-4.341458	0.009627	-1.69981
6	-4.324283	0.010146	
5	-4.343544	0.010307	
4	-4.412842	0.009954	
3	-4.439376	0.010029	
2	-4.5134491	0.009630	
1	-4.572882	0.010052	

* Provided for the highest significant lag at 95% significance level (t =1.671).

TABLE A3. Selection of Lag for *TWIN.*

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)	t-value*
12	-6.944044	0.023968	
11	-7.034086	0.023619	
10	-7.050806	0.027443	
9	-7.069081	0.027998	
8	-7.148907	0.028087	
7	-7.204357	0.020568	
6	-7.285836	0.029105	
5	-7.364649	0.028643	
4	-7.393047	0.028547	
3	-7.469492	-7.050806	
2	-7.515608	0.027980	
1	-7.588993	0.026843	3.43247

* Provided for the highest significant lag at 95% significance level (t =1.671).

TABLE A4. Selection of Lag for *MIPI*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)	t-value*
12	-5.065597	0.003764	1.83466
11	-5.056534	0.003940	
10	-4.833409	0.005110	
9	-4.902283	0.004947	
8	-4.917655	0.005051	
7	-4.995129	0.004845	
6	-4.934228	0.005335	
5	-4.899635	0.005720	
4	-4.978230	0.005474	
3	-5.046508	0.005290	
2	-5.054802	0.005427	
1	-5.101585	0.005354	

* Provided for the highest significant lag at 95% significance level (t =1.671).

TABLE A5. Selection of Lag for *RIR*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)	t-value*
12	-6.353851	0.001073	
11	-6.409487	0.001053	
10	-6.238761	0.001296	
9	-6.330796	0.001226	
8	-6.350254	0.001246	2.28847
7	-6.327591	0.001312	
6	-6.378956	0.001300	
5	-6.414088	0.001300	
4	-6.490635	0.001246	
3	-6.486254	0.001295	
2	-6.541231	0.001268	
1	-6.617408	0.001214	

* Provided for the highest significant lag at 95% significance level (t =1.671).

Appendix-B

Univariate Granger-Causality Regressions

Table B1. *BUDGET* ⇒ *RIR* Inference

Variable	Coefficient	Std. Error	*t*-Value	Partial-R^2
RIR 1	-.96095	.16593	-5.79113	.5040
RIR 2	-.76017	.24754	-3.07091	.2223
RIR 3	-.80571	.28057	-2.87169	.1999
RIR 4	-1.06305	.32974	-3.22384	.2395
RIR 5	-.85004	.38386	-2.21447	.1294
RIR 6	-.69785	.41957	-1.66323	.0773
RIR 7	-.42516	.41890	-1.01493	.0303
RIR 8	-.01908	.42953	-.04442	.0001
RIR 9	.02376	.38278	.06207	.0001
RIR 10	-.06021	.33968	-.17725	.0010
RIR 11	.08688	.26343	.32980	.0033
RIR 12	.18605	.17824	1.04380	.0320
BUDGET 1	-.02231	.04506	-.49515	.0074
BUDGET 2	-.03417	.06096	-.56050	.0094
BUDGET 3	.01925	.07882	.24421	.0018
BUDGET 4	.02455	.08997	.27288	.0023
BUDGET 5	.00755	.09288	.08133	.0002
BUDGET 6	.02532	.08854	.28597	.0025
BUDGET 7	.00550	.08615	.06388	.0001
BUDGET 8	-.01744	.08311	-.20978	.0013
BUDGET 9	-.06007	.07512	-.79973	.0190
BUDGET10	-.03227	.06157	-.52410	.0083
BUDGET11	-.04126	.05022	-.82152	.0200
BUDGET12	-.05713	.03555	-1.60712	.0726
CONSTANT	.00163	.00445	.36676	.0041

$R^2 = .7401408$ $\sigma = .0309842$ F(24, 33) = 3.92 [.0002] DW = 2.024
RSS = .0316806030 for 25 Variables and 58 Observations
Information Criteria: SC = -5.762303; HQ = -6.304483; FPE = .001374
R^2 Relative to DIFFERENCE+SEASONALS = .88422

TABLE B2. *BUDGET* ⇒ *TWIN* Inference

Variable	Coefficient	Std. Error	*t*-Value	Partial-R^2
TWIN 1	.30598	.16621	1.84088	.0906
TWIN 2	.02419	.17121	.14129	.0006
TWIN 3	.00904	.16511	.05475	.0001
TWIN 4	.03757	.18177	.20666	.0013
TWIN 5	-.26451	.16534	-1.59975	.0700
TWIN 6	.05027	.17111	.29375	.0025
TWIN 7	.07243	.16785	.43148	.0054
TWIN 8	-.05483	.17338	-.31626	.0029
TWIN 9	-.04118	.17313	-.23788	.0017
TWIN 10	.06656	.17533	.37965	.0042
TWIN 11	-.10704	.18738	-.57121	.0095
TWIN 12	.13670	.20761	.65845	.0126
BUDGET 1	-.01254	.02923	-.42907	.0054
BUDGET 2	-.03178	.03397	-.93546	.0251
BUDGET 3	-.01784	.04464	-.39965	.0047
BUDGET 4	-.00793	.05132	-.15445	.0007
BUDGET 5	-.00038	.05815	-.00654	.0000
BUDGET 6	.00981	.06031	.16264	.0008
BUDGET 7	.05107	.06183	.82592	.0197
BUDGET 8	.07712	.05938	1.29874	.0473
BUDGET 9	.10385	.05558	1.86829	.0931
BUDGET10	.10902	.04638	2.35073	.1398
BUDGET11	.07629	.03754	2.03225	.1083
BUDGET12	.03891	.02647	1.46959	.0597
CONSTANT	.00172	.00312	.55076	.0088

R^2 = .4323270 σ = .0226642 F(24, 34) = 1.08 [.4122] DW = 1.869
RSS = .0174647030 for 25 Variables and 59 Observations
Information Criteria: SC = -6.397341; HQ = -6.934015; FPE = .000731
R^2 Relative to DIFFERENCE+SEASONALS = .31437

TABLE B3. *BUDGET* ⇒ *TRADE* Inference

Variable	Coefficient	Std. Error	*t*-Value	Partial-R^2
TRADE 1	-.58616	.17809	-3.29136	.2416
TRADE 2	-.14341	.20940	-.68485	.0136
TRADE 3	-.12698	.20778	-.61115	.0109
TRADE 4	-.19654	.19809	-.99215	.0281
TRADE 5	-.13518	.19354	-.69844	.0141
TRADE 6	-.25439	.17477	-1.45556	.0587
TRADE 7	-.32975	.16633	-1.98247	.1036
TRADE 8	-.29969	.17509	-1.71168	.0793
TRADE 9	-.22516	.17301	-1.30146	.0475
TRADE 10	-.10191	.17553	-.58056	.0098
TRADE 11	-.09584	.17397	-.55087	.0088
TRADE 12	-.05391	.16136	-.33409	.0033
BUDGET 1	-.02194	.11315	-.19389	.0011
BUDGET 2	-.00097	.15047	-.00644	.0000
BUDGET 3	.02351	.19050	.12344	.0004
BUDGET 4	.05428	.21612	.25115	.0019
BUDGET 5	.21050	.23524	.89484	.0230
BUDGET 6	.26217	.25258	1.03795	.0307
BUDGET 7	.29113	.26176	1.11220	.0351
BUDGET 8	.25677	.26281	.97702	.0273
BUDGET 9	.03468	.24304	.14270	.0006
BUDGET10	-.00961	.19940	-.04819	.0001
BUDGET11	-.04110	.14821	-.27731	.0023
BUDGET12	-.08421	.09771	-.86190	.0214
CONSTANT	-.00640	.01249	-.51236	.0077

$R^2 = .4916896$ $\sigma = .0902503$ $F(24, 34) = 1.37$ [.1960] DW = 1.963
RSS = .2769340055 for 25 Variables and 59 Observations
Information Criteria: SC = -3.633743; HQ = -4.170418; FPE = .011596
R^2 Relative to DIFFERENCE+SEASONALS = .76757

TABLE B4. *RIR* ⇒ *TRADE* Inference

Variable	Coefficient	Std. Error	*t*-Value	Partial-R^2
TRADE 1	-.58810	.18128	-3.24412	.2418
TRADE 2	-.14618	.20018	-.73026	.0159
TRADE 3	-.11404	.20097	-.56745	.0097
TRADE 4	-.28172	.19791	-1.42343	.0578
TRADE 5	-.32907	.19942	-1.65015	.0762
TRADE 6	-.30863	.18872	-1.63541	.0750
TRADE 7	-.34118	.19361	-1.76215	.0860
TRADE 8	-.33453	.18994	-1.76120	.0859
TRADE 9	-.02839	.20148	-.14090	.0006
TRADE 10	-.12537	.18621	-.67328	.0136
TRADE 11	-.30920	.18590	-1.66322	.0773
TRADE 12	-.06764	.17485	-.38686	.0045
RIR 1	-.44914	.53943	-.83261	.0206
RIR 2	-.14387	.73636	-.19538	.0012
RIR 3	-.30901	.86266	-.35821	.0039
RIR 4	-.90248	.93627	-.96391	.0274
RIR 5	-.73710	1.04384	-.70614	.0149
RIR 6	-.74321	1.11581	-.66607	.0133
RIR 7	-1.03688	1.12418	-.92234	.0251
RIR 8	-1.23654	1.05311	-1.17418	.0401
RIR 9	-1.22679	.93601	-1.31066	.0495
RIR 10	-.57392	.83439	-.68784	.0141
RIR 11	-.33362	.68281	-.48860	.0072
RIR 12	-.14586	.46723	-.31218	.0029
CONSTANT	-.00792	.01283	-.61720	.0114

R^2 = .4760487 σ = .0929595 F(24, 33) = 1.25 [.2728] DW = 1.902
RSS = .2851684419 for 25 Variables and 58 Observations
Information Criteria: SC = -3.564927; HQ = -4.107108; FPE = .012366
R^2 Relative to DIFFERENCE+SEASONALS = .76066

TABLE B5. *TWIN* ⇒ *TRADE* Inference

Variable	Coefficient	Std. Error	*t*-Value	Partial-R^2
TRADE 1	-.56883	.17261	-3.29540	.2421
TRADE 2	-.21980	.20153	-1.09065	.0338
TRADE 3	-.27689	.21054	-1.31515	.0484
TRADE 4	-.53614	.20854	-2.57094	.1628
TRADE 5	-.46974	.20810	-2.25731	.1303
TRADE 6	-.43358	.17743	-2.44358	.1494
TRADE 7	-.38081	.18935	-2.01111	.1063
TRADE 8	-.39668	.20072	-1.97628	.1030
TRADE 9	-.24099	.22124	-1.08924	.0337
TRADE 10	-.34615	.21550	-1.60621	.0705
TRADE 11	-.43672	.19279	-2.26530	.1311
TRADE 12	-.22099	.15894	-1.39043	.0538
TWIN 1	.32984	.68934	.47849	.0067
TWIN 2	-.99355	.73284	-1.35575	.0513
TWIN 3	-.81847	.72147	-1.13445	.0365
TWIN 4	.06922	.74550	.09285	.0003
TWIN 5	-.71567	.69852	-1.02455	.0299
TWIN 6	-.29871	.72156	-.41398	.0050
TWIN 7	.51784	.71210	.72719	.0153
TWIN 8	-.63523	.74464	-.85307	.0210
TWIN 9	.24997	.74928	.33361	.0033
TWIN 10	-1.13949	.72461	-1.57255	.0678
TWIN 11	.21207	.73847	.28717	.0024
TWIN 12	-.14073	.72722	-.19352	.0011
CONSTANT	-.00654	.01198	-.54574	.0087

R^2 = .5118265 σ = .0884446   F(24, 34) = 1.49 [.1422]   DW = 2.108
RSS = .2659631740   for 25 Variables and 59 Observations
Information Criteria: SC = -3.674165; HQ = -4.210839; FPE = .011137
R^2 Relative to DIFFERENCE+SEASONALS = .77678

TABLE B6. *MIPI ⇒ TRADE* Inference

Variable	Coefficient	Std. Error	*t*-Value	Partial-R^2
TRADE 1	-.62069	.16273	-3.81414	.2997
TRADE 2	-.16063	.19749	-.81334	.0191
TRADE 3	-.01373	.21605	-.06356	.0001
TRADE 4	-.21055	.19223	-1.09532	.0341
TRADE 5	-.12398	.19135	-.64793	.0122
TRADE 6	-.15485	.17461	-.88686	.0226
TRADE 7	-.28538	.17123	-1.66661	.0755
TRADE 8	-.18732	.17890	-1.04710	.0312
TRADE 9	-.16869	.17938	-.94038	.0254
TRADE 10	-.13932	.18040	-0.77232	.0172
TRADE 11	-.19279	.16110	-1.19671	.0404
TRADE 12	-.17399	.14405	-1.20785	.0411
MIPI 1	.17603	.26907	.65424	.0124
MIPI 2	-.11634	.30916	-.37633	.0041
MIPI 3	.02287	.29076	.07867	.0002
MIPI 4	.15572	.29547	.52702	.0081
MIPI 5	-.14342	.30580	-.46899	.0064
MIPI 6	-.15642	.28851	-.54216	.0086
MIPI 7	-.32614	.28270	-1.15366	.0377
MIPI 8	-.29686	.27962	-1.06164	.0321
MIPI 9	-.38346	.27004	-1.42001	.0560
MIPI 10	-.09021	.27859	-.32382	.0031
MIPI 11	.05272	.28833	.18285	.0010
MIPI 12	.24310	.25580	.95033	.0259
CONSTANT	-.00423	.01514	-.27900	.0023

R^2 = .5455714 σ = .0853330 F(24, 34) = 1.70 [.0761] DW = 2.126
RSS = .2475785022 for 25 Variables and 59 Observations
Information Criteria: SC = -3.745795; HQ = -4.282469; FPE = .010367
R^2 Relative to DIFFERENCE+SEASONALS = .79221

Appendix-C

Constructing the *TRADE* Model

TABLE C1. Appropriate Lag Selection for *TRADE*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-4.208780	0.009474
11	-4.194118	0.009977
10	-4.255479	0.009734
9	-4.329661	0.009373
8	-4.365087	0.009719
7	-4.393464	0.009117
6	-4.314208	0.010593
5	-4.316109	0.010947
4	-4.396182	0.010458
3	-4.416565	0.010599
2	-4.481613	0.010268
1	-4.498996	0.010428

* The appropriate lag for *TRADE* is chosen to be 7.

TABLE C2. Appropriate Lag Selection for *TRADE* and *BUDGET*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-3.887383	0.010423
11	-3.949418	0.010105
10	-4.003196	0.009883
9	-4.072301	0.009522
8	-4.138800	0.009202
7	-4.042411	0.010470
6	-4.104973	0.010166
5	-4.167020	0.009878
4	-4.236047	0.009535
3	-4.272555	0.009509
2	-4.341198	0.009187
1	-4.386708	0.009084

* The appropriate lag for *BUDGET* is chosen to be 8 with 7 lags of *TRADE*.

TABLE C3. Appropriate Lag Selection for *TRADE* and *TWIN*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-3.818177	0.011170
11	-3.885847	0.010769
10	-3.950976	0.010413
9	-4.017875	0.010055
8	-4.065050	0.009907
7	-4.062445	0.010263
6	-4.130782	0.009907
5	-4.199880	0.009559
4	-4.253671	0.009368
3	-4.320060	0.009068
2	-4.369076	0.008934
1	-4.387196	0.009080

* The appropriate lag for *TWIN* is chosen to be 2 with 7 lags of *TRADE*.

TABLE C4. Appropriate Lag Selection for *TRADE* and *MIPI*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-4.016376	0.009162
11	-4.046971	0.009166
10	-4.100700	0.008965
9	-4.162793	0.008698
8	-4.095225	0.009612
7	-4.152812	0.009376
6	-4.220312	0.009058
5	-4.274357	0.008873
4	-4.342259	0.008574
3	-4.317433	0.009092
2	-4.384408	0.008798
1	-4.434849	0.008657

* The appropriate lag for *MIPI* is chosen to be 4 with 7 lags of *TRADE*.

TABLE C5. Appropriate Lag Selection for *TRADE* and *RIR*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-3.703498	0.012469
11	-3.769143	0.02046
10	-3.834057	0.011651
9	-3.892460	0.011348
8	-3.946669	0.011105
7	-4.016365	0.010703
6	-4.081841	0.010363
5	-4.141492	0.010099
4	-4.190041	0.009949
3	-4.259851	0.096001
2	-4.329151	0.009270
1	-4.398748	0.008951

* The appropriate lag for *RIR* is chosen to be 1 with 7 lags of *TRADE*.

TABLE C6. Appropriate Lag Selection for *TRADE*, *MIPI* and *BUDGET*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-3.710433	0.011047
11	-3.775996	0.010648
10	-3.844816	0.010237
9	-3.910488	0.009879
8	-3.969931	0.009597
7	-3.945894	0.010141
6	-4.002590	0.009889
5	-4.064887	0.009593
4	-4.098136	0.009584
3	-4.165772	0.009255
2	-4.233014	0.008944
1	-4.274671	0.008870

* The appropriate lag for *BUDGET* is chosen to be 1 with 7 lags of *TRADE* and 4 lags of *MIPI*.

TABLE C7. Appropriate Lag Selection for *TRADE*, *MIPI* and *TWIN*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-3.717855	0.010965
11	-3.784038	0.010563
10	-3.851036	0.010174
9	-3.914404	0.009840
8	-3.974417	0.009554
7	-4.042626	0.009206
6	-4.044563	0.009482
5	-4.113031	0.009142
4	-4.144145	0.009153
3	-4.212950	0.008829
2	-4.271911	0.008603
1	-4.274384	0.008872

* The appropriate lag for *TWIN* is chosen to be 2 with 7 lags of *TRADE* and 4 lags of *MIPI*.

TABLE C8. Appropriate Lag Selection for *TRADE, MIPI* and *RIR*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-3.645427	0.011734
11	-3.710490	0.011316
10	-3.770121	0.010979
9	-3.812749	0.010841
8	-3.876246	0.010491
7	-3.945388	0.010099
6	-4.003053	0.009840
5	-4.072409	0.009480
4	-4.123373	0.009306
3	-4.185903	0.009034
2	-4.243199	0.008819
1	-4.311524	0.008518

* The appropriate lag for *RIR* is chosen to be 1 with 7 lags of *TRADE* and 4 lags of *MIPI.*

TABLE C9. Appropriate Lag Selection for *TRADE, MIPI, RIR* and *BUDGET.*

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-3.719548	0.010643
11	-3.788437	0.010218
10	-3.857356	0.009816
9	-3.926423	0.009435
8	-3.990163	0.009122
7	-3.987438	0.009431
6	-4.004922	0.009560
5	-4.059234	0.009344
4	-4.088153	0.009373
3	-4.155608	0.009046
2	-4.222895	0.008749
1	-4.263402	0.008676

* The appropriate lag for *BUDGET* is chosen to be 1 with 7 lags of *TRADE,* 4 lags of *MIPI* and 1 lag of *RIR.*

TABLE C10. Appropriate Lag Selection for *TRADE*, *MIPI*, *RIR* and *TWIN*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-3.670053	0.011183
11	-3.736218	0.010766
10	-3.803576	0.010359
9	-3.870651	0.009976
8	-3.936258	0.009627
7	-4.005172	0.009265
6	-4.007797	0.009532
5	-4.075473	0.009194
4	-4.110677	0.009164
3	-4.178592	0.008843
2	-4.232472	0.008658
1	-4.263224	0.008678

* The appropriate lag for *TWIN* is chosen to be 2 with 7 lags of *TRADE*, 4 lags of *MIPI* and 1 lag of *RIR*.

TABLE C11. Appropriate Lag Selection for *TRADE*, *MIPI*, *RIR*, *TWIN* and *BUDGET*.

Lag	Schwarz Criteria (SC)	Final Prediction Error (FPE)
12	-3.633640	0.010987
11	-3.696512	0.010596
10	-3.763730	0.010183
9	-3.832792	0.009775
8	-3.894887	0.009455
7	-3.884496	0.009839
6	-3.914698	0.009837
5	-3.977127	0.009529
4	-4.008068	0.009530
3	-4.076202	0.009187
2	-4.145312	0.008852
1	-4.164155	0.008972

* The appropriate lag for *BUDGET* is chosen to be 2 with 7 lags of *TRADE*, 4 lags of *MIPI*, 1 lag of *RIR* and 2 lags of *TWIN*.