Opposites Attract:

The Case of Greek and Turkish Financial Markets

By[♣]

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Opposites Attract:
The Case of Greek and Turkish Financial Markets

Abstract

We investigate the presence of financial linkages between Turkey and Greece. In particular, we estimate bivariate vector error correction systems between the Greek and Turkish stock markets and then between the Greek Drachma and the Turkish Lira to test for long and short run causality and interdependence. The findings indicate that interdependence and a long-run causal relationship are indeed present. Given the apparent evidence for nominal linkages, we test a number of possible propagation mechanisms that could produce these linkages, such as real linkages, trade linkages, common balance of payments shocks, and contagion. Our findings suggest that the observed comovement of the two markets can be primarily attributed to the increased real integration of both countries, as well as the fact that they share a common set of trade and FDI partners. We also find evidence of contagion effects between the Drachma and Lira markets, but not between the stock markets. Finally, we conclude with a discussion of the implications of our findings.

Keywords: Cointegration, Contagion, Interdependence, and Market Linkages.

1. Introduction

The empirical literature on the transmission of financial shocks has defined interdependence as the presence of cross-market linkages in financial returns (Rigobon, 1999; Rigobon and Forbes, 1999). Linkages that tie markets together should ultimately result in their comovement. This study is a first attempt to investigate the extent to which the Turkish and Greek financial markets are interdependent. In particular, we address the following questions:

- Is there long-term financial interdependence between Turkish and Greek markets in the sense that the equilibrium for the Turkish (Greek) financial market depends on the equilibrium for the Greek (Turkish) market?
- Is there short-term interdependence between Turkish and Greek financial markets? In other words, do short-term fluctuations in one market spill over to the other?
- What is the direction of causality (in the Granger (1969) sense) between the two financial markets? Can we identify one market as being the 'cause' and the other the 'effect'?

The Greek and Turkish markets might be linked because of their geographical proximity, trade and foreign direct investment linkages, common macroeconomic shocks, or contagion. These questions are addressed by focusing on a set of two key financial variables: stock market indices and exchange rates.[1] Initially, we test whether there are any linkages present between the general indices of the Istanbul Stock Exchange (hereafter, ISE) and the Athens Stock Exchange (hereafter, ASE). Then we test for the presence of any linkages between the Turkish Lira (hereafter, TL) and the Greek Drachma (hereafter, GD).

There is a scant literature on the two emerging markets (Greece and Turkey). All the available work focuses on the individual stock markets, examining a variety of issues, such as market efficiency, behaviour of returns, volatility, and wealth effects.[2] There is no study that integrates the two literatures. We extend this literature in two directions. First, we provide initial evidence from foreign exchange markets. Second, we merge the two separate literatures on the stock market.

This paper is organized as follows. In the next section we explain our methodology and, in Section 2, we present our empirical findings. In Section 3 we examine the potential sources of financial market linkages between the Turkish and Greek markets, while we discuss policy implications of our findings in Section 4. Section 5 concludes the paper.

2. Econometric Methodology: Cointegration

To test for long-run financial linkages between Turkey and Greece, we employ the Johansen procedure (Johansen, 1988, 1991, 1995). Short-run linkages are investigated using a vector error-correction model (VECM), which allows us to test for temporal causal chains (in the Granger sense) linking the variables. Cointegration, as an 'equilibrium' concept, implies that there must be some causation between the cointegrated series to provide the necessary dynamics for attaining this equilibrium (Granger, 1986, 1988). In other words, stationary linear combination(s) of the data in levels must Granger-cause the change in at least one of the cointegrated variables. A closely related issue is that of exogeneity (see Ericsson, 1992 and Engle et. al., 1983).

In the context of cointegrated systems there exists a direct interpretation (or a definition rather) of the notions of weak and strong exogeneity in terms of the parameters of the VECM. In the context of cointegrated systems weak exogeneity (also usually called[3] *Long-Run Granger non-causality*) is a long run notion of

exogeneity implying that the long run relations are block triangular. Weak exogeneity means no long-term feedback (insignificance of the speed of adjustment coefficients) towards the relevant (say the *i*th) variable exists and implies a 'weak' form of Granger non-causality. Finally, weak exogeneity of a variable in conjunction with absence of Granger-causality in the short run (insignificance of the differences) establishes strong exogeneity for that particular variable.

2.1 Data Issues and Stationarity tests

The analysis employs the closing prices of the Istanbul Stock Exchange and the Athens Stock Exchange general indices, expressed in domestic currency, and the Turkish Lira and Greek Drachma dollar exchange rates. Exchange rate series are sampled monthly from 1986:03 to 2000:12 providing 178 observations. Stock market indices are available only from 1988:10 to 2000:12 providing 147 observations.

Prior to testing for cointegration we conducted unit root tests (Dickey and Fuller, 1979, 1981; Phillips and Perron, 1988) for the series[4]. As expected, the null of non-stationarity is not rejected for the levels of all four series implying that standard asymptotic theory cannot be applied. In contrast, the null of non-stationarity was rejected for the first differences of the series leading to the conclusion that all four series are integrated of order one [I(1)]. These results are rather commonplace and therefore are not reported for space considerations, but they are available upon request.

3. Empirical Results

The finding that the series are I(1) allows one to use the Johansen procedure. The Johansen procedure is known to be sensitive to deviations from 'whiteness' in the residuals. In particular, autocorrelation has adverse effects on inference. For that reason the lag length was chosen to guarantee absence of autocorrelation.

Additionally, a vector of dummy variables is included to account for periods of excessive turbulence or systemic shocks that might distort the estimation and inference[5]. Table 1 summarizes the tests for the cointegration rank of the bivariate systems (stock markets/exchange rates), which we have restricted to include a constant in the cointegration space[6], based on the Johansen test procedure. The systems dynamics are of order six for the stock markets system and four for the exchange rates. Applying a battery of multivariate autocorrelation tests and univariate heteroscedasticity tests, we establish residual 'whiteness' in both the exchange rates and stock markets systems.

[Table 1]

As far as the cointegration rank of the bivariate systems is concerned, both the maximum eigenvalue and trace statistics in Table 1 indicate that there exists one cointegration vector in each of the two bivariate systems. In particular, the null of no cointegration was rejected in both cases, whereas the null that the cointegration rank of each system is one was not possible to reject at the 5% level of significance. Given the presence of one cointegration vector between each of the two pairs of variables we conclude that there exists one common stochastic trend between them. In other words, the ISE and ASE price indices share a common stochastic trend, as do the TL and GD. On the basis of this evidence, we cannot reject the hypothesis that a long run dynamic linkage between the Turkish and Greek financial markets exists.

The finding of cointegration implies that the two financial markets exhibit long run interdependence. The restricted cointegration analysis delivers the following estimates of the long-run error correction mechanisms[7]:

System	ECM
Stock Markets	*ASE - 0.16 * ISE - 3.1*
Exchange Rates	*GD - 0.2* TL - 2.4*

Notice the similarity of the cointegration vectors between the two systems. The long-run elasticity of the Greek stock market with respect to that of Turkish market is positive and significant at the 1 percent level. A 10% increase in the Istanbul stock market returns raises the Greek market returns by 1.6 percent, ceteris paribus. The corresponding long-run exchange rate is elasticity is 0.20 and statistically significant. We interpret this finding as suggesting that the long run relationship that ties financial variables from the two countries is quite uniform across different types of financial markets[8]. The dynamic behaviour of the two long run (statistical) equilibrium relationships as measured by the cointegration vectors is shown in figures 1 and 2.

[Figures 1 and 2]

Visual inspection of the graphs reveals, as expected, that the error correction vectors exhibited significant variation around the (benchmark) zero line. One point though deserves our attention. The cointegration vector for the exchange rates contains an exceptionally high deviation from equilibrium at the period corresponding to the summer '94 crisis in the Turkish economy (that is also mirrored at the residuals obtained from the TL equation). It should be noted that the analysis used an impulse dummy in order to account for this, attempt that was rather limited although to some extent the model captures such eventualities.

3.1 Temporal Causality

The finding of cointegration in each of the bivariate systems implies that a Granger causal chain is in place. In other words, causality in at least one direction is guaranteed with the potential for feedback to be present (bi-directional causality). Identifying 'causes' and 'effects' in the long run sense is achieved by testing for the

significance of the adjustment coefficients. Panel A of Table 2 summarizes the relevant statistics.

[Table 2]

In both systems we cannot reject the null hypothesis that the Greek series (stock market, exchange rate) is not Granger-caused by the Turkish series in the long run. In contrast, the symmetric null (for the Turkish series) is rejected. This implying that in the long run, changes in the Greek financial market are the 'cause' and movements in the Turkish market the 'effect'. In other words, the Greek financial market is found to be weakly exogenous to the Turkish market. Such a finding implies that although both countries' markets take part in an equilibrium relationship that ties them together, it is mainly the Turkish market that adjusts to achieve equilibrium. The Turkish financial market acts as a receptor of the shock and in a sense absorbs it so as to eliminate the realized equilibrium error. Short run causal chains are taking place through the significance of the lagged differenced terms in (2).

Panel B of Table 2 reports the statistics for the relevant tests. The null of no short run causality is rejected in only one out of four cases. In particular, the only short run causal chain found was from the Athens Stock Exchange to the Istanbul Stock Exchange. Interpreting Granger-causality as predictability, our findings imply that using information from the Greek stock market can lead to improved forecasts for the movement in the Turkish stock market.

The overall results suggest that the Greek financial market is strongly exogenous with respect to the parameters of the system. A clear picture emerges from inspection of the above-mentioned tests. The empirical findings imply that the Greek financial market is the 'Granger-cause' and the Turkish financial market the 'effect'. Given that Greece is a member of the European Union (EU), one could interpret the

result through that prism. The Greek financial market is relatively more exposed to shocks in the international financial markets and in particular to European ones, which are then at least partly transmitted to the Turkish market through the established linkage. In other words, it is the Turkish financial market that adjusts so as to 'clear' deviations from the long run statistical relationship that links the two markets[9].

3.2 Discussion of the Empirical Findings

The existence of cointegration among the Greek and the Turkish stock markets and their exchange rates provides evidence for the presence of a long-run linkage between the two financial markets. What is interesting from a policy-making point of view is the source of this linkage. The finding of comovement is compatible with a number of reasons. In other words, a variety of theoretical models would produce an observationally equivalent outcome.

Forbes and Rigobon (2000) divide these into two groups: *crisis-contingent* and *non-crisis contingent* theories. The first group explain why transmission mechanisms change during a crisis and, as a consequence, cross-market linkages increase after a shock. The second group assumes that transmission mechanisms are the same during a crisis and during more stable periods. In this view, cross-market linkages do not increase after a shock.

According to the same authors crisis-contingent theories of how shocks are transmitted can be divided into three mechanisms: multiple equilibria, endogenous liquidity, and political economy. The first mechanism takes place when a crisis in one country functions as sunspot for other countries. The second category asserts that a crisis in one country can reduce the liquidity of market participants. Depending on the severity of the liquidity shock this could force investors to a reshuffling of their portfolio composition where essentially investors liquidate their assets in order to

cope with the apparent credit rationing. The third mechanism, political contagion, describes a co-ordinated switch in policy due to reduced political costs. The common feature of all three mechanisms is that the crisis causes a structural shift, which opens up a channel for shock propagation that did not exist before (in relatively stable periods).

In contrast, non-crisis contingent theories advocate that the transmission mechanisms after a shock are not different to that before the crisis. These channels are often called *'real linkages'* since they identify economic fundamentals as their basis. For instance, if two countries share a common set of trading partners these real linkages may be related to competitiveness where as a consequence shocks in one country's balance of payments and/or foreign direct investment may be transmitted to the other country. Additionally, if the two countries are directly close trade partners themselves an even stronger effect is expected. Another potentially important mechanism argues that random aggregate or global shocks may simultaneously affect the fundamentals of several countries. This may become even more dramatic in the case of geographically neighbouring economies and/or economies of the same structure and status (for instance emerging markets).

Therefore, if one wants to pin down the source of the existence of cross-market linkages has to somehow distinguish among the above-discussed possibilities. *It should be noted however, although Rigobon and Forbes do not discuss this possibility, a coexistence of the crisis-contingent and non-crisis contingent theories could be in place. It is perfectly admissible that a number of mechanisms are active in the presence or not of a crisis while at the same time a crisis may trigger a 'new' mechanism that otherwise would be inactive*.

In our analysis, we will consider a number of possibilities from those discussed. In particular, in order to assess whether the crisis-contingent theories are a better description of the Turkish-Greek case we explore how cross-market correlations in returns behaved before and after the Asian and Russian Crises. Furthermore, in order to assess the relevance of 'real linkages' we consider an 'informal' indicator and a 'formal' one. The 'informal' one consists of analysing the structure of Turkey's and Greece's trading partners in search of a common set of those as well as their direct trade. The 'formal' one basically tests whether the two countries' real fundamentals are tied together. The next section presents the results from this analysis.

4. An Inquiry into the Sources of Financial Market Linkages

4.1. *Bilateral Trade Linkages?*

One avenue via which real shocks are transmitted across markets is that country-specific shocks influence the economic fundamentals in other countries (Eichengreen, Rose and Wyplosz, 1996). Trade linkages are one such source of transmission (Gerlach and Smets, 1995). In case of strong trade linkages between countries, a recession in one country hurts the exports of the other country, reducing economic growth in the latter country as well. Thus, the two markets experience a common downward trend in stock markets as they both observe declines in their economic growth. Table 3 reports the bilateral export and import shares of Turkey with respect to Greece since 1985. The exports and imports figures in Table 3 clearly indicate that no strong trade linkage exists between the two countries. Turkey's exports to Greece (Greece's imports from Turkey) make up only about 1 percent of

Turkey's total exports while the import shares are even smaller. Thus, bilateral trade flows cannot explain the observed financial market linkages between the markets.

[Table 3]

4.2. *Common Balance of Payments Shocks?*

Another channel via which country-specific shocks would influence the economic fundamentals in other countries is that both Greece and Turkey have similar trading partners. Table 4 and 5 report the top 10 trading partners of Turkey and Greece for exports and imports, respectively. The results indicate that the U.S., Germany and other EU countries are the most significant trading partners of both countries. A significant drop (increase) in EU income would affect both the Greek and Turkish trade with the EU, bringing about a slow down (increase) in GDP growth in both countries. As a result, both countries' stock markets would tend to move together or exhibit cointegration, everything else constant.

[Tables 4 and 5]

Yet another potential channel is the source of foreign direct investment. Table 6 lists the top foreign direct investors and reports the amount of foreign direct investment (FDI) inflows from these countries to Greece and Turkey in 1999. The U.S. and EU countries are the main investors in both countries. This evidence suggests that FDI linkages can also be a very significant source of the transmission of global shocks from these countries to Turkey and Greece, which would affect economic fundamentals in both countries (Masson, 1997 and Fleming et. al., 1998). A sudden worldwide reduction (increase) of FDI by EU members would slow (speed) economic growth in both Greece and Turkey. As growth declines (increases), both stock markets would share a common downward (upward) trend over time in their stock markets and hence they would be cointegrated. In summary, the balance of

payments shocks seem to be an important source of the observed financial linkages between the two countries.

[Table 6]

4.3. Real Linkages?

In addition to trade and investment, linkages between real interest rates, real exchange rates and output may cause stock market co-movements, reflecting the increasingly integrated nature of the world real economy (Dickinson, 2000). The existence of real linkages among Turkey and Greece would also imply that their fundamentals should move together over time and therefore be cointegrated. To investigate the existence of such real linkages, we test whether real exchange rates, real interest rates and real income, which is proxied by an industrial production index, are cointegrated.

4.3.1. Data

Quarterly data on nominal Turkish Lira (against the DM and the US) and the real effective rate of Greek Drachma were collected. Greek and Turkish Consumer Price Index (CPI), Real Industrial Production (GDP) and short-term interest rates (3-month rates) were also collected. The data were sampled for different time periods due to their unavailability. In particular, exchange rates and the CPI were sampled form 1980:Q1 to 1999:Q1, interest rates from 1985:Q3 to 2000:Q1. Data were collected from the IFS CD-ROM database. Since real series (apart from the Drachma real effective exchange rate) were not directly available, they were constructed. Ex post real interest rates (r) were constructed by subtracting the realized inflation rate (π) from the nominal interest rate (i) as follows:

$$r = i - \pi \qquad \textbf{(1)}$$

Finally, for Turkey the real exchange rate was constructed by taking into account the fact that the Central Bank of Turkey computes the effective lira nominal exchange rate (TL) as a weighted average of the DM and US dollar in the following fashion:

$$TL = 0.75 * DM + 0.25 * US\$ \quad \textbf{(2)}$$

Therefore, we constructed the real exchange rat (q) for Turkey using the formula in equation (3) below:

$$q = \frac{e * P}{P^*} \quad \textbf{(3)}$$

where e is the effective nominal exchange rate, and P and P* are the domestic and foreign price levels, respectively. Note that P* is given by:

$$P^* = 0.75 * CPI_{Germany} + 0.25 * CPI_{US} \quad \textbf{(4)}$$

4.3.2. Real Linkages: Empirical Results

Prior to testing for long-term real linkages among variables, the stationarity tests are conducted for the real fundamentals.[10] The tests indicated that all the series are I(1) and thus we can proceed with the cointegration tests.

Table 7 summarizes the empirical results from the Johansen procedure. Among all three bivariate systems the null that no cointegration vector exists between the two countries fundamentals was rejected in favour of the alternative that one cointegration vector is present. Therefore, the comovement of real fundamentals provides evidence, at least to some extent, for real integration between the two countries. Geographical proximity, exposure to common shocks, and close economic cooperation between the two countries may account for this comovement. For the latter, both countries are members of the Black Sea Economic Cooperation Organization (BSECO), which involves joint efforts between Turkey, Greece, and its

other members to plan and to finance infrastructure projects in the region, including telecommunications and energy. The members include the following countries: Turkey, Greece, Ukraine, Georgia, Russia, and others in the region. Greece and Turkey are also members of the Organization for Economic Cooperation and Development (OECD), representing the world's biggest economies.

[Table 7]

4.4. Contagion effects?

In order to test for the relevance of the crisis-contingent theories we focus on the linear correlations among daily percentage changes in nominal exchange rates and daily nominal stock market returns before and after two major international crises. We identify two dates associated with these crises. First is July 1997 corresponding to the Asian Crisis and second is August 1998 corresponding to the Russian Crisis. The former had a worldwide significant effect on financial markets while Russia has significant economic linkages with both countries (Tables 4-6). Thus, studying the correlation structure before and after the crises should provide some reasonable evidence about the significance of contagion. The results are reported in Table 8.

[Table 8]

Starting with the exchange rates a shift in their correlation structure is apparent. In the pre-Asian Crisis period the Drachma and the Lira exhibited no significant correlation where as in the post-Asian Crisis period their correlation becomes significant. Similar behaviour is found when the benchmark used is the Russian Crisis. Note that the correlation is relatively higher for the post-Russian crisis period. To some extent a stronger effect for the post-Russian crisis is expected for two reasons. First, the Russian Crisis followed the Asian Crisis and therefore may have caused a cumulative effect to an already turbulent period. Secondly, both countries have strong economic

relationships with Russia. In summary, the behaviour of exchange rate correlations point to contagion effects between the two markets.

Moving to stock markets a different pattern altogether emerges. Not only cross-market correlation does not increase following a crisis, but it actually declines. In the case of both crises identified in our sample correlation reduces in the post-shock period bearing no relevance to the crisis-contingent theories. All in all, if indeed contagion effects are in operation between the two markets the transmission mechanism is described by the exchange rates rather than the stock markets.[11] For the latter, real linkages might provide better answer for the observed linkages between the two markets. This is interesting evidence. It would be useful to see whether this evidence that foreign exchange markets are subject to more contagion than stock markets holds for other emerging market economies.

5. Implications of Research Findings

Our empirical results have implications for pricing assets in emerging markets. Our findings suggest that information contained in the Greek market is relevant for the pricing of securities traded in the Istanbul stock market. This is the result of the observed real integration of the two financial markets as well as the increased globalisation of the Turkish and Greek markets, especially since 1980s, following the start of the economic liberalization in Turkey.

Concerning investors, our results suggest that the benefits associated with portfolio diversification can be quite small in a region with significant geographic linkages, such as Eastern Europe, where countries like Turkey and Greece share close common trading and business partners. However, understanding the ways in which the two financial markets interact allows investors in both countries to carry out hedging and trading strategies more effectively.

Our finding of contagion between the Turkish and Greek foreign exchange markets is important information for international institutions such as the IMF, because contagion may require significant IMF intervention and dedication of funds to stabilize affected economies. Furthermore, contagion may spread to other countries in the region such as Russia, which has significant economic linkages with both Turkey and Greece (Tables 4-6). Given the frequent financial crises in both Russia and Turkey, this is a significant source of information for the IMF.

Finally, our findings are encouraging for Turkey's entry chances to the European Monetary System (EMS) and the European Union. Turkey and the EU signed the Customs Union agreement in January 1996, providing the first key step for full membership in the EU. The evidence that Turkish economy shares nominal and real linkages with that of Greece indicates that Turkish economy has made significant progress in terms of satisfying some of the policy convergence criteria necessary for joining the EMS.

6. Conclusions

We have examined the long- and short-run linkages between the Greek and Turkish financial markets linking the two separate literatures on these markets. To our best knowledge, this is the first attempt in the literature to study the transmission of information between the markets. We have found that the Greek and Turkish markets are interdependent in both long and short run, while there is evidence of contagion between the Greek and Turkish foreign exchange markets. The observed financial market linkages especially between the two stock markets seem to be a reflection of close links between real economic fundamentals in both countries as well similar trading partners and common foreign direct investors.

Our results also suggest that crisis-contingent theories may hold better for explaining foreign exchange market linkages, while stock market linkages can be better explained by non-crisis contingent theories. Therefore, more evidence is needed from other countries to better understand the exact channels in which information is transmitted between the emerging markets.

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Table 1: Johansen tests for cointegration[a]

Stock Markets						
		λ_{max}			λ_{tr}	
Null	Alt/ve	Test Statistic	Critical value	Alt/ve	Test Statistic	Critical value
r = 0	r = 1	16.87*	15.75	r ≥ 1	20.63*	20.16
r ≤ 1	r = 2	3.75	9.09	r = 2	3.75	9.09
ECM = (ASE - 0.16 * ISE - 3.1)						
Diagnostics						
R^2 (ASE)	0.15		**R^2 (ISE)**		0.19	
Multivariate Residual Analysis						
L-B(35)				0.73* (p-value)		
LM(1)				0.61* (p-value)		
LM(4)				0.9* (p-value)		
ARCH(6) (ASE)				3.7		
ARCH(6) (ISE)				3.8		
Exchange Rates						
r = 0	r = 1	44.8*	15.75	r ≥ 1	47.53*	20.16
r ≤ 1	r = 2	2.73	9.09	r = 2	2.73	9.09
ECM = (GD - 0.2*TL - 2.4)						
Diagnostics						
R^2 (GD)	0.09		**R^2 (TL)**		0.24	
Multivariate Residual Analysis						
L-B(36)				0.64* (p-value)		
LM(1)				0.54* (p-value)		
LM(4)				0.19* (p-value)		
ARCH(6) (GD)				10.8		
ARCH(6) (TL)				12.3		

Notes: a. The asterisk denotes significance at the 5% level. The estimation included an intercept restricted in the cointegration space. Six dummy variables were also included in each system in order to account for the following events: crisis in Turkish economy (early 1994), Asian crisis (July 1997), speculative attack on Drachma (late 1997), Brazilian crisis (late 1998 and early 1999), Russian crisis (August 1998), and finally the earthquake in Turkey (summer 1999). For the maximal eigenvalue test the null is for at most *r* cointegration vectors, against the alternative of *r + 1* cointegration vectors. For the trace test the null is at most *r* cointegration vectors, with more than *r* vectors under the alternative. L-B stands for the Ljung-Box autocorrelation statistic. LM stands for the Lagrange Multiplier autocorrelation statistic.

Table 2: Causality tests[a]

Temporal causality	**Stock markets**		**Exchange rates**	
Null	ISE does not cause ASE	ASE does not cause ISE	TL does not cause GD	GD does not cause TL
		Panel A		
Long run causality	-1.49 (0.13)	-3.94* (0.00)	-1.83 (0.07)	-3.09* (0.00)
		Panel B		
Short run causality	17.62* (0.00)	4.77 (0.57)	4.84 (0.43)	5.98 (0.3)

Notes: a. The asterisk denotes significance at the 5% level. The long run tests (Panel A) are based on a t-statistic, corrected for heteroscedasticity by White's method (White, 1980). The short run tests are based on a Wald test distributed with six degrees of freedom for the stock markets and four for the exchange rates.

Table 3: Bilateral Trade Linkages: Percentage Shares (%)

	Turkey's exports to Greece (%)[a]	Turkey's imports from Greece (%)[b]
1985	0.96	0.42
1986	1.01	0.71
1987	0.57	0.86
1988	0.82	0.56
1989	1.06	0.59
1990	1.04	0.54
1991	1.05	0.36
1992	1.00	0.36
1993	0.77	0.41
1994	1.06	0.45
1995	0.97	0.56
1996	1.02	0.65
1997	1.14	0.88
1998	1.37	0.70

Notes: a. Exports to Greece/total Turkish Exports
b. Imports from Greece/total Turkish imports

Numbers are in Millions of U.S. dollars.
Source: Direction of Trade Statistics, IMF.

Table 4: Top 10 export partners: Percentage Shares (%)

Panel A: Turkey

Year	1	2	3	4	5	6	7	8	9	10
1985	Germany	Iran	Iraq	UK	US	Italy	Saudi A.	France	Nether.	Russia
Share	17.48	13.56	12.08	6.77	6.36	6.31	5.4	2.7	2.68	2.39
1990	Germany	Italy	US	UK	France	Russia	Iran	Nether.	Saudi A.	Belgi-Lux
Share	22.99	8.24	7.21	5.55	5.49	3.96	3.69	3.24	2.52	2.32
1995	Germany	US	Italy	Russia	UK	France	Nether.	Saudi A.	Belgi-Lux	Bolivia
Share	23.26	6.99	6.73	5.72	5.25	4.77	3.4	2.17	2.09	2.03
1998	Germany	US	UK	Italy	Russia	France	Nether.	Belgi-Lux	Spain	Algeria
Share	20.24	8.28	6.45	5.77	5	4.85	3.3	2.48	1.92	1.79
Total	Germany	US	Italy	UK	France	Russia	Nether.	Saudi A.	Iran	Iraq
85-98	21.81	7.34	6.59	5.53	4.80	4.77	3.27	2.91	2.83	2.30

Panel B: Greece

Year	1	2	3	4	5	6	7	8	9	10
1985	Germany	Italy	US	France	UK	Nether.	Saudi A.	Russia	Egypt	Belgi-Lux
Share	20.06	11.25	8.13	7.91	6.95	4.01	3.97	3.11	3.11	1.84
1990	Germany	Italy	France	UK	US	Nether.	Cyprus	Yugos.	Belgi-Lux	Sweden
Share	22.31	16.66	9.62	7.32	5.63	3.46	2.51	2.25	2.04	1.61
1995	Germany	Italy	UK	France	Bulgaria	Spain	US	Cyprus	Nether.	Russia
Share	22.32	14.23	6.15	5.50	4.11	3.51	3.17	2.97	2.74	2.17
1998	Germany	Italy	UK	France	US	Bulgaria	Cyprus	Turkey	Nether.	Spain
Share	18.41	11.86	6.72	4.61	4.46	4.09	3.81	3.14	3.02	2.65
Total	Germany	Italy	UK	France	US	Nether.	Cyprus	Bulgaria	Russia	Spain
85-98	21.46	14.64	6.67	6.64	5.01	3.12	2.91	2.40	2.10	2.10

Notes: All numbers are in millions of US dollars
Data is collected from the Direction of Trade Statistics, IMF
Data given for Russia for the years 1985-1991 are originally for USSR
Abbreviations: Belgi-Lux (Belgium-Luxemburg), Nether. (The Netherlands), Saudi A. (Saudi Arabia), Switz. (Switzerland), UK (United Kingdom), US (United States), Yugos. (Yugoslavia).

Table 5: Top 10 import partners: Percentage Shares (%)

Panel A: Turkey

Year	1	2	3	4	5	6	7	8	9	10
1985	Germany	Iran	Iraq	US	Italy	Libya	France	Japan	UK	Spain
Share	11.88	11.22	10.09	10.08	5.81	5.51	4.53	4.47	4.12	2.86
1990	Germany	US	Italy	France	Russia	Japan	Iraq	UK	Saudi A.	Nether.
Share	14.71	9.52	7.21	5.59	5.2	4.67	4.37	4.23	3.02	2.39
1995	Germany	US	Italy	Russia	France	UK	Japan	Saudi A.	Nether.	Belgi-Lux
Share	15.54	10.43	8.94	5.83	5.59	5.12	3.92	3.88	3.04	2.55
1998	Germany	Italy	US	France	UK	Russia	Japan	Nether.	Spain	Belgi-Lux
Share	16.13	9.33	8.94	6.69	5.91	4.75	4.51	3.19	2.81	2.65
Total	Germany	US	Italy	France	UK	Russia	Japan	Saudi A.	Nether.	Belgi-Lux
85-98	15.58	9.78	8.48	5.85	5.22	4.45	4.38	3.48	2.59	2.52

Panel B: Greece

Year	1	2	3	4	5	6	7	8	9	10
1985	Germany	Italy	Saudi A.	France	Japan	Nether.	Libya	Russia	Iraq	UK
Share	16.99	9.39	7.99	6.46	6.13	5.86	5.53	4.94	4.57	3.81
1990	Germany	Italy	France	Nether.	Japan	UK	Belgi-Lux	US	Spain	Iran
Share	20.80	15.40	8.09	6.73	5.92	5.26	3.74	3.68	2.02	1.91
1995	Italy	Germany	France	Nether.	UK	Belgi-Lux	Spain	US	Japan	Russia
Share	18.85	16.60	8.21	6.97	6.51	3.64	3.40	3.25	2.65	2.51
1998	Italy	Germany	France	UK	Nether.	US	Spain	Japan	Iran	Korea
Share	16.31	15.34	8.70	6.42	6.33	3.96	3.67	3.23	2.12	2.07
Total	Germany	Italy	France	Nether.	UK	Japan	US	Belgi-Lux	Spain	Russia
85-98	17.62	15.25	7.94	6.60	5.81	4.82	3.57	2.81	2.65	2.14

Note: See Table 4.

Table 6: Top Foreign Investors: FDI figures (1999)

GREECE		TURKEY	
Country	Investment in mil $	Country	Investment in mil $
Germany	74.3	Germany	407.31
United States	51.7	United States	292.51
Italy	31.8	Netherlands	234.57
France	22.6	France	146.72
United Kingdom	14.3	Italy	95.22
Denmark	10.5	United Kingdom	88.40
Belgium	9.2	Switzerland	50.89
Netherlands	7.5	Belgium	23.41
Russia	6.6	Sweden	16.41
Cyprus	6.3	Saudi Arabia	14.47
Switzerland	6.1	Japan	13.85
Total sum of foreign investment proposals approved	240.9		1,700.51

Table 7: Johansen tests for cointegration among real fundamentals

λ_{max} (5% critical value)[a,b,c]			
Null (alt/ve)	Real Exchange Rates (GD, TL)	Real Interest Rates (GI, TI)	Real Income (GY, TY)
r = 0 (r = 1)	34.9♣ (19.96)	27.88♣ (25.32)	17.24♣ (15.41)
r ≤ 1 (r = 2)	7.15 (9.24)	7.46 (12.25)	2.93 (3.76)
Error Correction Mechanisms			
*ECM1 = RGD - 4.25*RTL* *(-2.06♣)*			
*ECM2 = RGI - 0.26*RTI - 14.75 + 0.3*t* *(-3.3♣)*			
*ECM3 = RGY - 0.21*RTY + 1.16* *(-15.04♣)*			

Notes: a. Critical values differ due to differences in the deterministic components included in the Johansen tests. Parentheses next to the λ_{max} correspond to the critical values at the 5% significance level. Numbers in the parenthesis below the ECM's report the t-statistic for the relevant coefficient. Finally, ♣ denotes significance at the 5% level.

b. For brevity we report only the Maximal Eigenvalue statistic (identical conclusions are reached by using the Trace statistic), which tests the null that at most *r* cointegration vectors are presetn, against the alternative of *r + 1* cointegration vectors. GD stands for Greek Drachma; TL stands for Turkish Lira, GI and TI stand for Greek Interest Rate and Turkish Interest Rate respectively; GY and TY stand for Greek GDP and Turkish GDP respectively and finally, *t* stands for a linear time trend.

c. Critical values differ due to differences in the deterministic components included in the Johansen tests. Parentheses next to the λ_{max} correspond to the critical values at the 5% significance level. Numbers in the parenthesis below the ECM's report the t-statistic for the relevant coefficient. Finally, ♣ denotes significance at the 5% level.

Table 8: Conditional Correlations (Regression-based)[a] [Daily % changes in nominal Drachma and Lira, and daily stock market returns (ASE, ISE)]

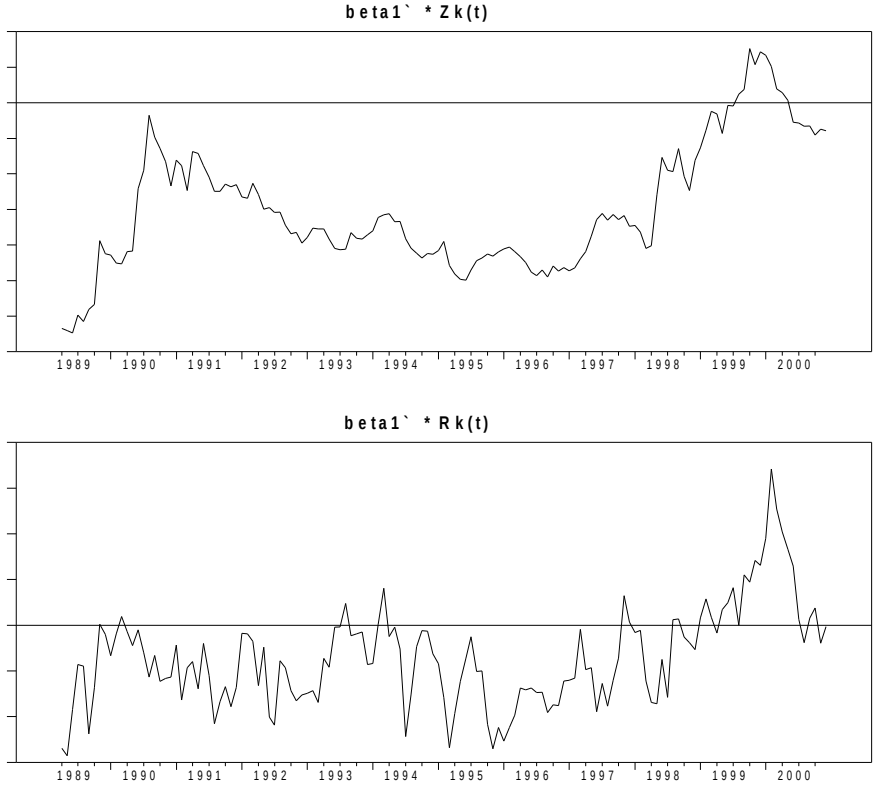
$$\%\Delta(GD_t) = a + b_{1,xr}\%\Delta(TL_t) + u_{t,xr}$$
$$\%\Delta(TL_t) = a + b_{2,xr}\%\Delta(GD_t) + \varepsilon_{t,xr}$$
$$\%\Delta(ASE_t) = a + b_{1,sm}\%\Delta(ISE_t) + u_{t,sm}$$
$$\%\Delta(ISE_t) = a + b_{2,sm}\%\Delta(ISE_t) + \varepsilon_{t,sm}$$

	Exchange Rates	Stock markets
Pre-Asian Crisis[b]		
$b_{1,j}$	0.08 (0.78)	0.17 (2.76)*
$b_{2,j}$	0.27 (1.51)	0.5 (2.06)*
Post Asian Crisis		
$b_{1,j}$	0.76 (3.56)*	0.12 (1.39)
$b_{2,j}$	0.24 (3.08)*	0.39 (1.47)
Pre-Russian Crisis		
$b_{1,j}$	0.08 (0.83)	0.19 (3.31)*
$b_{2,j}$	0.26 (1.64)	0.50 (2.43)*
Post Russian Crisis		
$b_{1,j}$	0.80 (4.22)*	0.03 (0.62)
$b_{2,j}$	0.36 (3.24)*	0.23 (0.60)

Notes: a. Numbers in parentheses report the White adjusted for heteroscedasticity t-statistic (White, 1980). The asterisk denotes significance at the 5% significance level. The index j denotes exchange rates (xr) and stock markets (sm).

b. The periods identified correspond to the following: Beginning of our sample until 1997:6 (Pre-Asian Crisis), 1997:7 until end of our sample (Post-Asian Crisis), Beginning of our sample until 1998:7 (Pre-Russian Crisis), 1998:8 until end of our sample (Post-Russian Crisis).

Figure 1: Cointegration vector (stock markets)



Notes: The difference between the upper and the lower graphs is that beta*Zk (t) pictures the actual disequilibrium as a function of all short-run dynamics including the dummies. Whereas beta*Rk (t) is corrected for the short-run effects, and pictures the 'clean' disequilibrium. It is the series in the lower graph that is actually tested for stationarity and thus determines r in the maximum likelihood procedure. (for more details see Hansen and Juselius, 1995).

Figure 2: Cointegration vector (exchange rates)

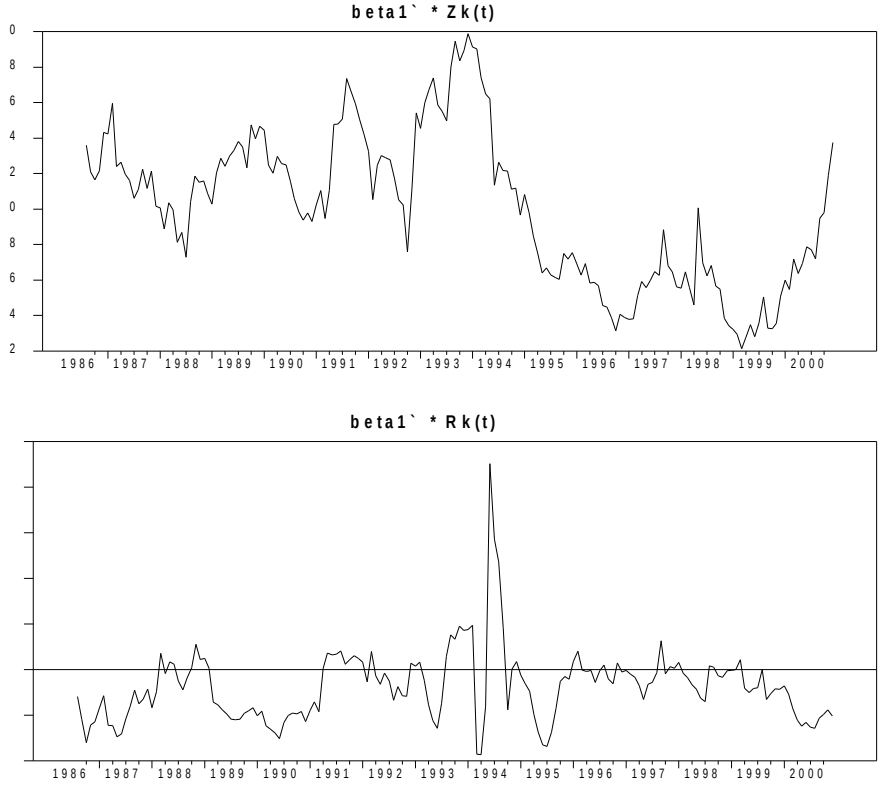


Figure 3: Residuals (Istanbul Stock Exchange)

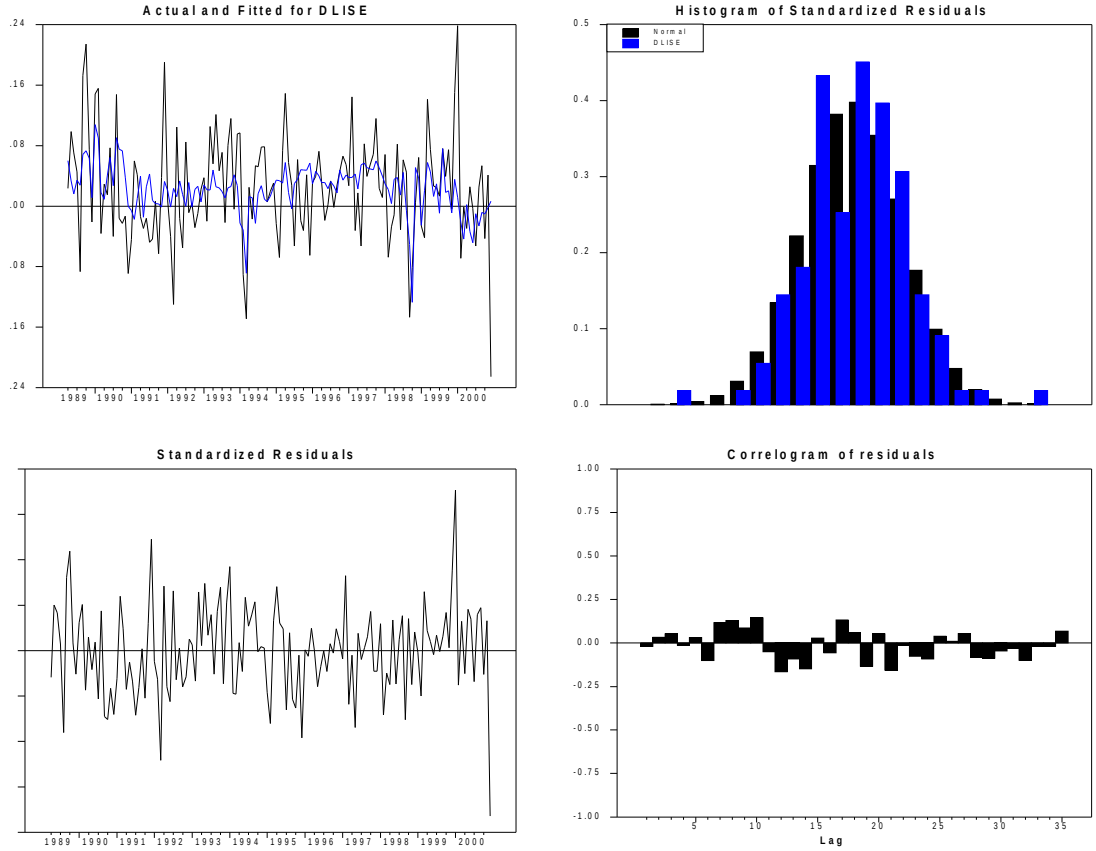


Figure 4: Residuals (Athens Stock Exchange)

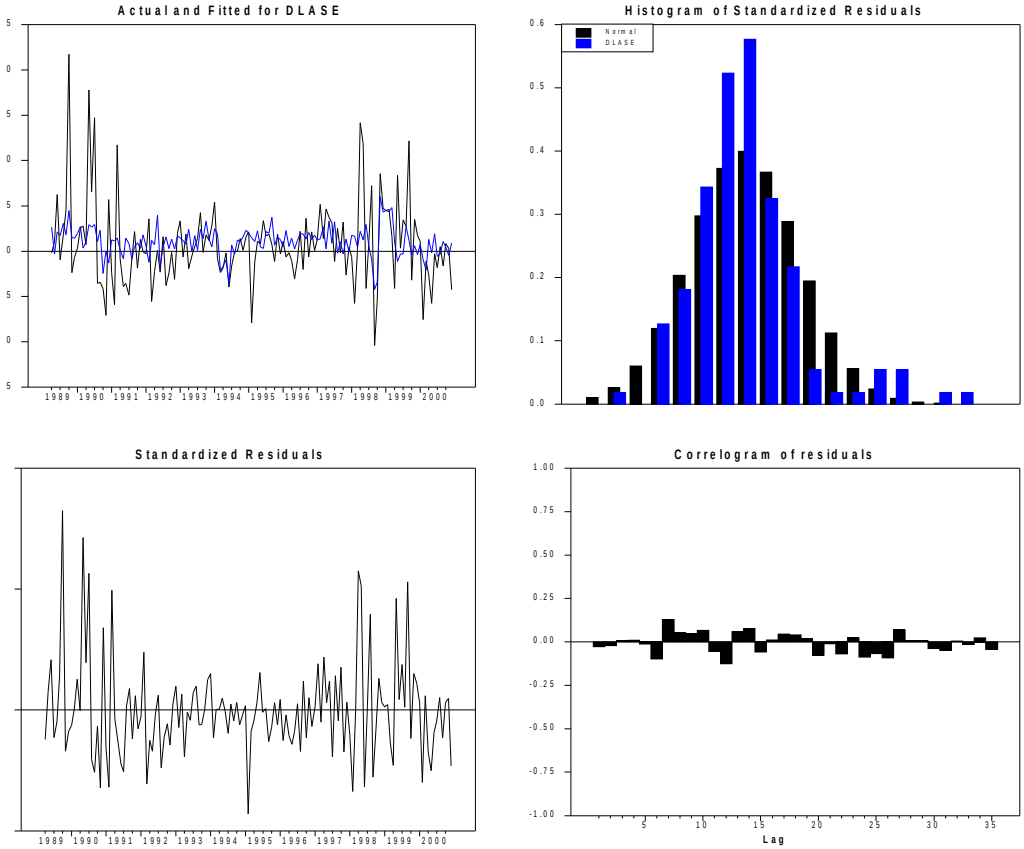


Figure 5: Residuals (Turkish Lira foreign exchange market)

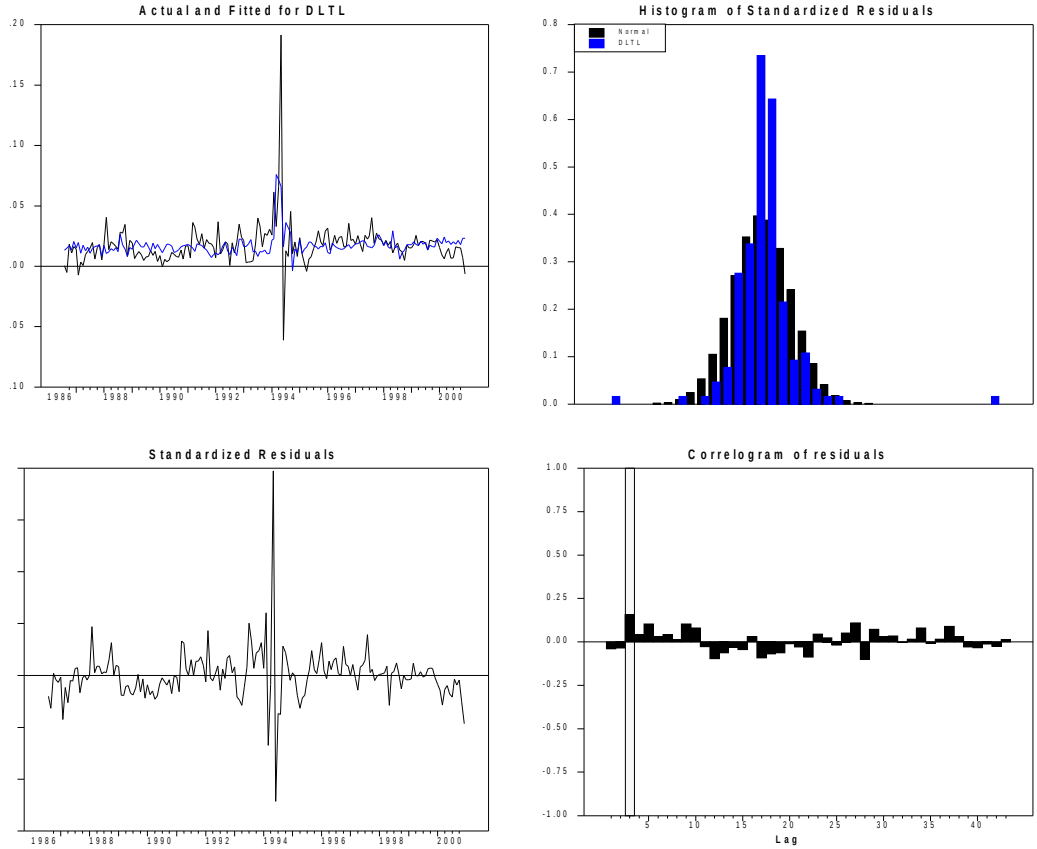
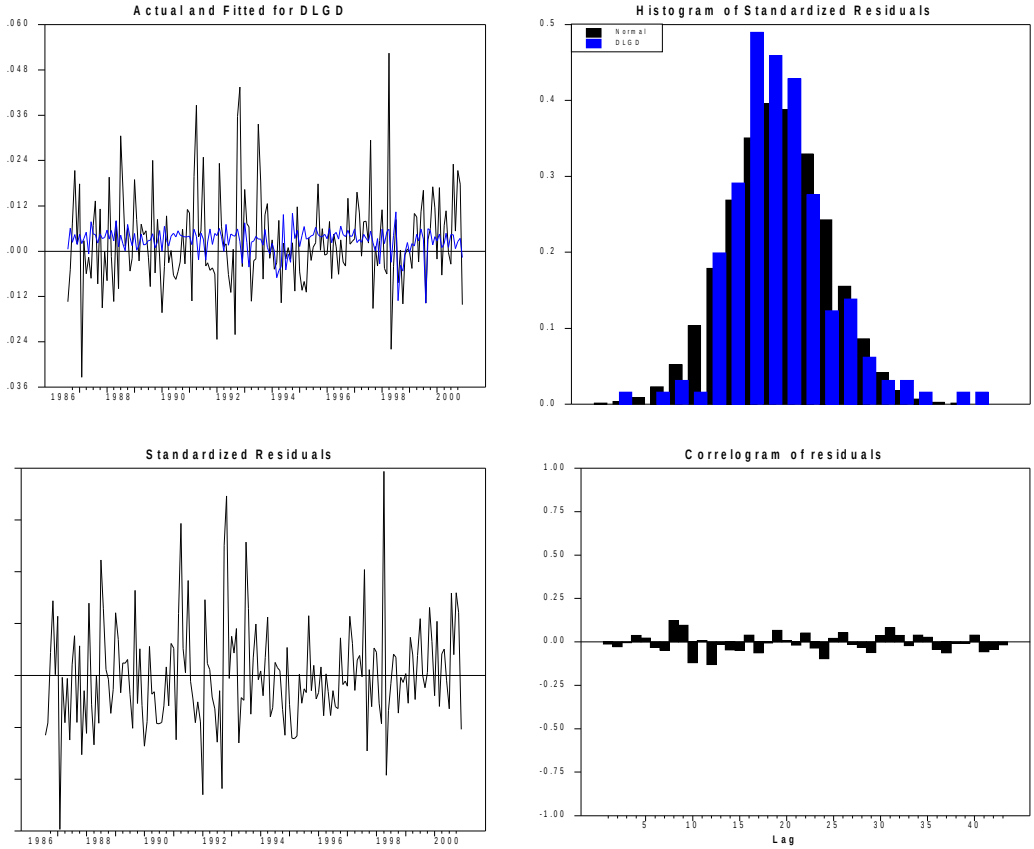


Figure 6: Residuals (Greek Drachma foreign exchange market)



ENDNOTES

[1] Interest rates are not used in this paper for two reasons. First is that changes in interest rates typically reflect monetary policy stance, rather than market conditions. Second, they are heavily controlled by the government, in particular in Turkey.

[2] Studies on Turkish stock market include Basci et. al., (1996) and Muradoglu and Metin (1996), while Alexakis and Petrakis (1991), Alexakis and Xanthakis (1996), Barkoulas et. al., (2000), Couts et. al., (2000) Niarchos and Alexakis (1998), Niarchos et. al., (1996), and Tsangarakis study the Athens stock market. Niarchos et. al., (1996) examine the transmission of information from U.S. stock market to that of Greece and find no evidence of transmission.

[3] These two terms will be used interchangeably in the remaining of the paper.

[4] The logarithm of all series is used.

[5] A detailed list of the dummies used appears in Table 1.

[6] Given the nature of the time series we have opted for omitting deterministic trends from our VAR models.

[7] Coefficients on the Greek series are normalized to unity.

[8] Such an argument is informal and bears relevance more to intuition than formal evidence.

[9] An apparent drawback of the temporal causality tests is that, strictly speaking, they are *'in-sample'* tests. As a complement to our causal analysis we also conducted variance decompositions (VDCs) that essentially provide information regarding the *'out-of-sample'* causal structure of the systems. The VDCs are calculated by first assuming that the VAR(p) has a vector Moving Average (MA) representation (see Hamilton, 1994; Lutkepohl and Reimers, 1992). All in all, the VDC analysis confirmed our causality findings suggesting that the Greek money market is exogenous and in fact is a Granger-cause for the Turkish market. We found that the Greek markets have stronger predictive power for the Turkish market especially at relatively shorter horizons. For instance, the results indicated that the ASE market shocks can explain about 17.3 % changes in the ISE at a 10-month horizon, whereas at a 5-month horizon, the GD innovations account for about 14 % of changes in the TL.

[10] The results are available upon request from the authors.

[11] We also computed the standard simple correlations for the two sub-samples generated before and after each of the crisis. The results, which are available upon request, were consistent with the results reported in Table 8.