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Interactions between bank behavior and financial structure: evidence from a developing country

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Abstract:

We use time-series analysis to examine bank behavior with respect to credit supply employing both banking data and other financial variables for the Turkish economy over the 1990 – 2009 period. We provide a vector error-correction (VEC) model to test for multivariate cointegration and Granger causality. More specifically, this paper seeks to fill the gap on how the bank behavior interacts with the financial structure given the conditions of macroeconomic policy. Our findings suggest that Granger causality is present between credit-deposit ratio and maturity of time deposits which implies that depositor decision on maturity changes the composition of balance sheet of banks leading to low credit creation. This result implies that macroeconomic uncertainty and instability lead to a kind of credit contraction with the decrease of deposit maturity. Our results also reveal that economic cycles are credit-driven in Turkey.

Keywords: Credit-deposit ratio; deposit maturity; Granger causality
JEL classification: C32; E50; G21

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1. Introduction

Typically, banks provide liquidity insurance by pooling funds in exchange of demandable deposit-contracts and diversify away idiosyncratic credit risk by financing different investment projects[1]. Demand deposit contracts which offer liquidity insurance make banks prone to runs leading to insolvency due to early liquidation of long-term debt contracts. In this study, our main intention is to understand how bank behavior interacts with the depositor behavior given the conditions of financial constraints on both the demand side and the cost side of bank credit. Our focus is not on the deposit drain like in the classical bank-run, although it is more likely to be a concern for the banking sector especially in a developing country like Turkey where several exchange rate crises were associated with recurrent banking crises. The twin crisis of 1994 and 2001 are the examples of such episodes where maturity and currency mismatches inside the banking sector amplified the severity of the liquidity crisis.[2]

We rather turn our attention on the possible shortening of deposit maturity by the risk-averse depositors due to increased uncertainty over real asset returns. Both theoretical and empirical studies consider the case of possible bank runs in the absence of (full-coverage) deposits insurance. There are few studies which deal with the deposit composition of banks varying from longer-termed time deposits and immediately demandable deposits. Kashyap et al. (2002) show theoretically and Gatev and Strahan (2006) find empirically that synergies between credit lines and deposit-taking enable banks to keep safe from the likeliness of runs

[1] See Diamond and Dybvig (1983), Diamond (1984) and Kashyap et al. (2002)

[2] In a very recent study Karabulut et al. (2010) investigated the determinants of currency crises in Turkey and concluded that the share of short term debt in GDP and the ratio of credit to deposit are the determinants of these crises.

and thus reduce their liquid asset holdings. However, in the case of full insurance, depositor behavior might not give priority to the solvency of the individual bank or any liquidity risk, but it might concern rather with the price stability in the financial system. For small open economies, the concern for price stability can arise from exchange shocks or high public-debt driven default risk which might worsen the expectations that either inflation would accelerate or/and nominal interest rates would increase. Facing that nominal shock would likely to occur; the depositor might switch to shorter termed time deposits denominated either in dollar or in national currency to avoid any likely loss in real terms. The motivation of the risk-averse depositors might be either to minimize the loss incurring from the increasing perceived risk associated with the uncertainty arising from the default on the public debt, or to avoid any depreciation resulting from the high pass-through effect of exchange rate, especially in the several emerging countries who have suffered from high inflation in the past[3]. Turkey fell into such category with many Latin American countries where inconsistent exchange rate regime and fiscal policy favor for short-termism as the only financing pattern for the debts contracts. Tirole (2002) argues that short-term debt might be an optimal response to systemic or macroeconomic risks.

In line with the bank-run models, it is widely discussed that short-term debt can be a source of fragility leading to balance of payments crisis (e.g Chang and Velasco 2000). Bussiere et al. (2006) discuss that higher economic or political uncertainty tightens solvency constraints and favors the short term debt since debt maturity decreases with economic uncertainty about investment returns. Furthermore, Jeanne and Guscina (2006) using a longitudinal data find that Latin American countries have very low shares of long-term domestic-currency debt and discuss that the history of monetary instability in these countries can be the reason of the high ratio of short-term domestic debt. We can expect that the banks will alter their asset

[3] See Kara and Öğünç, (2008) for more discussion.

composition unless the depositors' concerns are instantaneous or temporary. The compositional change will likely be in favor of holding more assets like government bonds or treasury bills rather than debt contracts which are less solvent and more risky in the short run. Thus, expectations about the price stability in the financial system whether derived from the depositors or the banking sector do affect the credit market through maturity channel. We can make an analogy with the bank-run case in terms of its impact on the credit market. The maturity channel might not forcefully lead to a contraction in the funds available to banking sector but it might lead to a contraction in the credit volume given the expectations of depositors and the reluctance of the banking sector to expand credits, which in turn impedes economic growth. We argue that the systemic costs similar to bank-run cases are likely to appear if the financial system runs into an unstable period due to increased uncertainty and risk perceptions over the asset-price stability.

The depositor behavior can be a reflection of the expectations of the financial markets, which in turn contributes more to the short-term use of bank resources by creating a considerable cost effect for the banking sector. However, the degree of reaction of depositors may change depending on the expectation about the macroeconomic stability. It needs more inquiry at the individual bank level on how much banks decide to reduce the maturity gap[4] vis-à-vis the shortening of the deposit maturity. Nevertheless, it can be asserted that banks might become more reluctant to finance investment projects. The contribution of this study is to assess the role of the price and maturity effects on the entire banking credit expansion given the interacting structure of financial system, such as exchange rate regime and domestic debt.

[4] Since there is no information on the maturity of the credits, we cannot directly argue over the shortening of credit maturity.

The remaining of the paper is organized as follows. Section 2 discusses briefly the stability and the Turkish banking sector. Section 3 describes the data and the methodology used for testing the econometric model. Section 4 presents the results and Section 5 concludes.

2. Banking sector and stability in Turkey

The Banking sector in Turkey has a low capacity of credit creation. The indicators such as commercial bank loan to gross domestic product (GDP) ratio and commercial bank loan to deposit ratio are very low in comparison with OECD countries. As an example, credit-to-GDP ratio was 35% for Turkey while it was 157% for the EU-27 in average. Similarly, deposit-to-GDP ratio was respectively 42% and 136% in 2007[5]. Combining both of these indicators, we see that credit-to-deposit ratio was 83% for Turkey which is significantly lower than the EU-27 average which reaches up to 116%.

Table 1 provides a comparison of different economic and financial variables between the EU-27 and Turkey for 2007. European countries including Turkey are examples of bank-based economies where main financial system works through credit institutions. Comparing Turkey with other European countries, we notice that the share of investment to GDP (I/GDP)--a proxy of finance demand—is almost equal to the average value of European countries in Turkey. However, there is a considerable difference in terms of financial variables (deposit interest rates (DIR), bond interest rates (BIR), ratios of credit to GDP (CR/GDP), deposit to GDP (DEP/GDP) and credit to deposit (CR/DEP)) which are rather related to the credit availability of the banking sector.

[Table 1 here]

According to Table 1 the ratios of deposit-to-GDP and credit-to-GDP are very high for the EU-27 countries. Compared with the case of Turkey, it is about 4.5 times higher for the first

[5] See TCMB (2008) for further discussion.

and 3.2 times higher for the second ratio. The financial deepening indicators show evidence of lower size of credit supply in Turkey. The same relatively low banking performance of Turkey can be traced when it comes to the low transformation rate of deposits to credit. The credit-to-deposit ratio is 1.4 times higher for the EU-27 countries.

From the development perspective, the financial liberalization that took place in the mid-1980s has not produced enough financial deepening in Turkey. The financial system was not capable of generating a high volume of credit, which in turn impeded economic development all throughout the 1990s. Although recent stable economic conditions facilitated stronger banking sector that was hardly affected from the global crisis of 2008, it is nevertheless evident that if the Turkish banking system were to catch-up with the EU averages, ceteris paribus, one would expect more investment and economic growth. Several studies support this view in the literature: Bencivenga and Smith (1991) develop a theoretical model where financial intermediation raises the economic growth rate. The basic idea in their paper is that without financial intermediaries, there will be an excessive holding of unproductive liquid assets that cannot be transformed into productive investment. As a result, financial intermediaries, by changing the composition of savings, produce higher investment and growth rates even without an increase in savings rates[6]. A second paper, Levine et al. (2000) provide strong empirical evidence that a more efficient financial system which ameliorates information asymmetries and facilitates transactions, promotes economic growth.

One of the main factors explaining the underdevelopment of the Turkish banking system is uncertainty and high volatility in Turkish economy. From 1994 to 2001 the Turkish economy has undergone three serious subsequent economic crisis, namely in 1994, 1999 and 2001 (the

[6] Low saving rate is a controversial issue for the Turkish case due to two-decade chronic high-inflation. Van Rijckeghem, C. and M. Üçer (2008) discuss that saving-credit relation in Turkey is strongly linked to cycle effects.

severest) which led to volatile growth rates and exchange rates, high and volatile interest and inflation rates, high fiscal deficit. During the period between 1980 and 2007, the average inflation rate was 53% while the debt requirement to GDP ratio was 5% in the same period. Although the average GDP growth was 4%, it showed very unstable: in 1994 and 1999 Turkey had hit to a growth rate of -4.7%, while in 2001 it was even lower with -7.5%. Under the fiscal dominance and financial distress resulting from higher public deficits and exchange rate shocks, real interest rates showed very volatile in the same period.

A second factor explaining the underdevelopment of the Turkish banking system may be political instability. Between 1980 and 2008, 17 governments have been in rule which makes an average of only 2 years even though general elections are held in every 5 years. According to Kaufmann et al. (2009) Turkey has a score of -0.73 from the political instability index (which ranges -2.5 to 2.5) while the EU-27 has 0.78 in average. This picture was even worse for Turkey in 1996, having -1.49 compared to 0.81 for the EU-27 average. For the second index, which shows whether governments design and implement policies and regulations that permit and promote private sector development, Turkey's situation is again found to be worse with regard to the EU-27: in 2008 Turkey has an index number of 0.22 and that of the EU-27 is much higher, that is 1.29. Interestingly, Turkish government's regulatory quality is found to be higher in earlier years (e.g. 0.54 in 1996), meaning that the situation is worsening.

These economic and political uncertainties may modify deeply the composition and maturity of financial contracts and thus generating a contraction in the volume of bank loans. From a small open economy perspective, higher interest rates -due to higher uncertainty- will not only reduce new investment but also change the risk composition of new projects via credit rationing. Typically, when interest rates are higher, banks will face with the loan demand of more risky projects. However this is not the only effect of uncertainty on investment projects, it may also affect the maturity composition of deposits which in turn shrink the volume of

credits. With rising uncertainty depositors may be more averse to the risk and some of them may switch to shorter-term deposit contracts than it would be in a more stable period. This curtail in deposit maturity may also reallocate the funds available away from investment projects if banks' risk perception/aversion is affected by maturity of deposits.

3. Data and methodology

3.1. Data description

We use monthly data of the aggregate banking sector, since our aim is to see whether the compositional change on the asset side is affected from various financial variables and especially from the liability side of the balance sheet in the short run. The model covers almost 20 years-period starting from January 1990 up to October 2009 including the entire financially liberalized phase of the Turkish economy. We try to test whether there is a casual relationship in the sense of Granger between short-term liabilities and long-term commitments as debt contract inside the banking sector. In order to eliminate the level effect of possible deposit drain which accompanies any shortening, we use credit/deposit ratio as a proxy of bank behavior. We only consider the bank credit to private sector (CRDP) which is supposed to be longer-term commitment as debt contract rather than consumer credit. The deposit variable in the denominator only consists of deposits both in foreign and national currency having maturity equal to one month and over. The maturity of deposit (MTDP) is the weighted average in days again only consists of deposits having maturity equal to one month and longer. For the cost of funds, we take the interest rate spread (IRSP) between one-month time deposits and average monthly rate of short-term treasury bills. The monthly production index of manufacturing sector (PROD) is taken as a proxy of credit demand which also might be seen as the expansion component of the real side. Along with the short-termism hypothesis, we also consider the maturity of government bonds (TRES) which serve, in the absence of more developed financial debt-contracts such as a commercial paper, as a major

asset for the banking sector. Exchange rate variable (EXCH) is also added to the model which is supposed to reflect the probable nominal shocks in a small-open economy. The next sub-section discusses the methods used to establish the casual relationship between the variables mentioned above.

3.2. Empirical methods

Our empirical estimation has two main objectives. The first one is to explain how the variables are related one to another over time. The second one is to provide an understanding of the causal relationships involved in different models. The pioneering study by Granger (1969) was the first to test for the direction of causality between two variables. The test, in its primitive form, is quite simple. Granger (1988, p.200) gives the definition of causality in terms of predictability: considering two time-series, x and y, it is argued that "if y_t causes x_t, then x_{t+1} is better forecast if the information in y_{t-j} is used than if it is not used". Hence the standard causality test runs ordinary least squares (OLS) regression of a variable *x* in level form on the lagged levels of both *x* and *y*. Then a Fisher test is sufficient to check for Granger causality from *x* to *y* (*vice versa* for the inverse direction of causality). However, with non-stationary series it has been shown that the standard causality test can yield spurious causality results (see, among others, Granger and Newbold, 1974). Thus, each time-series analysis should begin by testing for the stationarity of the variables.[7] In the case of non-stationarity of the variables (with the proviso that they are integrated of the same order), Engle and Granger (1987) showed that any combination of these variables may be stationary which means that there exists a cointegrating vector such that the linear combination of the variables formed

[7] Recently, new econometric techniques have been developed to address the non-stationarity problem. For example, while Maximum entropy bootstrap (Meboot), (Vinod, 2004) can be used with non-stationary data, autoregressive distributed lag (ARDL) models (Peseran et al., 2001) are designed for dealing with the variables that are integrated of different orders.

using this vector is integrated of order zero. Thus, following the unit root tests, the second step of the analysis should consist of exploring cointegration properties of the series and the Johansen cointegration test procedure (Johansen and Juselius, 1990) is widely used for this purpose. If a cointegrating relationship exists, that is we have a long-run equilibrium relationship between the variables involved, then the dynamic Granger causality can be captured from a vector error correction model (VECM) derived from this cointegrating equilibrium relationship.[8]

Using the variables discussed above, the VECM can be expressed as follows:

$$\Delta CRDP_t = \psi_1 + \sum_{i=1}^{m} \beta_{11i} \Delta CRDP_{t-i} + \sum_{i=1}^{n} \beta_{12i} \Delta MTDP_{t-i} + \sum_{i=1}^{o} \beta_{13i} \Delta IRSP_{t-i} + \sum_{i=1}^{p} \beta_{14i} \Delta EXCH_{t-i} + \sum_{i=1}^{r} \beta_{15i} \Delta PROD_{t-i} + \sum_{i=1}^{s} \beta_{16i} \Delta TRES_{t-i} + \alpha_1 \varepsilon_{t-1} + u_{1t} \quad (1.1)$$

$$\Delta MTDP_t = \psi_2 + \sum_{i=1}^{m} \beta_{21i} \Delta CRDP_{t-i} + \sum_{i=1}^{n} \beta_{22i} \Delta MTDP_{t-i} + \sum_{i=1}^{o} \beta_{23i} \Delta IRSP_{t-i} + \sum_{i=1}^{p} \beta_{24i} \Delta EXCH_{t-i} + \sum_{i=1}^{r} \beta_{25i} \Delta PROD_{t-i} + \sum_{i=1}^{s} \beta_{26i} \Delta TRES_{t-i} + \alpha_2 \varepsilon_{t-1} + u_{2t} \quad (1.2)$$

$$\Delta IRSP_t = \psi_3 + \sum_{i=1}^{m} \beta_{31i} \Delta CRDP_{t-i} + \sum_{i=1}^{n} \beta_{32i} \Delta MTDP_{t-i} + \sum_{i=1}^{o} \beta_{33i} \Delta IRSP_{t-i} + \sum_{i=1}^{p} \beta_{34i} \Delta EXCH_{t-i} + \sum_{i=1}^{r} \beta_{35i} \Delta PROD_{t-i} + \sum_{i=1}^{s} \beta_{36i} \Delta TRES_{t-i} + \alpha_3 \varepsilon_{t-1} + u_{3t} \quad (1.3)$$

$$\Delta EXCH_t = \psi_4 + \sum_{i=1}^{m} \beta_{41i} \Delta CRDP_{t-i} + \sum_{i=1}^{n} \beta_{42i} \Delta MTDP_{t-i} + \sum_{i=1}^{o} \beta_{43i} \Delta IRSP_{t-i} + \sum_{i=1}^{p} \beta_{44i} \Delta EXCH_{t-i} + \sum_{i=1}^{r} \beta_{45i} \Delta PROD_{t-i} + \sum_{i=1}^{s} \beta_{46i} \Delta TRES_{t-i} + \alpha_4 \varepsilon_{t-1} + u_{4t} \quad (1.4)$$

8 Since the literature is very rich on the matter we do not discuss the methodological issues in detail. See for example Hamilton (1994) and Hayashi (2000) for a detailed time-series analysis.

$$\Delta PROD_t = \psi_5 + \sum_{i=1}^{m} \beta_{51i} \Delta CRDP_{t-i} + \sum_{i=1}^{n} \beta_{52i} \Delta MTDP_{t-i} + \sum_{i=1}^{o} \beta_{53i} \Delta IRSP_{t-i} + \sum_{i=1}^{p} \beta_{54i} \Delta EXCH_{t-i} + \sum_{i=1}^{r} \beta_{55i} \Delta PROD_{t-i} + \sum_{i=1}^{s} \beta_{56i} \Delta TRES_{t-i} + \alpha_5 \varepsilon_{t-1} + u_{5t} \quad (1.5)$$

$$\Delta TRES_t = \psi_6 + \sum_{i=1}^{m} \beta_{61i} \Delta CRDP_{t-i} + \sum_{i=1}^{n} \beta_{62i} \Delta MTDP_{t-i} + \sum_{i=1}^{o} \beta_{63i} \Delta IRSP_{t-i} + \sum_{i=1}^{p} \beta_{64i} \Delta EXCH_{t-i} + \sum_{i=1}^{r} \beta_{65i} \Delta PROD_{t-i} + \sum_{i=1}^{s} \beta_{66i} \Delta TRES_{t-i} + \alpha_6 \varepsilon_{t-1} + u_{6t} \quad (1.6)$$

where Δ is the difference operator, *m*, *n*, *o*, *p*, *r* and *s* are the number of lags determined by Hannan-Quinn information criterion, ε_{t-1} is the lagged error correction term derived from the cointegration equation and u_{it} is a white noise.

This system of equation represents a framework which enables us to investigate multivariate Granger causality. As argued by Lutkepohl (1982), Granger non-causality tests in a bivariate system may be subject to the omitted-variable bias. In addition to this technical aspect, our model does not consider only credit to deposit ratio and maturity of deposits, but it takes into account interest rate spread, exchange rates and the maturity structure of government bonds in order to capture the possible interactions inside the financial system.

4. Results and discussion

As described above, as a preliminary step, we test for unit root by means of the augmented Dickey Fuller (ADF; Dickey and Fuller, 1981) test. Furthermore, we employ the Kwiatkowski et al. (1992) test, known as the KPSS test for the null hypothesis of stationary of a univariate time series. The results indicate that all variables involved are non-stationary in level but stationary in first difference, that is, they are all I(1).[9]

[9] We do not report the stationary test results to conserve space. All unreported results are available from the authors upon request.

Since the non-stationary variables are integrated of the same order, their linear combination may be stationary indicating that the variables are cointegrated. We test for cointegration or long-run relationship between these variables employing the Johansen-Juselius test (Johansen and Juselius, 1990; Johansen, 1991). The results are given in Table 2. To check the robustness of the results, the Engle-Granger two-step procedure (Engle and Grange, 1987) is also performed (not reported here in view of the similar findings).

[Table 2 here]

As shown in Table 2, both trace and maximum eigenvalue statistics indicate the presence of two cointegrating equations at the 5% level.

[Table 3 here]

From Table 3, it follows that the error correction term is significant only for the CRDP equation. This means that, if there is a deviation from the cointegrating relationship, this variable has the tendency to restore the long-run equilibrium absorbing the effect of the shock to the system. Considering only Eq. (1.1), we see that both in short and long runs (joint causality), Granger causality runs from MTDP and IRSP to CRDP. This finding implies that, in the long run, credit supply in Turkey is affected by changes in the interest rate spread but is not preceded by the demand side which is proxied by production index (PROD). Thus, it can be said that the credit market is affected majorly by cost-driven factor given the considerable price of uncertainty.

Another important finding is that MTDP is found to be exogenous variable, which means that none of other variables involved in the analysis does not Granger cause MTDP. This finding is crucial for the focus of our theoretical discussion. The expectations of depositors emerge as an exogenous factor affecting the bank behavior in terms of credit creation. Considered the high volatility in the Turkish financial market, it is not surprising that the expectations change

quite frequently under a high inflation and rapid exchange rate adjustments. We argue that expectations of depositors contribute to the shift in the allocation of funds in terms of maturity. On the other hand, in the short- and long-run dynamics, our results indicate that interest rate spread changes should be considered as endogenous variables to both credit supply and deposit maturity. Furthermore, taking into account the results from Eq. (1.1), we see that bi-directional causality exists between IRSP and CRDP, implying that the price effect and rationing of credits are mutually reinforcing and give rise to circularity in terms of Granger causality.

Considering both Eqs. (1.5) and (1.1), we conclude that a uni-directional causal relationship exists between CRDP and PROD and that the direction of causality is from the former to the latter. This finding provides enough evidence that credit market is driven by the supply side rather than the demand side: throughout two decades of open economy experience, the economic cycle is constrained by credit market conditions.

Finally, from Eqs. (1.4), (1.5) and (1.6), it follows that a unidirectional causality runs from PROD to TRES, indicating that the government budget constraints weight on the maturity of public financing. We can conclude that there is a connection between tax revenues and the default risk on public debt. As the growth of economy accelerate and tax revenues increase, the default risk on public debt decreases, leading to a greater facility in terms of maturity for public finance.

To make brief account of our results, we underline several major points for the case of Turkey in 20 years period of financial liberalization; For a small open economy under fiscal dominance and chronic inflation; i) given the uncertainty on price stability, depositor behavior in terms of deposit maturity conditions both the composition of the liability side in banks and the cost structure of funds, that is, the interest rate spread in the financial market, ii) the interest rate spread and credit ratio have a bi-directional causal relationship implying a

feedback mechanism given that the maturity of deposit plays a common shock, iii) credit ratio constraints the real side of the economy, implying that cycles are rather driven by the supply side of the credit market, iv) given that the credit conditions facilitate the growth of the economy, it, in turn, alleviates the budget constraints of the public sector, leading to a decline in the default risk and thus facilitating to borrow in longer terms.

5. Conclusion

In this paper, we focused on the relationship between the banking sector credit expansion and the depositor behavior in Turkey during the period from 1990 to 2009. Considered macroeconomic instability resulting from the two major imbalances (budget deficit and inflation), past two decades under financial liberalization have not contributed enough to deepen the credit market compared to other countries' experiences. The multivariate causality analysis provides evidence to a circular relationship in which the major role can be given to effect of the uncertainty on the structure of financial market.

Several major results can be summarized as; i) given the uncertainty on price stability, depositor behavior in terms of maturity influences both the liability side of the balance sheet of the banking sector and the interest rate spread in the financial market, ii) the interest rate spread and credit ratio have a bi-directional causal relationship implying a feedback mechanism iii) credit creation precedes the production, implying that cycles are rather driven by the supply side of the credit market, iv) given that the credit conditions drive the growth of the economy, the budget constraint of the public sector improves in a way that it leads to a decline in the default risk and thus facilitating to borrow in longer terms.

For further research we may suggest different extensions of our results. A possible extension of this work would be to conduct similar analyses for other or small open economies or for countries under fiscal dominance. The case of Greece would be an interesting exercise to see

whether such feedback mechanism between uncertainty and financial market is in play regarding the recent fiscal imbalances. The panel data analysis instead of a time-series approach should also be considered in future research.

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Tables

Table 1: Economic and financial indicators

	DIR	BIR	CR/GDP	DEP/GDP	CR/DEP	growth	I/GDP	inflation
Turkey	21	18.4	35	42	83	4.7	25.2	8.4
EU-27	4.3	4.5	157	136	116	4.6	25.2	3.6

Data source: Turkish Statistical Institute (TURKSTAT).

Table 2: Johansen Test for the number of cointegrating relationships

Eigenvalue	$H_0 : r =$	Trace	L Max	Critical values at 95%	
				Trace	L Max
0.23288	0	127.32	62.83	82.49	36.36
0.13025	1	64.49	33.07	59.46	30.04
0.06218	2	31.41	15.21	39.89	23.80
0.04310	3	16.20	10.44	24.31	17.89
0.02365	4	5.76	5.67	12.53	11.44
0.00038	5	0.09	0.09	3.84	3.84

r indicates the number of cointegrating relationships. The critical values for Maximum eigenvalue and trace test statistics are given by Johansen and Juselius (1990). The model specification includes an intercept and no trend in the cointegrating equations.

Table 3: Temporal Granger causality test results

Sources of causation													
	Short-run						Long-run	Joint (short-run/long-run)					
	F-statistics						LR-statistics	*F*-statistics					
	CRDP	MTDP	IRSP	EXCH	PROD	TRES	ε_{t-1}	CRDP, ε_{t-1}	MTDP, ε_{t-1}	IRSP, ε_{t-1}	EXCH, ε_{t-1}	PROD, ε_{t-1}	TRES, ε_{t-1}
CRDP	-	0.10	2.54	0.33	0.60	0.73	7.66**	-	3.63*	4.33**	2.59	1.59	1.51
MTDP	0.09	-	1.90	0.07	0.35	0.56	0.18	0.11	-	1.31	0.10	0.32	0.46
IRSP	2.25	24.09**	-	1.33	0.10	0.42	3.47	2.39*	14.03**	-	1.87	0.72	1.11
EXCH	0.08	0.11	0.37	-	0.89	2.14	1.26	0.33	0.64	0.65	-	0.78	1.84
PROD	3.57**	0.12	0.11	0.82	-	0.82	0.48	2.88**	0.27	0.21	0.73	-	0.81
TRES	1.26	1.80	0.24	2.85	2.56*	-	1.82	1.72	1.66	0.70	2.34	3.19**	-

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