ISE and exchange market pressure

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Mete Feridun

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Mete Feridun
Department of Economics
Loughborough University
Loughborough, Leicestershire
LE11 3TU
United Kingdom
E-mail: m.feridun@lboro.ac.uk

Abstract
This article aims at investigating the long-run relationship between stock prices and speculative pressure in the Turkish exchange market through Granger-causality analysis for the period 1986:01-2006:11. For this purpose an Exchange Market Pressure Index is built using the weighted average of exchange rate changes, interest rate changes and foreign exchange reserve changes. This index is then used in pairwise causality analyses with Istanbul Stock Exchange (ISE) National-100 Index. Results of the ADF unit root tests suggest that the series are stationary. Hence, no-cointegration analysis was carried out before the Granger-causality tests. Results of Granger-causality indicates that there exists no long-run relationship between stock prices and the speculative pressure in the exchange market in Turkey.

JEL: F30, E44
Key words: currency crises, stock prices, co-integration, exchange market pressure

I. Introduction

Since the 1980s, the IMF and the World Bank have increasingly required certain measures to be adopted by low-income borrowing countries as conditions of access to foreign credit. These have included cuts to public spending, privatization of public enterprises, removal of government subsidies, trade liberalization, and the deregulation of the financial system, among others (Ogbuaku et al. 2005). Country experiences have shown that these reforms have led to severe problems of capital inflows and real exchange rate misalignments, and in most cases, to financial crises (Grabel, 1995). Integration of emerging economies into the world financial system through financial liberalization has exposed them to speculative short-term capital movements and rendered them vulnerable to currency crises. Under conditions of capital account liberalization, in particular, the exchange rate have become subject to speculative attacks. In most cases, the crises are formed pretty much in the same way: Deregulation allows hot money in the form of foreign portfolio investments into the country and results in a large increase in private and public sector indebtedness. More specifically, abolition of foreign exchange controls and the adoption of more flexible exchange rate regimes in emerging economies in the late 1980's and early 1990's has increased the volatility of foreign exchange markets and the risk associated with such investments (Phylaktis and Ravazzolo, 2005).

Turkey is one of the emerging economies that bought into the promises of the IMF prompted financial liberalization in 1980s, and that has witnessed severe currency crises since then. Given the Turkish experience, one can easily trace out the drastic impacts of unregulated financial liberalization of the domestic financial
market. As a result of these reforms, the economy experienced a massive inflow of short-term capital and the threat of capital flight became a dominant motive in policy-making, which necessitated a firm commitment to high interest rates. Hence, Turkish economy saw a number of currency crises in its post-liberalization history.

In the currency crisis literature, stock market index has frequently been used as a measure of the possible evolution and collapse of asset price bubbles. Besides, a decline in the growth rate of asset prices may lead to loan defaults and may also signal loss of investor confidence (Kaminsky et al. 1998). According to the portfolio approach of analysing the relationship between stock prices and exchange market pressure, a rise in stock prices increases the domestic wealth of investors, facilitating a rise in the demand for money. Following the consequent rise in interest rates, capital is attracted into the domestic economy appreciating the domestic currency (Bahmani-Oskooee and Sohrabian, 1992 and Granger et al. 2000). In the literature, the first attempt to incorporate the domestic stock market into empirically based currency crisis models has been Kaminsky and Reinhart (1996) and Kaminsky et al. (1998). Since then, domestic stock markets are generally found to be a significant leading indicator of currency crises, over a number of different currency crises in the recent past by Goldstein et al. (2000), Granger et al. (2000), Edison (2000), Wu (2001), El-Shazly (2002), Broome and Morley (2003).

The rest of the article is structured as follows: The next section presents the theoretical framework on which the empirical analysis is built. Section 3 will introduce the data and methodology. Section 4 will provide the empirical results and the last section will point out the conclusions that emerge from the present study.

II. Theoretical Framework

The theoretical foundation of this model is based on a slightly modified version of Krugman’s (1979) model of currency crisis. Krugman’s model is based on several assumptions. Firstly, a small open economy produces and consumes a single consumption good, which is produced in the country and overseas. Purchasing power parity (PPP) holds and the foreign price level is normalized to 1:

\[ \frac{(e_t P_t^*)}{P_t} = 1 \] with \( P_t^* = 1 \rightarrow e_t = P_t \] (1)

where \( P \) is the domestic currency price of the good, \( P^* \) is the foreign currency price of the good, and \( e \) is the exchange rate. Setting the given value of \( P^* \) to unity, the domestic price level is equal to the exchange rate. The domestic price level remains constant under a fixed exchange rate system. Secondly, there is perfect foresight and the foreign interest rate is normalized to 0:

\[ e_t^{e+1} = e_{t+1} \text{ with } i_t^* = 0 \rightarrow [(e_{t+1} - e_t)/ e_t] = i_t \] (2)

Thirdly, uncovered interest parity is assumed to hold between domestic and foreign currency assets:

\[ i_t = i_t^* + \lambda_t \] (3)

where \( i \) is the domestic interest rate, \( i^* \) is the foreign interest rate and \( \lambda \) is the expected rate of depreciation of the domestic currency. Fourthly, there is a lower bound on the level of foreign reserves that the central bank owns:
\[ R_t \geq 0 \]  \hspace{1cm} (4)

where \( R \) is the foreign exchange reserves of the central bank. Based on these assumptions, Krugman (1979) explains that market participants launch speculative attacks by buying foreign exchange in the face of impending devaluation with the deterioration of economic fundamentals. As a result, the foreign reserves of the central bank decrease all of a sudden, and the currency is devalued or the exchange rate system changes from a fixed exchange rate system to a flexible exchange rate system, which is defined as a currency crisis. The general model is based on the money demand equation:

\[
\left( \frac{M^d_t}{P_t} \right) = \alpha - \beta i_t \hspace{1cm} (5)
\]

which states that real money demand depends negatively on the expected rate of depreciation and also slips in the normalization that the foreign price level is fixed at unity. Full employment prevails and the level of output is normalized to zero. Real money demand, therefore, can be expressed solely as a function of the nominal interest rate, \( i \). Money market equilibrium requires that:

\[
\frac{M^s_t}{e_t} = a - b_i t, \hspace{1cm} a, b > 0
\hspace{1cm} (6)
\]

where \( M \) is the nominal money stock. Krugman (1979) explains that in the absence of commercial banks we have:

\[
M^s_t = R_t + D_t \hspace{1cm} (7)
\]

where \( R \) is the central bank's foreign exchange reserves and \( D \) is the domestic credit component of the money supply. In addition, investors' behavior is captured by uncovered interest parity condition:

\[
[(e_{t+1}^e - e_t)/e_t] = i_t - i^{*}t \hspace{1cm} (8)
\]

The money market equilibrium is:

\[
M^d_t = M^s_t \rightarrow [(R_t + D_t)/P_t] = \alpha - \beta i_t
\hspace{1cm} (9)
\]

which can also be shown as:

\[
[(R_t + D_t)/e_t] = \alpha - \beta [(e_{t+1}^e - e_t)/e_t]
\hspace{1cm} (10)
\]

where:

\[
e_t = \bar{e} \hspace{1cm} \forall t
\hspace{1cm} (11)
\]

In the present study, the stock prices is included in the money demand function a la Edin and Vredin (1993) and Broome and Morley (2003) for three reasons: First, it acts as a wealth effect, as a rise in stock prices increases nominal wealth (Friedman, 1988). Second, a rise in stock prices reflects a rise in expected returns from risky
assets and to offset this rise in risk, agents switch away from long-term bonds to safer monetary assets (Friedman, 1988). Third, a rise in stock prices implies a rise in financial transactions and thus transactional demand for money (Friedman, 1988). These imply a positive relationship between money and stock prices. Consequently, money demand takes the following form:

\[ m_t = \lambda m_t^* + \phi y_t - \chi s_t + \frac{\lambda_d e}{dt} \]  

Where \( m \) is domestic money balances, \( y \) is domestic income and \( s \) is a domestic stock market index. We have assumed that the domestic money supply is purely accommodating. By rearranging the above equations, we get:

\[ e_t = m_t + \lambda d_t^* + p_t^* - \phi y_t - \chi s_t + \frac{\lambda d e}{dt} \]  

To test for the effects of stock prices on the exchange rate, we introduce an exchange market pressure index:

\[ EMP = (1/\sigma_e)^*(\Delta e/e_{t-1}) + (1/\sigma_i)^*(\Delta i/r_{t-1}) - (1/\sigma_{ir})^*(\Delta ir/r_{t-1}) \]  

Where \( \sigma_e \) is the standard deviation of the exchange rate, \( \sigma_i \) is the standard deviation of the interest rate and \( \sigma_{ir} \) is the standard deviation of the international reserves. The weights attached to the three components of the index are the inverse of the standard deviation for each series, in order to equalize volatilities of the three components and to avoid any of them dominating the index (Kaminsky et al 1997). A positive value of the index measures the depreciation pressure of the currency, while a negative value of the index measures the appreciation pressure of the currency. We suggest that the index is a function of:

\[ EMP = f(\Delta ds) \]  

Where \( ds \) is the domestic stock market index. This notation is not meant to oversee a number of other relevant variables. Yet, this choice is justified in the sense that it provides an ad hoc theoretical basis for the pairwise granger causality tests, which can accommodate only two variables at a time. Furthermore, it would not be possible to incorporate all the potential leading indicators into the model, so we have concentrated on the stock market index as suggested by Broome and Morley (2003).

III. Data and Methodology

All data is obtained from the Central Bank of the Republic of Turkey online data dissemination system, spans the period 1986:01-2006:11, and is in monthly percent changes. Exchange Market Index is Istanbul Stock Exchange (ISE) National -100 index obtained from the Central Bank of the Republic of Turkey online data dissemination system. Interest rates are the averages of 3-month nominal interest rates (calculated as the average of maximum deposit rates reported by banks to the Central Bank). Foreign exchange reserves are the Turkish Central Bank’s gross foreign exchange reserves. Exchange rate is the US dollar-Turkish lira nominal exchange rate. Most studies of currency crises define the currency pressure measure...
in terms of the bilateral exchange rate against the US dollar. Hence we use US dollar-Turkish lira nominal exchange rate. The reason why these three variables should be considered simultaneously in such index is very well documented by Moreno and Trahan (2000). The authors explain that if a country’s exchange rate is floating, or if a peg has collapsed, a sharp depreciation is a clear-cut indicator of a shift in sentiment or speculative pressure against a currency. Nevertheless, if exchange rate stability (or the peg) is maintained, pressure on the exchange rate will be reflected through the action taken by the monetary authorities. If investors want to switch away from a country’s assets, the exchange rate will tend to depreciate and, in order to prevent depreciation of the currency, the central bank will either sell foreign reserves to accommodate the increased demand for foreign assets, or allow interest rates to rise (Moreno and Trahan, 2000). Particularly, including interest rates in the index enables us “to seize the full period of the turbulence, which might begin with interest rate increases defending a peg” (Eliasson and Kreuter, 2001). The index of exchange market pressure calculated according to the equation (14) is shown in Figure 1.

Figure 1 Exchange Market Pressure Index

Source: The author’s calculation.

The analysis of the index of speculative pressure identified numerous periods of excessive market volatility. We find that the crisis variable successfully portrays the crisis periods that occurred in Turkey in the sample period using a crisis threshold of
mean $+3$ Standard Deviation. We will test the causal relationships between the selected variables and the calculated EMP index. A practical way for testing for causality was proposed by Granger (1969) and popularized by Sims (1972). Testing causality, in the Granger sense, involves conducting $F$-tests to see whether lagged information on a variable $X$ provides any statistically significant information about a variable $Y$ in the presence of lagged $Y$. To implement the Granger test, we assume a particular autoregressive lag length $k$ (or $p$) and estimate Equation (4.2) and (4.3) by OLS:

$$X_t = \lambda_1 + \sum_{i=1}^k a_{1i}X_{t-i} + \sum_{j=1}^k b_{1j}Y_{t-j} + \mu_{1t} \quad (15)$$

$$Y_t = \lambda_2 + \sum_{i=1}^p a_{2i}X_{t-i} + \sum_{j=1}^p b_{2j}Y_{t-j} + \mu_{2t} \quad (16)$$

$F$ test is carried out for the null hypothesis of no Granger causality:

$$H_0 : b_{11} = b_{12} = \cdots = b_{1k} = 0, i = 1,2. \quad (17)$$

where $F$ statistic is the Wald statistic for the null hypothesis. If the $F$ statistic is greater than a certain critical value for an $F$ distribution, then we reject the null hypothesis that $Y$ does not Granger-cause $X$, which means $Y$ Granger-causes $X$. If it is also found that when regressing $X$ on its past values and current and past values of $Y$, some or all of the current or past values of $Y$ are significant, then we say that there exists feedback between the variables. Unidirectional causality exists when it can be shown that one variable Granger causes the other, but not the other way around. The definition of the Granger causality is based on the hypothesis that $X$ and $Y$ are stationary or $I(0)$ time series.

**IV. Empirical Results**

The definition of the Granger causality is based on the hypothesis that $X$ and $Y$ are stationary or $I(0)$ time series. Therefore, the first necessary condition to perform Granger-causality tests is to study the stationary of the time series under consideration and to establish the order of integration present. Table 1 below presents the results of the unit root test.

<table>
<thead>
<tr>
<th>Test with an intercept</th>
<th>Test with an intercept and trend</th>
<th>Test with no intercept or trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADF (Levels)</strong></td>
<td><strong>ADF (1st differences)</strong></td>
<td><strong>ADF (Levels)</strong></td>
</tr>
<tr>
<td>ISE</td>
<td>-10.70087</td>
<td>-10.81375</td>
</tr>
<tr>
<td>CV* (1%)</td>
<td>-3.456514</td>
<td>-3.995340</td>
</tr>
<tr>
<td>CV* (5%)</td>
<td>-2.872950</td>
<td>-3.427975</td>
</tr>
</tbody>
</table>


The lag length was determined using Schwartz Information Criteria (SIC)
As the calculated ADF statistics are larger than the MacKinnon values, we can reject the null hypothesis of a unit root. Hence we conclude that both series are stationary, i.e. \( I(0) \). Therefore, there is no need for co-integration analysis and we can proceed to the Granger-causality tests shown in equations 15 and 16. Table 2 shows the results of these tests.

### Table 2. Granger Causality Test Results (Total observations: 244)

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Lag 1</th>
<th>Lag 2</th>
<th>Lag 3</th>
<th>Lag 4</th>
<th>Lag 5</th>
<th>Lag 6</th>
<th>Lag 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMP ( \Rightarrow ) ISE</td>
<td>0.32288</td>
<td>0.30643</td>
<td>0.11618</td>
<td>0.10663</td>
<td>0.07924</td>
<td>0.22275</td>
<td>0.22866</td>
</tr>
<tr>
<td>ISE ( \Rightarrow ) EMP</td>
<td>0.15271</td>
<td>0.15602</td>
<td>0.22803</td>
<td>0.29994</td>
<td>0.21153</td>
<td>0.22388</td>
<td>0.24759</td>
</tr>
</tbody>
</table>

Strong evidence emerges showing that there exists no long-run relationship between the EMP index and ISE National-100 index.

### V. Conclusion

This article aims at investigating the long-run relationship between stock prices and speculative pressure in the exchange market in Turkey through Granger-causality analysis. For this purpose an Exchange Market Pressure Index is built using the weighted average of exchange rate changes, interest rate changes and foreign exchange reserve changes. This index is then used in pairwise causality analyses with Istanbul Stock Exchange (ISE) National-100 Index. Results of the ADF unit root tests suggest that the series are stationary. Hence, no-cointegration analysis was carried out before the Granger-causality tests. Results of Granger-causality clearly suggest that there exists no long-run relationship between stock prices and the speculative pressure in the exchange market in Turkey.

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