DETERMINANTS OF CURRENCY CRISIS IN JORDAN A MULTINOMIAL LOGIT MODEL

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Abstract

In this paper, an early warning system will be developed to explain any potential currency crisis and identify a number of leading indicators that can help the understanding of the crises, using Jordanian data. The methodology of this paper includes utilizing the Multinomial Logit analysis. The paper has found evidence that number of key indicators including real exchange rate (*RER*), money supply-reserves ratio (*M2R*), growth rate of domestic credit (ΔDC) and Central Bank foreign assets to liabilities ratio (*AL*), play significant roles in explain the currency crises. While their marginal effect varies, they are consistent with theory in terms of signs.

Keywords: Currency crisis, early warning systems, logit model, Jordan

1 Introduction

Over the past two decades, many countries have witnessed financial instability and were affected by financial crises. These crises embarrassed policy makers and took them somewhat by surprise and tended to lead to huge losses in income. These events have been the focus of research attention in an attempt to develop methods that could assist explaining and understanding the causes of crises and to identify indicators that could predict them.

There is no widely accepted definition of a currency crisis, which is normally considered as part of a financial crisis. Kaminsky *et al.* (1998), for instance, define currency crises as when a weighted average of monthly percentage depreciations in the exchange rate and monthly percentage declines in exchange reserves exceeds its mean by more than three standard deviations. Frankel and Rose (1996) define a currency crisis as a nominal depreciation of a currency of at least 25% but it is also defined at least 10% increase in the rate of depreciation. In general, a currency crisis can be

defined as a situation when the participants in an exchange market come to recognize that a pegged exchange rate is about to fail, causing speculation against the peg that hastens the failure and forces a devaluation or appreciation.

The focus of this study will be on Jordan, which is a small open economy, with a fixed exchange rate against the dollar since 1995, and was hit by a currency crisis in 1988-1989. Prior to the crisis, the economy exhibited several imbalances caused by huge deficit of the trade balance, a lack of foreign exchange reserves, which arose as a result of the decrease in workers' remittances and foreign grants, banking problems, and a decrease in the growth rate of real production.

This paper aims to employ quantitative method to explain the currency crises in Jordan, using multinomial Logit model. The objective is to develop an early warning system to explain any potential currency crisis in Jordan over the time period January 1976 to December 2010. This system can be used as a useful policy tool to serve policy makers, besides providing them with a way to forecast crisis development. Moreover, this paper attempts to identify a number of leading indicators that can help the understanding of crises.

The remainder of this paper is structured as follows: Section 2 reviews the empirical work. Section 3 discusses the data and methodology used in the analysis. Section 4 reports the empirical results. Finally, section 5 concludes the analysis.

2 Literature review

There are various types of models used empirically to investigate the issue of currency crises, firstly, the significant indicators of currency crises and, secondly, the timing of the crisis for a specific country or for a group of countries. The main approaches are categorised by their research methodology: (1) A non-parametric criteria, signals approach, which monitors some key indicators which tend to perform at the beginning of the crisis. The performance of certain macroeconomic factors changes in the build-up to a currency crisis from that of tranquil periods, enabling observers to identify the main reasons behind the increase in risk potential of currency crisis; (2) Econometric modelling, Logit-probit and Markov switching models, in such approaches researchers estimate a quantitative model, reflecting the probability of a currency crisis on a group of economic indicators.

Kaminsky *et al.* (1998) and Tambunan (2002) used the signals approach to analyse currency crises, using data for 20 countries and Indonesia, respectively. They defined a currency crisis as a weighted average of monthly percentage depreciations in the exchange rate and monthly

percentage declines in foreign exchange reserves when they exceed the mean by more than 1.1 or 3 standard deviations. They found that the exchange rate changes were the main indicator in any early warning system. In Bruggemann and Linne (2002), a currency crisis is defined as a 20% depreciation against the US dollar within ten trading days, and they found that, in addition to the overvaluation of the exchange rate, weak exports, falling foreign exchange reserves, and banking sector indicators were useful in indicators assessing crisis vulnerabilities.

Frankel and Rose (1996) used a probit model to analyse a currency crisis, employing data for 105 countries. They defined a currency crisis as a nominal depreciation of the currency by at least 25%, or at least a 10% increase in the rate of depreciation. They found that currency crises will occur when output decreases, domestic credit growth increases, foreign interest rates rise and when the exchange rate is overvalued. On the other hand, Bussiere and Fratzscher (2002), Lestano andKuper (2003), and Feridun (2008) developed a Logit model for 32 emerging countries, six Asian countries and Turkey, respectively. They found that many variables play a significant role in predicting a currency crisis, such as the ratio of M2 to foreign reserves, the domestic real interest rate, and the use of contagion variables.

Abiad (2003) and Schweickert *et al.*(2005) used a Markov-switching model for five Asian countries and Russia and Brazil, respectively. They found that the majority of crises events can be explained by the negative evolution of macroeconomic fundamentals and financial sector variables. Boinet *et al.* (2005) and Cipollini *et al.* (2008) studied currency crises in Argentina and the European monetary system, respectively; using Markov switching models to investigate whether first or second generation can explain the crises in these countries. Furthermore, Ford *et al.* (2007) developed a GARCH and path independent Markov-switching GARCH model for four Asian countries. They employed five indicators in the analysis, including market pressure on the exchange rate; M2/international reserves; growth in domestic credit; real exchange rate; and risk premium. They found that macroeconomic variables can explain the crises and the probability of its occurrence at any time. Recently, Ford *et al.* (2010) used a three-regime Markov-switching model for Indonesia and Taiwan. They found that three regimes of market pressure can be distinguished in both countries. However, macroeconomic fundamentals, such as the growth of domestic credit, the reserves position, the real exchange rate, the current account and the government's fiscal balance, are important determinants of market pressure for Indonesia, and to some extent for Taiwan.

Other studies used different techniques, for example Sachs *et al.* (1996) used cross-sectional analysis, for 20 countries at 1995, depending on

an equation for the index of the crisis. This index is a function of a number of indicators, including the real exchange rate, lending boom, and weak fundamentals. They found that some degree of previous misbehaviour was a necessary condition for a crisis. The misalignment takes the form of an overvalued real exchange rate and a recent lending boom, coupled with low reserves relative to the Central Bank's short-term commitments. Aziz *et al.* (2000) use a comparison approach of pre- and post-crisis behaviour of indicators, including measures of overheating, external imbalances, unemployment rate, short-term capital inflows, and the world interest rate. They found that overvaluation, terms of trade, inflation, domestic credit growth, M2-reserves ratio, world interest rate, and the current account are all useful indicators.

To summarise, these studies used various models and techniques first to find the significant indicators of currency crises and then the timing of the crisis for a specific country or for a group of countries. Nevertheless, a number of leading indicators were suggested by the empirical studies. These indicators were found to be important in determining currency crises, and included macroeconomic fundamentals, such as the real exchange rate, the money supply-reserves ratio, the growth rate of domestic credit, the current account balance and the debt-GDP ratio. Other indicators included a measuring of banking sector fragility and financial sector weaknesses, such as banks' reserve-assets ratio, banks' loans-deposits ratio and portfolio-capital flows ratio. Therefore, the survey provides a solid base as a starting point for the investigation in this paper.

3 Data and Methodology

3.1 Data

This section analyses the empirical effects of the fundamental variables on market pressure in Jordan, using monthly observations over the period January 1976 to December 2010. The objective is to estimate a model to capture the key determinants of a market pressure index for the Jordanian exchange market. It employs eight variables in the empirical model, namely market pressure on the exchange rate, MP_t; the real exchange rate, RER_t; the ratio of broad money supply (M2) to reserves, $M2R_t$; the growth rate of domestic credit; ΔDC_t; the ratio of Central Bank's foreign assets to foreign liabilities; AL_t; the growth rate of exports, ΔX_t; the growth rate of imports, ΔM_t; and the output growth rate approximated by industrial production (as output data are available annually or quarterly only), ΔIP_t. All data are assembled from the International Monetary Fund's International Financial Statistics (IFS).

3.1.1 Market pressure on the exchange rate (*MP*):

Central Banks arbitrate in the foreign exchange market through either reducing its holding of foreign exchange reserves or increasing the interest rates aiming to avoid exchange rate fluctuations. Therefore, an ideal exchange rate market pressure index should include, in addition to exchange rate changes, changes in the reserves, and changes in the interest rates.

An index of speculative pressure that incorporates the measures of speculative attack on the exchange rate is labelled as *MP* with a currency crisis defined as when this index exceeds a certain threshold. Following Eichengreen *et al.* (1995), the market pressure index can be calculated as:

$$MP_t = \alpha \Delta ex_t - \beta \Delta r_t + \gamma \Delta i_t \qquad (1)$$

where: Δ denotes monthly percentage change; ex_t is the nominal exchange rate (Jordanian dinar: US$); r_t is the Central Bank's foreign exchange reserves; i_t is the discount rate; the parameters α, β, and γ are weighted average calculated as: $1/\sigma_i$, where σ_i is the standard deviation[140] of the full sample for the exchange rate, reserves, and interest rate, respectively. A positive value of *MP* indicates increased pressure in the foreign exchange market that can be caused by any combination of a devaluation of the nominal exchange rate, a loss of the reserves, or an increase in the interest rate. On the other hand, a negative value of *MP* can be caused by an appreciation, an increase of reserves, or a decrease in the interest rate. Figure 1 shows the plot of *MP*. Therefore, a currency crisis will occur if the value of *MP* exceeds a particular threshold[141]. The threshold is a certain value set as the average of *MP* ± standard deviation of *MP*. This generates two bounds for the market pressure index; the upper bound represents the depreciation case and the lower bound denotes appreciation. In order to make a comparison, three thresholds are calculated using 1, 1.5, and 2 standard deviations in each case.

The methodology of this paper measures the market pressure index as a weighted average of the Jordanian dinar depreciation (appreciation) against the US dollar, change in reserves, and change of discount rate. These weights are country specific, and calculated as inversely related standard deviation of each series over the period January 1976 to December 2010.

[140]Eichengreen *et al.* (1995) suggest weighting the components of the index by the inverse of their standard deviation aiming to equalize the weights of the components, thus, avoiding the most volatile component dominating the index.

[141]The choice of the standard deviation to calculate a threshold value is arbitrary. According to the literature, it lays between 1 and 3 standard deviations.

Figure (1): Market Pressure Index (1976-2010):

Table 1 shows crisis episodes captured by the estimated *MP* index. It is clear that the index successfully captures the late 1980s crisis. However, the fluctuations in the index prior to 1990 were due to changes in the exchange rate and the interest rate, while thereafter it is caused by changes in interest rate and changes in reserves, as the exchange rate is pegged with US dollar.

Table (1): Crisis episodes captured by the estimated *MP* (1976-2010):

	Threshold 1		Threshold 2		Threshold 3	
	+1 SD	-1 SD	+ 1.5 SD	-1.5 SD	+2 SD	-2 SD
MP Date as: (M/Y)	12/76, 12/79, 09/81, 10/88, 11/88, 02/89, 06/89, 07/89, 02/90, 08/91, 08/98, 09/04, 11/04, 12/04, 02/05, 03/05, 05/05, 08/05, 09/05, 10/05, 11/05, 12/05, 02/06, 04/06, 05/06, 03/08	12/93, 07/97, 10/97, 12/97, 07/99, 10/99, 01/00, 09/00, 02/01, 06/01, 10/01, 11/02, 04/03, 05/03, 06/03, 08/06, 11/06, 09/07, 02/08, 04/08, 06/08, 07/08, 11/08, 03/09, 04/09, 07/09, 12/09	12/76, 12/79, 09/81, 11/88, 02/89, 07/89, 02/90, 08/91, 08/98, 05/05, 09/05, 10/05, 11/05, 03/08	12/93, 07/99, 10/99, 01/00, 09/00, 02/01, 10/01, 11/02, 04/03, 05/03, 06/03, 09/07, 02/08, 07/08, 11/08, 03/09, 04/09, 07/09, 12/09	12/76, 09/81, 07/89, 02/90, 08/91, 08/98, 09/05, 10/05, 03/08	12/93, 07/99, 10/99, 01/00, 09/00, 02/01, 11/02, 04/03, 06/03, 09/07, 02/08, 03/09, 04/09, 12/09
No. of crises	26	27	14	19	9	14

3.1.2 Explanatory variables:

The real exchange rate overvaluation, *RER*, is measured by the difference between *REX* and REX^e (see Feridun (2008)), where *REX* is the real exchange rate calculated by multiplying the official exchange rate, *e*, (JD: $US) by the US wholesale price index, *P**, and divided by the consumer price index of Jordan, *P*, as:

$$REX = e\left(\frac{P^*}{P}\right)$$

and REX^e is the deterministic trend of the real exchange rate.

RER is a measure of international competitiveness and is a proxy for over (under) valuation. We expect the *RER* will affect *MP* negatively, where an overvalued real exchange rate leads to a high probability of a currency crisis.

The ratio of the money supply (M2) to total reserves minus gold in the Central Bank, *M2R*, measures the available foreign exchange reserves. This indicator captures the extent to which the liabilities of the banking system are backed by foreign currencies. In the event of a currency crisis, individuals may rush to convert their domestic currency deposits into foreign currency and so this ratio captures the ability of the Central Bank to meet their demand. We expect to find a positive relation between *M2R* and *MP*.

Domestic credit growth rate, ΔDC, is calculated by taking the change in the natural logarithm of domestic credit. An increase in domestic credit growth may serve as an indicator of the fragility of the banking system. We expect that ΔDC will have a positive effect on *MP*.

The ratio of a Central Bank's foreign assets to foreign liabilities, *AL*, is an indicator of banking fragility. Therefore, any decrease in this ratio reflects a decrease in a Central Bank's ability to manage its foreign commitments. We expect to find a negative relation between *AL* and *MP*.

The growth rate of exports and imports, ΔX and ΔM, are calculated by taking the change in the natural logarithm of exports and imports. Declining export growth implies that there is a loss in competitiveness in the international goods market. That decline may be caused by an overvalued domestic currency; also it indicates the weakness of the country's ability to earn foreign currency to finance an existing current account deficit. On the other hand, excessive import growth may show that the exchange rate is overvalued, which could lead to a loss in competitiveness and a worsening in the current account position. We expect to find a negative relationship between ΔX and *MP*, and a positive relationship between ΔM and *MP*.

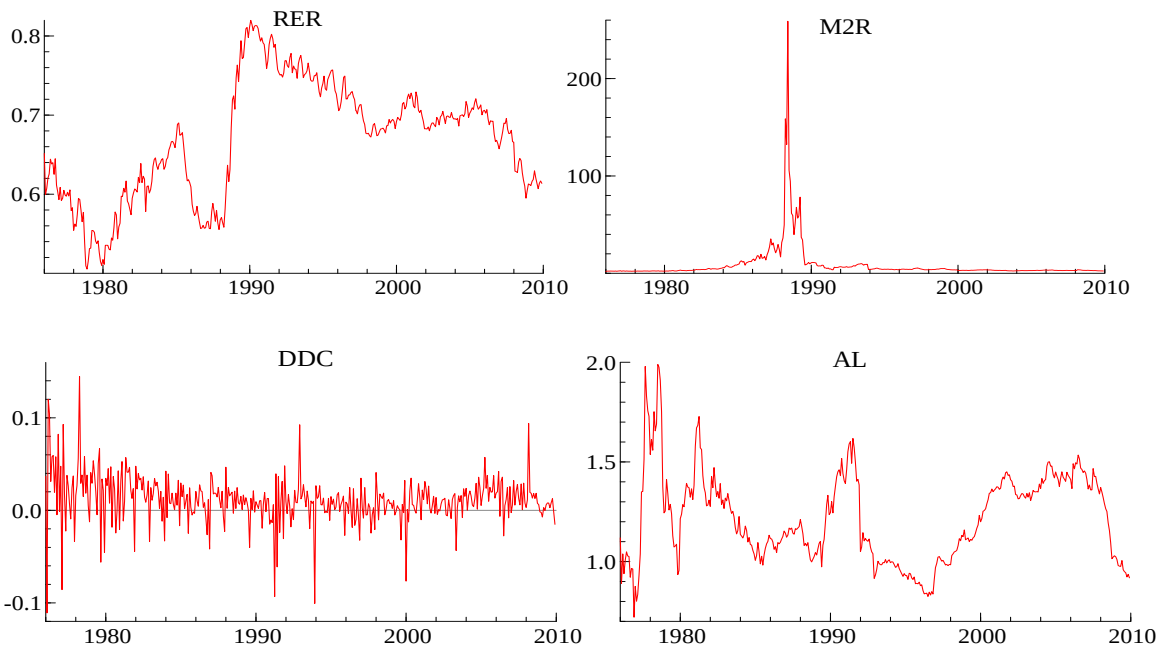
The growth rate of industrial production index, ΔIP, is used as a proxy of the output growth, where a recession often precedes financial crises. We expect to find a negative relationship between ΔIP and *MP*.

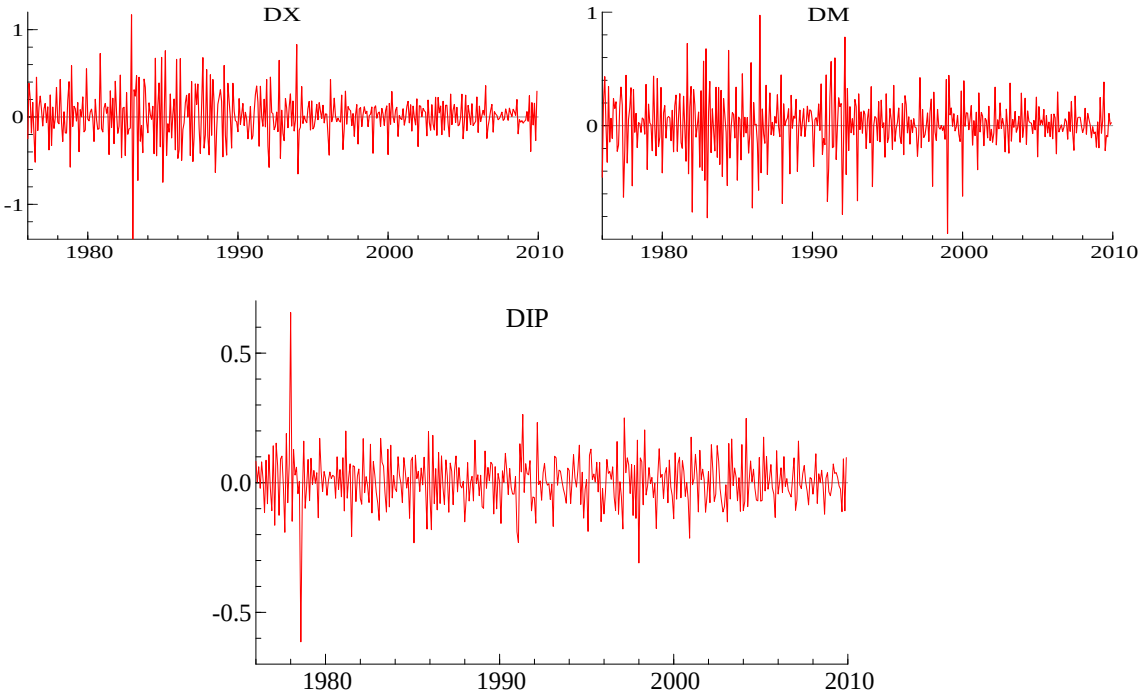
The discussion above considers the effect of each variable on *MP* in the case of depreciation; however, the expected signs are reversed in the case of appreciation. Figure 2 shows the plots of the explanatory variables. Table 2 summarizes the explanatory variables and their expected effect on the market pressure index (depreciation case) as mentioned in the literature.

Table (2): Explanatory variables and the expected effect on MP:

Indicator	Expected effect on MP	References
Real Exchange Rate (*RER*)	-	Frankel & Rose (1996), Kaminsky *et al.* (1998), Berg & Pattillo (1999), Edison (2003), Ford *et al.* (2007), Feridun (2008)
M2 over Reserves (*M2R*)	+	Frankel & Rose (1996), Berg & Pattillo (1999), Edison (2003), Ford *et al.* (2007)
Domestic Credit Growth (ΔDC)	+	Kaminsky *et al.* (1998), Berg & Pattillo (1999), Edison (2003), Feridun (2008)
Ratio of foreign assets to foreign liabilities (*AL*)	-	Frankel & Rose (1996), Kaminsky *et al.*(1998), Feridun (2008)
Export Growth (ΔX)	-	Kaminsky *et al.* (1998), Berg & Pattillo (1999), Edison (2003), Feridun (2007)
Import Growth (ΔM)	+	Kaminsky *et al.* (1998), Berg & Pattillo (1999), Edison (2003), Ford *et al.* (2007)
Industrial Production (ΔIP) Growth	-	Kaminsky *et al.* (1998), Berg & Pattillo (1999), Feridun (2008)

Figure (2): Plots of the explanatory variables (1976-2010):





3.2 Methodology

Previous studies are followed by using econometric models to analyse currency crises, particularly the Logit or Probit and Markov switching models. The aim is to capture the main indicators responsible for explaining a currency crisis. A group of economic indicators suggested by the literature will be used to model the probability of a currency crisis using the index of market pressure (*MP*). The suggested model can formed as follows:

$$MP_t = \beta_0 + \beta_1 RER_t + \beta_2 M2R_t + \beta_3 \Delta DC_t + \beta_4 AL_t + \beta_5 \Delta X_t + \beta_6 \Delta M_t + \beta_7 \Delta IP_t + \varepsilon_t \quad (2)$$

Since the objective of this paper is to analyse the determinants of a currency crisis in Jordan, following the literature, the multinomial Logit model used in this paper, in view of the fact that the market pressure can be converted to three outcomes; -1, 0 and 1 according to the definition of the currency crisis followed in this paper by taking appreciation in account.

In line with Feridun (2008), the dependent variable (*MP*) can be converted to a binary representation as:

$$Y = f(x) = \begin{cases} 1, & MP > AVG(MP) + 2SD(MP) \\ -1, & MP < AVG(MP) - 2SD(MP) \\ 0, & otherwise \end{cases} \quad (3)$$

i.e. *f(x)* has three outcomes. When market pressure exceeds its average plus two standard deviation, (Y=1), the crisis happened because of a depreciation. When market pressure is less than its average minus two standard deviation, (Y=-1), the crisis happened because of an appreciation. When the market pressure index lies between the two bounds, (Y=0), then the currency is not facing pressure to change. In such a situation, a linear regression model cannot be used because it would lead to an egregious regression. Instead, a non-linear probability model will be employed using a multinomial Logit model, giving a S-shaped logistic function to constrain the probabilities into an interval of (-1,1). The econometric regression is run on a number of variables to explain a dichotomous indicator equal to 1 or -1 if a crisis occurs within the specified time period, or equal to zero otherwise,

$$P(Y=1)=\Omega(\alpha_1+\beta_1 X)=\frac{e^{(\alpha_1+\beta_1 X)}}{1+e^{(\alpha_1+\beta_1 X)}} \qquad (4)$$

$$P(Y=-1)=\Omega(\alpha_2+\beta_2 X)=\frac{e^{(\alpha_2+\beta_2 X)}}{1+e^{(\alpha_2+\beta_2 X)}} \qquad (5)$$

where Ω is the logistic cumulative distribution function, and β_i represents a vector of the coefficients of the explanatory variables. Positive values of these coefficients mean an increase in the probability of crises and negative ones imply the opposite.

In order to interpret the coefficients, the marginal effect for each coefficient is estimated, where the coefficients themselves represent probabilities. The marginal effect can be expressed as:

$$\frac{dy}{dx}=\beta_i\Omega'(\alpha_i+\beta_i X) \qquad (6)$$

Using this model resolves some disadvantages associated with other approaches. Here, the results appear easier to interpret, because they are the probabilities of a crisis. Furthermore, statistical tests are immediately available, and the effect of all explanatory variables can be captured simultaneously. Finally, these models are flexible enough to deal with different functional forms for the relationship between the dependent and explanatory variables, including dummy variables (Schardax, 2002).

4 Empirical Results

4.1 Unit root test

According to figure 2, all variables have just an intercept and no trend. Therefore, a constant has been included in the unit root tests.

A visual inspections of the data confirmed that all variables were *I*(0). Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowiski-Phillips-Schmidt-Shin (KPSS) unit root tests confirmed the stationary hypothesis for the level of each series. Table (3) summarizes unit root tests results.

Table (3): Unit root tests results (Intercept included):

Variables	ADF	PP	KPSS
MP	-7.956*	-18.608*	0.454
RER	-2.993***	-2.593***	0.451
M2R	-4.253*	-6.183*	0.688
ΔDC	-8.827**	-22.401**	0.659
AL	-2.907**	-3.219**	0.192
ΔX	-10.822*	-43.662*	0.020
ΔM	-6.913*	-51.832*	0.022
ΔIP	-6.534*	-28.198*	0.065

-ADF, Augmented Dickey-Fuller; PP, Phillips-Perron; KPSS, Kwiatkowiski-Phillips-Schmidt-Shin. For ADF Schwarz information criterion used to select the lag length and the maximum number of lags was set to be 17. For PP and KPSS Barlett-Kernel was used as the spectral estimation method and Newey-West used to select the bandwidth.

-ADF & PP critical values: 1% -3.447, 5% -2.869, KPSS critical values: 1% 0.739, 5% 0.463.

-*Significant at 1%, **significant at 5%, and ***significant at 10%.

For the level variables[142], under ADF and PP the null hypothesis of a unit root is rejected at the 5% significance level, except for *RER* which can be rejected at the 10% significance level. While according to KPSS test, the null hypothesis of stationarity cannot be rejected at level 1% significant, except for *M2R* and ΔDC which cannot be rejected at the 5% significance level.

4.2 Multinomial Logit model results

In order to estimate the probability of currency crises, *MP* values are converted to three values, -1, 0, and 1, to represent the dependent variable in the multinomial Logit model. The conversion procedure depends on table 1. Therefore, three market pressure indices are constructed following the number of the standard deviations used in calculating the threshold. MP1 used 1 standard deviation, MP2 used 1.5 standard deviation, and MP3 used 2 standard deviation.

Tables 4, 5, and 6 show the results of the multinomial Logit models which investigate the probability of the currency crises employing the explanatory variables mentioned above. The second column represents results of the appreciation of *MP*; i.e. when *MP* less than its average minus the standard deviations. The fourth column, on the other hand, shows the results of the depreciation of *MP*; i.e. when *MP* exceeds its average plus the

[142] Keep in mind that most variables presented by growth rates, so we expect variables to be $I(0)$.

standard deviation. The third and the fifth columns report the marginal effect for each output.

Table (4): Coefficient estimates of the multinomial Logit model (MP1):

Variables	(Y=-1)	ME (Y=-1)	(Y=1)	ME (Y=1)
RER	2.567 (2.829)	0.154 (0.158)	-3.765*** (2.096)	-0.223*** (0.123)
M2R	-0.421*** (0.232)	-0.024*** (0.013)	0.007 (0.008)	0.002*** (0.001)
Δ*DC*	-23.842* (7.633)	-1.356* (0.433)	7.564 (8.005)	0.501 (0.456)
AL	-0.519 (0.933)	-0.034 (0.052)	1.773*** (0.927)	0.103*** (0.055)
Δ*X*	-0.926 (1.008)	-0.058 (0.056)	2.025** (0.875)	0.119** (0.052)
Δ*M*	-0.782 (0.981)	-0.044 (0.055)	0.142 (0.967)	0.010 (0.055)
Δ*IP*	1.262 (2.019)	0.072 (0.113)	-0.648 (2.080)	-0.041 (0.119)
Constant	-0.213 (1.535)	-	-5.186* (1.239)	-
LR statistic (df=14) Probability	42.37 0.000		Log likelihood	-173.114

-Standard error in brackets,
-* 1%, ** 5% and *** 10% Significant levels.

Results, in table 4, show that there is strong evidence that the money supply to reserves ratio (*M2R*) and domestic credit growth (Δ*DC*) play a significant role in the appreciation case (Y=-1). However, the real exchange rate (*RER*), foreign assets to liabilities ratio (*AL*) and growth rate of exports (Δ*X*) play significant roles in depreciation case (Y=1). The marginal effect is varying. The impact of Δ*DC* has the greatest marginal effect, in both cases, being -136 percent for an appreciation; nonetheless is not significant in the depreciation case.

All signs appear to be consistent with the theory, except for Δ*X* where the probability of a crisis is increased by an increase of exports growth. Although it is a significant probability, it has a small marginal effect, 12 percent. This finding may reflect the fact that some parts of the Jordanian exports are not significant sources of foreign currency.

Table 5 shows the results of the estimated model using MP2, which is calculated using 1.5 standard deviations as the threshold value. It shows that there is no difference in signs or magnitudes of the probabilities of the explanatory variables when including the new market pressure index.

Table (5): Coefficient estimates of the multinomial Logit model (MP2):

Variables	(Y=-1)	ME (Y=-1)	(Y=1)	ME (Y=1)
RER	2.407 (3.416)	0.101 (0.138)	-3.536 (2.766)	-0.117 (0.093)
M2R	-0.561***	-0.023 (0.014)	0.005 (0.010)	0.001 (0.001)

	(0.336)			
Δ*DC*	-24.582* (8.480)	-0.992* (0.355)	2.867 (10.804)	0.119 (0.346)
AL	-0.841 (1.104)	-0.034 (0.045)	0.415 (1.260)	0.014 (0.041)
Δ*X*	-1.044 (1.209)	-0.044 (0.049)	2.250** (1.102)	0.074*** (0.039)
Δ*M*	-0.851 (1.152)	-0.034 (0.046)	-0.022 (1.292)	0.0002 (0.042)
Δ*IP*	1.691 (2.274)	0.071 (0.092)	-2.945 (2.801)	-0.097 (0.093)
Constant	0.192 (1.927)	-	-4.098** (1.605)	-
LR statistic (df=18) Probability	31.93 0.004		Log likelihood	-121.144

-Standard error in brackets,
-* 1%, ** 5% and *** 10% Significant levels.

Table (6): Coefficient estimates of the multinomial Logit model (MP3):

Variables	(Y=-1)	ME (Y=-1)	(Y=1)	ME (Y=1)
RER	-1.884 (4.208)	-0.052 (0.120)	-3.142 (3.794)	-0.059 (0.075)
M2R	-0.762*** (0.424)	-0.022*** (0.013)	-0.015 (0.042)	0.0001 (0.001)
Δ*DC*	-22.927** (9.237)	-0.658** (0.283)	12.662 (12.345)	0.252 (0.246)
AL	-0.874 (1.264)	-0.025 (0.036)	-0.187 (1.585)	-0.003 (0.030)
Δ*X*	-0.962 (1.488)	-0.028 (0.043)	0.652 (1.578)	0.013 (0.030)
Δ*M*	-0.808 (1.395)	-0.024 (0.040)	1.186 (1.645)	0.023 (0.032)
Δ*IP*	0.599 (2.888)	0.018 (0.082)	-2.070 (3.693)	-0.040 (0.072)
Constant	0.556 (2.238)	-	-3.843*** (2.029)	-
LR statistic (df=14) Probability	20.43 0.117		Log likelihood	-86.492

-Standard error in brackets,
-* 1%, ** 5% and *** 10% Significant levels.

Table 6 shows the results of the estimated model including MP3, which is calculated dependent on 2 standard deviation. It shows that as the bounds of the threshold get wider (the number of estimated crises decreased), the estimated coefficients become insignificant and give incorrect signs. However, in the appreciation case, *M2R* and Δ*DC* are the only significant estimated coefficients in the model with correct signs of the influence of the explanatory variables. The marginal effect of these probabilities is -2 percent and -66 percent, respectively.

For each model, the Likelihood Ratio (LR) statistic, which is testing whether the coefficients are simultaneously significantly different from zero, confirms the general statistical significance of the first and second models at the 1% level of significance. However, the third model appears to be insignificant.

5 Conclusion

This paper develops an early warning system to explain any potential currency crisis in Jordan and identify a number of leading indicators that can help our understanding of the crisis. To achieve these objectives, a market pressure index (*MP*) was constructed and employed in a multinomial Logit model, using monthly data for Jordan covering the time period from January 1976 to December 2010.

Three indices were used in transforming the *MP* to a binary variable to be used in the model, using different thresholds. It was found that regardless of the index included in the model, real exchange rate (*RER*), money supply-reserves ratio(*M2R*), growth rate of domestic credit (ΔDC) and Central Bank foreign assets to liabilities ratio (*AL*), play significant roles in explaining the currency crises. While their marginal effect varies, they are consistent with theory in terms of sign.

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