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FINANCIAL CRISES'  
PREVENTION AND RECOVERY

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## Abstract

After the completion of the capital account liberalization in 1989, Turkey recovered from two financial crises which occurred in 1994 and 2000/2001. Focusing on the twin crises dynamics, this paper delves into the roles of the banking system soundness and the political stability in the design of preventive and recovering economic policies. Using a non-linear Markov switching model, we show that an Early Warning System (EWS) should take in account not only the classic macroeconomic fundamentals but also the banking system financial vulnerability (foreign exchange risk, interest rate risk, higher public assets holding) as well as the degree of the political instability. Besides, we identify three tools of recovering policies: *i*) reducing the interest rate mismatch, *ii*) encouraging the exchange risk hedging, and *iii*) reducing the political instability .

## ملخص

تعافت تركيا من أزميتين مالييتين وقعتا في عامي 1994 و 2001/2000 وذلك بعد اكتمال تحرير حساب رأس المال في عام 1989. وتقوم هذه الورقة ببحث الأدوار التي يلعبها كل من النظام المصرفي القوي والاستقرار السياسي في وضع السياسات الاقتصادية الوقائية التي تساعد علي التعافي من الأزمات المختلفة وذلك من خلال التركيز علي الديناميكيات المتشابهة للازميتين. وعن طريق استخدام نموذج ماركوف تبادلي غير خطي ، نجد أن أي نظام تحذير مبكر ينبغي ألا يأخذ في الاعتبار أساسيات الاقتصاد الكلاسيكية فحسب، بل أيضا نقاط الضعف المالية في النظام المصرفي (مثل مخاطر الصرف الأجنبي ، مخاطر أسعار الفائدة ، وارتفاع حجم الأصول العامة المملوكة)، وكذلك درجة عدم الاستقرار السياسي. الي جانب ذلك ، تم تحديد ثلاث أدوات لسياسات التعافي الاقتصادي. وهي 1- الحد من عدم تطابق سعر الفائدة، 2- تشجيع الوقاية من مخاطر سعر الصرف، 3- الحد من عدم الاستقرار السياسي.

## 1. Introduction

Many countries in the MENA region liberalize their capital accounts, hoping to fuel economic growth by attracting foreign investment. Egypt and Turkey have realized full capital account liberalization in 1991 and 1989 respectively. Morocco and Tunisia liberalized inward foreign direct and portfolio investments and external borrowing by residents. At present, they are heading for full capital account liberalization while improving the soundness of their financial sectors and their macroeconomics imbalances. Some economists (e.g. Chan-Lau and Chen, 2001) argue that these policies reduce the risk of a financial crisis occurrence after the capital account liberalization. However, others (e.g. Arestis and Glickman, 2002) argue that the capital account liberalization weakens the financial system. This could be explained by the sudden reversal of the international investors' expectation regarding the banking sector's vulnerability to a systemic crisis. Indeed, in many emerging countries where informational asymmetries between international investors and domestic banks are important, banks' difficulties (liquidity and solvability problems) occurred after a first phase of lending boom and low cost of external financing subsequent to capital account liberalization (Giannetti, 2007).

When the banking system vulnerability to a systemic crisis is combined with macroeconomics imbalances (misalignment of exchange rate, high current account deficit high inflation/unemployment, high public deficit) the triggering of a twin crises becomes very likely. This scenario is confirmed by the twin crises that occurred in Iceland in 2008. For MENA countries, the Turkish experience is very insightful since Turkey recovered from two financial crises (1994, 2000/2001) after its capital account liberalization in 1989. It is particularly important to draw lessons from it about the importance of the banking sector's soundness in immunizing MENA countries against financial crises. Hence, this paper delves into the following questions:

(i) How important is considering the banking system vulnerability and the political instability in the design of an Early Warning System (EWS) to prevent a financial crisis? ii) Is it possible for an economy to hasten its recovery from a financial crisis by reducing its banking system financial vulnerability?

The literature identified two scenarios of twin crises. In the first scenario, banking crises lead to currency crises (Calvo, 1995). In the second one, banking difficulties engage the currency crisis which in turn exacerbates the banking difficulties. This vicious spiral ends by the currency collapse and a banking crisis (Kaminsky and Reinhart, 1999). Therefore, in the two scenarios, the banking fragility is an important ingredient not to neglect. Many studies (Mariano et al., 2004; Özale and Metin-Özcan, 2007; Yilmazkuday and Akay, 2008) tried to propose an EWS based on the Turkish financial crises. However, they neglect the twin-crises' feature of the Turkish crisis. Indeed, they only consider the first and second generations' crisis mechanisms where no role is assigned to the banking system fragility. This is not realistic since, just after the capital account liberalization, Turkish banks were channeling short-term credit obtained from foreign markets to a government facing worsening fiscal balances.

Hence, their vulnerability to a jump in both the exchange rate and interest rate would have played a role in the triggering of the banking and currency crises experienced by Turkey in 1994 and 2000/2001. Contrary to the previous studies, we develop an EWS based on third generation mechanism using a non-linear Markov switching model. This model allows us to discriminate between tranquil periods (before a crisis) and crisis periods. Therefore, we are able to analyze the behavior of the twin crises' determinants during the two types of periods. In addition, we can assess the effects of the financial fragility factors on the transition probabilities of the Turkish economy from a tranquil period to a crisis period and vice versa. The second novelty of this paper in comparison to the above cited studies is analyzing the effect of reducing the

banking sector's financial vulnerability (foreign exchange risk, interest rate risk, higher public assets holding) on the recovery from a financial crisis.

The paper is organized as follows: Section 2 outlines the macroeconomic imbalances of the Turkish economy as well as its banking system's financial vulnerability on the eve of the financial crises. Section 3 develops a twin-crises EWS using the Markov switching regime (MSR) approach. Section 4 presents relevant policy recommendations after investigating the importance of reducing the banking sector's exposure to the financial risks. Section 5 offers some concluding remarks.

## **2. The Turkish Economy on the Eve of the Financial Crises: Macroeconomic Imbalances and Banking System Financial Vulnerability**

According to Yilmazkuday and Akay (2008), the capital account liberalization completed in 1989 generated a new situation in Turkey which is the extreme dependence of its macroeconomic performance on short-term capital inflows. Change in the public deficit financing mechanism is one of the important symptoms of this situation. Indeed, it became based on the large amounts of short term credit borrowed by the banking system from foreign markets. Therefore, the completion of the capital account liberalization was accompanied with the germination of a financial crisis. The economy became vulnerable to a vicious cycle of bad macroeconomic performance causing costly capital inflows that generated, in turn, higher public deficit and a more financially vulnerable banking system. In the following parts of this section we firstly present some indicators of Turkey's macroeconomic imbalances and then we illustrate some of its banking system financial vulnerability on the eve of the two financial crises 1994 and 2000/2001.

### ***2.1 Macroeconomic imbalances***

Many important macroeconomic imbalances are common characteristics of the periods preceding the two financial crises. The first one is the deteriorating competitiveness of the Turkish economy which is represented by the continued appreciation of the real effective exchange rate (Figure 1) which has in turn generated an increase in the current account deficit. The second one is the worsening of the fiscal balances due to the rise of interest payments and the shortening of the public debt term structure. This is captured by the increasing trend of the treasury domestic debt to GDP ratio which reached 67% in January 1994 and 79% in October 2000 (Figure 2). The increase of the short term debt measured in terms of foreign reserves (Figure 3) has also preceded the onset of the two crises. The fourth macroeconomic imbalance is the increasing size of foreign reserves relative to M2. This indicator measures the potential ability of the government to respond to the potential liquid monetary assets conversion to foreign exchange.

### ***2.2 Banking system financial vulnerability***

The Turkish banks were borrowing short-term in foreign currencies in order to invest in the long-term Turkish government bonds. In the absence of hedging policies this transformation process exposed them naturally to the interest rate and foreign exchange risks. When measuring the interest rate risk by the difference between the interest rate on the one-month USD foreign deposits and the Turkish Treasury Bill rate we could identify its importance before the 1994 financial crisis (Figure 5). The increasing fragility of the banking sector to the foreign exchange risk could be assessed by the uncovered short exchange position (net foreign assets to total assets) which worsened before the two crises (Figure 6). The excessive holding of government securities by banks is measured by banks' assets receivable from public sector to banks' total assets. This ratio largely increased a few months before the two crises relative to the previous periods (Figure 7). Here, we should mention that the Treasury faced two conflicting objectives.

On the one hand, it was responsible of the banking sector regulation and on the other hand its principal focus was on the budgetary financing of the government (Alper and Ziya, 2002).

### 3. An Early Warning System for the Twin Crises' Prevention

#### 3.1 Methodology

Many studies (Mariano et al., 2004; Özale and Metin-Özcan, 2007; Yilmazkuday and Akay, 2008) proposed an EWS for the Turkish financial crises. They used the Markov switching approach to model the nonlinear behavior of the crises index without a need to transform it into a binary variable, as it is the case in the qualitative models (probit or logit models)<sup>1</sup>. According to Abiad (2003), this transformation is based on the arbitrary choice of the crises index threshold which identifies the tranquil and crisis periods. Besides, it generates a loss of information with the possibility of unaccounted crises periods (Mariano et al., 2004). Following the above cited literature we apply the Markov switching regime model to avoid these drawbacks. This econometric approach allows us to test the pertinence of the banking system's financial vulnerability relative to the classic macroeconomic fundamentals in the outbreak of the Turkish financial crises.

In line with Hamilton (1989) and Cerra and Saxena (2002), a Markov switching autoregressive model AR (p) of order p is constructed with two regimes. Contrarily to these studies, in our case, there is no jump in the twin crises mean subsequent to the regime change. Therefore, following Alvarez-Plata and Schrooten (2006) we assume that the twin crises index mean smoothly approaches a new level after the transition from one regime to another. Thus, our model is specified with a regime-dependent intercept term, regime-dependent autoregressive parameters and heteroscedastic error terms.

The empirical studies based on the second generation models (Jeanne and Masson, 2000; Cerra and Saxena, 2002), analyze the determinants of a given crisis using the pre-crisis period. Hence, they control for the effect of the fundamentals' bifurcation on speculators' beliefs about the success probability of a speculative attack. Relative to these studies our model has the following novelty: taking into account the structural change in some fundamentals triggered by the occurrence of the crisis. This is the case for example of the Turkish treasury indebtedness (defined by the ratio Domestic Debt Position of Treasury over the GDP) which went from 1% in average during the period 1991–2000 to almost 2.25% after the 2000/2001 crisis— principally due to the difficulties of the government to finance its increasing deficit through the banking system as it used to do. Such changes in the fundamentals affect the speculators' beliefs regarding the success of their attacks and we think they could be very insightful for the design of our EWS. Hence, we include in the system the lag coefficients of the exogenous variables that switch over time according to the economic state (before and after the crisis). At this stage we could detail our MSAHX(2)-AR(1)<sup>2</sup> model which is given by:

$$Twin_t = \mu_{s_t} + \phi_{s_t} Twin_{t-1} + \sum \beta_{i,s_t} X_{i,t-1} + e_t \quad (1)$$

where  $Twin$  depicts the twin crises index measuring the severity of the currency crisis combined with the banking fragility;  $X_{it}$  is the vector of explanatory variables and  $e_t \sim iidN(0, \sigma_{s_t}^2)$ . The model uses an AR (1) process which depends on the unobserved states  $S_t \in \{0,1\}$  such that  $S_t=0$  depicts the tranquil state and  $S_t=1$  captures the crisis state. According to Hamilton (1989), the  $S_t$  process follows a Markov chain of order one. Its transition probability matrix  $P$  is given by:

$$P = \begin{pmatrix} P_{00} & P_{01} \\ P_{10} & P_{11} \end{pmatrix} \quad (2)$$

<sup>1</sup> Which are also used in the crisis EWS literature (e.g. Glick and Rose, 1999; Kamin et al., 2001).

<sup>2</sup> See also Krolzig (1997) for a broad discussion of different specifications.

where  $p_{ij}$  represents the probability<sup>3</sup> that state  $j$ , which prevailed at time  $t-1$ , will be followed by state  $i$  at time  $t$ :

$$P_{i,j} = Pr (S_t = i / S_{t-1} = j) \quad \forall i,j = 0,1 \quad (3)$$

Therefore, the following equalities hold

$$P_{00} + P_{10} = 1 \quad (4)$$

$$P_{01} + P_{11} = 1$$

Finally, following Kim and Nelson (1999), we define the expected duration of the state (regime)  $i \in \{0,1\}$  by

$$E(D_i) = \frac{1}{1 - P_{ii}} \quad (5)$$

Hence, an increase of the probability  $p_{ii}$  which signifies higher persistence of state  $i$  is captured through an increase in the expected duration of the tranquil state ( $i=0$ ) or the crisis state ( $i=1$ ).

### 3.2 Data sources and variables definitions

Our sample includes monthly data between February 1992 and December 2007<sup>4</sup>. This period includes the two most important financial crises that Turkey faced after its capital account liberalization. The first one occurred in 1994 while the second one was more persistent beginning at the end of 2000 and finishing in 2001.

*The dependant variable:* in order to capture the potential twin crises type of the Turkish financial crises, we develop a new crisis index that combines currency crisis and banking crisis indicators. Following Kaminsky et al. (1998) the currency crisis indicators are the monthly variations of the exchange rate and international reserves. These two indicators measure the exchange market pressure and capture the currency depreciation and/or the reaction of the monetary authorities. Following Çesmeçi and Önder (2008) the banking crisis indicators are the monthly variations of the interbank interest rate and the central bank loans in total bank liabilities. High values of these two indicators are symptomatic of the banking sector liquidity problems. Figure 8 (see Appendix) shows the important variations of the interbank overnight interest rate during the two financial crises of 1994 and 2000/2001. During the latter, interest rates hiked to four-digit levels as capital outflows intensified depleting international reserves \ causing a severe liquidity crunch in the banking system (Akyüz and Boratav, 2003). According to Kaminsky and Reinhart (1999) a common feature of the banking crises is the intervention of the central bank as a lender of last resort. Çesmeçi and Önder (2008) also noted the intervention of the Turkish Central Bank in the interbank market through a massive injection of liquidity in order to satisfy the banks' increased demand for liquidity. Therefore, our twin crisis index, which represents our dependent variable, is constructed as a weighted average of the above presented indicators. Following Mody and Taylor (2007) we weight each variable by the inverse of its standard deviation in order to control it from dominating the index. It is denoted by *Twin* and is given by:

$$IND_t = \frac{(\% \Delta e_t)}{\sigma_{\Delta e_t}} - \frac{(\% \Delta r_t)}{\sigma_{\Delta r_t}} + \frac{(\% \Delta i_t)}{\sigma_{\Delta i_t}} + \frac{(\% \Delta CBL_t)}{\sigma_{\Delta CBL_t}}$$

<sup>3</sup> The transition probabilities, which are assumed to be constant over time, are specified by the logistic functional form ( Henry, 2009).

<sup>4</sup> See Table 1 of the Appendix for data sources.



where  $e_t$ ,  $r_t$ ,  $i_t$  and  $CBL_t$  represent, respectively, the nominal exchange rate<sup>5</sup>, the level of foreign exchange reserves, the interbank interest rate and the central bank credit in total bank liabilities.

We denote by  $\Delta$  the first-difference operator and  $\sigma_{\Delta e_t}$ ,  $\sigma_{\Delta i_t}$ ,  $\sigma_{\Delta r_t}$  and  $\sigma_{\Delta CBL_t}$  the standard deviations of the variables' variations.

Figure 10 shows the evolution of the Twin Crises index.

*The explanatory variables:* they could be classified in three categories.

- Macroeconomic variables: REER, the ratio of Treasury domestic debt to GDP.
- TDEBT, the real effective exchange rate; STD, the ratio of short term debt to foreign exchange reserves; and M2RES the ratio of M2 to foreign exchange reserves. These variables are used in the above cited studies that proposed an EWS of the Turkish financial crises.
- Banks financial vulnerability variables: PUBASS, the ratio of banks assets receivable from public sector to total assets; OPENPOS, the ratio of banks' net foreign assets to total assets; INTRISQ, the difference between the interest rate on USD foreign deposits for 1 month and the Turkish Treasury Bill rate. To our knowledge there is no previous study that used these financial vulnerability variables with a Markov switching regime approach in order to construct an EWS.
- Political instability variable: INSPOL is a binary variable taking the value 1 if there is a government crisis in the considered month and 0 elsewhere. This variable, which has not been employed in the related literature, captures the instability of the Turkish political climate. We think it is important to consider it when constructing an EWS. Indeed, the speculators' beliefs are sensitive to government stability. For example in February, 19, 2001 the financial markets reacted immediately to the confrontation between the President Ahmet Necdet Sezer and Prime Minister Bülent Ecevit. Few hours after, the Istanbul Stock Exchange dropped by 14% and massive capital outflows compelled the Central Bank to sell \$5 billion of its reserves even though the overnight rates reached a historic level of 6,200% (Ozatay and Sak, 2003).

In order to test the stationarity of these variables— except INSPOL since it is a binary variable— we apply the Augmented Dickey-Fuller (ADF) and Perron tests. The results indicate that only the ratio of Treasury domestic debt to GDP (TDEBT) is stationary in level  $I(0)$ . The rest of the variables are  $I(1)$  and we use their first differences to make them stationary.

### **3.3 How important is including the financial vulnerability variables in the design of an EWS?**

In order to respond to this question we estimate the MSAHX(2)-AR(1) model (equations (1) to (4)) with fixed transition probabilities. But first, we need to justify the choice of the Markov switching specification. Hence, we start by comparing the Markov switching model to a benchmark: the linear model which includes the same macroeconomic variables as explanatory variables. We use the likelihood ratio (LR) tests in order to test the null hypothesis which is the linearity of the dynamic behavior. The alternative hypothesis is the Markov switching model. As noted by Davies (1977), since there is a nuisance parameter under the null hypothesis, the LR statistic ( $LR = 2(\log(L_{MS}) - \log(L_{Linear}))$ ) has a non-standard asymptotic distribution.

Therefore, it is more judicious to adopt the Davies (1977) upper bound approach as suggested by Garcia and Perron (1996). The results, which are reported in Table 2, support rejecting the null hypothesis (the linearity of the model) at a significant level of 5% since the LR statistic is

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<sup>5</sup> It gives the equivalent of one dollar in terms of the Turkish Lira. Hence, a positive value of  $\Delta e_t$  signifies a depreciation of the Lira.

equal to 49.76, which is far superior to the  $X^2(7)$ <sup>6</sup> critical values of Garcia and Perron (1996). Hence, the MSAHX(2)-AR(1) model provides a superior description of the data than the linear model. In order to analyze the importance of including the banking sector financial vulnerability variables {PUBASS, OPENPOS, INTRISQ}, we estimate four specifications of the Markov switching model. In each specification, one of these variables is added to the set of the macroeconomic control variables<sup>7</sup>.

Following Hamilton (1989) and Diebold et al. (1994), we estimate our Markov switching model by implementing the EM (Expectation - Maximization) algorithm<sup>8</sup>, programmed in Gauss 7.0 to obtain the maximum likelihood estimates of all the parameters. The estimates of the four specifications of the MSAHX(2)-AR(1) model with fixed transition probabilities are presented in Table 3. The results of the two regimes (tranquil regime and crisis regime) are presented for each specification.

Firstly, the estimation results confirm the high transition probabilities  $P_{00}$  of staying in regime 0 for all the specifications (all values of  $P_{00}$  exceed 0.8). They show that the transition probabilities  $P_{11}$  of remaining in regime 1 are less than  $P_{00}$ . Indeed, except for the specification (5) of political instability, the  $P_{11}$  are inferior to 0.77. Secondly, for the first four specifications, the expected duration of the Turkish crises during the period 1992–2007 ranges between 2.6 and 4.2 months. Meanwhile, the expected duration of the stability regime ranges between 5 and 8.5 months. Concerning the fifth specification, the results show that the expected duration of the crisis regime is about 9.3 months whereas that of the tranquil regime is about 13.5 months. These results imply that, for the Turkish economy, the tranquility regime is more persistent than the crisis regime. This finding PUBASS corroborates that of Yilmazkuday and Akay (2008) and Mariano et al. (2004).

Moreover, Figure 10 exhibits the filtered probabilities of being in the crisis regime using estimations of the four specifications. The plots show clearly that several shifts between the regimes match with the two financial crises of 1994 and 2000/2001.

Indeed, all the filtered probabilities of being in the crisis regime ( $P(S_t=1)$ ) are equal to 1 in June 1994 and between February – April 2001. Besides, we can identify another period where the probability of being in the crisis regime is high (not necessarily equal to one but superior to 0.79). In particular, we capture the higher probability of the first quarter of 1993, June/ July 2002, March/April 2003 and June 2006.

Besides, the estimation results show that the financial vulnerability of the Turkish banking system and the political instability are significant in explaining the triggering of the financial crises. Individually, the coefficients associated to the interest rate risk (INTRISQ, specification 2) and to the political instability (INSPOL, specification 4) are positive and significant at a 5% level only in the tranquil regime.

This finding suggests that higher interest rate mismatches (measured by the difference between the interest rate on the one-month USD foreign deposits and the Turkish Treasury Bill rate) as well as the political instability affect significantly and indirectly the financial markets (the foreign exchange and the interbank markets) preparing the switching of the Turkish economy to the crisis regime. This result is consistent with the results of Feridun (2008) who found that global liquidity conditions played an important role in the triggering of Turkish crises. According to this author, the high interest rate differential intensified the expectations about future devaluation of the Lira and increased the likelihood of the crisis occurrence. This is a

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<sup>6</sup> In our case, the degree of freedom is equal to 7 which is equivalent to the additional parameters appearing in the Markov switching model.

<sup>7</sup> The inclusion of all the financial vulnerability variables in the same specification prevents the convergence of the model.

<sup>8</sup> This algorithm is proposed by Dempster et al. (1977). Diebold et al. (1994) provide more description for the EM algorithm.

second-generation mechanism based on the self-fulfilling expectations which were fuelled by the increasing concern about the financial risks and the political instability in Turkey.

In addition, our findings show that the exchange risk (OPENPOS, specification 3) and the importance of the banks' assets receivable from public sector (PUBASS, specification 1) are significant with a negative sign in the crisis regime. The negative sign of the OPENPOS is intuitive since this variable is negative and its decrease involves higher exchange risk (the short exchange position increases). Therefore, we conclude that the currency mismatch is a significant determinant of the twin crises intensification. Since the values of the variable PUBASS are positive, its negative estimated coefficient signifies that the banking system reduced its excessive holding of the government securities during the crisis regime. This result is intuitive since many banks went through a severe liquidity crunch.

Furthermore, some interesting results should be mentioned concerning the control variables. First, the size of the short term external debt relative to foreign reserves appears as an intensifying factor of the speculative attacks during the crises regimes. Indeed, the coefficient associated to the variable STD is positive and significant at 5% level of significance for the four specifications (for three specifications out of four). Second, the reduction of the M2RES ratio during the crises periods explains its negative and significant coefficient that we found for the fourth specification. Besides, the TCER is significant for the tranquil regime of the second specification. This result suggests that the deteriorating competitiveness of the Turkish economy would have intensified the speculators' expectation about the success of their speculative attacks.

Finally, results show a negative and significant coefficient associated to the treasury domestic debt to GDP ratio (TDEBT) during the tranquil regime of the third first specifications. This could be interpreted cautiously as follows. The lower the level of public indebtedness financed through the Treasury debt instruments during the tranquil periods, the higher is the incentive for the Government to appeal to Central Bank financing (through cash advances to the Treasury) in order to finance its increasing debt. However, this second type of financing accentuates the inflationary pressures, which in turn increase the real appreciation of the Turkish currency. Taking into account this mechanism, the speculators' expectations about the future devaluation of the Lira become more justified.

#### **4. The Banking System Financial Fragility and the Recovery from a Financial Crisis**

##### **4.1 Methodology**

The second objective of this study is to assess the possibility of hastening the recovery from a financial crisis by reducing the banking system financial vulnerability. To this end, we firstly analyze the marginal effects of the different financial and political vulnerability factors (denoted by  $z_t$ ) on switching from a tranquil state to a twin crises state. Then, we go further by adopting time-varying transition probabilities depending on  $z_t$  in order to identify the preventive/recovery type of the measures that could be taken by the government to deal with twin crises. We consider the benchmark MSAHX (2)-AR(1) model of the twin crises (equation 1). Following Diebold et al. (1994), the transition probabilities of the twin crises index may be written as follows:

$$P'_{00} = P_r(S_t = 0 / S_{t-1} = 0) = \frac{\exp(q_0 + q_1 Z_{t-1})}{1 + \exp(q_0 + q_1 Z_{t-1})} = 1 - P'_{01} \quad (5)$$

$$P'_{11} = P_r(S_t = 0 / S_{t-1} = 1) = \frac{\exp(P_0 + P_1 Z_{t-1})}{1 + \exp(P_0 + P_1 Z_{t-1})} = 1 - P'_{10} \quad (6)$$

where  $P_{10}^t$  ( $P_{01}^t$ ) represents the probability of switching from the tranquil (crisis) state to the crisis (tranquil) state in the next period. The equalities presented by equation 4 always hold. Note that the Markov switching model with constant transition probabilities may be obtained by setting  $q_1=P_1=0$ . Following Filardo (1994) we lagged the financial and political vulnerability variables ( $z_t$ ) to ensure they are strictly exogenous and conditionally not PUBASS related with the unobserved state. Introducing the variable  $z_{t-1}$  in the transition probabilities, could enhance the ability to predict the future behavior of the unobserved state St (Chippollini et al., 2008).

### **The Prevention/Recovery Type of the Financial and Political Vulnerability Variables:**

If an increase (decrease) of the variable  $z_t$  value increases (decreases) the probability  $P_{01}^t$  (that the economy switches from the crisis state to the tranquil state), then it is called a *recovery variable*. The government could adopt a recovery policy based on the variation of this variable's value. In contrast, if the variable  $z_t$  affects the probability  $P_{00}^t$  of maintaining the tranquil state, then it is called a *prevention variable* and could be useful for the design of a prevention policy. In order to classify the financial and political vulnerabilities variables in terms of their prevention and/or recovery type we follow the approach of Tchana (2008). It consists of computing the marginal effects of each variable on the probability to remain in the twin crises state and the tranquil state. According to Filardo (1994), the marginal effect of  $z_t$  on  $P_{ii}^t$  for  $i = 0,1$  is given by:

$$\frac{\partial P_{00}^t}{\partial z_{t-1}} = q_1 P_{00}^t (1 - P_{00}^t) \quad (7)$$

$$\frac{\partial P_{11}^t}{\partial z_{t-1}} = P_1 P_{11}^t (1 - P_{11}^t) \quad (8)$$

Since the transition probabilities  $P_{00}^t$  and  $P_{11}^t$  are non-negative and range between zero and unity in magnitude, then the marginal effect  $\partial P_{00}^t / \partial z_{t-1}$  ( $\partial P_{11}^t / \partial z_{t-1}$ ) has the same sign as  $q_1(P_1)$ . Therefore, if  $\hat{q} < 0$  then a decrease of the risk  $z_t$  increases the probability of remaining in the tranquil state then this is a preventive variable. In contrast, if  $\hat{P} > 0$  then a decrease of the risk  $z_t$  diminishes the probability of remaining in the crisis state and increases the probability of switching from the crisis state to the tranquil one and this is a recovery variable.

### **4.2 Recovery, preventive strategies and policy recommendations**

As noted earlier, the use of the TVTP assesses the impact of the banking sector's financial vulnerability on the probability of switching from one regime to another. Table 4 contains estimates of the four specifications of our benchmark model. For each specification the TVTP is function of one of the financial vulnerability and political instability variables {PUBASS, OPENPOS, INTRISQ, INSPOL}. Relative to the TFP estimations (Table 3 presented in section 3.3), the results concerning the macroeconomics control variables (rows 2 to 5) haven't changed except for the TCER which is no longer significant.

The rows (10-11) present the coefficients ( $p_0, p_1, q_0, q_1$ ) which enable us to identify the prevention/recovery type of the financial and political vulnerability variables according to the criteria discussed above. For the first specification where TVTP is a function of PUBASS, the coefficient  $\hat{q}_1$  is equal to -0.468. Therefore, the marginal effect of PUBASS on the probability of remaining in the tranquil regime is negative. Hence, we could conclude that the increase of

the ratio of the banking system's public assets to total assets decreases the probability of staying in the tranquil regime. Therefore, in the tranquil regime, a financial crisis preventive policy consists of limiting the share of banks' assets receivables from the public sector. This would send a positive signal to the foreign investors/depositors enhancing their confidence in the soundness of the banking system. Indeed, a high share of public assets held by domestic banks could be considered a potential channel through which future government difficulties to repay its debt could generate banking difficulties. The latter could lead to a bank run causing a currency crisis when banks should repay their foreign-currency denominated deposits.

Moreover, in the second and forth specifications,  $\hat{p}_1$  is equal to 0.138 and 21.89 for the TVTP function of INTRISQ and INSPOL respectively. Hence, we conclude that both the interest rate risk and the political instability have positive marginal effects on the probability of remaining in the crisis regime. Therefore, during the crisis period, we could identify two recovery policies. The first one consists of diminishing the interest rate differential by increasing, temporarily, the domestic interest rate on the Treasury Bills in order to restore foreign investors' confidence and reducing the risk premium in a second stage. The second one, consists of reducing the political instability through positive signals about the government cohesion, stability and willingness to react rapidly to the crisis situation by proper economic policies. These recovery policies will increase the probability of switching from this crisis regime to the tranquil regime or equivalently reducing the expected duration of the crisis.

In addition, the results show a coefficient  $\hat{p}_1$  equal to -1.216 for the TVTP as a function of the short exchange position OPENPOS. Noting that this variable has a negative sign<sup>9</sup>, we conclude that an increase of the foreign exchange risk (in absolute terms) has a positive marginal effect on the probability of remaining in the crisis regime. Therefore, during the crisis period, the government has a third policy recovery tool to use, which is limiting the uncovered short exchange position of the banking system. This could be through adopting and announcing to the public a program of subsidizing the banks' hedging policies.

## 5. Conclusion

By analyzing the banking system's financial vulnerability and the political stability roles in the financial crises' preventive and recovering policies, this paper enriches the Early Warning System (EWS) literature. Indeed, it shows that existing studies, which take into account only the macroeconomic fundamentals, neglect an important risk factors related to the banking system's financial vulnerability (foreign exchange risk, interest rate risk, and higher public assets holding) and to the degree of the political instability.

Using a Markov switching model with both fixed and time-varying transition probabilities, we develop an EWS based on a third-generation mechanism of financial crises. Estimating our EWS with monthly data ranging between February 1992 and December 2007, we show that the model captures not only the two major Turkish financial crises of 1994 and 2000/2001 but also the recent twin crises of June 2006.

In addition, we show that the financial vulnerability of the Turkish banking system and the political instability are significant in explaining the triggering of the financial crises. This finding suggests that currency and interest rate mismatches as well as the political instability affect, significantly and indirectly, the financial markets (the foreign exchange and the interbank markets) and induce the switching of the Turkish economy to the crisis regime. Hence, we conclude that the speculators' self-fulfilling expectations about the Lira devaluation were

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<sup>9</sup> Note that the short exchange position variable (OPENPOS) takes negative values. Hence, its decrease corresponds to an increase of the foreign exchange risk ( $z_t$  values). Therefore, it is a preventive variable if  $\hat{q}_1 > 0$  and a recovery variable if  $\hat{p}_1 > 0$ .

fuelled by their increasing concern about the banking system financial vulnerability and the political instability in addition to the deteriorating competitiveness of the Turkish economy.

Furthermore, we show that limiting the share of banks' assets receivables from the public sector would send a positive signal to the financial markets regarding the banking system's soundness, representing a possible prevention policy. In addition, we identify three tools of recovering from a financial crisis which are: *i*) reducing interest rate mismatch, *ii*) encouraging hedging of exchange risk, and *iii*) reducing political instability.

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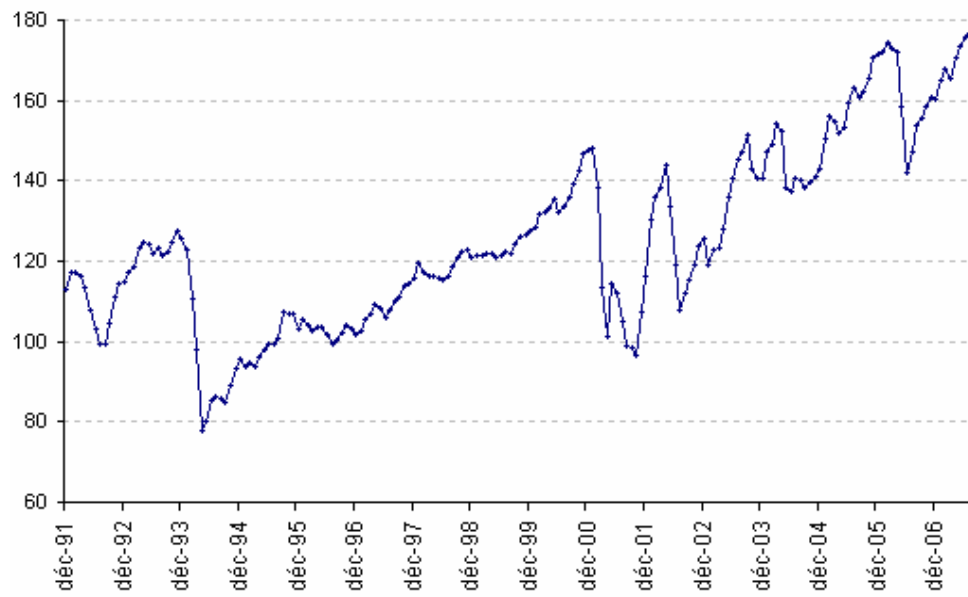


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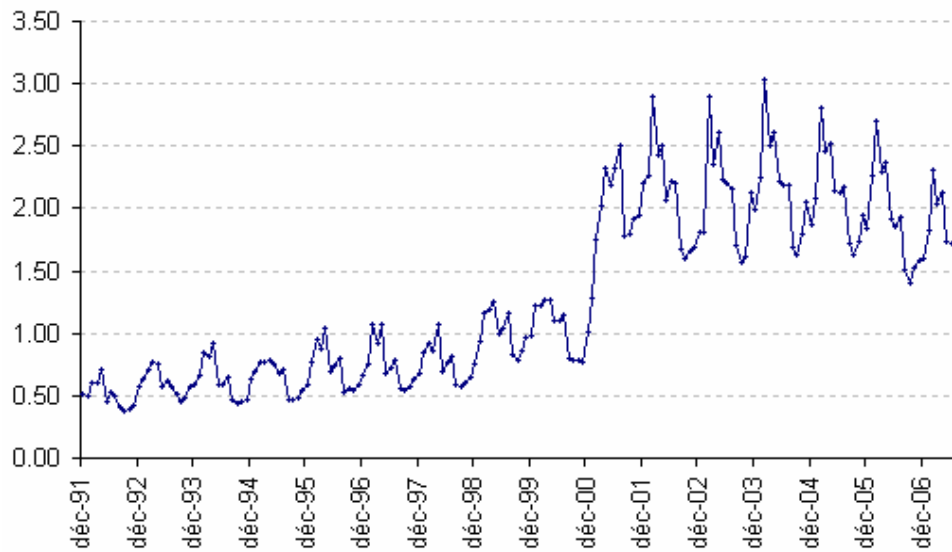
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## Appendix

**Figure 1: The Real Effective Exchange Rate**



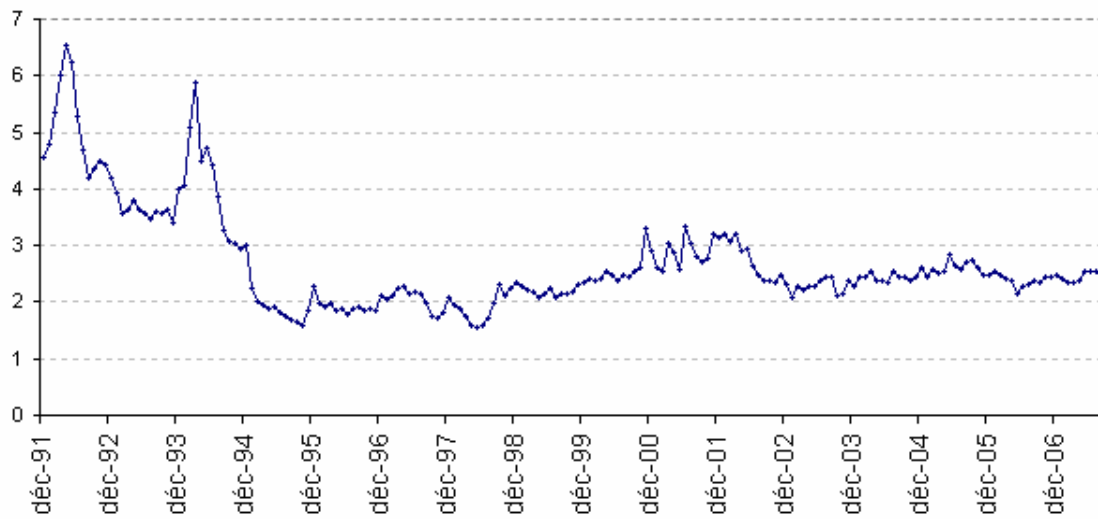
**Figure 2: The Treasury Domestic Debt to GDP Ratio**



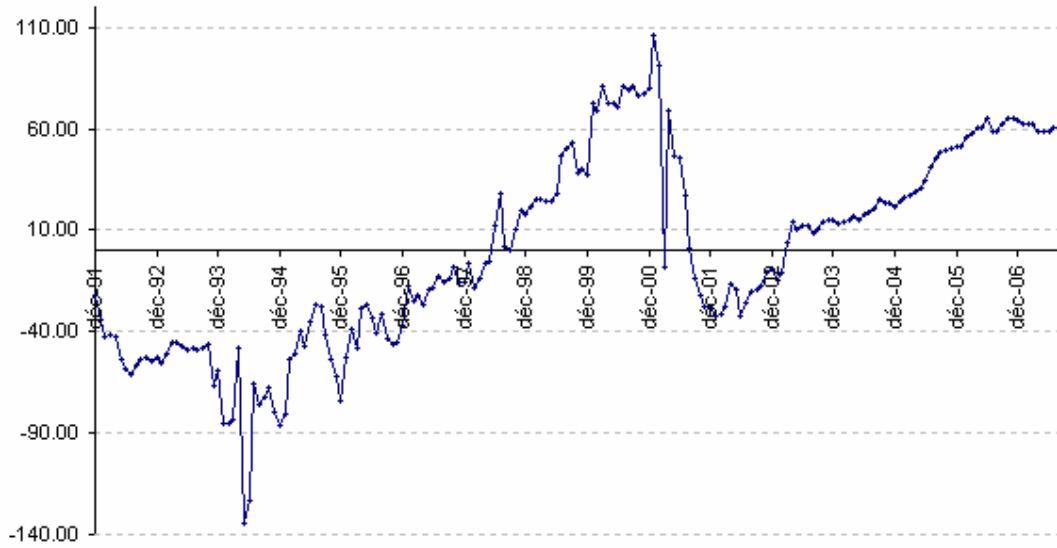
**Figure 3: The Short-Term Debt to Foreign Reserves Ratio**



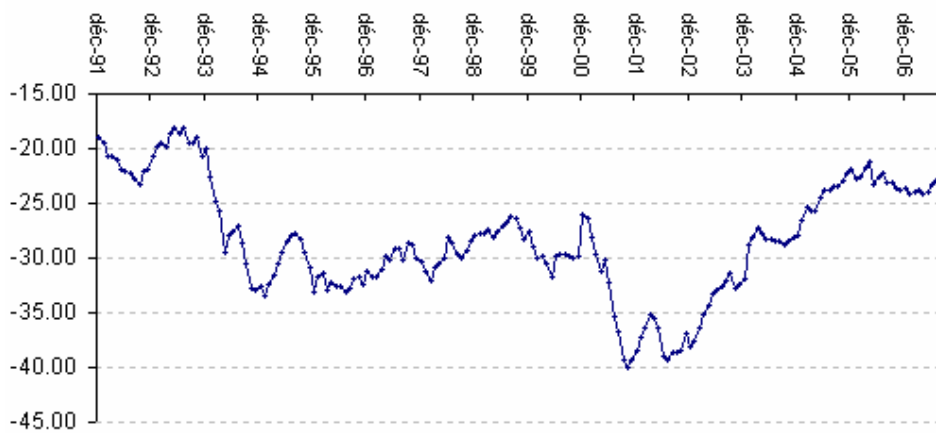
**Figure 4: The Ratio M2/Reserves**



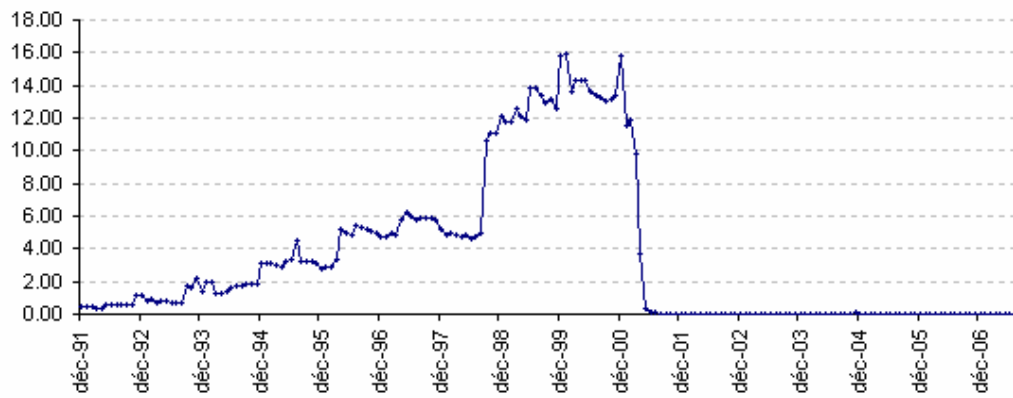
**Figure 5: The Interest Rate Risk**



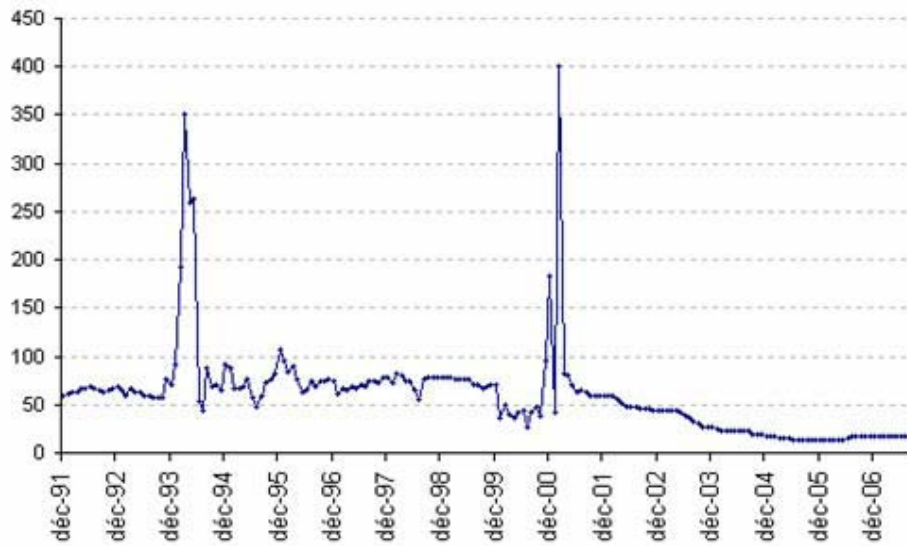
**Figure 6: The Exchange Position**



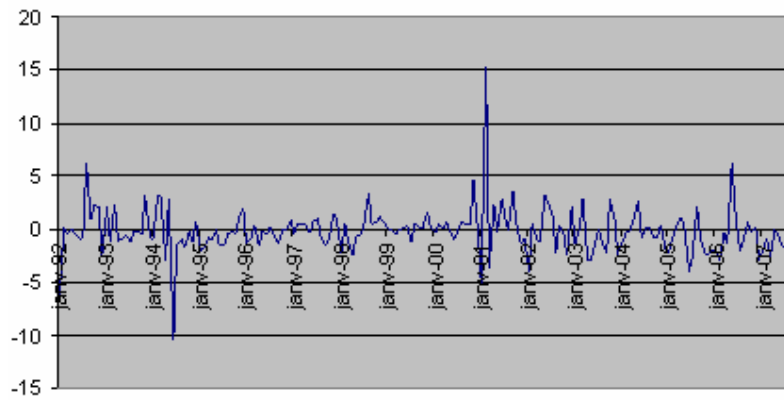
**Figure 7: The Banks' Assets Receivable from the Public Sector**



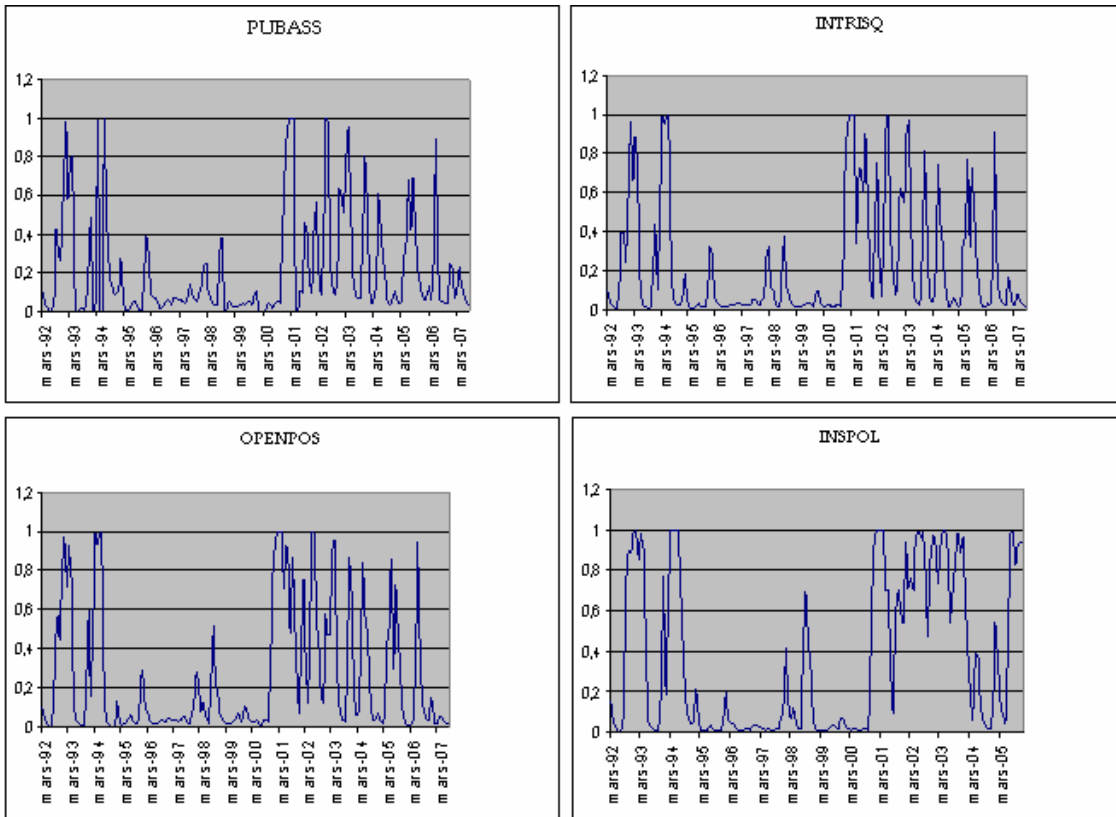
**Figure 8: The Interbank Overnight Interest Rate**



**Figure 9: The Twin Crises Index**



**Figure 10: Filtered Probabilities of the Twin Crises Index for the Five Specifications**



**Table 1: Variables Classifications and Sources**

<b>Variables Type</b>	<b>Crisis Model Generation</b>	<b>Indicators</b>	<b>Sources</b>
<b>Macroeconomic</b>	First generation	<ul style="list-style-type: none"> <li>▪ TDEBT: Treasury Domestic Debt/GDP</li> </ul>	<ul style="list-style-type: none"> <li>▪ International Financial Statistics, 2007 (IFS).</li> <li>▪ World Bank Development Indicators CD 2007 (WDI).</li> <li>▪ The web site of Central Bank of Turkey</li> </ul>
	Second generation	<ul style="list-style-type: none"> <li>▪ REER: Real effective exchange rate</li> <li>▪ STD: Short term debt/foreign exchange reserves</li> <li>▪ M2RES: M2/foreign exchange reserves</li> </ul>	
<b>Banking System Financial Fragility</b>	Third generation	<ul style="list-style-type: none"> <li>▪ Central Bank loans in the banks' liabilities</li> <li>▪ PUBASS: Banks Assets receivable from public sector in total assets %</li> <li>▪ OPENPOS: Open Positions (Banks' Net Foreign Assets to Total Assets)</li> <li>▪ INTRISQ: Interest Rate Risk (Interest rate on the one month USD foreign deposits / Treasury Bill Rate)</li> </ul>	
<b>Political instability</b>		<ul style="list-style-type: none"> <li>▪ INSPOL: political instability defined as the monthly number of government crises.</li> </ul>	<ul style="list-style-type: none"> <li>▪ The annual data from the Cross-National Time-Series Data Archive (Databanks International, 2009 (CNTSDATA)) was changed to a monthly data after looking for the months of the government crises.</li> </ul>

**Table 2: Davies Linearity Test Results**

	<b>MSIH(2)-AR(1)</b>	<b>AR(1) Linear model</b>
<i>Log (L)</i>	-356.72684	-381.6062
<i>LR statistic</i>	49.76	
<i>P-value</i>	0.000	

**Table 3: Estimations Results of the TFP Models with Financial Vulnerability and Political Instability Variables**

	Specification 1		Specification 2		Specification 3		Specification 4 <sup>b</sup>	
	Crisis regime	Tranquil regime	Crisis regime	Tranquil regime	Crisis regime	Tranquil regime	Crisis regime	Tranquil regime
<b>Twin (-1)</b>	-0.24907 <b>(0.12015**)</b>	0.24293 <b>(0.09137**)</b>	-0.42715 <b>(0.15196**)</b>	0.20408 <b>(0.08272**)</b>	-0.51194 <b>(0.13541**)</b>	0.16890 <b>(0.08531**)</b>	-0.23882 (0.14071)	0.17074 <b>(0.09430**)</b>
<b>TCER</b>	-0.06401 (0.05224)	0.08838 (0.49618)	-0.07946 (0.05956)	0.06239 <b>(0.03546*)</b>	0.09342 (0.06569)	0.05225 (0.03859)	-0.09643 (0.05760)	0.06550 (0.05109)
<b>STD</b>	0.15113 <b>(0.03286**)</b>	-0.01476 (0.01247)	0.07119 <b>(0.04377*)</b>	0.00499 (0.01493)	0.10745 <b>(0.03473**)</b>	0.00275 (0.01454)	0.10084 <b>(0.03957**)</b>	0.00105 (0.01353)
<b>M2RES</b>	-3.52119 <b>(1.19204**)</b>	0.09162 (0.49022)	-2.01886 <b>(1.56228**)</b>	0.22476 (0.54452)	-2.79336 <b>(1.21622**)</b>	0.21173 (0.52035)	-3.14750 <b>(1.36509**)</b>	0.07337 (0.42081)
<b>TDEBT</b>	-0.43442 (0.43450)	-0.37934 <b>(0.12689**)</b>	-0.06735 (0.53125)	-0.48949 <b>(0.19357**)</b>	0.03129 (0.35425)	-0.51977 <b>(0.22273**)</b>	-0.48463 (0.51832)	0.23532 (0.29718)
<b>PUBASS</b>	-2.18050 <b>(0.49618**)</b>	-0.11379 (0.10177)						
<b>INTRISQ</b>			0.02372 (0.02123)	0.01163 <b>(0.00943**)</b>				
<b>OPENPOS</b>					-1.33003 <b>(0.36028**)</b>	-0.01663 (0.15505)		
<b>INSPOL</b>							-3.81871 (2.0766)	1.08322 <b>(0.39626**)</b>
$\gamma$	1.10555 <b>(0.49022**)</b>	-0.00073 (0.4345)	0.84912 (0.92443)	0.0784 (0.21723)	0.62557 (0.52035)	0.10590 (0.23816)	1.04414 (0.85565)	-0.50111 <b>(0.26178*)</b>
$\sigma^2$	2.27329 <b>(0.22566**)</b>	0.93034 <b>(0.08275**)</b>	2.93353 <b>(0.29704**)</b>	0.91258 <b>(0.08154**)</b>	2.61412 <b>(0.2578**)</b>	0.92051 <b>(0.08041**)</b>	2.7892 <b>(0.26382**)</b>	0.83943 <b>(0.08125**)</b>
$P_{11}$	0.61721		0.72249		0.76209		0.89326	
$P_{00}$	0.8061		0.87054		0.88256		0.92636	
$E(D_1)$	2.612		3.597		4.2016		9.368	
$E(D_0)$	5.157		7.722		8.51		13.579	

Note: The figures in parentheses are standard error of the estimators.

\* Significance of the coefficients at the 10% level.

\*\* Idem 5% level.

<sup>b</sup> This specification is estimated using a sample including monthly data between February 1992 and December 2005.



**Table 4: Estimations Results of the Models with PTV as a Function of the Financial Vulnerabilities Variables**

	PUBASS		INTRISQ		OPENPOS		INSPOL	
	Crisis regime	Tranquil regime	Crisis regime	Tranquil regime	Crisis regime	Tranquil regime	Crisis regime	Tranquil regime
<b>Twin (-1)</b>	-0.42037 <b>(0.15489**)</b>	0.18109 <b>(0.08287**)</b>	-0.83490 <b>(0.25625**)</b>	0.06575 (0.06762)	-1.41848 <b>(0.96303**)</b>	0.08484 (0.07314)	-0.39673 <b>(0.16181**)</b>	0.17784 <b>(0.08065**)</b>
<b>TCER</b>	-0.06185 (0.05962)	0.05752 (0.03894)	-0.15057 (0.19053)	-0.02716 (0.02552)	-1.13331 (1.4761)	-0.0313 (0.02441)	-0.05786 (0.05822)	0.02845 (0.04136)
<b>STD</b>	0.09146 <b>(0.04191**)</b>	0.00189 (0.01570)	0.18592 <b>(0.06653**)</b>	0.00410 (0.01592)	0.14595 (0.1311)	-0.00418 (0.01863)	0.09046 (0.04214)	-0.00173 (0.01368)
<b>M2RES</b>	-2.84478 <b>(1.40215**)</b>	0.20517 (0.52739)	-1.48180 (2.58692)	-0.47722 (0.65011)	4.23054 (12.59807)	-0.25241 (0.59751)	-2.92288 <b>(1.45637**)</b>	0.29237 (0.51829)
<b>ENDPUB</b>	0.00679 (0.22960)	-0.50152 <b>(0.22661**)</b>	1.93418 (2.00501)	-0.20440 (0.18516)	1.51859 (2.48189)	-0.22477 (0.17253)	-0.3086 (0.65497)	-0.19187 (0.23916)
$\gamma$	0.68570 (0.53303)	0.10195 (0.24527)	0.61216 (2.2969)	-0.03486 (0.27886)	1.49270 (4.69168)	0.08119 (0.24997)	0.88982 (1.04245)	-0.10695 (0.23874)
$\sigma^2$	2.96313 <b>(0.30522**)</b>	0.92237 <b>(0.08783**)</b>	3.41622 <b>(0.69235**)</b>	1.38886 <b>(0.08928**)</b>	3.58100 <b>(1.01319**)</b>	1.45463 <b>(0.12739**)</b>	2.96924 <b>(0.3113**)</b>	0.88705 <b>(0.08921**)</b>
$P_0$	1.89723		3.41438		3.60529		1.64656	
$q_0$	0.92742		-0.32244		-1.34568		1.00374	
$P_1$	<b>0.07259</b>		<b>0.13804</b>		<b>-1.21633</b>		<b>21.89986</b>	
$q_1$	<b>-0.46898</b>		<b>0.03106</b>		<b>-0.30234</b>		<b>8.3198</b>	
<b>Type</b>	Preventive		Recovery		Recovery		Recovery	

Note: The figures in parentheses are standard error of the estimators.

\* Significance of the coefficients at the 10% level.

\*\* Idem 5% level.

<sup>b</sup> this specification is estimated using sample including monthly data between February 1992 and December 2005.