A Simple Model Of Currency Crises And Budget Deficits: The Case Of Turkey

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Abstract

The aim of this paper is to explore the determinants of currency crises and to illustrate the dynamic behaviour of the fundamental macroeconomic variables in a small open economy under a peg regime. The mainstream models in currency crises literature are not sufficiently available to explain the recent Turkish currency crisis observed in 2000. Turkey was successful to fix domestic credit at the same time with a crawling peg regime in order to achieve price stability. Furthermore, the political preferences were also in favour of continuing the program. Though these facts, the peg collapsed by a speculative attack. Depending on these issues, in our model, which uses a Keynesian framework augmented with a speculative foreign exchange market, it has been focused on the fundamental macroeconomic relationship between budget and trade deficits. In the simulation experiment derived from our theoretical model, we have found that it does not matter whether the budget deficit is financed by monetization or domestic borrowing, the increase in the total budget deficit causes the trade deficit and the devalutionary expectations to rise via the increase in national income. The conclusion is that, unless there is a decreasing budget deficit, it is inevitable to prevent the peg system to collapse.

Keywords: Currency Crises, Turkey, Budget Deficits, Balance of Payments, Peg Regime.

JEL Classification: F41

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1. INTRODUCTION

The main focus of this paper is on the reasons of the currency crises under peg regimes. We used a dynamic Keynesian framework, which examines the behaviour of the macroeconomic variables under open economy conditions. The actual example that we will analyse is the case of 2000 currency crisis in Turkey

The economic problems of Turkish economy have a long history. After a twenty years experience of high chronic inflation, Turkey started to apply a disinflation program on January 2000 and experienced a currency crisis resulting with a deep recession in the end of 2000**.** Following the crisis, the Turkish Lira depreciated more than hundred percent. During this process some of the banks became insolvent and the existing problems of the financial system has become severe. In these conditions, the explanation of the crisis and its determinants become crucially important.

In economic literature, the first theoretical examples related with currency crisis, later called first generation models, have been developed on the base of the models, which are introduced by Krugman (1979) and Flood and Garber (1984). In these studies, currency pegs are identified as unsustainable when the budget deficits are monetized. Collapse time of the fixed exchange rate regimes is determined by the expectations of rational speculators when they believe that they can deplete the reserves with an attack and break the currency peg. This causes the crisis to begin.

In the second generation models, starting with Obstfeld (1986), a different approach for currency crises has been developed. In these models dynamics of political preferences

became dominant in explaining the currency crises. If the political preferences are in favour of leaving the currency peg, speculative attacks can be successful, even in sustainable currency regimes. High interest rates and unemployment play an important role in this decision. Therefore, the cost of peg has become crucial in these models.

Krugman (1998), after the experience of Asian Crisis, presents a model which focuses on asset price bubbles in order to explain the cases excluded by the first generation models. Though these arguments of Krugman, a large budget deficit, which is crowding out investment and stimulating consumption, would certainly cause excess demand and trade deficit. It is not common sense to disregard the effect of trade deficit in explaining the determinants of exchange rate movements. Defining these movements as emerging only from monetary causes mismatch the main part of the relationship, trade deficit. Our model mainly focuses on this theme.

On the other hand, third generation models based on market imperfections, bailout guarantees and overlending problems to explain currency crises. In this models its argued that moral hazard leads banks to take unhedged foreign exchance positions in order to fufil the domestic overborrowing demands stimulated by the recovery phase of business cycle. The banks implicitly transfer most of the currency risk to the government through the deposit insurance scheme. Even the lack of an explicit deposit insurance scheme, banks expect the national government or international organizations to bail them out in the event of crisis. This process usually ends with a currency crisis because lenders refuse to roll-over debt

During the 2000 stabilisation program of Turkey, monetary policy is proposed to be organised in order to avoid budget deficits, furthermore, the political preferences were also in favour of continuing the program. Nevertheless the program collapsed. It is interesting that both first and second generation models are not effectively able to explain this crisis.

Large budget deficits followed by trade deficits make the agents suspicious about the peg system. As trade deficit increases, the agents believe that the probability of a devaluation increases. Finally, at a threshold level, as the large trade deficit makes the agents believe that a devaluation is inevitable, the capital flows out. As a result of that, in our model, the devalutionary expectations are determined by trade deficit. Therefore the role of budget deficit is crucial. However, the relationship between the budget deficit and the deficit financing process is identified in a broader scope. We argue that the currency crises may exist, even in the absence of monetization of budget deficit. It does not matter whether the budget deficit is financed by monetization or domestic borrowing, the increase in the total budget deficit causes the trade deficit to rise via the increase in national income. As a consequence, the currency peg systems have become unsustainable, as long as budget deficits persist..

In section 2 we focused on details relevant to Turkish currency crisis 2000. In section 3, we have developed a dynamic Keynesian macroeconomic model, which will be used in a simulation experiment, to analyse the Turkish crisis in 2000. In section 4, we present our simulation results in comparison with actual data. Section 5 is a brief conclusion of the paper.

2. TURKEY 2000 CRISIS

The disinflation program had a start in accordance with the stand-by agreement signed with IMF on January 2000. As Turkey experienced large current account deficits and high chronic inflation in the last decades, it was inevitable to apply such a program which was focused on solving these problems. In 1990's the ratio of current account balance over GNP is negative, except 1994 and 1998. Within the period 1990-1994, after the Gulf crisis, the government authorities tried to stimulate the effective demand by expansionary fiscal policies.

To maintain the sustainability of the growth in effective demand, the authorities suppressed the exchange rate, while they were setting the interest rates free, which caused short-term capital inflows. Therefore, it was intended to finance the expansion in domestic demand by foreign capital. Nevertheless, this process created a huge current account deficit, which implied opportunities for speculative currency attacks. In the beginning of 1994 it was perceived by the government that the regime was unsustainable and after an attack, the exchange rates were allowed to float freely. As a result of this devaluation in 1994, there existed a current account surplus. In 1998, a tight fiscal policy augmented with the international recession caused by Asian crisis, created a current account surplus via the decline in national income. In other years the economy experienced current account deficit. Moreover, the ratio of domestic dept over GNP has generally an increasing trend between 1999-2000.

In the beginning of the stand-by program annual growth rate of CPI was 64,8%. The program was based on the following principles:

i) Increasing the gross budget surplus by applying a tight fiscal policy,

ii) Income policies, emphasising a limitation of the rates of growth of wages and rents by applying 20% ceiling,

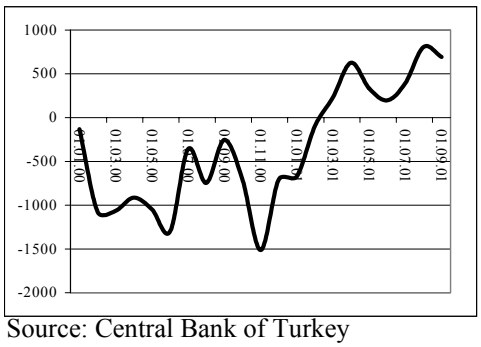
iii) A tight monetary policy, which includes fixing domestic credit,

Setting the targeted value of the basket, which consists of 1 dollar plus 0,77 Euro, as nominal anchor in a crawling peg regime, in which it is committed that the annual rate of growth of this currency basket would be 20%

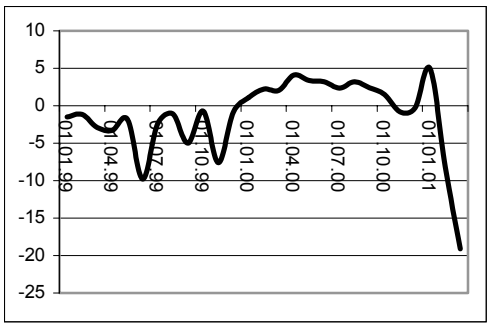
It was intended in the program that the peg policy would continue until June 2001 and following this date an expanding band system would be applied, in order to transform into a free floating system at the end of 2001.

Figure 1-a,b: Current Account Balance

a) Current Account Balance



b) Monthly Growth Rate of Total Credit (%)



Source: Central Bank of Turkey

The interest rates declined from 72.2% to 35.1 in the first three months of the program. Since there was a decline in both interest rates and import prices, the aggregate demand did not slow down and the decline in inflation rates was more slowly than it is expected. The high-levelled-aggregate demand was the main stimulator of the huge current account deficits. This process also caused an overlending problem and a total credit boom (Figure1–a, b).

Table 1

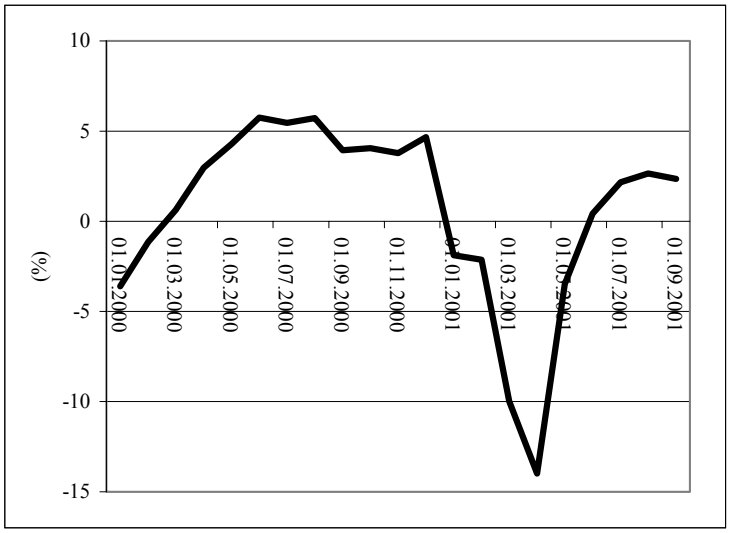
Domestic Credit (000 Billion TL)	01/1/1999 -1200	31/3/2000 -1200	30/6/2000 -1200	30/9/2000 -1200	31/12/2000 -1200
International reserves (Million USD)	12.000	12.000	12.750	12.750	13.500
Budget Deficit (Primary) (000 Billion TL)	-	2150	3850	5900	9100
Net Foreign Borrowing (Milyon USD)	8500	12.200	16.000	20.000	23.000

Source: Central Bank of Turkey

The program was successful in fixing the domestic credit. Budget deficits fully financed by domestic borrowing during the program, (Table 1). Fiscal policy could not be implemented effectively to prevent the rise in aggregate demand and to neutralise the expansionary effect of interest and exchange rates. During the program period, the net budget deficit was increasing approximately 5% per month in real terms. The first speculative attack

occurred on November 22nd, 2000. Following this fact, the government imposed a lump-sum tax and this was sufficient to reduce the budget deficit but in fact it was not available for the authorities to prevent the incoming crisis, (Figure 2). After November 2000 attack, Interbank overnight interest rates rose up to 873% and, consequently, Central Bank lost 5 billion dollars. The peg was defended by high interest rates and central bank interventions in foreign currency (FOREX) markets. Beside this, IMF provided supplementary reserve facility at the amount of 7.5 billions of dollar and this additional fund prevent further speculative attacks.

Figure 2: Monthly Growth Rate of Real Budget Deficit

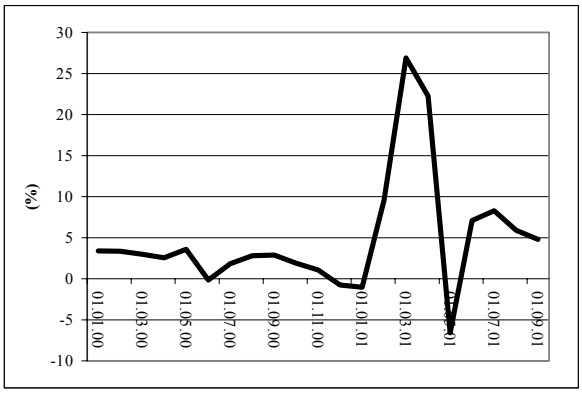


Source: Central Bank of Turkey

On the 19th February, 2001, a political crisis triggered the last speculative attack against Turkish Lira. Interbank overnight rates climbed up to 6200%. Central Bank sold 5,36 billion dollars to defend the peg, but, nevertheless, this reserve loss was not enough to stop the speculative attack. On the base of these developments, Central Bank was no more able to

main the pegged currency regime, therefore currency was allowed to float freely on February 21st, 2001.(Figure3-4)

Figure 3: Rate of Devaluation of Foreign Currency



Source: Central Bank of Turkey

Figure 4: Foreign Currency Reserves

Source: Central Bank of Turkey

3. MODEL

The model is essentially Keynesian in spirit including lagged variables, which maintain the adjustment process towards the equilibrium. The contribution is that a speculative foreign exchange (FOREX) market is included in the model together with the money, goods and the labour markets. It can be questioned that the nature of exchange rates represent a transformation of prices among different countries, each of which are denominated in different currencies, whereas our model treats exchange rates and foreign currencies as one

of the speculative assets in the agents' portfolio. This assumption can be valid for small country or emerging market cases. On the other hand, if one considers a large country case, such as global dollar-deutsche mark market, then this assumption of national speculative market collapses. Let us consider firstly the FOREX market:

A Speculative FOREX Market in a Small National Economy :

$$F^D = f_0 + f_1 Y - f_2 (r - r^f) + f_3 (e^{TB} - e) \qquad (1)$$

Equation (1) is a speculative FOREX demand equation, where the real demand of domestic agents for foreign currency is a function of real income, (in analogy with the transactions motive in basic Keynesian Liquidity Preference schedule), real interest rate differential, (representing the incentives of agents shifting their portfolios between foreign and national currency denominated interest yielding assets), and devalutionary expectations. Since all the variables are taken as logarithmic values except the foreign and domestic interest rates, linear relationships do not cause trouble. devalutionary expectations are taken as the difference[1] between ideal exchange rate, e^{TB}, which maintains trade balance, and the actual exchange rate. Consider a rise in real income. Given the demand relationship, the amount of foreign currency assets in the agents' portfolio increases with the rise in income. This shows the *income effect*. The substitution will be between the domestic and foreign assets. Therefore, the *substitution effect* should be demonstrated in terms of the returns. The opportunity cost of holding foreign assets is the domestic interest rate that can be earned alternatively by holding domestic assets. The expected revenue that can be earned by holding foreign assets is the foreign interest rate plus the expected devaluation rate. The third and the fourth elements in

[1] From now on, this difference will be called as *exchange rate differential*

the right hand side are representing this substitution effect. Third element is the interest rate differential and fourth is the exchange rate differential

$$F^S = R = R_{-1} + K_0 + \Delta K; \quad \Delta K = k_1(r - r^f) - k_2(e^{TB} - e) \quad (2)$$

Equation (2) shows the supply of foreign currency. It includes a difference equation in terms of reserves, R_{-1}, (here, we assume that national foreign currency reserves and the Central Bank's, (CB), foreign reserves are identical, that is the reserve level is equal to the supply of foreign currency), augmented with an autonomous foreign debt, K_0, (representing the credit coming from international finance institutions; e.g. IMF, WB, etc.), and the capital flows, ΔK, which are in turn a function of real interest and the exchange rate differentials. From the two equations we have presented the upward sloping supply and downward sloping demand curves which represents the speculative behaviour neatly. A very important variable in both equations is the ideal exchange rate, e^{TB}, that maintains the trade balance. The below equations will show the explicit definition of e^{TB}:

$$NX = x_1(e - p) - x_2 Y = 0 \longrightarrow e^{TB} = p + \frac{x_2}{x_1} Y \qquad (3)$$

Where NX is the logarithmic value of net of real exports from real imports, p is the logarithmic domestic price level, Y is the logarithmic value of real income. In equation (3) ideal exchange rate, e^{TB}, is defined as a function of real income and the price level. The expansion in domestic expenditures will cause a consequential rise in ideal exchange rate, which in turn implies a necessary devaluation rate.

The equilibrium in FOREX market will be maintained by equating the supply of and demand for foreign currency. That is solving the three equations for FOREX rate:

$$e = p + \gamma_0 - \gamma_1 K_0 - \gamma_1 R_{-1} + \gamma_2 Y - \gamma_3 (r - r^f) \qquad (4)$$

Where

$$\gamma_0 = \frac{f_0}{k_2 + f_3}, \gamma_1 = \frac{1}{k_2 + f_3}, \gamma_2 = \frac{f_1 x_1 + x_2 (k_2 + f_3)}{(k_2 + f_3) x_1}, \gamma_3 = \frac{k_1 + f_2}{k_2 + f_3}$$

Equation (4) is maintained by solving equations (1), (2) and (3) for the exchange rate, *e*, and this exchange rate equation shows us the values of exchange and interest rates, by which the FOREX market is in equilibrium.

In the paper, from now on, the curves in (e,Y) and (e,r) spaces, which represent the FOREX market equilibrium will be called as FX curve. It is identified by the equation (4), and shows how the equilibrium exchange rates are affected by the other economic variables. FX curve will be in the hard core of our analysis, and simply, it is one of the contributions of this paper.

Money Market in a Small Open Economy:

Remember the simple Keynesian Liquidity Preference. There, the agents were composing their portfolios from consols (interest yielding securities) and cash. These consols can theoretically be interpreted in a wide range of concepts. They can be interpreted as corporate or treasury bonds, or some other risk bearing assets. The common point is that the measure of risk is the same: the interest rates.

In the last decades, a very important problem, especially for the professionals in the emerging markets, has appeared. Under the rules of open economy, the risk can not be

$$M^D - p = l_0 + l_1 Y - l_2 (r - r^f) - l_3 (e^{TB} - e) + (1 - \theta) G \qquad (5)$$

explained solely by interest rates. There is a second crucial risk determinant: foreign exchange (FOREX) risk. The agents now had to select their portfolios from foreign and domestic assets. In this case, the agents should take into account three factors; foreign and domestic interest rates and the level of exchange rate risk. Holding cash, now, should also be evaluated by the cost benefit analysis for the foreign assets. Therefore, the liquidity preference schedule become no more a cash demand, but rather a demand for domestic currency denominated assets.

Equation (5) shows the real demand for domestic assets. The first and second terms in the right hand side are conventional determinants of the money demand. The third determinant is interest rate differential. It shows us the way, how the agents shift their portfolio decisions from domestic to foreign assets, or vice versa. A rise in domestic interest rate causes a decline in the prices of domestic currency assets and a rise in their demand by the domestic agents. This means they will sell some of their foreign currency denominated assets and increase the share of domestic assets in their portfolios. The fourth term shows us, how the devalutionary expectations affect the money demand. If the national currency is over-valued, that means if e is lower than e^{TB}, then there exists an expectation for the FOREX rates to rise. If the FOREX rates are to rise, then it means that in the near future the foreign assets will be more valuable than they are now. This causes a rise in the demand for foreign assets and, symmetrically, a decline in the demand for domestic assets. The last term shows the effect of government's domestic debt that is the part of the budget deficit, which is not financed by monetization. This effect simply refers to the crowding out case. However, it is different from the text book models, since in those models crowding out is an indirect result

of budget deficit via the rise in national income and liquidity preference. Here, the government's debt requirement directly influences the liquidity preference, since some part of the funds, which are available to the agents, are absorbed by the government.

$$M^S - p = H - p + R + \theta G \qquad (6.a)$$

Equation (6.*a*) is the real money supply equation. The last term in the right hand side shows the effect of financing the budget deficit by monetary expansion. The term *"G"* represents the logarithmic level of real budget deficit and the term *"θ"* represents the percentage of the deficit financed by monetary authorities. Eliminating the logarithmic level of prices from both sides and defining the reserve level explicitly as in equation (2) we have

$$M^S = H + R_{-1} + K_0 + \theta G + k_1(r - r^f) - k_2(e^{TB} - e) \qquad (6.b)$$

In equation (6.*b*) it is seen that the money supply is endogenous to the system by two ways. Firstly, a proportion of the budget deficit is financed by monetary expansion. Secondly, in the open economy, the CB has to create as much money as the level of foreign reserves. The level of reserves, in other words the supply of foreign currency, is determined by equilibrium FOREX rate as in equation (4), and this is a function of general price level, real income level, autonomous foreign debt, previous period's reserve level, and the interest rate differential. Therefore all these variables influence the money supply, and this means that money supply is endogenous to the system. The first term in the right hand side, *"H"*, is the level of domestic money. If these two additions to the domestic money that make money supply endogenous is excluded then money supply is identical to the domestic money. By definition, it is perfectly under the control of CB.

Equating equations (5), (6.b) and solving it for "r" with respect to (3), gives us the below result:

$$r = r^{f} + \phi_0 + \phi_1 p - \phi_2 (H + R_{-1} + K_0) + \phi_3 G + \phi_4 Y + \phi_5 e \quad (7)$$

Where

$$\phi_0 = \frac{l_0}{k_1 + l_2}, \phi_1 = \frac{(1 - l_3 + k_2)}{k_1 + l_2}, \phi_2 = \frac{1}{k_1 + l_2},$$

$$\phi_3 = \frac{(1 - 2\theta)}{k_1 + l_2}, \phi_4 = \frac{l_1 x_1 - l_3 x_2 + k_2 x_2}{(k_1 + l_2) x_1}, \phi_5 = \frac{l_3 - k_2}{k_1 + l_2}$$

Equation (7) shows us the level of interest rates, which maintain the money market equilibrium. This equation gives us the LM curve in the small open economy. LM curve can be illustrated both in (e,r) and (r,Y) spaces. An important parameter above is ϕ_3. Here, the effect of budget deficit over interest rates is seen. If we used the conventional models, government's budget deficit would influence the interest rates negatively in the short-run by the effect of monetization. Nevertheless, in actual life it is seen that, the sales of government bonds increase the interest rates even in an hour. Nobody waits for the budget deficit's expansionary impact on national income by the multiplier mechanism and a following rise in liquidity demand. By including the budget deficit directly to liquidity preference equation, we can show this momentary crowding out effect in our model neatly. Therefore, this parameter shows the total effect of government's domestic debt and the rise in money supply by the monetization of the rest of the budget deficit on the interest rates.

One of the main assumptions in this model is that while money and the FOREX markets are simultaneously reaching the equilibrium, the goods and the labour markets are adjusting to them with a lag. This is certainly acceptable, since the income and the employment level does not change in very short terms. Regarding the contractual agreements, production lags and the probable existence of rigidities in these markets, the one period

lagged movement of income and employment can be considered as reasonable. Therefore, the basic pillars of this model are the simultaneous equilibrium of money and FOREX markets, which are determined by one period lagged income and price levels. The goods market equilibrium is conventionally illustrated by IS schedule. Nevertheless, as our model extends the two dimensional IS-LM analysis to the three dimensional IS-LM-FX analysis, the graphical illustration of IS curve will be on both (e,Y) and (r,Y) spaces. In the below section, the determination of IS curve can be seen.

The Goods Market Equilibrium: IS Curve:

In conventional macroeconomics, the components of aggregate expenditures are consumption, "C", investment, "I", government expenditures, "G", net exports, "NX". As our model involves one period lagged adjustment of IS curve, all these aggregate expenditure items are defined by difference equations. Below;

$$
\begin{aligned}
&C = cY_{-1} \\
&I = b_1(C - C_{-1}) - b_2 r_{-1} \\
&G = A + (1-\theta)G_{-1} \\
&NX = x_1(e_{-1} - p_{-1}) - x_2 Y_{-1} \\
&Y = C + I + G + NX
\end{aligned}
\qquad (8.a)
$$

The equations in (8.a) shows us the aggregate consumption expenditures, *"C"*, investment demand including an accelerator mechanism, *"I"*, government expenditures net of taxes augmented with debt payments, *"G"*, and the net exports, *"NX"*. Let us explain these components in order. (8.a) introduces a series of difference equations, which characterises the nature of the path through the goods market equilibrium in our model. Consumption, which is the main element of aggregate expenditures, is assumed to be a function of previous period's income level. Investment demand has two components. These are a simple accelerator

mechanism and the impact of interest rates representing the marginal efficiency of capital. Accelerator mechanism depends on the change in consumption demand within one time period. This can be interpreted as the demand for consumption goods inflate the demand for capital goods. The second component is the conventional relationship between investment and interest rates. Government expenditures are representing the budget deficit after taxes and they include the debt payments from the previous period. For computational convenience, we ignore the interest payments on domestic debt.. It has also two components. First one is the autonomous public expenditures, *"A"*, representing the net expenditures other than the debt payments. This period's debt payment is the function of previous period's budget deficit and the interest rate. The ratio, *"1*-θ*"*, shows the proportion of deficit financed by domestic debt. Net exports are conventionally modelled by income and real exchange rates. The difference is that they adjust to those variables with a lag.

The equilibrium path of the national income can be obtained by applying lag operators to the system in equation (8.a) and solving it for Y. There exists a second order difference equation for Y and the solution consists of the sum of two lag polynomials in the relevant variables, as seen in below equation:

$$Y = \frac{g(L)}{1-\alpha_1 L-\alpha_2 L^2} A + \frac{L}{1-\alpha_1 L-\alpha_2 L^2}(x_1 e - x_1 p - b_2 r) \qquad (8.b)$$

Where *L* represents the lag operator, *A* is the autonomous budget deficit and g(L) is a lag polynomial, which shows the dynamic path of budget deficit depending on current and recent values of *A*. More formally;

$$g(L) = \frac{1}{1-(1-\theta)L} = \sum_{i=0}^{t} (1-\theta)^i L^i ; \alpha_1 = c + b_1 c - x_2 ; \alpha_2 = b_1 c$$

Equation (8.b) can be transformed into a lag polynomial representation, and, thus, according to the roots of the second order difference equation, it may be rewritten as:

$$Y = [\alpha_1(L) + \alpha_2(L)]g(L)A + [\alpha_1(L) + \alpha_2(L)]L(x_1 e - x_1 p - b_2 r) \qquad (8.c)$$

In (8.c), g(L)A is the expression for G. It can be easily seen that (8.c) gives us the dynamic version of IS curve.

Dynamic Aggregate Supply and Inflation :

In this Keynesian General Equilibrium model, the last part of the analysis is the determination of general price level. Instead of explaining the determination of prices, for convenience in the simulation experiment, we focus on the determination of inflation rate. The stationarity of our simulation results necessitates the usage of such a methodology. It is also consistent with the main theme of the model that tries to illustrate the dynamic adjustment mechanism from equilibrium to equilibrium. Below equation shows the dynamic aggregate supply relationship:

where

$$\Pi = p - p_{-1}; \quad y = Y - Y_{-1}; \quad y^f = Y^f - Y^f_{-1}; \quad m = M^S - M^S_{-1} \quad \textit{and} \quad \dot{e} = e - e_{-1}$$

On the left-hand side of equation (9) the current inflation rate is seen. Inflation rate is the difference between the current and previous period's logarithmic price levels. On the right hand side the first term represents the last period's inflation rate. That is a simple *adaptive expectations* process, which explains inflationary expectations by a backwards looking behaviour. The second term shows the one-period-lagged dynamic output gap, which is the difference between the growth levels of previous period's actual and full employment income levels. Full employment income-output level grows at a constant rate, *"ln(1+n)"*, logarithmically, where *"n"* is the population growth rate. Actual output has a path, which is identified by equation (8). The third term is the monetary expansion, which is represented as the logarithmic difference between current and previous periods' money supplies. The fourth term is the previous period's actual devaluation rate. This has two interpretations. First, the devaluation creates cost pressures, which is depending on the share of imported factors in the economy. Second, it can influence inflationary expectations. The supply side determinants of inflation can be extended in a much wider category, but this creates only unnecessary labour, it does not give different aspects to the model.

The solution can be maintained in the same with the IS curve. Using lag operators and solving the equation for "*p*", gives us the below equation:

$$p = \lambda_1(L)[\lambda_2 Y - \lambda_2 Y^f + \lambda_3 M^S + \lambda_4 e]; \quad \lambda_1(L) = \frac{L}{1-\lambda_1 L} \qquad (9.b)$$

The equilibrium path for general price level is seen in equation (9.b). We will use these results in the following sections, when dealing with the general equilibrium values.

Simultaneous Equilibrium in the FOREX and Money Markets :

According to our model, the FOREX and money markets are simultaneously coming to equilibrium. This is valid since these markets operate much efficiently relative to goods and

factor markets. In the goods and factor markets there may be a number of barriers for simultaneous equilibrium in aggregate level, (e.g., wage and price rigidity, long term contracts, imperfect competition in some of the markets and etc.). It is also a practical fact that most of the shifts in the relevant variables, including macro economic policy applications, affect the fundamental macroeconomic variables with a lag. Regarding these points, we assume that income and price levels adjust to their equilibrium values not simultaneously but within a dynamic adjustment process. On the other hand, even within a day, the FOREX and interest rates have their equilibrium values, hour by hour and/or moment by moment. To illustrate this nature of these markets, we have to solve equations (4) and (7) for FOREX and interest rates. After a series of solutions we have reached the below result:

$$e = \varphi_0 + \varphi_1 p - \varphi_2 (R_{-1} + K_0) + \varphi_3 H + \varphi_4 Y - \varphi_5 G \qquad (10)$$

and

$$r = r^f + \delta_0 + \delta_1 p - \delta_2 (R_{-1} + K_0) - \delta_3 H + \delta_4 Y + \delta_5 G \qquad (11)$$

where

$$\varphi_0 = \frac{\gamma_0 - \gamma_3 \phi_0}{1 + \gamma_3 \phi_5}; \quad \varphi_1 = \frac{1 - \gamma_3}{1 + \gamma_3 \phi_5}; \quad \varphi_2 = \frac{\gamma_1 - \gamma_3 \phi_2}{1 + \gamma_3 \phi_5};$$
$$\varphi_3 = \frac{\gamma_3 \phi_2}{1 + \gamma_3 \phi_5}; \quad \varphi_4 = \frac{\gamma_2 - \gamma_3 \phi_4}{1 + \gamma_3 \phi_5}; \quad \varphi_5 = \frac{\gamma_3 \phi_3}{1 + \gamma_3 \phi_5}$$

and

$$\delta_0 = \phi_0 - \phi_5 \varphi_0; \quad \delta_1 = \phi_1 - \phi_5 \varphi_1; \quad \delta_2 = \phi_2 - \phi_5 \varphi_2;$$
$$\delta_3 = \phi_2 - \phi_5 \varphi_3; \quad \delta_4 = \phi_4 + \phi_5 \varphi_4; \quad \delta_5 = \phi_3 - \phi_5 \varphi_5;$$

For the system to have a stable dynamic equilibrium there should be some constraints. These will be identified in the Appendix. In our model we try to search for the results of any policy implication under the stable equilibrium conditions. Nevertheless, the conditions may create unstable equilibrium or equilibria. The possible existence of these unstable equilibria, may explain some of the non-standard behaviour of financial asset returns in most of the emerging markets. This case of unstable equilibria may be a starting point for further research.

Completing the Analysis: A Dynamic General Equilibrium Case :

In the previous parts of this section, we have introduced a dynamic open economy macroeconomic model and presented the solutions for simultaneous equilibria of FOREX and interest rates. Now, the lagged adjustment process for the general price level and the national income will be examined.

Consider equations (8.c) and (9.b). In (8.c) we have three endogenous variables: e, p, and r. Similarly, in (9.b), there are three endogenous variables, too. These are Y, M^S, and e. As simultaneous equilibria for the FOREX and interest rates are given in equations (10) and (11), it is easy for us to calculate the equilibrium paths. The equilibrium paths may be written as:

$$\begin{aligned} Y^* &= \eta_0 + \eta_1(L)H + \eta_2(L)K_0 + \eta_3(L)G + \eta_4(L)Y^f \\ p^* &= z_0 + z_1(L)H + z_2(L)K_0 + z_3(L)G + z_4(L)Y^f \end{aligned} \qquad (12)$$

The equilibrium paths are determined as lagged functions of high-powered money, autonomous capital flows, budget deficit and full employment output level. Here, "*H*" and "K_0" are determined exogenously to the system, whereas "G" is an exogenous variable, which

is determined by its previous and current levels. "Y^f" is determined demographically by the rules of nature. Conclusively, all the endogenous variables are determined by exogenous variables in the system. Rewriting the equations for the equilibrium values of interest and exchange rates gives us :

$$e^* = \varphi_0 + \varphi_1 p^* - \varphi_2 (R^*_{-1} + K_0) + \varphi_3 H + \varphi_4 Y^* - \varphi_5 G \qquad (13)$$

and

$$r^* = r^f + \delta_0 + \delta_1 p^* - \delta_2 (R^*_{-1} + K_0) - \delta_3 H + \delta_4 Y^* + \delta_5 G \qquad (14)$$

where the parameters were explained in the previous section. The equilibrium level of Reserves can also be identified in terms of equilibrium levels of other variables. More formally:

$$R^* = R^*_{-1} + K_0 + \Delta K^*; \quad \Delta K^* = k_1 (r^* - r^f) - k_2 (e^{TB} - e^*) \quad (15)$$

4. THE SIMULATION RESULTS

In the simulation experiment of our model, we will examine four cases. In all of the cases, we try to see the determinants of the currency crises under a currency peg system. Our thesis is that the way of financing of the budget deficit is not important, because if the budget deficit is not controlled and raised down, neither policies can maintain the sustainability of the peg system because of the overlending problems stimulated by increasing demand, On the other hand, if the budget deficit is controlled, then the sustainability of the peg can be maintained by both ways. In the Turkish crisis in 2000, we see that the deficits could not be controlled and although there was a tight monetary policy, the peg could not be protected. Such a fact can not be explained by first and second generation models, since they do not take

into account the role of trade deficit in the fundamentals of exchange rate formation. In our model, as it is shown in the previous sections, the exchange rate differential, which represents the devalutionary expectations and which is determined by the trade deficit, is highly influential in the formation of supply of foreign currency via the capital flows and international lenders are sensitive to overlending process, It was seen that the trade deficit grew to enormous amounts during the peg period of Turkey in 2000 and this process ended with a large capital outflow and the collapse of the currency peg.

During the simulation experiment, we will set initial values for variables. After that, we defined equilibrium FOREX and interest rates as is shown in equations (10) and (11). The other variables were then defined depending on the levels of exogenous variables and the equilibrium levels of FOREX and interest rates. The experiment finishes by a recursive repeating of the system for 60 periods. A notable feature of the simulation experiment is that although it is completely deterministic and linear, the system can produce meaningful cycles and oscillations. Another important point is that the model is formulated in an extended Keynesian approach. The constant coefficients, such as marginal propensity to consume, are set by the authors in approximately same values with the current values in Turkish economy.

In the first case, Case 1, we will examine a case where there are uncontrolled budget deficits and starting with an high inflation rate, (80% level) the authorities try to pull down the inflation by applying a tight monetary policy under a peg system. The budget deficit is assumed to be financed wholly by domestic borrowing. The results show us that the system is unsustainable. In Figure 5, it can be seen that the peg regime collapses in the 16^{th} period by the sharp decline in the reserve level. Also, the dynamics of the FOREX rates can be seen in Figure 6.

Figure 5. Reserve Levels (Case 1)

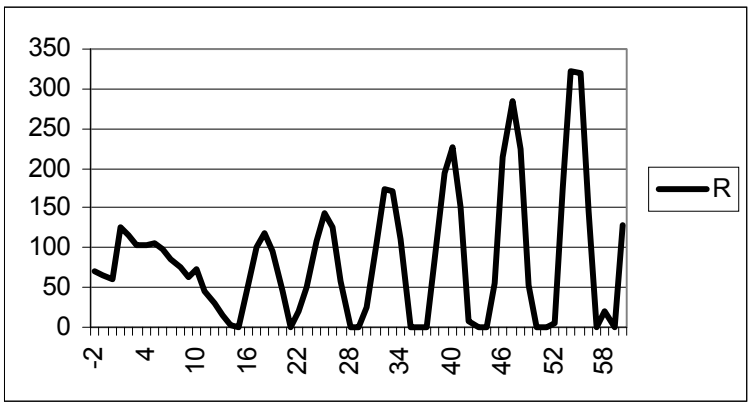
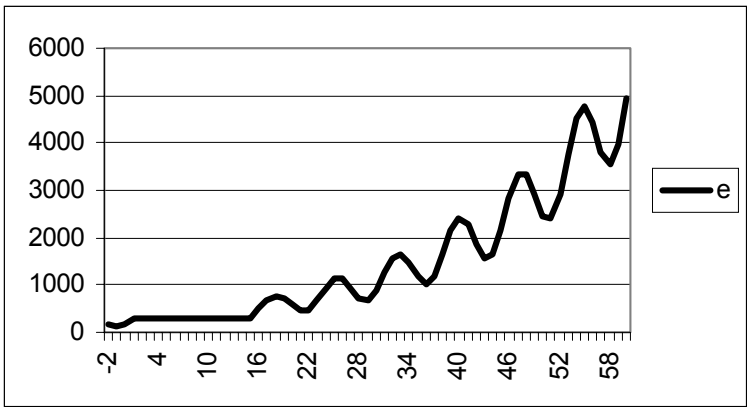


Figure 6. The Foreign Exchange (FOREX) Rates (Case 1)



It is seen that the currency peg collapsed at the 16th period since the foreign currency reserves declined sharply. The main reason of this sharp decline is the continuous rise in the exchange rate differential representing the devalutionary expectations. After the collapse of the peg, the exchange rates can not be controlled following large fluctuations, which are explosive in their nature.

The important point, here, is that the increasing budget deficit is not monetized but it is wholly financed by domestic borrowing. This case serves a fundamental explanation to the Turkish crisis in 2001. In figures 7 and 8, this issue is easily seen:

Figure 7. High Powered Money (H)

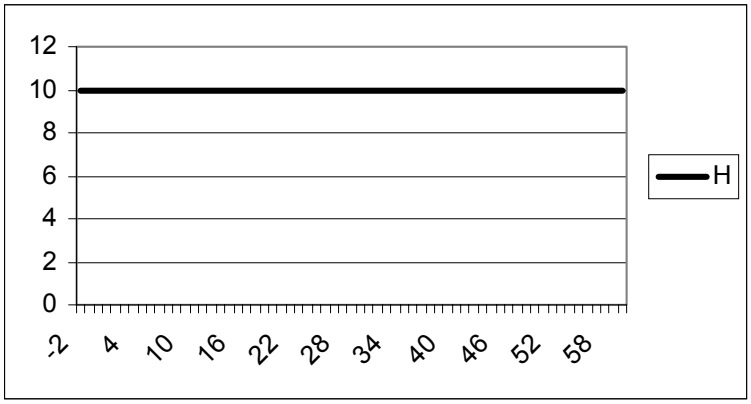
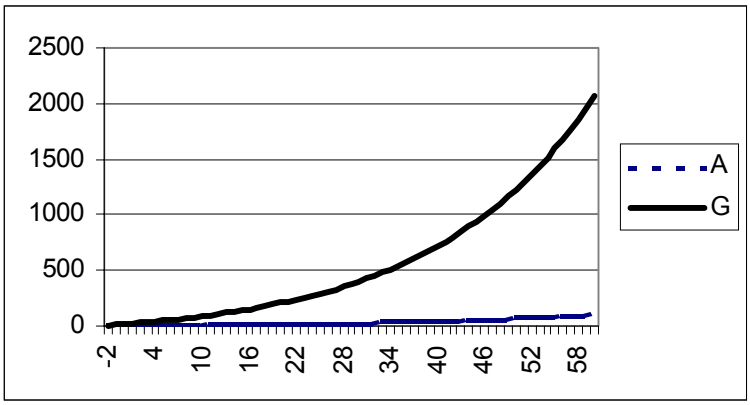


Figure 8. Primary Budget Deficit (A) and Gross Budget Deficit (G) (Case 1)



In Case 2, where the uncontrolled budget deficit is totally financed by monetisation, the peg collapses at the 16th period. In Case 2, similar to Case 1, uncontrolled budget deficits, make the peg system to be unsustainable. After leaving the peg system, the system can not produce equilibrium exchange rates, which maintains the trade balance although the rates are continuously increasing. This is because of the fact that the exchange rates are determined in a speculative market, in which uncertainty creates lagged oscillation in the rates, and there is no

guarantee that the free market FOREX rates can maintain the trade balance. The figures 9,10,11 and 12 show the simulation results of case 2.

Figure 9. Reserve Levels (Case 2)

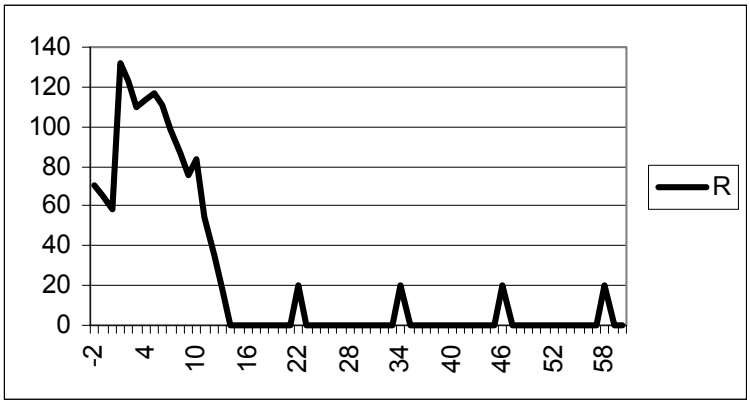


Figure 10. The Foreign Exchange (FOREX) Rates (Case 2)

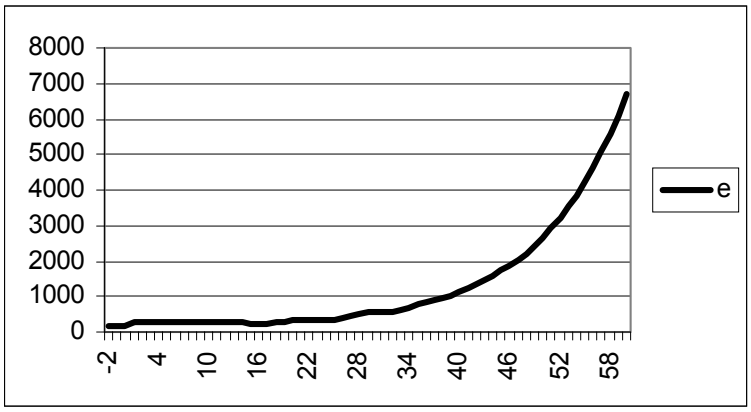


Figure 11. High Powered Money (H) (Case 2)

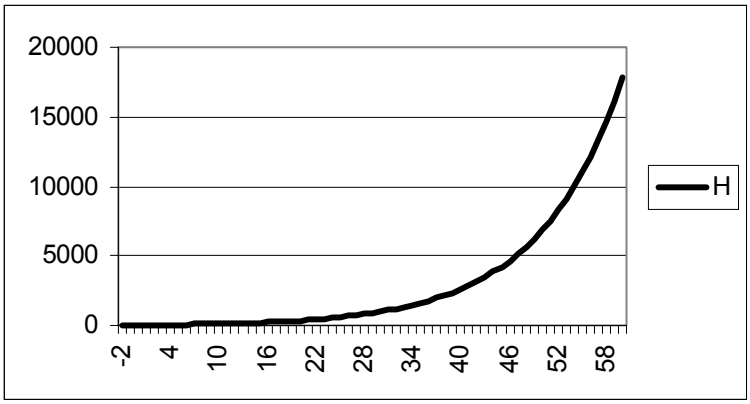
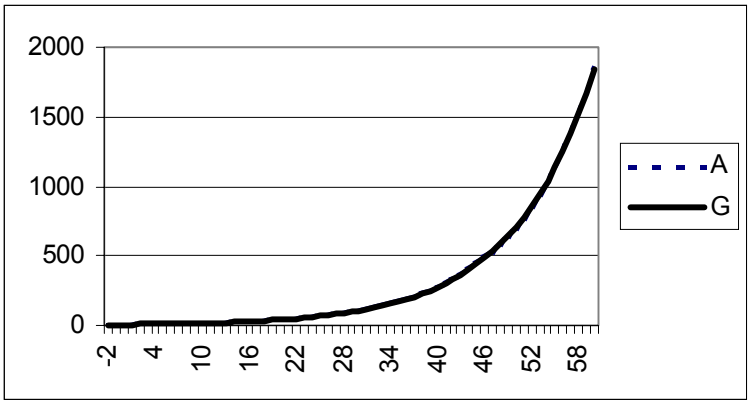


Figure 12. Primary Budget Deficit (A) and Gross Budget Deficit (G) (Case 2)



Even the exchange rates rise after the collapse of the peg, inflation accelerates faster than devaluation rate. This causes the real exchange rate not to maintain the trade balance. The collapse in NX causes the national income to decline in real terms.

If the budget deficits can be controlled, then the peg regime seems to be sustainable. In the simulation experiment of case 3, the primary budget deficit (A) is raised down by 5% in each period. It is assumed that the budget deficit is fully financed by borrowing. As the primary deficit declines, the gross deficit will rise in a decreasing rate. The decline in the acceleration of the budget deficit causes the income level to converge to an equilibrium level. The stationary path in the income level causes the net exports not to diverge from their

equilibrium path. And finally, this dampening effect coming from trade balance causes the system to be sustainable. The figures 13,14,15 and 16 show the relevant variables for Case 3:

Figure 13. Reserve Levels (Case 3)

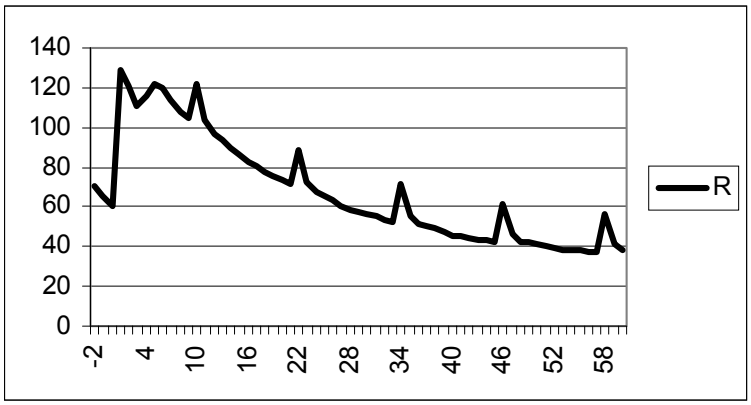


Figure 14. The Foreign Exchange (FOREX) Rates (Case 3)

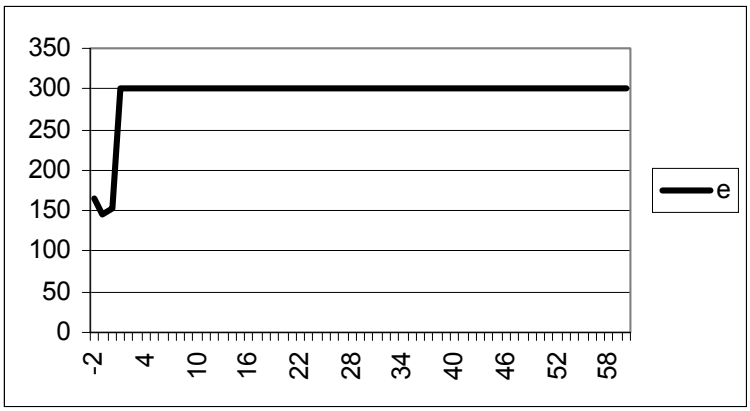


Figure 15. High Powered Money (H) (Case 3)

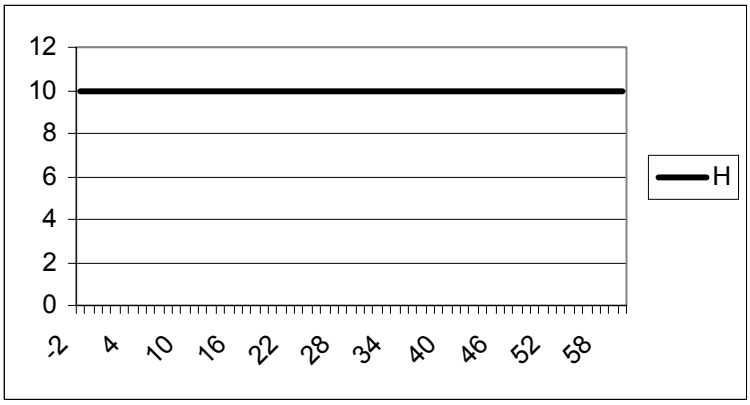
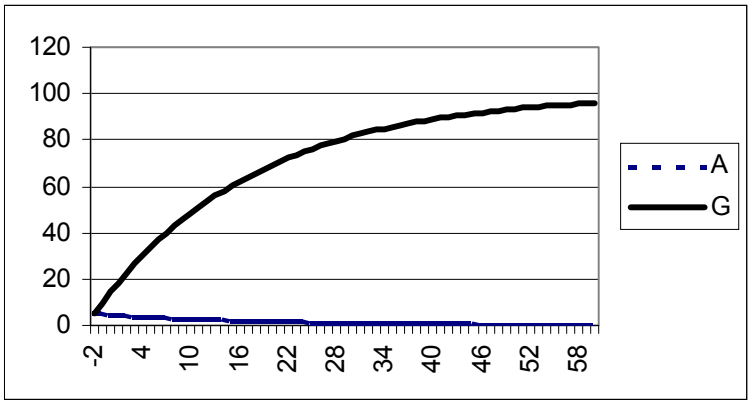


Figure 16. Primary Budget Deficit (A) and Gross Budget Deficit (G) (Case 3)



In Case 4, the conditions are similar to the ones in Case 3 except the High Powered money. But the main idea stays the same: if there is a fundamental control on the budget deficit, then, regardless with the case how the deficit is financed, the peg system is sustainable. The figures 17,18,19 and 20 present the simulation results, which support the above argument:

Figure 17. Reserve Levels (Case 4)

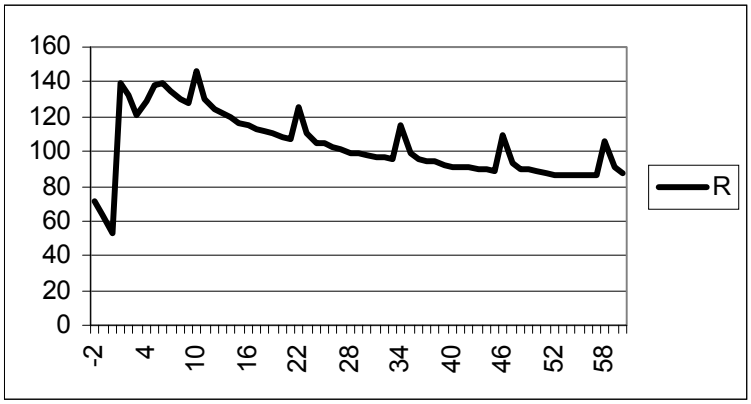


Figure 18. The Foreign Exchange (FOREX) Rates (Case 4)

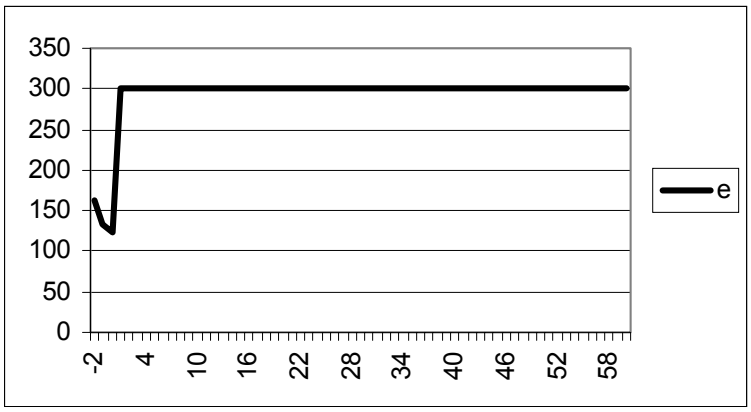


Figure 19. High Powered Money (H) (Case 4)

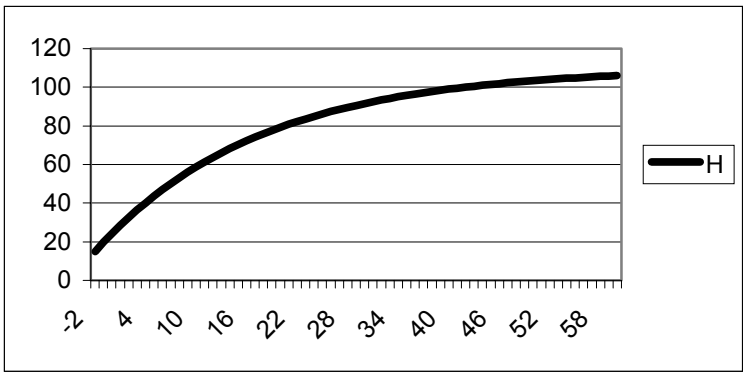


Figure 20. Primary Budget Deficit (A) and Gross Budget Deficit (G) (Case 4)

5. CONCLUSION

In this paper we tried to seek for the causes of the currency crises under a peg regime. Our findings show that the main determinants, which lead to a crisis, are budget, trade deficits and total credit boom. As our model is basically Keynesian in spirit, we especially focused on the components of aggregate demand. The first generation models focus generally on the budget deficits, when they are financed by monetization, as the main cause of the crisis.Since the political preferences were in favour of continuing the program second generation models are also failed to explain Turkish 2000 experience. However, our theoretical model and the simulation results indicate that whether the deficit is financed by monetisation or domestic borrowing, persisting budget deficits cause the peg system to collapse. Overborrowing problems and deterioating balance sheets also play an important role on the unsustainability of the peg regime. Therefore the Turkey 2000 Crisis and the results from simulation experiment based on our theoretical model are quite similar to third generation models.

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