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RESEARCH ARTICLE

A Fourth Generation Model Approach on Crises: Application on Subprime Mortgage Crisis (2008)

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Abstract

This paper is trying to explain the running US economy twin crisis using macroeconomic and social variables first time used in empirical works applied on United States. We consider also the influence of oil demand and real estate market to the form and turbulence of the crisis. These incidents cannot be explained using the three past crises generations or the existed fourth generation proposals so we introduced a new fourth generation crisis model specialized on the American case. The paper studies the effect of macroeconomic, market and social results bringing an innovative and wider approach in the field. The results show that the new variables of House Pricing Index and Oil Consumption along with economic freedom seem to explain the dollar's high volatility.

Keywords: *Credit crunch, Crisis analysis generations, House Pricing Index.*
JEL Classification: F 41, P 33

Introduction

At the end of the American sub mortgage crisis and during the Eurozone crisis developing now in the weaker members of the Union it would be fruitful to analyze the American crisis from its beginning to explore conclusions on crisis creating and developing based on a new and innovative fourth generation approach with structured characteristics compared to the past works developed in earlier years mainly for underdeveloped or developing countries.

The paper is constructed as following: The next section reviews previous theoretical and empirical research. Section 3 provides a discussion of the main problems and the history of the crisis. A description of the data and the variables used is provided in section 4. Section 5 presents the results of the empirical model. Finally, in the last section we offer some concluding remarks.

Review of Literature

The models of currency crises were built based on the real events. The first generation models were developed after the balance of payments crisis in Mexico (1973-82), Argentina (1978-81), and Chile (1983). The second generation models were developed after speculative attacks in Europe and Mexico in the 1990s. Finally, the third generation models started after the Asian crisis in 1997-98. Transition economies in Central and Eastern Europe and the former Soviet Union offer additional empirical input which allows for re-examination of the existing theoretical models and accumulated empirical observations and verification of policy conclusions and recommendations proposed by other authors.

The research on currency crises first emerged in the economic literature in the late '70s pioneered by Krugman [1]. According to him, under a fixed exchange rate system domestic credit creation in excess of money demand growth leads to a gradual but persistent loss of international reserves and, ultimately, to a speculative attack on the currency. The process ends with an attack because economic agents understood that the fixed exchange rate regime will ultimately collapse, and that in the absence of an attack they would suffer a capital loss of their holdings of domestic assets. Therefore, the first generation crisis occurs as a result of an expansionary macroeconomic policy incompatible with a peg exchange rate. The collapse may happen when the "shadow floating exchange rate" becomes equal to the exchange rate peg. This is the equilibrium exchange rate prevailing after the full depletion of foreign reserves and forced abandoning of the peg. A number of papers have extended Krugman's basic model in various directions [1]. Some of these extensions concern active governmental involvement in crisis management and sterilization of reserve losses [2].Other have

shown that speculative attacks would generally be proceeded by a real appreciation of the currency and a deterioration of the trade or current account balance, by an upward pressure of real wages and by higher interest rates. Extensions also include target zone models [3] post-collapse exchange systems other than permanent float, the possibility of foreign borrowing, capital controls, imperfect asset substitutability, and speculative attacks in which the domestic currency is under buying, rather than selling pressure.

The second generation models suggested by Obstfeld [4-6], Eichengreen, Rose and Wyplosz [7-8] and others are particularly useful in explaining self-fulfilling contagious currency crises. They use game theory and precisely non-cooperative game with three players: authorities who possess the stock of reserves to defend the currency regime and two private players. The idea of second generation models is based on the fact that defending exchange rate parity can be expensive (through higher interest rates) if the market believes that it will ultimately fail. This set of assumptions opens the possibility for multiple equilibria and self-fulfilling crises. Second generation models also tend to focus on political factors, such as political cost of high unemployment or foregone output.

A third generation of models gives a key role to financial structure fragility and financial institutions. Microeconomic problems, such as weak banking supervision, corruption e.t.c., trigger capital outflows and finally currency attack. The proponents of this view use data from the Asian crisis to support the main ideas (Corsetti, Pesenti and Roubini [9-10]. Stops of capital inflows are explained as a byproduct of bank runs due to internationally illiquid banking sector. Krugman [11], and Aghion, Baccetta and Banarjee [12-13] examine the effects of monetary policy on currency crises (such as moral hazard and resulting over-borrowing).Masson's [14] model, fails to rigorously capture a contagious effect in which a crisis starts in one country and can trigger crisis in another country. Vaugirard's [15] explanation of contagion involves real (trade and financial) linkages between the countries. Successful speculative attack against the currency of a country which exports goods that are substitutive to goods sell by a not-attacked country forces the latter also to devalue in order to maintain its competitiveness.

The empirical literature as regards currency crises is also vast. Most of the empirical studies (single-country and multi-country studies, "warning system" approach, and stylized facts) emphasize variables that were found as leading indicators of crises. All the studies were driven by desire of authors to analyze potential causes and symptoms of currency crises and to develop a warning system that would help to monitor whether a country may face a crisis or not.

The main findings of single country studies (for a review see Kaminsky, Lizondo and Reinhart, [16] is that macroeconomic indicators (foreign reserve losses, expansionary fiscal and monetary policies and high interest rate differentials) play a significant role in determining currency crises. The problem with these studies is that their results are limited since they are obtained from a small number of countries during very specific situation.

Multi-country studies avoid the limitations of the above single country studies. Among the most significant determinants of currency crises are the low levels of foreign direct investment, low international reserves, high domestic credit growth, high foreign interest rates, overvaluation of the real exchange rate, output, exports, deviations of the real exchange rate from trend, equity prices, and the ratio of broad money to gross international reserves etc.

Esquivel and Larrin [17] represents the first attempt to simultaneously test the main predictions of both the first and second generation models of currency crises. The explanatory variables closely associated with first generation models are seignorage, real exchange rate misalignment, current account balance, and M2/reserves ratio. As far as the second generation model is concerned, they use terms of trade shock, per capita income growth and contagion effects. Their results suggest that the insights developed by second generation models complement rather than substitute for the explanation provided by first generation models.

There is a major debate on the existence and presence of a possible fourth generation. In an early approach Chionis and Liargovas [18] suggested the introduction of a possible fourth generation based on political risk and black market premiums. A latter work Breuer [19] argues that poor institutional variables are an underlying cause for unsustainable policies. In their two years later work Simpalee and Breuer [20], they term institutional factors as "social capital" or "social infrastructure". Weak institutional fundamentals are still present. Their analysis is based on second generation modified models [21], Johnson et. al. [22] using variables such as central bank independence, financial

liberation, coordinated wage and corruption. The conflict and overlap between generations is obvious and in a determinants of currency crises analysis Cuaresma and Slacik [23] In a PhD thesis Dapontas, [24] suggested a double dimension on fourth generation crises analysis using the social variables and economic freedom and UN HDI variables in contrast to the second real economy dimension explaining crisis through contagion and banking crises existence. Finally they are past works that seem to reject the existence of possible fourth generation arguing that the past three generations can explain possible crises Castillo [25].

The aforementioned theoretical and empirical research is very useful in the analysis of currency crises in transition economies. However, we should take into consideration the peculiarities associated with the macroeconomic environment in these countries. Contrary to the moderate or low inflation in industrialized countries, countries in transition experience high and variable inflation rates. The result is that debt and contracts are of very short duration. Therefore, a decline in unanticipated inflation does not have unfavorable direct effect on firms' balance sheets that it has in industrialized countries. In transitional economies the improper management of the government debt plays an important role among factors provoking currency crises. Countries issue different types of debt instruments in foreign or national economies, though the currency denomination is irrelevant if investors lose confidence in the country and in its government. The loss of confidence also includes the currency which ceases to be the medium of exchange and the unit of account, due to the development of a dual economy. Therefore, when explaining the currency crises in transition economies, one needs to incorporate the critical role often played in these countries by the parallel market for foreign exchange in diffusing speculative pressures on the official rate.

In addition, the propagation of financial instability differs in the financial markets of industrialized countries versus transition countries. In industrialized countries, for example, a devaluation does not lead to large increases in expected inflation and hence in nominal interest rates. Also, the institutional

features in countries in transition, such as short term maturity of debt, significant amount of debt denominated in foreign currency and lack of credibility or high uncertainty, can interact with currency crisis, which can lead to a full-fledge financial crisis.

Theoretical Model Framework and Methodology

The subprime mortgage crisis was an economic problem manifesting itself through liquidity issues in the banking system owing to foreclosures which accelerated in the United States in late 2006 and triggered a global financial crisis (credit crunch) during 2007 and 2008. The crisis began with the bursting of the American housing bubble and high default rates on adjustable rate mortgages made to higher-risk borrowers.

Government legal framework loose and a long-term trend of rising housing prices and loan incentives encouraged borrowers to assume long term mortgages, believing they would be able to refinance at more favourable terms in the future. Housing prices drop sharply in 2006-7 raising refinancing difficulties. Defaults and foreclosure activity increased dramatically as interest rates reset higher. During 2007, nearly 1.3 million U.S. housing properties were subject to foreclosure activity, up 79% from 2006. The subprime defaults reached by the end of 2007 a level between U.S. $200-300 billion respectively.

The mortgage lenders that retained credit risk were the first to be affected, as borrowers became unable or unwilling to make payments. Major Banks and other financial institutions around the world have reported losses of approximately U.S. $200 billion as of April 1, 2008. Owing to securitization, many mortgage lenders had passed the rights to the mortgage payments and related credit/default risk to third-party investors facing significant losses, as the value of the underlying mortgage assets declined. Stock markets in many countries declined significantly.

The widespread dispersion of credit risk and the unclear effect on financial institutions caused lenders to reduce lending activity or to make loans at higher interest rates. Similarly, the ability of corporations to obtain funds through the issuance of commercial paper was affected. This aspect of the crisis is consistent with a credit crunch. The liquidity concerns drove central banks around the world to take action to provide funds to member banks to encourage the lending of funds to worthy borrowers and to re-invigorate the commercial paper markets.

The subprime crisis also placed downward pressure on economic growth, because fewer or more expensive loans decrease investment by

businesses and consumer spending, which driven the economy. A separate but related dynamic is the downturn in the housing market, where a surplus inventory of homes has resulted in a significant decline in new home construction and housing prices in many areas. This also places downward pressure on growth. With interest rates on a large number of subprime due to adjust upward during the 2008 period, U.S. legislators and the U.S. Treasury Department are taking action. A systematic program to limit or defer interest rate adjustments was implemented to reduce the effect. In addition, lenders and borrowers facing defaults have been encouraged to cooperate to enable borrowers to stay in their homes. The risks to the broader economy created by the financial market crisis and housing market downturn were primary factors in several decisions by the U.S. Federal reserve to cut interest rates and the economic stimulus package. Both actions are designed to stimulate economic growth and inspire confidence in the financial markets.

The strong relationship among financial markets effects each other. The decline in the Eurozone must be expected. In order to face the challenge due to the crisis, EC has aimed on improving the clarity of the risk management practice and on valuation of the financial means. Committee works on bonded trust and the financial education of the consumers. There is also a need on improving early warning systems on financial markets, developing of new estimating methods, securing that individuals can handle the perils properly and research on the role of the estimating banks before crisis.

The dollar itself show a major weakness against euro. From the 84 cents in July 2001, the dollar has fallen in value passing $ 1.57 in July 2008 and continuing to variable over than $ 1.30 until May 2010. This decline was a sign of looming economic problems. Only at the end of 2011 the signs of the crisis seem to be restored and the economy returned to a new development era.

We use FGLS squares methodology having major advantages against the one or multiple least squares analysis. Feasible generalized least squares (FGLS or Feasible GLS) is a regression technique. It is similar to generalized least squares except that it uses an estimated variance-covariance matrix since the true matrix is not known directly. The dataset is assumed to be represented by:

$$y = X\beta + u,$$

Where X is the design matrix and ß is a column vector of parameters to be estimated. The residuals in the vector u, are not assumed to have equal variances: instead the assumptions are that they are uncorrelated but with different unknown variances. These assumptions together are represented by the assumption that the residual vector has a diagonal covariance matrix Ω.Ordinary Least Squares estimation can be applied to a linear system with heteroskedastic errors, but OLS in this case is not Best Linear Unbiased Estimator (BLUE). To estimate the error variance-covariance Ω, the following process can be iterated: The ordinary least squares (OLS) estimator is calculated as usual by:

$$\widehat{\beta}_{OLS} = (X'X)^{-1}X'y$$

and estimates of the residuals $\widehat{u}_j$ are constructed.

Construct $\widehat{\Omega}_{OLS}$:

$$\widehat{\Omega}_{OLS} = \operatorname{diag}(\widehat{u}_1^2, \widehat{u}_2^2, \ldots, \widehat{u}_n^2).$$

Estimate β_{FGLS1} using $\widehat{\Omega}_{OLS}$ weighted least squares

$$\widehat{\beta}_{FGLS1} = (X'\widehat{\Omega}_{OLS}^{-1}X)^{-1}X'\widehat{\Omega}_{OLS}^{-1}y$$
$$\widehat{u}_{FGLS1} = Y - X\widehat{\beta}_{FGLS1}$$
$$\widehat{\Omega}_{FGLS1} = \operatorname{diag}(\widehat{u}_{FGLS1,1}^2, \widehat{u}_{FGLS1,2}^2, \ldots, \widehat{u}_{FGLS1,n}^2)$$
$$\widehat{\beta}_{FGLS2} = (X'\widehat{\Omega}_{FGLS1}^{-1}X)^{-1}X'\widehat{\Omega}_{FGLS1}^{-1}y$$

Estimations from WLS and FGLS are as follows:

$$\widehat{\beta}_{WLS} \sim N(\beta, (X'\Omega^{-1}X)^{-1})$$
$$\widehat{\beta}_{FGLS} \sim N(\beta, (X'\widehat{\Omega}_{OLS}^{-1}X)^{-1}(X'\widehat{\Omega}_{OLS}^{-1}\Omega\widehat{\Omega}_{OLS}^{-1}X)(X'\widehat{\Omega}_{OLS}^{-1}X)^{-1})$$

Model, Results and Implications

We have to focus on the factors that effect the exchange rate change on the light of previous generation models but also on the analyzed characteristics of the crisis. Our dataset consists of seven years (2001 Jan.-2008 Mar.) Data is given by the international Financial Statistics (Domestic credit expansion, reserves, GDP growth), OANDA (official rate against euro) the US energy organization (oil demand), Moodys (HPI), FED (Consumer credit outstanding) and the Heritage foundation (Economic Freedom). Data frequency is monthly with the exception of Economic Freedom index which is annual.

Official Rate against Euro

The monthly average rate against the euro given by OANDA is our dependent variable of this dataset.

International Reserves (Reserves)

Foreign exchange reserves expressed in USD. All the past theoretical or empirical models used this fundamental as the main (and before first generation models the only) measure of crisis likelihood. It is clear that the lower reserves are, the higher the probability of speculative attacks and currency crisis (negative effect). We should note, however, that the central bank can also keep other reserves beyond foreign exchange (gold, SDR etc.). Therefore, the variable is expected to have negative effect if the reserves are used as a measure of remedy or savings and positive if not.

Oil Consumption

Is the US oil consumption within a month officially counted by the US energy organization? We believe that the variable will have negative sign because any increase on the demand has an increase on the price of the oil because US are oil importer. On the oil price increase US economy will have major problems.

Consumer Credit Outstanding

Is the credit that consumers have to the banks and other institutions. This rate is given by FED and it has been increased over the last years mainly. The expected sign is negative.

House Price Index (HPI)

The HPI is given by Moody's and shows the variation of the average house price in US territory , main HPI measures the cost of single-family houses and is published by the Office of Federal Housing Enterprise Oversight. We expect a negative sign.

Domestic Credit Expansion

Is the monthly change of domestic credit for the US. We expect negative sign.

Current Account

Is the monthly net flow of goods, services and unilateral transactions (gifts) between the USA and other countries? We expect a negative sign.

Economic Freedom

Heritage rate of economic freedom is a total score consisting of indicators on trade, fiscal burden, government intervention, monetary policy, foreign investment, banking, wages and prices, property rights, regulation and informal market. It represents the progress that countries might have achieved regarding the implementation of structural reforms. Market and institutional reforms (e.g. the establishment of a sound financial and banking system, the well-functioning of fiscal institutions etc) offer great assistance to the countries in their effort to prevent a crisis. The effect of this variable is expected to be positive.

Gross Domestic Product Growth

Is the monthly growth of GDP in the USA given from IMF estimations? The variables used in the analysis are chosen in light of theoretical considerations and empirical determinants of crises. Also previous works framework as analyzed in the third sector has considered.
The FGLS results are shown below:

Table 1: Empirical results on 5 % significance

Variable	Coefficient (Str. Error)
C	**-0.3451 (0.0132)**
Oil Consumption	**0.0027 (0.0021)**
Consumer Credit outstanding	0.0001 (0.0027)
HPI	**0.0029 (0.0001)**
GDP growth	-0.0171 (0.0013)
Economic Freedom	**-0.0339 (0.0014)**
Current Account	0.0017 (0.0014)
Domestic Credit	-0.0001 (0.0002)
R^2	**0.827 (0.061)**

The results show that Oil consumption and Home Price Index are significant and positive. Any rise on US oil consumption seem to effect positive on the exchange rate against Euro raise as expected and leads to depreciation of the national currency. The exploit of national and imported resources has negative effect also on the value of national reserves of oil in the long term effect. House Pricing Index raise leads to dollar depreciation. As more and more fiat money enters the economy through housing sector higher prices leads rate to raise. Economic freedom negative sign means that the raise in the index leads to lower exchange rates and vice versa.

Conclusions

In our current research we examined the relationship between USD and Euro exchange rate and a series of eight independent variables (oil consumption, consumer credit outstanding, House Price Index, Domestic Credit expansion, Current account, Economic freedom Gross

Domestic Product Growth). We found that three variables and the constant were significant and with the expected signs, the oil consumption and the Home Price Index, were positive and important and economic freedom was negative. The negative constant means that there are additional factors we haven't included in our model which have negative effect.

The development of a fourth generation model, however is plausible and our innovative approach has revealed its main characteristics. It will include social and real economic indicators along with macroeconomic additional economic effecting constants as well. The matter is to analyze in a further revision on the countries affected from the American economy crisis and the possible factors. This paper is only a small and initial introducing approach to a new era on the field. Crises models used to apply on underdeveloped or developing economies cannot fulfill the needs of possible candidates among the developed economies crises explanation. The future will show if this work will be useful. The only thing that a researcher can do is to explain the facts that he or she already has and not try to make a guess on the future. The phenomenon is still on its beginning and we have to be cautious on any consequences or remedies that we cannot still imagine.

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