Predicting and Explaining Currency Crisis in Sudan

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ABSTRACT

Sudan is one of the countries that suffer enormously from currency crisis. The study adopts statistical methods to identify crisis episodes and investigate behaviors of some economic indicators that can predict crisis incidence. The indicators are then utilized to characterize the causes and implications of the currency crisis. The study finds that the most powerful predictors of currency crisis in Sudan are international reserves, political crisis, ratio of debt services to exports and inflation.

1. Introduction

Over the last two decades, a large number of theoretical models have been developed to examine the causes of currency crisis and collapse of exchange rate regimes. The majority of the empirical work focused on panel analyses of a large number of countries. However, there was no agreement about the causes of the crisis in the empirical literature.

Sudan has a long history of currency crisis. Speculative attacks normally succeed in crashing the exchange rate regime. The latest one was in April 2012 when the government was forced to abandon the local currency peg to the US dollar and allowed the Sudanese pound to float freely.

This study aims at explaining currency crisis in Sudan, predicting episodes, identifying causes and drawing policy implications. We employed the signal approach to investigate the probability of a currency crash in Sudan. We use annual data for the period (1972-2012) to assess warning signals prior to the crisis. The findings should judge whether some observable macroeconomic indicators are useful in predicting a currency crash. Section 2 of the study outlines the theory of currency crisis while Section 3 represents the key features of the Sudan economy. Section 4 discusses the empirical work and analysis and the last section represents the results, conclusions and policy implications of the study.

2. Currency crisis: Theoretical and statistical concepts

2.1. Definition of currency crisis
Currency crisis in a country generally involves a sudden and rapid fall in the value of the currency. It usually affects the fixed exchange rate regimes. The government fending for the value of the currency against speculative attacks often leads to depletion of foreign reserves. Consequently, the country will be under pressure to give up the prevailing exchange rate system.

2.2. Theories explaining currency crisis
Theoretical models of currency crises describe the causes of crisis. The models can be classified into first-generation models, second-generation models and third-generation models, though many models combine elements of more than one generic form.

The first generation models, for example, Krugman (1979) refers to inadequate macroeconomic policy as the main cause of the currency crises. High budget deficit implies that the government must create money or deplete reserves to finance it. Money creation leads to high inflation and eventually the collapse of the fixed exchange rate regime. This generation of models was adopted to explain the currency crises in Mexico (1973-1982) and Argentina (1978-1981) (see Glick and Hutchison, (2011) and Krznar (2004)).

The second generation models were pioneered by Obstfeld (1986, 1994). In these models doubts about whether the government is willing to maintain its exchange rate target can lead to the existence of multiple equilibrium. The models stress the self-fulfilling nature of a currency crisis. These models were used to explain currency crisis in Europe and Mexico in 1990s.

The third generation models stress financial and banking crisis leading to currency crises. In this respect, moral hazard and contagion are key factors leading to currency crisis. Examples of these models are Aghion, Bacchetta, and Banerjee (2001), Chang and Velasco (2001), Burnside, Eichenbaum, and Rebelo (2001 and 2004).

2.3. Effects of currency crisis

Currency crisis leads to decline in foreign investment and reduction in economic activity. To restore investors' confidence and regain control over currency value, the government needs to reduce deficit. The government will be adopting austerity measures when the economy is already in a recession. This will aggravate output and employment problems. Moreover, stabilizing the value of the local currency by using foreign reserves is not normally successful in the face of continuous attacks from speculators. This situation might require the IMF or other international institution to intervene to restore credibility to the economy. Furthermore, devaluation of the local currency increases the repayment costs of external debts and therefore worsen the balance of payments situation.

The currency crises can have adverse long-term effects. However, countries that are more open to trade are likely to experience less dramatic drops in real growth and much quicker rebounds in the aftermath of a currency crisis (Milesi-Ferretti and Razin, 1998; Gupta et al, 2003). For example, rapid export growth helped bring Asian economies out of recession following the 1997–98 crisis (Glick and Hutchison, 2011).

2.4. Statistical methodology for currency crisis
Measuring incidence of currency crisis

Measuring and forecasting currency crisis depends on definitions adopted by researchers. To find currency crisis incidence we must select a definition suitable for the country in question. Definition selection is associated with practical problems that affect research outcomes. For some authors, currency crisis is defined as a significant devaluation resulting from a successful speculative attack on currency. More precisely, Frankel and Rose (1996) define a currency crisis as a nominal depreciation of 25 percent or greater, which is at least 10 percent greater than the depreciation in the preceding year. Milesi-Ferretti and Razin (1998) adopt the same definition and required in addition to the 25 percent depreciation, at least doubling the rate of depreciation with respect to the previous year anda rate of depreciation the previous year below 40 percent.

Foreign Exchange Market Pressure Index (FEMPI)

A large number of authors adopted foreign exchange market pressure index as a definition to currency crisis. The index is a weighted average of exchange rate changes and reserve losses. It is used by Eichengreen et al (1995) and Kaminsky and Reinhart (1999). Changes in the index above some threshold are regarded as crises episode, identified by zero-one binary variable assigning the value of one to crisis and zero to no crisis. The thresholds used in the literature are one and a half standard deviation threshold, 2 standard deviation threshold, and three standard deviation thresholds. Some other technical restrictions are imposed by some authors to improve identification of crisis episodes (Glick and Hutchison, 2011).

The Foreign Exchange Market Pressure Index (FEMPI) can be computed according to the following formula:

$$FEMPI = \% \Delta et - \alpha \% \Delta rt$$

Where e_t : is the local currency exchange rate against the US dollar in period of time t; r_t : are international reserves in US dollars, and α : is the ratio of the standard deviation of the exchange rate changes and the standard deviation of the changes in international reserves. The Foreign exchange market pressure index (FEMPI)[1] is defined so that it is increased by local currency depreciation and a fall in international reserves. The index signals a currency crisis (ex post) when its value exceeds the given threshold Krznar (2004) and Ahec-Sonje and Babi (2002).

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[1]Some authors added interest rate changes to the above formula but we ignore this variable because in our case study, the central of Sudan adopts Islamic finance and does not recognize interest rate changes.

Statistical approaches

Early empirical work on currency crisis adopted econometric modeling based on the first generation models of Krugman. These studies include Blanco and Garber (1986) on the Mexican peso and Edwards (1989). Moreover, a descriptive methodology called the event studies approach was employed to examine the behavior of individual indicators in the period leading up to crises. For each variable, behavior during pre-crisis periods is compared with behavior during tranquil or non-crisis periods.

Recently, there have been two popular approaches used for assessing variables predicting a currency crisis. A signaling approached pioneered by Kaminsky, Lizondo, and Reinhart (1998) focuses on a set of leading indicators that behave differently before a crisis and examines whether these variables reach a "threshold" value that historically can be associated with the beginning of a currency crisis. Another approach due to Berg and Patillo (1999) uses probit/logit models to test the statistical significance of some variables that can explain a financial crisis. We will focus on the signaling approach because it is the most important approach in the literature of currency crisis. A good literature review on currency crisis empirical work is provided by Kaminsky et al (1998).

The signaling approach is a non-parametric method with two variables and relies on the comparison of movements of the chosen variables in a tranquil period with their dynamics immediately before the crisis. If the movement of a variable before the crisis differs from its usual movement, extreme values of the variable should be seen as warnings, signaling the possibility of a crisis. Implementation of signaling approach will be provided in the fourth section of this study. We use both event study approach and signally approach to discuss currency crisis in Sudan.

3. Background about the Sudan economy and the exchange rate policy

Structure of Sudan economy: The GDP of the Sudan is composed of the agricultural sector contributing about 31 percent, the industrial sector contributing about 21 percent and the services sector contributing 48 per cent (CBOS, 2010). One of the striking features of the Sudanese economy is the large size of the service sector, which accounts for almost half of the GDP of the country, compared to about 30 percent in all low-income countries. Before 1999, the trading sector constituted about 20 percent of the GDP, which was large by world standards. However, both policy and non-policy factors were responsible for the growth of this sector. In particular, the underdeveloped nature of the industrial sector and the large level of imports relative to exports involved more trading channels and less production processes in a very large country like Sudan[2] and the existence of some restrictions and controls that created high profits in the trade sector (Bannaga, 2005). In 2010, the trading sector declined to 10% of GDP and the industrial sector contribution to GDP increased to more than 20%. However, the service sector still contributes about 50% of GDP and more than one quarter of the activity in this sector is a government service (13% of GDP).

The key feature of the Sudan banking system is the comprehensive adoption of Islamic system. Interest rate dealings have been completely abolished since 1994. In 2009, the number of the Central Bank branches was 14. Moreover, the number of banks operating in Sudan in 2010 was 39 banks with their branches spreading throughout the country. Some of the banks are undercapitalized and most of them have no lines of credit extended from abroad.

Labor markets in Sudan are characterized by dualism, e.g. existence of modern and traditional labor markets. Agriculture plays a key role in employment generation accounting for more than 60 percent of the labor force in 2009 (IMF, 2010). Consequently, employment tends to display a marked seasonal pattern. The structural rigidities in labour markets result in a sharp deficiency of labor during the peak of the agricultural cycle and hence a loss of exports international competitiveness. Unemployment rate in Sudan was more than 15% in the last few years.

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[2] Formerly, Sudan was the largest country in Africa. At present, it ranks the third largest country in Africa and the 16th in the world.

Exchange rate policy in Sudan

Before 1998, the exchange rate policy has been characterized by:

1- Inconsistency in the objectives: While the declared objective of the exchange rate policy was to maintain international competitiveness, promote export and restrict imports, the actual behavior of the government was to fix the exchange rate as a target in itself despite the economic costs. This was reflected in using a more appreciated exchange rate for export valuation owing to tax the producer, in particular, cotton producers. Moreover, in many circumstances, the government introduced a tax/subsidy scheme following the announcement of a devaluation of the Sudanese pound that would result in real over valuation of the pound (see for example World Bank, 1985).

Moreover, attraction of the Sudanese Working Abroad (SWA) remittance played a major role in shaping the exchange rate policy (Elbadawi, 1992a). In fact, the government was concerned about the attraction of these remittances more than the export competitiveness through assigning specific depreciated rates for the SWA. However, the outcome of the policy was a dismal failure.

2- Confusion and loss of control over foreign exchange and payments policies:

Conflicting policies led to loss of creditability and speculative attacks on the currency. This aggravated the black market activity that attracted the bulk of the Sudanese Working Abroad (SWA) remittance (Umbada and Shaael Din (1986)).

3- Lack of supportive financial policies, limited effectiveness of monetary policy instruments and lack of sufficient foreign exchange reserves.

After 1998, the government was able to stabilize the exchange rate following three decades of deterioration. The basis for this stability was successful demand management, in particular reducing the fiscal deficit to less than one percent of GDP in 1997. Moreover, the government implemented a wide range of reforms to unify the official and market rates in 1997. These reforms included reducing and eliminating export surrender requirements to the central Bank of Sudan (CBOS) accompanied by shifting official imports from the CBOS to the private sector. Pricing and importation of several petroleum products were liberalized, financing of some public sector imports through the CBOS was eliminated and spread between the two exchange rates was progressively narrowed (see the IMF, 1999, 2000).

The Central Bank of Sudan also began to build up foreign exchange reserves and to develop procedures for operating in foreign exchange markets and for the co-ordination of the monetary and exchange rate operations. In October 1998, the exchange rate markets were unified. The banks and non-bank authorized dealers were free to determine exchange rate and transact freely within the unified regulatory framework (IMF, 1999). The reforms continued in 2000 and the exchange rate was stable. The process was fostered by oil exportation in 1999. This tranquil period continued until 2012 when currency crashed again.

4. Currency crisis in Sudan: Empirical analysis

4.1. Selecting definition for currency crisis in Sudan

Our definition of currency crisis for Sudan is based on an index of Foreign Exchange Market Pressure (FEMPI). The index is constructed by using the rates of change in the market exchange rate and the changes in international reserves of Sudan according to the following equation:

$$FEMPI_t = \% \, \Delta e_t - \alpha \% \, \Delta r_t$$

Where the $FEMPI_t$ is the Foreign Exchange Market Pressure Index explained in the second section of this study. The equation indicates that market pressure on foreign exchange market increases by currency devaluation and reduction in international reserves.

We apply this index on Sudan foreign exchange market using annual data for the period 1972-2012 to identify episodes of currency crashes in Sudan. The graph (1-A) provides a graphical presentation for Sudan's foreign exchange market pressure index (FEMPI) for the period (1972-2012). Because of the large number of crisis in Sudan during the period (1972-2012) we utilized the index as a filter to select the most important episodes of crisis. Using the previous equation and the percentile distribution of the index, we set a threshold at 0.95 (see graph (1-A) and graph (1-B)). Therefore, a currency crisis occurs if the value of the foreign exchange market pressure index (FEMPI) exceeds the threshold of 0.95. Accordingly, the graphs (1-A) and (1-B) reveal six episodes of currency crisis in Sudan in the years 1981, 1985, 1987, 1991, 1996 and 2012. In each of these cases the Sudanese currency lost more than 65% of its value against other currencies. Two crisis in two successive years are

regarded as one episode due to the likelihood of high correlation between them. The graph (1-A) also shows that the foreign exchange market pressure index declined substantially during the period 2001-2010.

Selecting economic indicators that predict currency crisis in Sudan

A large number of economic indicators have been used in the literature to predict currency crisis. Kaminsky, Lizondo, and Reinhart (1997) listed more than one hundred indicators. The choice of specific indicator for a country depends on economic structure and availability of data. For Sudan, we selected 12 economic indicators reflecting financial sector, real sector, government fiscal position, foreign exchange market, economic policy and political situation. The indicators that have been found to predict upcoming crisis successfully include Inflation rate, money supply growth, current account balance, exports as percentage of GDP, imports as percentage of GDP, external debts as percentage of GDP, debt services as percentage of exports, GDP annual growth rate, international reserves growth in US dollars, reserves to money ratio, claims on central government (annual growth as % of broad money) and political crisis (Regime Change). In the following section we explain how these indicators predict the crisis.

Threshold and time horizon of signals for Sudan currency crisis

Following the literature on currency crisis[3], a signal emitted within 12 months prior to the outbreak of currency crash constitutes a good signal. A signal emitted before that date is correspondingly a bad or false signal. An indicator provides a warning signal within a 12-month period if it exceeds a critical value (threshold). The critical values are set to achieve a certain balance between the risk of having false signals (noise) and the risk of ignoring good signals of a crisis that is in fact impending. However, there are no general rules for determining the critical value. If the threshold is set very high, the indicator is likely to ignore all but the most severe crises. If the critical value is set very low, there is a risk of catching a number of false warning signals in tranquil times.

The empirical research on currency crisis used percentiles distribution of observations of the indicator to set the critical values distinguishing between "normal" and "abnormal" behavior of an individual indicator. The threshold is normally set at 25% percentile of the distribution when the indicator falls prior to currency turmoil or 75% percentile of the distribution when the indicator rises prior to crisis. The choice of the threshold depends on the case study. After determining the thresholds, we determine the total number of good and false signals in crisis and tranquil times using a binary variable. An indicator sends a good signal if the binary variable equals one and a crisis occurs within the signal horizon or zero and no crisis occurs within a tranquil period. On the contrary, an indicator issues a false signal if the binary variable equals one and no crisis breaks out within a tranquil period or zero and a crisis breaks out within the signal horizon. Following Kaminskyet al (1998), effectiveness of an individual indicator is examined through the following matrix:

	Crisis (within 2 year)	No crisis (within two years)
Signal was issued	A	B
No signal was issued	C	D

In the previous matrix, A is the number of times in which the indicator issues good signals of an upcoming crisis, B is the number of times with bad signals (or noise), C is the number of times in which the indicator fails to issue a signal which would have been a good signal, and D is the number of times without a signal and no subsequent crisis. An ideal indicator is one that produces a signal in each time within the signal horizon, so that A>0 and C=0, or one which does not produce any signals in time horizon that is not to be followed by a crisis, so that D>0 and B=0.Before applying the signaling approach to Sudan, we analyze the currency crisis in Sudan using the event study approach in the following section.

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[3]See for example Kaminsky, Lizondo, and Reinhart (1998).

4.2. Event study approach for Sudan currency crisis

In this approach, we compare the behavior of each indicator during tranquil period and crisis period. We use thresholds ranging from 75% to 72% when the indicator rises before the crisis and a threshold of 25% when it falls before the crisis.

- Inflation rate: The graph (A-2) shows the percentile distribution for this variable. Inflation rate signals currency crisis if it exceeds the threshold of 72% of its percentile distribution. The graph shows that inflation rate was unusually high during crisis periods. The indicator sent a signal almost each year during the period of economic turmoil (1985-1997).

- Money supply growth: The graph (A-3) shows the signals sent by this indicator. Money supply growth signals currency crisis if it exceeds the threshold of 72% of its percentile distribution. Like inflation rate, most of the signals have been sent by this indicator during the period 1985-1997.

- Exports as percentage of GDP: The graph (A-4) shows the percentile distribution for this indicator. Exports as percentage of GDP signals currency crisis if it falls less than a threshold of 25% of its percentile distribution. The graph shows that exports deteriorated significantly during the period 1985-1997. Throughout this period, export as percentage of GDP signaled currency crisis.

- Imports as percentage of GDP: The graph (A-5) shows the behaviour of this indicator in tranquil and crisis periods. Imports as percentage of GDP signals currency crisis if it exceeds the threshold of 72% of its percentile distribution. The graph shows that the import grew excessively in the last few years sending an alarm of currency crisis. However, preemptive measures have not been taken to control its growth.

- Debt service as percentage of exports: The graph (A-6) shows the signals sent by this indicator. Debt service as percentage of export signals currency crisis if it exceeds the threshold of 75%of its percentile distribution. The graph (A-6) shows high levels of debt service ratio during the 1980s indicating that the debt service was a significant problem to the economy during that period. The indicator sent several signals of currency crisis in that period. The debt service problem was less serve in the following two decades.

- GDP annual growth rate: The graph (A-7) shows the signals of this indicator. GDP annual growth signals currency crisis if it falls short of a threshold of 25%of its percentile distribution. Most of the signals sent by this indicator were before 1990.

- International reserve growth: The graph (A-8) shows the signals sent by this indicator. International reserve growth (in US dollars) signals currency crisis if it falls short of a threshold of 25%of its percentile distribution. The indicator succeeded in sending a good signal of currency crash for every episode within the time horizon of crisis. Reserves depletion in the years before the currency crash in 2012 was not due to speculative attacks but due to problems in management of resources.

- Political crisis: Political crisis (regime change) is a binary variable taking the value of one or zero. The graph (A-9) shows the behavior of this indicator. The indicator signals currency crisis if it exceeds the threshold of 75%.

- The other indicators are less significant than the previously mentioned ones.

4.3. Signaling Approach for Sudan currency crisis

Along the lines of the above discussion, we examined the currency crisis in Sudan employing the signaling approach. Using the previous matrix we rank the indicators according to their predictive power. Table (1) shows the performance of the twelve indicators of currency crisis in Sudan for the period (1972-2012). Also, the table shows the results of our analysis. For each indicator, the first column of the table shows the number of good signals as a percentage of the number of possible good signals (A/(A+C)). The maximum score (which is 100%) would be registered by an indicator that sends signals every time within the signal horizon before every observed crisis. Accordingly, the best signal indicator for Sudan is the international reserves growth with 67% of good signals in the crisis period followed by the inflation rate and the ratio of debt to exports. By contrast, the ratio of reserves to money has the smallest share of good signals (25%).

The second column of Table (1) shows the number of false signals as a percentage of the number of possible false signals that is (B/(B+D)). Clearly, the lower the figure in the second column, the better the indicator's performance. According to this criterion, the lowest three indicators were international reserves growth, Debt services as percentage of exports and political crisis indicators (each of them issues less than 17% of false signals in tranquil times). The poorest performance belongs to the current account balance for issuing 31% of possible false signals.

Table (1) Performance of Indicators of Currency Crisis in Sudan

Indicator	Good signal as % of possible good signals	Bad signal as % of possible bad signals	Noise/signal ratio	Good signal as % of total signals	P(crisis/signal)-P(crisis)
	A/(A+C)	B/(B+D)	B/(B+D)/A/(A+C)	A/(A+B)	A/(A+B)-A+C/(A+B+C+D)
Inflation	0.5	0.21	0.41	0.5	0.21
MS Growth	0.33	0.24	0.72	0.36	0.07
Current Account Balance (Goods and Services)	0.33	0.31	0.93	0.31	0.02
Exports as % of GDP	0.33	0.21	0.62	0.40	0.11
Imports as % of GDP	0.33	0.28	0.83	0.33	0.04
Debt as % of GDP	0.33	0.24	0.72	0.36	0.07
Debt Service % of Exports	0.50	0.17	0.34	0.55	0.25
GDP annual Growth	0.42	0.21	0.50	0.45	0.16
International Reserves growth in US $	0.67	0.17	0.26	0.62	0.32
Reserves/Money ratio	0.25	0.24	0.97	0.30	0.01
Claims on central government (annual growth as % of broad money)	0.33	0.28	0.83	0.33	0.04
Political Crisis (Regime Change)	0.26	0.03	0.14	0.75	0.46

Source of data: author's calculation

The key measure calculated on the basis of the previous matrix is the adjusted noise-to-signal ratio that is [B/(B+D)/A/(A+C)]. The ratio provides information on the ability of the indicator to produce correct signals and to avoid false signals. The lower this ratio for an indicator, the more successful is the indicator in predicting currency crisis. If an indicator issues signals at random times, the expected value of the ratio is equal to unity. Therefore, all those variables with noise-to-signal ratio equal to or higher than unity should be removed from the analysis. Table (1) shows that the best (lowest) noise-to-signal ratio indicators are: political crisis (0.14) followed by international reserves growth (0.26), the ratio of debts to exports (0.34) and the inflation rate (0.41). None of the twelve indicator ratios exceeded the unity.

In addition, table (1) offers a measure of noisiness of indicators in terms of comparison between the probability of a crisis conditional on a signal from the indicator and the unconditional probability of a crisis. For those indicators that have good predictive power, the conditional probability would be higher than the unconditional one (the fifth and the sixth column of Table (1)). From these estimates, it is obvious that the indicators, whose conditional probability of a crisis is higher than the unconditional one, are the same ones as those whose adjusted noise-to-signal ratio is lower than unity. Political crisis (0.46), international reserves growth (0.32) and ratio of debt services to exports (0.25) are the highest scores and reserves to money ratio is the lowest score (0.01).

The results of the signaling approach analysis can serve as a base for an early warning system of currency crisis in Sudan. The early warning system should consist of the indicators which detect the disturbance very early, and emit a persistent signal within the signal horizon. Apart from international reserves growth, none of the previous indicators was able to signal all the six episodes of turbulence, each of them missed at least two episodes (see table (2)).

4.4. Explaining currency crisis in Sudan
Currency crashes in 1981 and 1985
The period 1978-1985 witnessed a series of devaluations of Sudanese currency against the US dollar culminating in currency crashes in 1981 and 1985. Regarding the first currency crash in 1981, the Sudanese pound was devalued from the rate of 1 US $ = 0.05 SD[4] in 1980 to the rate of 1 US $ = 0.09 SD. This means that the currency lost more than 80% of its value against the dollar. This currency crash was signaled by many economic indicators showing abnormal movements. Namely, the current account deficit reached 14% of GDP, imports increased to 23.7% of GDP, debt services as percentage of export was 24%, international reserves growth was negative and ratio of reserves to money supply changed by more than 40% (see table (2) and graph (A-10)).

Most of the signals of the 1981 crash were emitted by indicators related to the external sector which reflect a major problem in that sector. However, the real sector showed that the GDP growth in 1981 was 7.4%.

In 1985 currency crash, the Sudanese pound lost more than 90% of its value depreciating from the rate of 1 US $ = 0.13 SD in 1984 to the rate of 1 US $ = 0.25 SD in 1985. The crash was signaled by a large number of indicators showing abnormal movements such as inflation rate, money supply growth, debt services as percentage of export, GDP annual growth, international reserves growth and political crisis (see graph (A-10) and table (2)). These indicators belong to both financial and real sectors.

The two currency crisis in 1981 and 1985 took place when Sudan was under the Economic Recovery Programme (ERP) sponsored by the IMF and the World Bank for the period 1978-1985. The government implemented the IMF austerity measures and abandoned the "Breadbasket Strategy of Arab World". The ERP programme failed to achieve its objectives and eventually led to the collapse of the government military regime in 1985 following a popular uprise.

In fact, there has been little dispute about the limited success of the IMF programmes during the period 1978-1985. The IMF attributed the failure to poor implementation, and more specifically to 'lack of fiscal and monetary discipline and personalized nature of lending'[5]. The government blamed the decline of cotton's international prices in the early 1980s, the second oil prices' hike in the same period, and the drought of 1983-1985.Some authors argued that poor performance during the Economic Recovery Programme (ERP), if any, should be understood in the context of interrelationship between sequencing and financing of the reforms, and critical domestic and global determinants in which the programmes were applied (El Hassan (1993)). For the World Bank (1985), the implementation has been on average satisfactory.

Obviously, the IMF failed to deliver credibility to the reform programme that would have restrained speculative attacks on exchange rate, stopped capital flight and attracted SWA remittance. Moreover, the ERP programme design included concurrent trade liberalization and easing restriction on capital mobility. This led to capital flight out of the country. The period 1978-1985 witnessed the highest level of capital flight in Sudan history. According to Taylor (1991): "It resembles that of South American countries like Mexico and Argentina during the 1980s". Brown (1992) estimated a total capital flight from Sudan of about US$21 billion for the period 1978-1987, while Ali (1986), estimated a capital flight of about US$ 14 billion for the period 1978-1984.

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[4] One Sudanese Dinar (SD) is equivalent to ten Sudanese pounds (SD 1 = £.s.10).
[5] See Fanos (1987)

Table (2): Signals of Crisis Episodes

Indicator	1981	1985	1987	1991	1996	2012
Inflation	0	√	0	√	√	√
MS Growth	0	√	0	√	√	0
Current Account	√	0	0	√	√	0
Exports	0	0	√	√	√	0
Imports	√	0	0	0	0	√
Debt/GDP	0	0	0	√	√	0
Debts/Exports	√	√	√	0	0	0
GDP Growth	0	√	0	√	0	√
International Reserves growth	√	√	√	√	√	√
Reserves/Money	√	0	0	0	0	√
Claims on central government (growth as % of broad money)	0	0	0	0	0	√
Political Crisis (Regime Change)	0	√	√	0	0	√

Source of data: author's calculation

Currency crashes in 1987 and 1991
In 1987 currency crash, the Sudanese pound lost 80% of its value depreciating from the rate of 1 US $ = 0.25 SD in 1986 to the rate of 1 US $ = 0.45 SD in 1987.

The crash was signaled by some indicators such as export as percentage of GDP (declined to only 5.5% of GDP), debt service as percentage of export (increased by more than one fifth), international reserve growth (eroded by 80%) and political crisis represented by regime change from military to democratic regime.

In 1991 currency crash, the Sudanese pound lost more than 230% of its value depreciating from the rate of 1 US $ = 0.45 SD in 1990 to the rate of 1 US $ = 1.5 SD in 1991. The majority of the economic indicators signaled the crisis. In particular, inflation rate increased to 120%, money supply grew at a rate of 66.5%, current account deficit was more than 8% of GDP, exports as percentage of GDP fell to 3.3% (the lowest level for the period (1972-2012)), ratio of external debt to GDP was more than 133% and international reserves declined by one third of its previous value (see table (2) and graph (A-10)).

The period 1986-1991 was a period of political and economic instability. The period witnessed three different government systems: Military regime followed by democracy and then military regime again. Some of the IMF measures were implemented while other was reversed. In 1990, the military government introduced comprehensive price controls, import bans, and direct rationing of goods and services. The controls were enforced by harsh measures, including death penalty in case of foreign currency trading (Awad, 1992). However, in 1992 the government abandoned the centrally controlled economic system and adopted liberalization policies which are in place up to present.

Currency crash in 1996
In 1996 currency crash, the Sudanese pound lost more than 175% of its value depreciating from the rate of 1 US $ = 52.63 SD in 1995 to the rate of 1 US $ = 114.9 SD in 1996. A large number of the economic indicators signaled the crash such inflation rate (136%), money supply growth (65%), current account deficit (more than 8%), export as percentage of GDP (7.5%), ratio of debts to GDP (188%) and international reserves (decline by more than 34%).

There was adherence to liberalization policies during the period 1995-1996. However, the civil war between the North and the South escalated and foreign assistance for the country was suspended (Johnson, 2003). The government failed to control monetary expansion. In fact, there was little hope to arrest the economic decline given the background of several natural disasters, civil conflict, net outflow on the official capital account and

failure in normalising political relations with most of the countries in the Middle East, Africa and Europe. The 1996 currency crash was inevitable.

Currency crash in 2012
This currency crash followed a long tranquil period (1999-2011) in which the exchange rate stability was maintained. The crash took place in April 2012. The Sudanese pound lost more than 66% of its value depreciating from the rate of 1 US $ = 262.51 SD in 2011 to the rate of 1 US $ = 442 SD in 2012. A few months before the crash, some economic indicators showed abnormal movements. For instance, inflation rate increased from 19% in 2011 to 34 in 2012 (a change of about 79%), import as percentage of GDP increased to more than 21%, GDP growth declined by about 5%, ratio of reserves to money declined by 50%, claims on central government growth as percentage of broad money increased by more than one and half times. Besides, political crisis represented by the secession of South of Sudan.

4.5. Analyzing the causes and implications of currency crisis on Sudan
In the second section of this study we showed that there are three theoretical models explaining currency crisis namely the first, the second and the third generation models. The first generation model blames weak and inadequate macroeconomic policy for currency crisis in developing countries. The implication of this model is that currency crisis is not difficult to avoid provided that correct measures are taken to restore economic indicators to their pre-crisis levels. The second generation model refers to the doubt about government willingness to maintain the exchange rate peg and the self-fulfilling nature of the crisis. This explanation of crisis is more sophisticated than the previous one.

Both the first and the second generation models of currency crisis offer a viable explanation for currency crisis in Sudan. On the one hand, the first generation model focuses on weaknesses in economic fundamentals which is the case of Sudan. The implication of this model is that causality goes exclusively from economic fundamentals to expectations and the government has to undertake more reforms to restore internal and external equilibrium. On the other hand, the second generation models suggest that causality can run in both directions from the economy to the expectation and vice versa. The implication of this model is that since the crisis depends largely on expectations, and there is no explanation for the loss of confidence and coordination of expectations, the time of speculative attack on the local currency and the onset of a currency crisis are impossible to determine. The third generation models consider the main causes of currency crisis are banking system crisis, herd behavior and contagion effects. This interpretation is less clear in the case of currency crisis in Sudan. The banking system and the stock exchange markets in Sudan are not well developed to transmit or magnify the crisis as in the case of the emerging markets.

Looking at the causes of currency crisis in Sudan, we find that the first crash in 1981 was caused by problems in the external sector of the economy as revealed by the economic indicators. One of the key signs of the crisis was the excessive import growth as shown by graph (A-5). The problem was aggravated by overvalued exchange rate regime and adoption of foreign trade liberalization policies. This led to escalation of current account deficit. Another economic indicator of the crash in 1981 was the ratio of external debts to exports. Debt burden was a real challenge to the economy in that period. The problem was aggravated by easy accessible international loans during that period. Availability of external finance explains the weak and insufficient internal finance mobilization and the lack of government expenditure and tax reforms.

In 1985 currency crash, the economic crisis was deepened and transmitted from the external sector to the real sector resulting in a negative economic growth rate. Further, exports declined and inflation increased. The economic crisis was followed by political crisis leading to regime change in 1985. External shocks such as drought and decline in export commodity prices exacerbated the economic situation. Economic policy intervention failed to restore internal and external balances in that period.

After 1985 currency crash there was a political breakthrough and an elected government took power. However, political change was not accompanied by an economic change due to the failure of the new government in adopting austerity measures. Consequently, the local currency crashed again in 1987 followed by government collapse in 1989 and a military ruler resumed power[6]. This suggests that political reform does not always indicates economic reform. Economic failure in 1989 led to a military government that sought restoring economic

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[6]This is the current government of Sudan (1989-2012).

balances through security forces and full government control of the economy. However, this led to the biggest currency crash in the recent history of Sudan and the local currency lost more than 230% of its value in 1991. The government abandoned these policies and adopted liberalization policies in 1992 which is still in place in 2012. The policy implication from this is that control measures, restriction and over-involvement of the government in economic activity did not solve economic problems but aggravated them. For instance, export competitiveness of the Sudanese commodities was almost completely lost during that period. The export as percentage of GDP declined to all times record low registering merely 3.3% of GDP in 1991.

The Sudanese government adopted liberalization policies in 1992. At the beginning, success of these policies was limited. In fact, economic liberalization led to surge in domestic price level, rise in import volume, increase in balance of payments deficit and decline in foreign reserves. This led to currency crash in 1996. After, that the economy began to readjust and respond to economic reforms that included both stabilization and adjustment policies. The final result was restoration of internal and external balances following two decades of decline. By the end of 1990s, the liberalization reforms succeeded in achieving economic stabilization until 2011.

In 2012 currency crash, warning signals of upcoming crisis were sent by many indicators even before South Sudan secession in July 2011, for instance, excessive import growth, decline in external reserves in addition to the effect of global recession. These indicators showed that the economy was on the verge of a currency crash even if the South did secede. After secession, the government lost about 75% of its revenues. Consequently, the currency crash was not avoidable.

5. Conclusions

The study investigates the numerous incidents in which the Sudanese pound crashed against other currency. It employed the Foreign Exchange Market Pressure Index (FEMPI) to identify the most import episodes of currency crisis during the period 1972-2012.On this basis, six episodes of currency crisis in Sudan were identified namely in 1981, 1985, 1987, 1991, 1996 and 2012.The study analyzed the behaviors of some economic indicators that served as an early warning system for currency crisis occurrence. These indicators revealed the causes of crises and their economic repercussions.

The study has shown that the best theoretical models to explain the currency crisis in Sudan are the first generation models. Accordingly, the currency crisis in Sudan is caused by inadequate economic policy in the first place. Also, the study demonstrates that the crisis in Sudan begins in the external sector and transmits to the real sector and the production sectors and finally transforms into political crisis. Further, it is shown that the Sudanese governments adopted different types of economic policies during the period (1972-2012) ranging from centrally planned to free market economic systems. However, the best economic performance was achieved though the liberalization policies. Moreover, the economic reforms under the IM/World Bank supervision was not successful due to economic and non-economic factors.

The study identified he most important indicators that can predict currency crisis in Sudan. These are Inflation rate, money supply growth, current account balance, exports, imports, external debts, debt services as percentage of exports, GDP annual growth rate, international reserves, reserves to money ratio, claims on central government and political crisis (Regime Change).The most powerful predictors of the currency crisis in Sudan are international reserves, political crisis, ratio of debt services to exports and inflation.
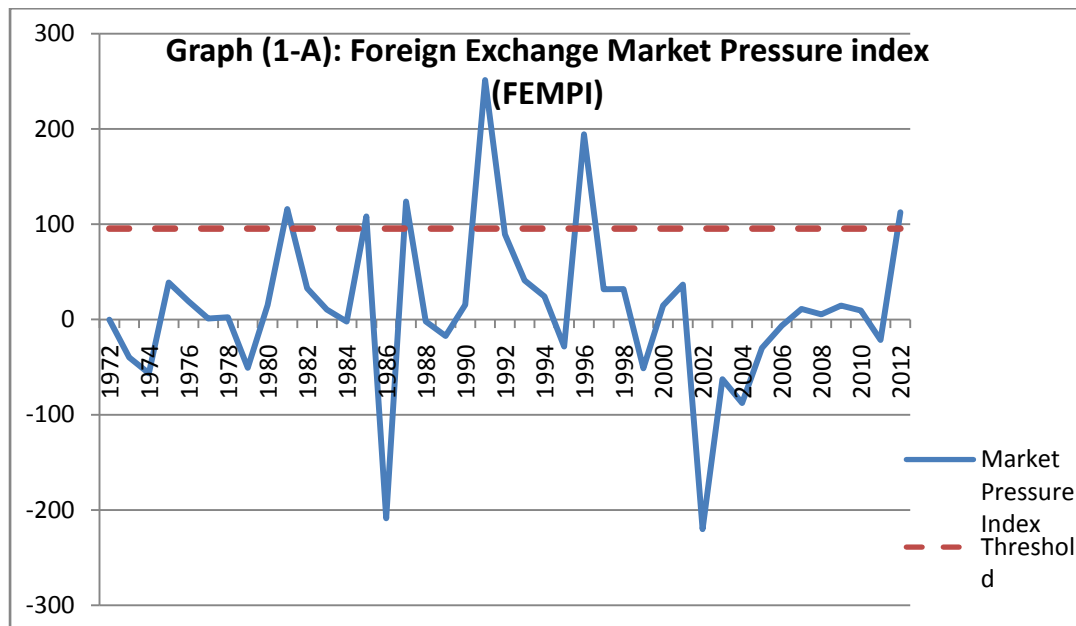
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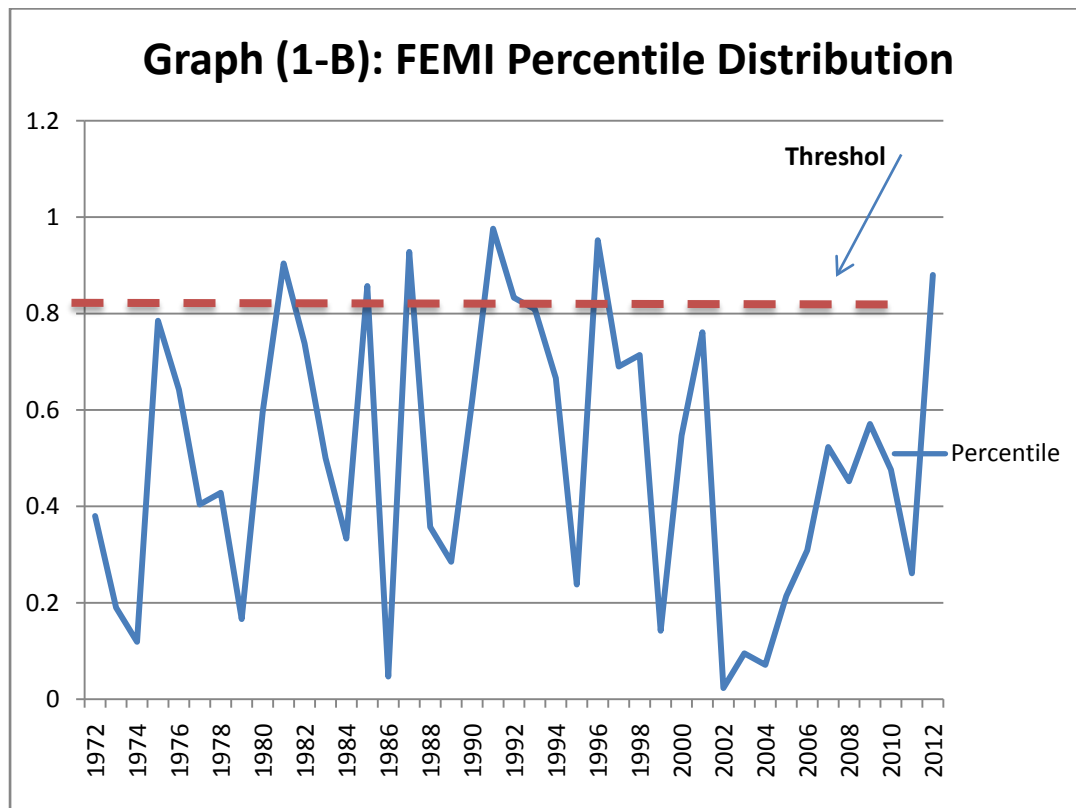   Approach*", Hrvatskanarodnabanka, mimeo*.

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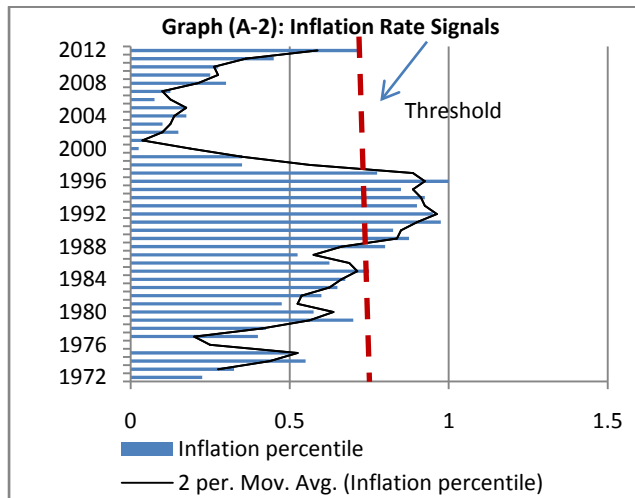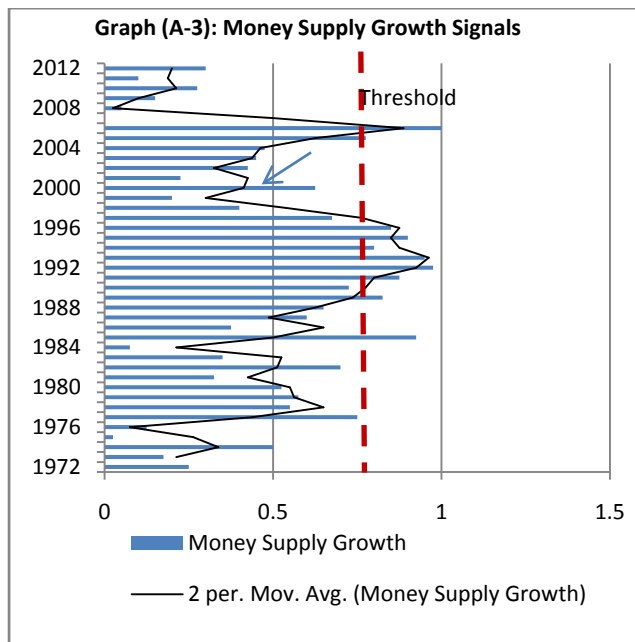World Bank. *African Economic Indicators*, Washington, D.C: World Bank.

Appendix
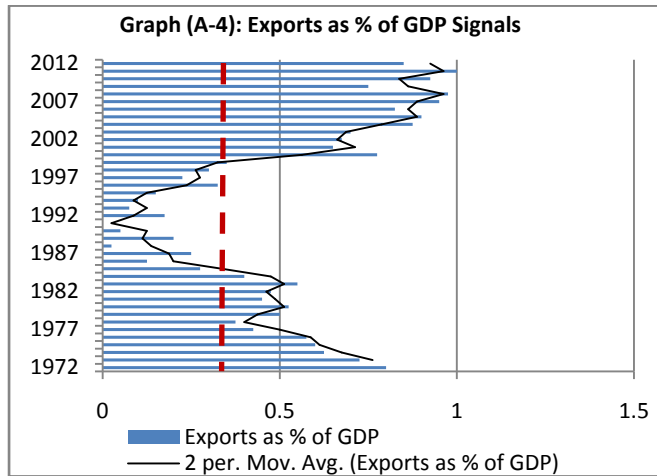

Source of data: Author's calculation

Source of data: Author's calculation

Graph (A-2): Inflation Rate Signals

Threshold

- Inflation percentile
- 2 per. Mov. Avg. (Inflation percentile)

Source of data: CBOS annual report, different issues

Graph (A-3): Money Supply Growth Signals

Threshold

- Money Supply Growth
- 2 per. Mov. Avg. (Money Supply Growth)

Source of data: CBOS annual report, different issues

Graph (A-4): Exports as % of GDP Signals

Source of Data: WDI

Graph (A-5): Imports as % of GDP Signals

Source of Data: WDI

Graph (A-6): Debt Service % of Export Signals

Source of Data: WDI

Graph (A-7): GDP Annual Growth Rate Signals

Source of data: CBOS Annual Report, Different Issues

Graph (A-8): International Reserves growth Signals
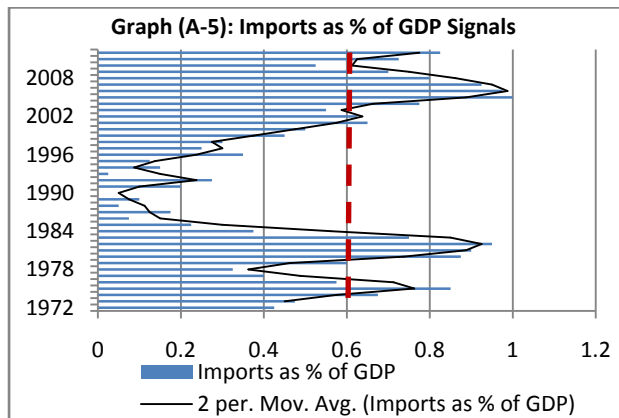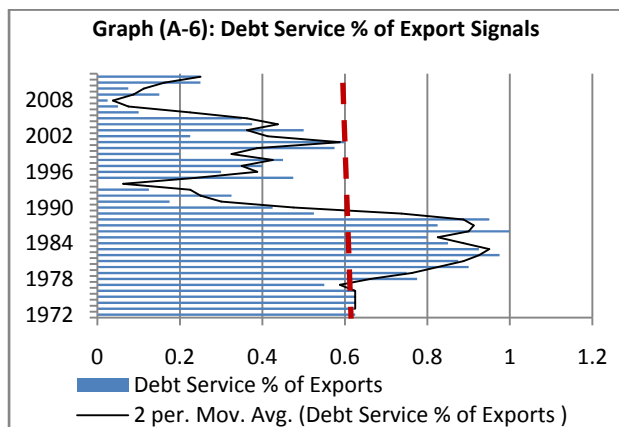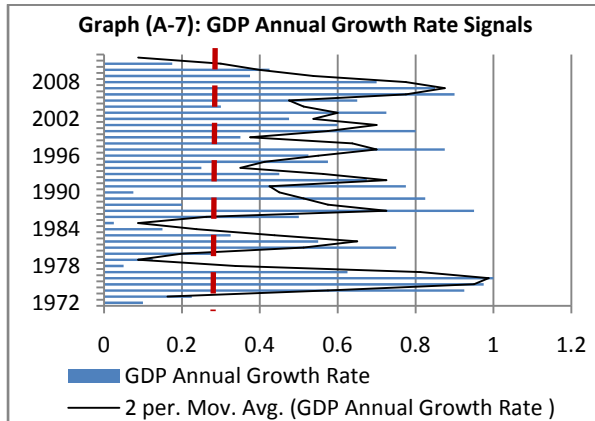
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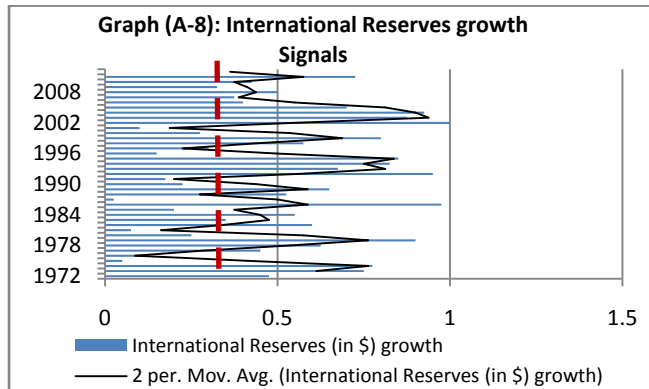
Gragh (A-9): Political Crisis Signals
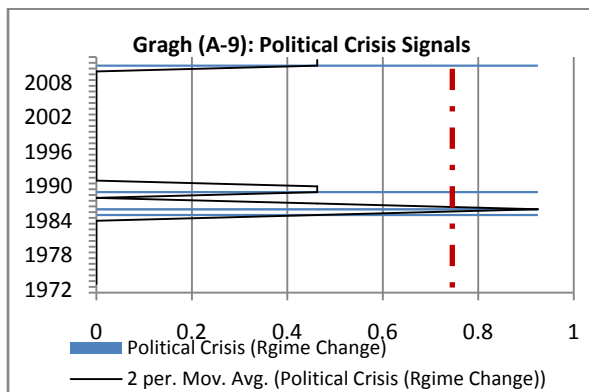
Source of data: Johnson (2003)

Graph (A-10): Signals of Different Indicators

Source of data: author's calculation