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Abstract

This paper uses an error-correction model to examine the dynamic of the currency substitution phenomenon (CS) in two of Africa's emerging economies: Egypt and South Africa. The study also assesses the causal relationships of this phenomenon. There are three main CS- related differences between Egypt and South Africa. These are: (i) the orientation of economic policy and the instrument used, (ii) the degree and level of CS, and (iii) the direction or trend of CS. During the study period 1991-2001, Egypt used the exchange rate as an anchor to its economic stabilization program. While in the case of South Africa, the monetary authorities directly targeted inflation by controlling the growth of money. During the same period, CS in Egypt started with a very high level (51% of M2 was in the form of foreign currency deposits) and experienced a steady decline till it reached less than 20% in 1999. On the contrary, CS in South Africa was less than half a percentage point in 1991 and observed a significant and uninterrupted increase till it passed the 6% mark in 2001. The results of the error-correction model suggest that the elasticity of CS, with respect to exchange rate, of South Africa is 2.3 times that of Egypt, and that the speed of adjustment in South Africa is 5 times faster than in Egypt. The results of the Granger-causality tests between the exchange rate and CS, in both Egypt and South Africa, agree that there is a unidirectional Granger-causal relationship from the exchange rate to CS. However, the tests between the interest rate differential and CS indicate that while the causality runs in one direction from the interest rate differential to CS in the case of South Africa, it runs in the opposite direction in the case of Egypt. The implication of these results is that the policy of exchange rate anchoring is more suitable to a high CS environment, and more effective in reducing the rate of substitution. However, this policy is not free of costs. As for the inflation targeting policy, the implication is that the policy can be effective in achieving its objective as long as the CS is insignificant. In an environment of High CS, monetary authorities should consider switching to the exchange rate anchoring policy.

Résumé

Cet article utilise un modèle de correction des erreurs pour examiner la dynamique du phénomène de substitution monétaire dans deux économies émergentes d'Afrique: l'Égypte et l'Afrique du Sud. Il examine également les liens de causalité propres à ce phénomène. S'agissant de la substitution monétaire, trois différences distinguent l'Égypte et l'Afrique du Sud. Ce sont : (i) l'orientation de la politique économique et l'instrument utilisé, (ii) le degré et le niveau de la substitution monétaire, et (iii) la direction ou tendance de la substitution monétaire. Au cours de la période étudiée (1991-2001), si l'Égypte a utilisé les taux de change pour ancrer son programme de stabilisation économique, en Afrique du Sud, les autorités monétaires ont préféré cibler directement l'inflation par une maîtrise de la croissance monétaire. Au cours de la même période, la substitution monétaire en l'Égypte a démarré à un niveau très élevé (51% de M2 sous la forme de dépôts en devises) avant de décliner régulièrement pour passer sous la barre des 20% en 1999. En Afrique du Sud, par contre, la substitution monétaire représentait moins d'un demi point de pourcentage en 1991 et a enregistré une augmentation substantielle et non interrompue jusqu'à plus de 6% en 2001. Les résultats du modèle de correction des erreurs suggèrent que, en ce qui concerne le taux de change, l'élasticité de la substitution monétaire en l'Afrique du Sud est 2,3 fois celle de l'Égypte et que la vitesse d'ajustement de l'Afrique du Sud est 5 fois plus grande que celle de l'Égypte. Selon les résultats des tests de causalité de Granger entre le taux de change et la substitution monétaire, en Égypte et en Afrique du Sud, il existe un lien de causalité unidirectionnel entre taux de change et substitution monétaire. Cependant, les tests entre le différentiel de taux d'intérêt et la substitution monétaire indiquent que si la causalité va dans un sens dans le cas de l'Afrique du Sud, c'est à dire du différentiel de taux d'intérêt vers la substitution monétaire, elle va dans le sens opposé dans le cas de l'Égypte. Ceci implique que la politique de l'ancrage par les taux de change convient mieux à un environnement de substitution monétaire forte et est plus propice à une réduction effective du taux de substitution. Cependant, cette politique a un coût. S'agissant de la politique qui cible l'inflation, on doit déduire qu'elle peut effectivement atteindre son objectif si le taux de substitution monétaire est peu important. Dans un environnement de substitution monétaire forte, les autorités monétaires devraient envisager de passer à la politique d'ancrage des taux de change.

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I. Introduction

In a large number of emerging and developing economies local currencies do not adequately fulfil the functions of money. Therefore, local residents tend to hold foreign currency-denominated deposits at domestic banks in addition to their local currency deposits. The degree at which a foreign currency takes the role of the local currency reflects the extent of the prevalence of the phenomenon of dollarization or currency substitution: from the extreme case of full dollarization to partial dollarization or some degree of currency substitution. On the one hand, under full dollarization, a foreign currency, such as the dollar, is used as a legal tender instead of the local currency and, consequently, the monetary authorities lose its functions.[1] On the other hand, under partial dollarization, local currency is partially substituted by a foreign currency and, therefore, erodes the control of the monetary authorities over its aggregates. The latter describes a situation where the demand for foreign exchange by local residents is no longer tied to foreign trade and transactions requirements but used instead as a store of value and even as the local medium of exchange.

The policy implications of partial dollarization or currency substitution are far-reaching and extend beyond the monetary variables. Tanzi and Belejer (1982) argue that governments that resort to financing their deficits through inflation force their people to respond to the expected inflation by reducing their holdings of domestic currency and the substitution of foreign currencies for the domestic ones. This substitution often leads to balance of payments deficits and/or depreciation and to the reduction of domestic real balances and the erosion of the potential transfer of purchasing power to the government. Brillembourg and Schadler (1979) and Fasano-Filho (1986) add the argument that as residents shift away from holding local currencies, the component over which domestic monetary authorities usually exercise control shrinks, as does its capacity to influence local monetary developments. On the other hand, others have raised the possibility of positive effects of a reversed currency substitution process. Ramirez-Rojas (1985) argues that improvements in the macroeconomic environment that gave rise to the original currency substitution phenomenon could trigger a reverse substitution. Local residents could repatriate their holdings of foreign currencies and significantly increase their demand for money to allow the government to increase the supply of money with little or no impact on inflation.

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However, the literature is generally noncommittal on the direction of causation between exchange rate instability and currency substitution. Batten and Hafer (1986) consider currency substitution in an attempt to explain US inflation under the flexible exchange rate regime of the 1970's and early 1980's. Their implied direction of causation is from exchange rate instability to currency substitution. Earlier, Miles (1978) had implied the same causal relationship in his study on the influence of currency substitution on money demand in Canada. El-Erian (1988) points to foreign exchange changes as the main explanatory factor for the instability of the demand for domestic currency in Egypt and Yemen. However, Griton and Roper (1981), using a theoretical framework, had found that currency substitution could produce exchange rate instability. More recently, Berg and Borensztein (2000a) suggest that currency substitution tends to increase exchange rate volatility. The literature also suggests that the relationship between currency substitution and exchange rate instability depends on the policy orientation (inflation targeting or exchange rate-based stabilization). Giovannini and Turtrlboom (1994) and McKinnon (1996) are more inclined to adopt a fixed exchange rate policy in a volatile economic environment and high currency substitution. However, none of the previous studies has validated the implied direction of causality between exchange rate instability and currency substitution by specific empirical assessment.

The objective of this paper is to determine whether the choice of the policy instrument has an impact on the process of currency substitution and its speed of adjustment and whether it has an impact on the direction of causality between currency substitution and exchange rate instability. The paper examines the short and long-term dynamic of currency substitution and tests for the direction of causality in two African emerging economies with two different policy orientations. The two countries, Egypt and South Africa, are implementing stabilization programs but with different instruments. While Egypt uses the exchange rate as an anchor to its program, South Africa targets inflation by controlling the growth of money. The main implication of this paper is that exchange rate anchoring policy is effective in reversing the direction of substitution in an environment of high CS. However, the reversal of CS is not free of costs. As for the inflation targeting policy, the implication is that the policy can be effective in achieving its objective as long as the CS is insignificant. However, in a high CS environment, monetary authorities should consider switching to the exchange rate anchoring policy.

The paper is organized into 5 sections. Section 2 reviews the process of currency substitution in Egypt and South Africa. Section 3 briefly presents the theoretical framework of currency substitution, and uses an error-correction mechanism to estimate it in the two countries. The assessment of the direction of causality between exchange rate instability and currency substitution is presented in Section 4. The paper finishes with some concluding remarks.

II. Currency Substitution in Egypt and South Africa

Currency substitution (CS) can be defined as the demand for foreign fiat money by domestic residents. This demand can be either for foreign cash money or for foreign currency deposits held in domestic banks or abroad. There are three major difficulties associated with measuring CS using available statistical data. Firstly, it is difficult to estimate the foreign cash held by domestic residents. Secondly, it is not always possible to determine if the deposits in domestic banks are held by foreigners or by domestic residents. Thirdly, it is not possible to track deposits held abroad by domestic residents. The only source of measurable data is the foreign currency deposits in domestic financial institutions, which are held mostly by domestic residents. The quantitative importance of the above three shortcomings is not easy to estimate. Therefore, one has to keep in mind that misspecification is possible and it is more likely that the measured CS underestimates the actual magnitudes.

Both Egypt and South Africa allow their residents to hold foreign currency deposits in commercial financial institutions. Therefore, in both countries CS is calculated as the ratio of foreign deposit in the financial institutions relative to money supply (M2). The two countries pursue tight monetary policies aiming at stabilizing the economy and reducing inflation rates. However, the policy orientation and instrument is different in each country. Egypt's policy focuses on the exchange rate and uses it as the anchor for its economic program. The monetary authorities occasionally intervene in the market to maintain the exchange rate within the bands specified by the policy. On the other hand, South Africa's monetary authorities directly target the inflation rate, through its control over the liquidity in the economy, and let the market freely determine the exchange rates.[2]

Table 1: Currency Substitution, Exchange Rate, and Interest Rate in Egypt and South Africa

	EGYPT				SOUTH AFRICA			
	Currency	Exchange Rate[2]		Interest	Currency	Exchange Rate[2]		Interest
Year	Substitution[1]	Level	% Ch.	Rate[3]	Substitution[1]	Level	% Ch.	Rate[3]
1991	50.19	3.065	97.75	11.16	0.35	2.770	6.92	11.8
1992	39.14	3.323	8.42	14.08	0.32	2.863	3.37	12.7
1993	29.27	3.354	0.93	12.30	0.43	3.281	14.58	10.2
1994	27.01	3.387	0.97	9.37	0.54	3.549	8.18	8.4
1995	27.83	3.392	0.15	7.64	0.64	3.629	2.25	9.1
1996	25.61	3.391	-0.01	7.31	1.61	4.337	19.49	11.3
1997	21.93	3.389	-0.07	5.35	2.50	4.619	6.51	11.6
1998	20.20	3.388	-0.02	4.66	3.84	5.552	20.19	13.4
1999	19.72	3.396	0.23	4.97	5.20	6.123	10.30	10.0
2000	22.35	3.489	2.74	3.98	4.84	6.985	14.07	5.3
2001[4]	26.68	3.843	10.17	5.59	6.16	7.953	13.86	6.4

1. Currency Substitution = foreign currency deposits in commercial financial institutions over money supply (M2).
2. Number of units of local currency per one dollar.
3. Interest rate differential = domestic interest rate – interest rate on the dollar.
4. Average of the first half of 2001.

Sources: - International Monetary Fund, International Financial Statistics, CD-Rom November 2001.
- Web Site of South African Reserve Bank (www.resbank.co.za).

Three studies analysed the phenomenon of CS in Egypt. El-Erian (1988) indicated that domestic demand for foreign currency holding is sensitive to the expected real returns to holding them, inflationary pressures, and expectation of exchange rate depreciation. Hussain (1997) found that in conditions of high CS, real interest rate is not the most important financial liberalization instrument. More recently, Alami (2000) suggested that residents in Egypt hold foreign currency deposits as a store of value rather than as a medium of exchange. These studies were triggered by the magnitude of CS in Egypt in the 1980s. CS reached its peak in 1991, with more than 50% of M2 was in the form of foreign currency deposits in the commercial financial institutions (Table 1). However, after the complete liberalization of the interest and exchange markets in 1990 and the implementation of tight monetary and fiscal policies, CS started to reverse in 1992 and continued to declined, till it reached less than 20% in 1999. This reversal of CS was influenced by a large interest rate differential between Egyptian pound and dollar denominated assets, which reached more than 14% in 1992. Reverse CS continued even after the narrowing of the interest differential during the period 1993-1999. This period observed significant fiscal adjustment, stability of the exchange rate (the anchor of the policy), large capital inflows, and improvement in investor sentiment. However, in the last two years, 2000-2001, CS has shown some increase despite the increase in interest rate differential. This could be explained by the international and domestic economic slow down, and the decline in capital inflows.

Contrary to Egypt, CS in South Africa did not draw the attention of researchers, most likely because of the fact that this phenomenon was not significant in the South African Economy. However, in the last seven years, the share of foreign currency deposits in M2 has increased ten times (Table 1). In the first half of the 1990s less than 1% of the money supply was in foreign currency deposits. The main factor behind this insignificant share is the international sanctions in the period 1985-1995 and the extensive capital control, which the government imposed during this period.[3] After the collapse of the apartheid regime and the lifting of the sanctions in 1995, the authorities have further liberalized the economy and followed the policy of inflation targeting and not intervening in the foreign exchange market. CS increased from 0.6% in 1995 to 6.2% in 2001. It seems, however, that the turbulences in the foreign exchange and money markets in mid-1998 have further accelerated CS in South Africa. In the two years 1998-1999 alone, CS more than doubled to reach 5.2%. At the same time, the exchange rate of the rand to the dollar depreciated by more than 30%. This happened despite the 13% interest differential observed in 1998. In the last two years, 2000-2001, while the interest rate differential shrank by almost half, CS continued to rise and the rand continued to depreciate.

The previous discussion reveals the importance of CS in Egypt and South Africa. While in Egypt this phenomenon represents almost 25% of the supply of money in the economy, CS is consistently on the rise in South Africa. A substantial increase in this phenomenon in South Africa could hamper the effectiveness of the inflation targeting policy pursued by the authorities. In the following section, a simple model uses an error correction mechanism is used to estimate the short-term and long-term dynamics of CS in both Egypt and South Africa.

III. Estimation of Currency Substitution

The model applied here follows Pool’s (1970) framework, which was the base for a number of CS studies in several countries (see, for example, Calvo and Rodriguez (1977), Miles (1978), Bilson (1979), and El-Erian (1988), Rogers (1992) and Berg and Borensztein (2000a)). There is general agreement that this model provides an adequate representation of the CS process, however it does not explain the direction of causality between CS and exchange rate instability (this is the subject of the following section). The model is based on two separate underlying money demand functions for domestic and foreign currency denominated balances, each of which includes relevant transaction demand variables and variables for measuring the opportunity cost of holding money. The reduced form of the model describes the demand for foreign balances relative to domestic balances as a function of the differential return to the two holdings. However, in dynamic and often unstable economic environment interest rate parity conditions are not usually satisfied. Under these circumstances the estimated coefficient of the interest rates differential will be insignificant and its impact will be picked up by the changes in the exchange rate. A general reduced form of the model can be written as follows:

$$(1) \quad \ln CS_t = \alpha_1 + \alpha_2 * \ln X_t + \alpha_3 * ID_t + e_t$$

where

- CS = Currency Substitution or the share of nominal foreign currency in money supply (M2).
- X = nominal exchange rate measured by the number of units of local currency per one unit of foreign currency (dollar).
- ID = interest rate differential or the difference between the interest rate on local currency and that on the dollar.
- e = residual

This specification, however does not take into consideration the fact that the variables involved could be non-stationary. In this situation the estimates of the equation will be misleading. To address this issue and test for the long-run relationship between these variables, Engle and Granger (1987) suggest that one should test for the stationarity of each variable and for the cointegration of the group as a whole.[4] Engle and granger indicate that: (a) if the variables in equation (1) are all first order non-stationary, that is they are non-stationary in level but stationary in first difference, then they are integrated of order 1, i.e. I(1); and (b) if the residual series in equation (1) is stationary (i.e. integrated of order I(0)), then the variables are cointegrated and there exists a long-run relationship which could represent them. In other words, cointegration could exist when, despite the variables in equation (1) being individually non-stationary, there exists some linear combination that produces a stationary, I(0), residual series. Hence, long-term relationship of the cointegrated group can be represented by equation (1) and the short-term relationship can be represented by an error-correction mechanism as follows:

$$(2) \quad \Delta \ln CS_t = b_1 + b_2 * \Delta \ln CS_{t-1} + b_3 * \Delta \ln X_t + b_4 * \Delta ID_t + b_5 * e_{t-1} + u_t$$

Where Δ is the change in the value of the variable from period t-1 to period t.
Solving equation (1) for e_{t-1} and substituting the result into equation (2) we end up with

$$(3) \quad \ln CS_t = c_1 + c_2 * \ln CS_{t-1} + c_3 * \ln CS_{t-2} + c_4 * \ln X_t + c_5 * \ln X_{t-1} + c_6 * ID_t + c_7 * ID_{t-1} + u_t$$

Equation (3) will be used to estimate CS in Egypt and South Africa. Actually, the equation is a special case of the partial adjustment model, where the sum of c_2 and c_3 reflects the speed of adjustment from the short term situation, or actual holdings of foreign currency relative to total money, to the long-term equilibrium, or the desired holdings, in response to changes in the exchange rate or changes in interest rate differential.

Before we turn to the estimation of equation (3), we will discuss the results of the unit root tests of the three variables in equation (1), and the result of the unit root test of its the residual series. The first set of tests is required for the assessment of the stationarity of each variable and the last test is a test for the cointegartion of all the variables as a group.

Table 2 shows the unit root test for CS, X and ID for both Egypt and South Africa. The results of the tests with an intercept and trend indicate that all the variables are non-stationary in levels but stationary in the first-differences, that is they are all integrated of order 1 or I(1). The results of the tests with no intercept or trend also support the same conclusion, with only two exceptions: CS for Egypt and X for South Africa. Table 3 presents the results of the cointegration test for the three variables as a group, as well as the cointegration test for CS and X as a group. This test simply examines the stationarity of the residual of equation (1), or the order of integration of this residual. The upper half of Table 3 indicates that the residual of a regression equation with

Table 2: Unit Root Tests for Variables Stationarity*

	ADF Statistic			5%
	CS	**X**	**ID**	***Critical Value***
EGYPT				
Levels				
No Intercept or Trend	-3.16	1.36	-1.23	*-1.94*
With Intercept and Trend	-2.98	-0.03	-1.31	*-3.45*
First Differences				
No Intercept or Trend	-2.30	-3.80	-4.95	*-1.94*
With Intercept and Trend	-4.57	-4.40	-5.01	*-3.45*
SOUTH AFRICA				
Levels				
No Intercept or Trend	1.83	3.13	-0.93	*-1.94*
With Intercept and Trend	-2.08	-1.61	-2.42	*-3.45*
First Differences				
No Intercept or Trend	-6.07	-6.22	-5.53	*-1.94*
With Intercept and Trend	-6.52	-7.97	-5.52	*-3.45*

* All tests used monthly data from 1991:07 to 2001:07, and included 2 lags.
Data sources: same as Table 1.

all three variables (CS, X and ID) is stationary in levels, i.e. integrated of order I(0), in both Egypt and South Africa. Therefore one can conclude that CS, ln X and ID are cointegrated in both Egypt and South Africa. The lower half of Table 3 suggests a similar result for the cointegration of the two variables CS and X. The results presented in Table 2 and Table 3 suggest that all the variables involved are non stationary in levels but stationary in the first differences, and that they are cointegrated, therefore the short-run and long-run relationships of theses variables can be represented and estimated by an error-correction mechanism similar to equation (3).

Table 3: Unit Root Tests for Cointegration of Variables*

	ADF Statistic	*5% Critical Value*
Test on the residual series of: $ln\ CS_t = a_1 + a_2 * ln\ X_t + a_3 * ID_t$		
EGYPT		
Levels		
No Intercept or Trend	-3.88	*-1.94*
With Intercept and Trend	-4.06	*-3.45*
SOUTH AFRICA		
Levels		
No Intercept or Trend	-4.65	*-1.94*
With Intercept and Trend	-4.63	*-3.45*
Test on the residual series of: $ln\ CS_t = a_1 + a_2 * ln\ X_t$		
EGYPT		
Levels		
No Intercept or Trend	-2.45	*-1.94*
With Intercept and Trend	-0.37	*-3.45*
SOUTH AFRICA		
Levels		
No Intercept or Trend	-2.98	*-1.94*
With Intercept and Trend	-2.93	*-3.45*

* All tests used monthly data from 1991:07 to 2001:07, and included 2 lags.

We now turn to the estimation and assessment of the CS phenomenon in Egypt and South Africa. Regression equations 4.1 and 4.3 in Table 4 present the estimation of the full error-correction model, as specified in equation (3), for both Egypt and South Africa. The estimation is based on monthly data for the period 1991:07 – 2001:07. The coefficients of interest rate differential (ID) in equations 4.1 and 4.3 are insignificant, and with the wrong sign in the case of Egypt. It seems that this is the result of the deviation form the interest rate parity conditions, as indicated above. Therefore, Equations 4.2 and 4.4 drop the interest rate differential and its lag from the model. The two equations also drop the lag of the exchange rate (ln X), as this improves the overall quality of the estimation with no significant change in the information provided by the model.

In the case of Egypt, the result of equation 4.2 indicates that changes in the exchange rate have a significant impact on CS. The coefficient of the exchange rate suggests a short-term elasticity of 0.14, meaning that 10% depreciation in the Egyptian pound will lead to 1.4% increase in CS.[5] The dynamic of the model implies a very slow adjustment process. The sum of the coefficients of the lagged dependent variable means that only 2% of the discrepancy between desired and actual holdings of foreign currencies is eliminated within one month.[6] In other words, the long term desired holding of foreign currencies, in response to a change in exchange rate, will approach its level in about four years, assuming every thing else constant. This slow adjustment process implies a very high long-term elasticity (CS with respect of exchange rate) of about 7. However, in a dynamic environment, and with such a long adjustment period and many other factors in action, one would not expect the long-term elasticity to reach this high level. What is important from the

Table 4: Estimation of Currency Substitution in Egypt and South Africa*

Equation	C	CS(-1)	CS(-2)	ln X	ln X(-1)	ID	ID(-1)	Adj. R^2	F-Stat	D-W
EGYPT										
4.1	-0.025	1.265	-0.279	1.019	-0.961	-0.002	0.001	0.997	7180	2.050
	(-0.43)	(15.45)	(-3.34)	(4.61)	(-4.11)	(-0.58)	(0.31)			
4.2	-0.108	1.295	-0.315	0.140				0.997	12677	1.950
	(-1.91)	(15.72)	(-3.90)	(3.31)						
SOUTH AFRICA										
4.3	-1.050	0.864	-0.044	-0.022	0.674	0.001	0.015	0.984	1230	1.988
	(-3.35)	(9.32)	(-0.47)	(-0.04)	(1.21)	(0.07)	(0.63)			
4.4	-0.420	0.925	-0.022	0.319				0.983	2346	2.015
	(-1.99)	(10.02)	(-0.24)	(2.12)						

* Estimation is based on monthly data from 1991:07 to 2001:07. AR(1) is a first order auto-regressive mechanism to Correct for auto-correlation, and D-W is the Durbin-Watson Statistics. t-statistics are in parenthesis.

policy-making point of view is the estimated short-term elasticity. The result for South Africa, as reflected equation 4.4, indicates that CS is more responsive to changes in exchange rates than it is in Egypt. The coefficient of X suggests a short-term elasticity of CS with respect to the exchange rate of 0.32. This means that 10% depreciation in the South African rand will result in 3.2% increase in CS. This elasticity is 2.3 times that of Egypt. The adjustment process is also 5 times faster than that of Egypt. The sum of the coefficients of the lagged dependent variable suggests that the discrepancy between the desired and actual holdings of foreign currencies is reduced by 9.7% within one month, or the long run equilibrium approaches its level in about 10 months. The dynamic of the model indicates a long-term elasticity of 3.29.

It is important that one puts these results in the context of the economic policy implemented in Egypt and South Africa. It seems that the difference in the policy orientation in the two countries is a major factor behind the results discussed above. As indicated earlier, Egypt's monetary policy focuses on the exchange rate and uses it as an anchor to its stabilization program, and therefore the authorities occasionally intervene in the market to maintain the exchange rate within the targeted bands. As for South Africa, the monetary authorities target inflation through its control over the liquidity in the economy. It appears that the impact of each policy on CS comes through the interaction between the interest rate and exchange rate. In the case of Egypt, the authorities use the interest rate differential to partially maintain the required exchange rate, and by doing so they were able to reverse the CS in 1990s (Table 1), reduce the impact of the exchange rate on CS, and slow its adjustment process. However, this policy is not cost-free. The cost is either bared by the reserve of the central bank reserve, or transferred to the fiscal side, (the cost of maintaining a large interest rate differential). There is also the additional cost associated with the reduction in GDP as a result of high interest rate. As for South Africa, the policy is to allow the interest rate to change in accordance with the inflation target, and to allow the market to freely determined the exchange rate. This resulted in noticeable fluctuations in the interest rate and steady depreciation of the rand during the study period (Table 1). The two factors combined can induce further increase in CS, which may reduce the influence of monetary authorities over the domestic monetary developments (as indicated by Fasano-Filho (1986)), and consequently reduce the effectiveness of the inflation targeting policy. The other factors that could explain the variance between the result of Egypt and that of South Africa is the level and trend of CS in each country. During the study period, Egypt experienced reverse CS, where it declined from 51% in 1991 to less than 20% in 1999. On the contrary, in South Africa CS started at the minimal level of 0.35% in 1991 and observed a significant and uninterrupted increase up to 6.2% in 2001. This suggests asymmetric elasticity of CS, with respect to exchange rate, both in value and speed of adjustment, implying that policies aiming at reverse CS may require persistent and substantial policy measures for a long period of time. To further investigate the phenomenon of CS the following section will test the pair-wise direction of causality between the CS, exchange rate and interest rate differential.

IV. Direction of Causality

The causality between CS and changes in the exchange rate has not drawn much of the attention of the literature. It was always implicitly assumed that causality runs from exchange rate (replacing either the interest rate differential or the ratio of inflation of the two countries involved) to CS. The following analysis formally assesses the direction of causality between CS, exchange rate and interest rate differential. The causality test applied here is based on Granger (1969), where he provided the following definition: a time series X_t causes another time series Y_t if the present value of Y_t can be predicted better by using U including X_t than using U excluding X_t, where U is the set of all past and present information.[7] Practically, this means that X_t Granger-causes Y_t if X_t helps in the prediction of Y_t, or the coefficients of the lagged Xs are significant (in a equation with Y on the left hand side, and lagged Ys and Xs on the right hand side). Therefore, Granger-causality can be assessed by an F test where the unrestricted equation includes lagged Ys and lagged Xs, and the restricted equation includes only lagged Ys and drops lagged Xs. The null hypothesis is that X does not Granger-cause Y, or the coefficients of lagged Xs, as a group, are not significantly different from zero. If the calculated F is significant, then the coefficients of the lagged Xs are statistically significant and the null hypothesis is rejected. However, one should keep in mind, as argued by Harvey (1990), that "causality" is too strong a word. Granger-causality should only be considered as purely a statistical notion and not give it a philosophical dimension. Rather, it should be limited to the narrow concept of predictability and sequentiality.

Table 5 presents the result of the pair-wise Granger causality tests for CS, exchange rate and interest rate differential. The statistical significance of the F-tests indicate that: (i) Causality is unidirectional from X (exchange rate) to CS (X Granger-causes CS but CS does not Granger-cause X) in both Egypt and South Africa; (ii) causality is a unidirectional from CS to interest rate differential (ID) in the case of Egypt and the opposite in the case of south Africa; and (iii) causality is a unidirectional from ID to X in the case of South Africa and no causal relationship between ID and X in the Case of Egypt. It is clear that in both Egypt and South Africa changes in the exchange rates lead changes in CS. However the interaction between interest rates and exchange rates and between interest rates and CS differ in the two countries.

In Egypt, changes in exchange rates lead changes in CS but also changes in CS lead changes in interest rate differentials. This suggests that in the case of currency depreciation, due to current account deficit for example, local residents will tend to increase their holdings of foreign currency

Table 5: Granger Causality Tests*

	F-Statistics	Probability
EGYPT		
CS does not Granger Cause X	1.68	0.131
X does not Granger Cause CS	2.88	0.012
CS does not Granger Cause ID	5.74	0.00003
ID does not Granger Cause CS	0.39	0.885
X does not Granger Cause ID	1.37	0.231
ID does not Granger Cause X	0.27	0.950
SOUTH AFRICA		
CS does not Granger Cause X	0.32	0.925
X does not Granger Cause CS	5.27	0.00009
CS does not Granger Cause ID	0.55	0.768
ID does not Granger Cause CS	2.93	0.011
X does not Granger Cause ID	1.73	0.122
ID does not Granger Cause X	3.87	0.002

* The tests used monthly data from 1991:07 to 2001:07, and 6 lags. Tests with 2, 3, 4 and 5 lags were also applied and produced results consistent with these reported here.

deposits. The authorities will attempt to counter balance this by tightening the supply of money and raising the domestic interest rate, by doing so they will also reduce the pressure on the domestic currency from further depreciation. Alternetavily, the authorities may use its reserves to intervine in the market for foreign currencies to stabilize the exchange rate (this is reflected by the unclear causality between interest rate and exchange rate). Either policy action represents the cost of the exchange rate anchoring policy, which could be high to the extent that the authorities are forced to let the exchange rate depreciate to a more sustainable level.

In South Africa, changes in interest rate differentials lead changes in exchange rate and changes in the exchange rate lead changes in CS, and therefore changes in interest rate differential lead changes in CS. This scenario, combined with the depreciation observed in the past 11 years, suggest that the inflation targeting policy produced interest rate differentials consistent with its target, but not high enough to prevent the rand from depreciation (given the status of the balance of payments during this period), and consequently led to noticeable increase in CS. Additional pressures on the rand to depreciate, due to internal or external factors, may lead to further increase in the CS. Over time, this might lead to erosion in the control of monetary authorities over its aggregates and therefore to a reduction in the effectiveness of the inflation targeting policy, which may force the authorities to abandon the inflation targeting policy.

V. Concluding Remarks

Currency substitution (CS) or the share of foreign currency in the broadly defined money supply continues to be a substantial factor in many developing and emerging economies. In the past decade, the development of this phenomenon in tow of Africa's largest economies, Egypt and South Africa, was different in both the magnitude and direction. Egypt managed to considerably reverse its CS, which was at a very high level early in the decade. Contrary to this, South Africa started the decade with marginal CS, but its level observed significant and uninterrupted increase. The two countries adopt economic stabilization programs with different orientation. While Egypt focuses on the stability of the exchange rate (exchange rate anchoring), South Africa directly targets inflation. As such, Egypt and South Africa provide an excellent testing ground of the process and dynamics of CS in emerging economies under different policy orientations.

The result of the error-correction model indicates that the elasticity of CS, with respect to exchange rate, is larger in South Africa than in Egypt, and the speed of adjustment from the short-term to long-term equilibrium is much faster in South Africa than in Egypt. The Grange-causality tests confirm that, in both Egypt and South Africa, changes in exchange rate lead changes in CS. However, the causality between the exchange rate and interest rate differential breaks under the exchange rate anchoring policy (Egypt). The evidence provided here suggests that in a high CS environment, exchange rate anchoring policy can be effective in reversing the CS. The cost of this policy could take the form of a reduction in the reserves of the central bank and/or additional burden to public expenditure. As for the inflation targeting policy, the evidence suggests that it can be effective in achieving its target in a low CS environment. The cost in this case could take the form of high domestic interest rate and/or increase in CS. With a substantial increase in CS, the central bank may find itself forced to abandon inflation targeting and probably switch to exchange rate anchoring policy. However, under either policy, if the depreciation pressure on the domestic currency (and therefore increase in CS) sources from chronic current account difficulties, either policy will be costly and ineffective. The long-term solution is to improve the productivity and competitiveness of the economy, which will ultimately reduce the pressure on the domestic currency from depreciation and bring the required stability to the economy.

Notes and References

1. Calvo (2001) and Berg and Borensztein (2000b) discus of the pros and cons of full dollarization.
2. See Fischer (2001) for a discussion of the exchange rate regimes in developing and emerging market countries.
3. Garner (1994) describes the financial system which the authorities used to control capital flow in the South Africa in the early 1990s. In this system, the financial rand mechanism, financial transactions were traded at a discount exchange rate.
4. Banerjee and others (1993) provides a comprehensive survey of the literature of cointegration and non-stationary data.
5. El-Erian (1988), using quarterly data for the period 1980-1986, estimated an elasticity of 0.07. This, along with the estimate of the present paper, may suggest that CS in Egypt in became more responsive to change in exchange rate in the 1990s. This is despite the decline in CS experienced in the decade.
6. This equals to 1 minus the sum of the coefficients of the lagged dependent variable (1 – (1.295 - 0.315)).
7. Also see Granger and Newbold (1986). For further development of the Granger-causality test see Sims (1972) and Geweke, Meese and Dent (1982).

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