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Relationship between the misalignment of the real exchange rate and capital flight in the developing countries

Abdessalem GOUIDER
URECA, University of Sfax, Tunisia
Ridha NOUIRA
UREP, University of Sfax, Tunisia
ridhnou@yahoo.fr

Abstract. *The objective of this work is to determine the role of the misalignment of the real exchange rate in capital flight for a sample of developing countries over the period 1980-2010. Firstly, we calculated the degrees of misalignment for all countries of our sample, which degrees were introduced as a determinant of capital flight. Then, we examined the effect of the overvaluation and the undervaluation on capital flight. The results show that a strong undervaluation may discourage capital flight, while a strong overvaluation can stimulate it.*

Keywords: capital flight, equilibrium real exchange rate, overvaluation, undervaluation, cointegration.

JEL Classification: C21; C23; F31.
REL Classification: 8N, 9E.

1. Introduction

Capital outflow is usually manifested by an outside transfer of a portion of private savings leading to a decrease of the domestic savings. This phenomenon has long flowed a lot of link. Indeed, the concern was not only to define the term and set up the necessary measures to quantify it but especially to seek the main causes of the capital outflow and propose measures to remedy it.

In the economic literature, the concept of "capital flight" has been defined in different ways. The diversity of definitions reflects the complexity of this phenomenon. Actually, the nuances concern mainly the distinction between the normal outflow and the capital outflow due to some unfavorable factors characterizing the original countries such as the political instability, uncertainty about the government policy, the taxation system, the external debt, the budget deficit, the inflation rate etc.

In the developing countries, capital outflows have attracted much interest since the 80s because of the appearance of the debt crisis in these countries. Capital outflow generally leads to a loss of investment and growth because it is seen as a diversion of domestic savings outward (Deppler and Williamson, 1987).

Several variables are considered as determinants of capital outflows. These determinants include the real exchange rate. Its role is usually determined by its level of appreciation or depreciation. Many empirical studies have investigated this relationship and justified the important role played by the real exchange rate in the magnitude and the direction of the capital outflow especially in the indebted countries (Dornbusch, 1985; Cuddington, 1966; Lessard and Williamson, 1987; Pastor, 1989 and Pastor, 1990). In addition, it is generally accepted that the misalignment of the real exchange rate is a key determinant of the capital outflow. In this context, Fry (l993) states that the expectations of a devaluation of the exchange rate caused by the external debts of a country, is an incentive to hold assets abroad.

Mcleod (2002) states that the capital outflows are more frequent when the exchange rate is unstable. According this author, the anticipation of a devaluation of the national currency is a major cause of capital outflow in the sense that speculators can choose to withdraw their funds from domestic banks to outward. Moreover, according to Hermes, Lensink and Murinde (2002), the overvaluation of the real exchange rate gives rise to the capital outflow because it causes a strong expectation of a depreciation of the domestic currency. The economic agents choose to invest their money abroad. However, according to Vos (1992), it is rather the undervaluation of the real exchange rate that leads to a strong capital outflow.

Our contribution in this article is to study the impact of the misalignment of the real exchange rate on capital outflow. According to Edwards (1989), misalignment refers to the set of "sustained deviations of the real exchange rate observed in relation to the level of the long-term equilibrium". The degree of misalignment leads to imbalances represented by the phenomena of over-or under-evaluation of the real exchange rate which is expressed by losses or gains in competitiveness. The misalignment of the exchange rate appears to be a key determinant of the FDI flows.

In this article, we try to determine the role of the misalignment of the real exchange rate in the capital outflow for a sample of 52 developing countries over the period 1980-2010. Thus, this paper will be composed of two sections. In the first section, we briefly recall the main determinants of the capital outflow. In the second, we will detect the role of overvaluation and undervaluation in the capital outflow.

2. Classical determinants of capital flight

The reasons behind the capital flight, as discussed in economic literature, are many. These reasons are mainly of economical origin related to macroeconomic stability. However, they can also have a political origin which concerns, in particular, the governance policy.

Various indicators provide information about the economic stability in one country such as the rate of the GDP growth, the inflation rate, the level of the external debt, the budget deficit, etc. Most of these factors contribute, in one way or another, to the capital outflow.

Rate growth of GD: A low growth rate of the GDP leads to capital flight (Morgan, 1988). This relationship seems indirect. Indeed, the weakness of the growth rate can be translated by a budget deficit and thus a reduction of the government incomes. This economic imbalance that characterizes most of the developing countries may also be a consequence of the deterioration of the trade terms which prevent the State from paying its external debts. In this situation, the government can increase the taxes to finance its expenditure. Thus, by anticipating an increase of the taxes, capitalists decide to invest their money abroad because the increase of the local taxes causes a decline in their expected profits. The relationship between tax and capital outflow was studied by Cardoso and Dornbusch (1989). Both authors suppose that the capital outflow results from the behavior of the residents seeking avoid local taxes. Moreover, if the government chooses to finance the budget deficit through money creation, the investors expect the rising

of the inflationary pressures and prefer to transfer their assets abroad. Therefore, the budget deficit is a cause of capital flight (Ajayi, 1992).

In addition to the budget deficit and taxation, inflation is also considered as a determinant of capital outflow (Dornbusch, 1985; Cuddington, 1986; Conesa, 1987). Considered as an indicator of the government inability to manage the economy (Fisher, 1993), inflation allows to reduce the real value of the domestic assets and obliges the residents to keep their assets abroad.

External *debt:* over-indebtedness may lead to the capital outflow. On the one hand, the increase of the debt level, by exercising a pressure on the increase of the national currency, leads individuals to transfer their funds abroad to protect themselves against an expected devaluation of the domestic currency (Conesa, 1987). On the other hand, according to Henry (1986), Cuddington (1987) and Duwendag (1989), external debt can cause capital outflow by providing the corrupt leaders the necessary resources to carry out this outflow.

The low growth rate of the GDP, the budget deficit, the increase of tax, inflation and external debt are variables which increase the risk and uncertainty relative to the profitability of domestic investment. Therefore, the risk aversion leads the investors to diversify their portfolios. The objective of the diversification obliges individuals to keep their assets abroad (Cuddington, 1986). Besides, the uncertainty characterizing the macroeconomic environment, the portfolio diversification, the main source of capital outflow, can result from the political instability and the interest rate gap (Hermes and Lensink, 1992; Lensink et al., 2000).

In addition to the economic factors, there are some determinants related to the political stability and the quality of institutions which constitute important causes of the capital flight, especially in the developing countries. Indeed, political instability and bad governance would be translated by an unfavorable macroeconomic environment in terms of economic performance and investment climate. This situation increases uncertainty, discourages domestic investment and leads to the capital outflow. According to Hermes, Lensink and Murinde (2002), the lack of confidence in the political environment of a country led residents to transfer their assets abroad. In addition, bad governance can be translated by an unequal distribution of the national wealth because of corruption. This is the case of several political leaders who use their power to appropriate a portion of the wealth and transfer it abroad. This argument refers to the strong relationship between governance and capital outflow. Indeed, a badly managed country cannot create a favorable investment climate causing capital outflows. In addition, corruption can allow the misappropriation of the help, for the poor countries. In

the same context, Ajayi (1992) and Awung (1996) confirmed the relationship between corruption and capital flight.

After recalling the main determinants of capital flight, we focus our analysis to the study of the relation between the capital flight and the misalignment of real exchange rate in developing countries. This is the purpose of the following work.

3. Misalignment and capital flight in the developing countries

The misalignment of the real exchange rate is generally considered as an important determinant of the capital flight. An overvaluation of the exchange rate leads to the capital outflow because it is at the origin of high anticipations of the national currency depreciation. The economic agents choose to place their money abroad. The misalignment of the real exchange rate can also favor speculation, which leads to massive capital flights abroad and a reduction of the property in the country (Cuddington, 1986). There are not many studies that took the role played by the misalignment in the capital flight into account. Among these studies, we can quote those of Pastor (1990), Hermes and Lensink (1992), Murinde, Hermes and Lensink (1996), Hermes, Lensink and Murinde (2002).

To examine the effect of the misalignment of the real exchange rate on the capital flight, we adopt an approach in two stages. First, we will determine the real degrees of the misalignment of the exchange rate for all the countries of the sample, which will be introduced as a determinant of capital outflow. Then, we will determine the effect of overvaluation and undervaluation on the capital outflow for a sample of developing countries (Appendix A) over the period 1980-2010.

3.1. Estimation of misalignment

- *The economic model*

The REER discussed above is widely used as an indicator of the "price competitiveness" of an economy. However, because of misconceived policies or imperfect functioning of the exchange market, it may be a poor indicator of the competitiveness of an economy. Misconceived economic policies can maintain exchange rate away from its equilibrium level but a country can also be willing to keep an over evaluated exchange rate in order to reduce the cost of importing machinery and other inputs for domestic firms. The resulting misalignment has been found to be damaging to economic performance (Edwards, 1988 and Cottani et al. 1990) implying that the REER should be maintained as close as possible to its equilibrium level (i.e. EREER).

Over the last thirty years, the economic literature on the exchange rate has developed in a way that allowed determining the influence of a limited range of

variables affecting the long run real value of a currency (e.g. Williamson, 1994; Edwards, 1998). These variables, called the "fundamentals", include external (e.g. the international terms of trade) as well as internal factors (e.g. government expenditure). The impact of these determinants can be estimated through an econometric regression and are used to calculate the EREER and potential misalignment of the actual rate. Practically, the REER is decomposed into the EREER and misalignment. Edwards (1988) was the first to propose an approach that makes it possible to distinguish between the two sources of REER variations. The latter is regressed on external and domestic ''fundamentals'', which bring about changes in the EREER if sustained over a long time period and do not create misalignment, unless price adjustment is extremely sluggish. In literature, the fundamental variables which can act on the internal and external balance are multiple. In this paper, after having tested ten of them, the six retained are namely: The bias of productivity (or the Balassa-Samuelson effect) (Balassa) , the terms of international trade (TOT), the government consumption (Gov), the debt services (Debtser), the net capital inflow (Capinf).

So Edward's model can be represented under the following shape:

$$Log(REER)_{it} = \alpha_{i0} + \alpha_1 \text{Log}(Balassa)_{\text{it}} + \alpha_2 \text{Log}(Open)_{\text{it}} + \alpha_3 \text{Log}(Gov)_{\text{it}} + \alpha_4(Capinf)_{it} + \alpha_5 \text{Log}(Debtser)_{\text{it}} + \alpha_6 \text{Log}\,(TOT)_{\text{it}} + \varepsilon_{it} \quad (1)$$

The *Balassa* is the ratio between the country's real per capita GDP and the geometric mean (weighted in a similar way as the *REER*) of the same variable in trading partners. *Open* is the ratio of export plus imports to GDP. *Gov* is government consumption in percentage of the GDP. *Capinf* is the net capital inflow scaled by GDP. *Debtser* is the country debt services including interest payments and reimbursements as a share of GDP. *TOT* is the terms of trade (the ratio of export to import prices).

We expect a rise in the terms of trade (TOT) to appreciate the equilibrium REER to the extent that it improves the trade balance; the income effect dominating the substitution effect. It is expected that restricted trade openness (Open) will exert downward pressure on the relative price of tradable to non-tradable goods, thereby leading to an appreciation in the equilibrium REER. Higher capital inflows (Capinf) involve stronger demand for both tradables and non-tradables and lead to a higher relative price of non-tradables and REER appreciation. This is needed for domestic resources to be diverted toward production in the non-tradable sector in order to meet increased demand. Government consumption (Gov) has a similar effect: stronger demand for non-tradables increases their relative prices leading to an appreciation in the equilibrium REER. The higher the country debt services (Debtser) the higher will be the demand for foreign currencies inducing depreciation of exchange rate. The variable (Balassa) reflects a productivity gap

and aims at capturing the potential Balassa-Samuelson effect. Assume the prices for tradable sectors homogeneous across countries and their productivity higher than in non-tradable sectors. The increase in wages in the tradable sectors due to higher productivity spills over the wages in non-tradable sectors. The latter induce an increase in inflation and an appreciation of the REER.

- *The econometric analyses*

Equation (1) will be used to estimate the EREER and potential misalignment on a sample of 52 developing countries from Africa, Asia and Latin America over the period 1980-2010 (see Appendix B). However, as explained above, the EREER concerns the long term relationship between the REER and the fundamentals. In order to determine such relationship, one should use the co-integration methodology.

While co-integration analysis has been for a long time applied to "pure" time series (e.g. for a given country), in this paper we take advantage of the time series and the cross-section dimensions of the sample to study the relationship in Equation (1) using recent development of panel-data-co-integration analysis (e.g. Pesaran, 2007; Pedroni 2004). The model is estimated by considering a panel dataset. We combine information about 52 developing countries from Africa, Asia and Latin America over the period 1980-2010. The sample is determined according to the availability of data with the major source of information we used (e.g., the World Development indicators of the World Bank).

On the one hand, the combination of both time series and cross section information has the valuable advantage to provide a large the number of observations. Time series available are extremely short, making the country-by-country estimation of equation a procedure of limited interest (Edwards, 1994). Pooling the data potentially improves the robustness of estimations with misalignments being determined according to a "normal" behavior given by the average estimated coefficients over the sample. On the other hand, panel data analyses may suffer from hidden heterogeneity. This is the reason why country fixed effects have been introduced in empirical models while time fixed effects did not prove statistically significant over the period. The latter allows for more efficient estimation and testing; especially when the number of time periods is limited. However, in order to avoid too much technicality in the main text, the panel-data-co-integration analysis is presented in Appendix B.

To estimate this model, and given that all the variables of the model are I (1) and cointegrated in panel, the Within estimates of the parameter are convergent but not efficient (Kao, Chiang and Chen, 1999). To solve this problem, we used the FMOLS estimator (Fully Modified OLS) developed by Pedroni (2000). The

objective of this estimator is to eliminate the bias of the Within estimator. The FMOLS expression is:

$$\hat{\beta}_{FM} = [\sum_{i=1}^{N}\sum_{t=1}^{T}(x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)']^{-1}\left[\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)\hat{y}_{it}^{+} - T\,\hat{\Delta}_{\eta\mu}^{+}\right)\right] \quad (2)$$

The resulting long term relationship between the REER and the explanatory variables is given in Table 1. It has a good overall quality of fit and all the coefficients are significant with the expected sign.

Table 1. *Result of FMOLS estimator Estimation Results of Equation (1)*

Variables	
	FMOLS
Capital Inflow / GDP	0.00
	6.9***
Openness	-0.42
	17.1***
Balassa Samuelson	0.28
	8.30***
Debt Services	-0.07
	-8.9***
Government Consumption / GDP	0.03
	3.31**
Terms of Trade	0.13
	6.53***
A-R^2	0.52

t-statistics are in bold.

* = Significant at 10%, ** = Significant at 5%, *** = Significant at 1%.

Using the coefficients in Table 1, we can compute the extent of the *REER* misalignment for the developing countries. We have to recall, however, that misalignment refers to the difference between the *REER* and its equilibrium level, the *EREER*. The latter is given by the fitted values using the estimates together in Table 1 and the long-run values of the explanatory variables. To get such long run values, we use the Hodrik-Precsott filter to separate the permanent and temporary components of each variable.

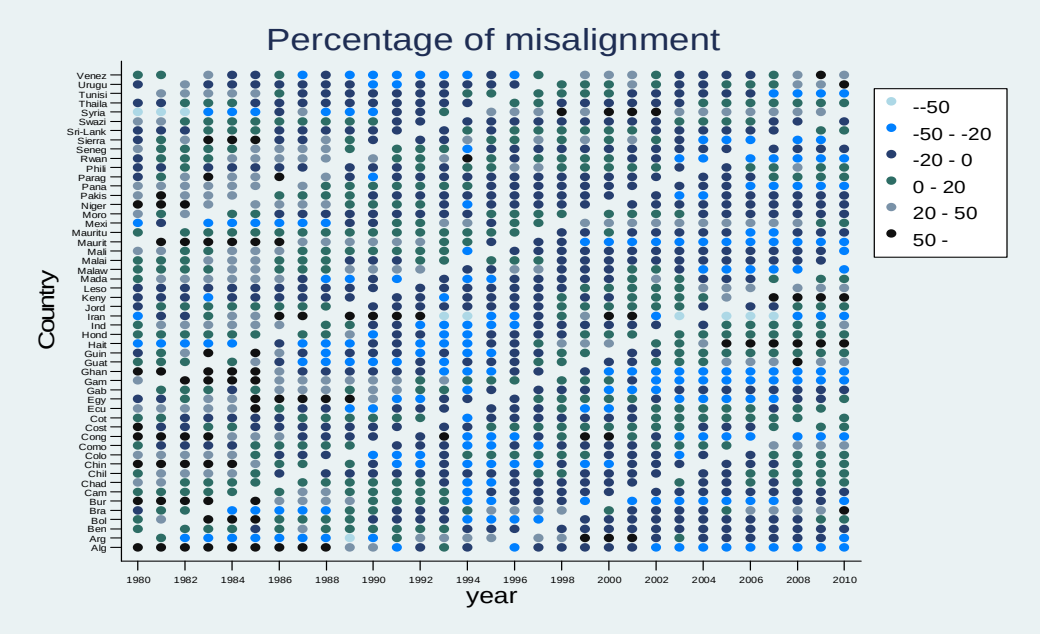
We define misalignment as:

$$Mis = (REER / EREER) - 1 \quad (3)$$

the positive values of which correspond to overvaluations.

Table 2 and Figure 1 describe the obtained misalignment series.

Figure 1. *The exchange rate misalignment during the periods 1980-2010*



This figure presents, the exchange rate misalignment during the periods 1980-2010. This period was characterized by light exchange rate overvaluation (0%; 20%) and light undervaluation (-20%; 0%). The figure shows that, in general, the percentage of years during which exchange rate were undervalued is higher during the 1991-2010 than during 1980-1990.

Table 2 provides the average of undervaluation and of overvaluation for countries and the percentage of years during which exchange rate was undervalued. Out of the 52 countries in the sample, 48 exhibit an overvalued currency over the period 1980-2010. Among these countries the overvaluation highly differs; ranging from about 41% in Iran to 0.3% in Gabon. In this table we also calculated the average overvaluation and the average undervaluation for every country. Ghana has the highest average overvaluation (198%) and Iran has the highest average undervaluation (-42%). From Table 2, we also notice that, out of the 52 countries in the sample, in 21 countries, the overvaluation occurred at least in 15 years (half of the period). However, in a majority of countries (50 out of 52) overvaluation occurred during at least 10 years (1/3 of the period). Only for Panama, overvaluation occurred during at least 20 years.

Table 2. *The percentage of Misalignment, Undervaluation and Overvaluation between 1980 and 2010*

Country	Average Misalignment	Average undervaluation	Average Overvaluation	Percentage of years of overvaluation
Algeria	13,66%	-27%	75%	36%
Argentina	5,56%	-21%	44%	42%
Benin	0,96%	-7%	13%	49%
Bolivia	2,18%	-14%	28%	39%
Brazil	4,63%	-18%	23%	49%
Burkina Faso	4,92%	-21%	37%	46%
Cameroon	0,81%	-9%	13%	42%
Chad	2,03%	-12%	12%	59%
Chile	1,78%	-8%	14%	33%
China	9,38%	-20%	51%	47%
Colombia	2,67%	-14%	16%	46%
Comoros	2,67%	-12%	18%	42%
Congo, Rep,	16,93%	-21%	71%	46%
Costa Rica	1,75%	-7%	10%	59%
Cote d'Ivoire	-0,63%	-8%	5%	42%
Ecuador	2,63%	-13%	17%	41%
Egypt, Arab Rep,	7,48%	-21%	36%	57%
Gabon	0,30%	-13%	19%	62%
Gambia, The	7,28%	-37%	30%	62%
Ghana	21,43%	-25%	198%	23%
Guatemala	3,69%	-19%	22%	55%
Guinea-Bissau	2,08%	-13%	16%	55%
Haiti	11,49%	-26%	57%	46%
Honduras	0,59%	-18%	9%	65%
India	0,96%	-16%	16%	49%
Iran, Islamic Rep,	41,76%	-42%	144%	46%
Jordan	1,97%	-6%	7%	58%
Kenya	3,32%	-14%	36%	46%
Lesotho	2,92%	-8%	21%	55%
Madagascar	2,64%	-14%	23%	52%
Malawi	2,98%	-20%	19%	59%
Malaysia	0,43%	-9%	11%	58%
Mali	3,04%	-13%	21%	46%
Mauritania	8,60%	-26%	46%	42%
Mauritius	0,02%	-12%	9%	55%
Mexico	4,74%	-25%	23%	58%
Morocco	0,00%	-6%	8%	49%
Niger	3,58%	-15%	30%	39%
Pakistan	1,92%	-10%	29%	36%
Panama	2,58%	-12%	19%	71%
Paraguay	3,45%	-12%	29%	39%
Philippines	2,23%	-9%	11%	52%
Rwanda	4,59%	-23%	21%	62%
Senegal	2,11%	-12%	19%	46%
Sierra Leone	9,53%	-19%	31%	49%
Sri Lanka	-0,42%	-4%	5%	52%
Swaziland	1,85%	-7%	10%	46%
Syrian Arab Republic	7,87%	-35%	38%	62%
Thailand	-0,02%	-5%	8%	49%
Tunisia	0,65%	-10%	15%	52%
Uruguay	2,88%	-10%	21%	39%
Venezuela, RB	1,65%	-16%	24%	49%

In the next section, focuses on whether countries having overvalued exchange rate, especially if overvaluation is maintained for some time, have an effect on capital flight. We will introduce the variable misalignment that we calculated as a determinant of the capital flight.

3.2. Empirical Relation between the misalignment and the capital flight

- *Data and methodology*

Ignored in the majority of the empirical studies, misalignment can be a determinant of capital outflow in the developing countries. To estimate the effect of misalignment on the capital flight, we will estimate a model of capital flight for a sample of developing countries over the period 1980-2010. In the economic literature, several methods in measuring of the capital flight are proposed. In the present study, and due to the lack of data, we are limited to the use of the method of the World Bank (1985). Hence, the variable capital flight used in this paper is calculated according to this method. In this method, the capital outflow for a country i in year t is measured as follows:

$$\mathrm{CF_{it}} = [\Delta \mathrm{FD_{it}} + \mathrm{NFDI_{it}}] - [\mathrm{CA_{it}} + \Delta \mathrm{FR_{it}}] \qquad (4)$$

Where CF is the capital flight; ΔFD is the variation of the foreign debt; NFDI is the net Foreign Direct Investment; CA is the balance of the current account and ΔFR the variation of the foreign reserves. All these data are obtained from the database of the World Bank 2012 (WDI).

The existing theory does not specify the independent variables which have to be included in an empirical model in analyzing the determinant of the capital outflow. In the case of our sample of developing countries, besides misalignment, we had retained the following explanatory variables: Capital flight delayed period, the ratio of foreign debt in the GDP, the rate of the GDP growth, the degree of opening of the economy, the debt service, the differential interest, corruption and the inflation rate. To determine empirically the relation between misalignment and the capital flight of the developing countries, three specifications were estimated. Every time, we introduce a new determinant of the capital flight in the estimated equation in order to determine the effect of the new variable on the significativity of the coefficients of the other determinants.

The effect of the misalignment variable on the capital flight depends on its sign as it is about an undervaluation (negative misalignment) or an overvaluation (positive misalignment). Indeed, following overvaluation, the investor anticipates a depreciation of the national currency which leads to strong capital outflows. It is thus necessary to distinguish between these two variables. For this reason, we created the two following variables “Overvaluation” and “Undervaluation”. The “Overvaluation” variable is going to take the positive values of the misalignment

while the variable "Undervaluation" is going to take the negative values. The data which helped us estimate the relation between misalignment and the scale of the capital flight from the countries of our sample generally cover the period between 1980 and 2010.

To estimate the effect of overvaluation and undervaluation on the capital outflow, we will estimate the three specifications by using three estimators: Within with fixed effects, Blundell-Bond and finally the PMG estimator. The estimation as well as the interpretations results constitutes the objective of the subsection which follows.

- *Results and Interpretation*

To examine the impact of overvaluation and undervaluation on the capital flight, we will highlight three specifications. We will estimate these specifications firstly by the Within estimator with fixed effects. Secondly, we will add the lagged capital flight as a determinant and we will estimate these specifications into the Blundell-Bond and the PMG estimators. The results of the estimations are summarized in Table 3.

Table 3. *Separate Effect of REER Undervaluation and Overvaluation on the capital flight*

	OLS with fixed effects			Dynamic estimator (Blundell-Bond)			Non-stationary estimator PMG		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Capital flight {1}	0.41 3.89	0.44 4.10	0.47 3.97	0.31 4.39	0.35 4.18	0.36 4.91	0.7 5.49	0.69 4.9	0.62 4.19
Ratio change debt/gdp	0.003 4.8	0.003 4.34	0.003 3.63	0.003 4.6	0.003 4.31	0.003 4.6	0.006 4.63	0.007 4.64	0.01 4.71
Growth	-0.004 -0.93	-0.009 -1.37	-0.002 -0.24	-0.002 -0.42	-0.008 -1.1	-0.001 -0.1	-0.00 -2.65	-0.00 -1.54	-0.001 -1.76
Open	0.004 2.45	0.004 1.94	0.019 2.87	0.006 1.36	0.008 1.42	0.012 2.05	0.00 2.27	-0.00 -0.98	-0.00 -1.5
Service dette	-0.016 -1.92	-0.012 -1.29	-0.02 -1.23	-0.03 -2.28	-0.02 -1.98	-0.03 -1.93	0.001 0.81	-0.001 -1.45	-0.002 -1.61
Differential interest	-	-0.00 -0.29	-0.003 -0.75	-	-0.00 -2.3	-0.00 -0.11	-	-0.001 -3.86	-0.002 -4.07
Corruption	-	-0.1 -2.33	-0.2 -2.9	-	-0.05 -0.51	-0.21 -2.26	-	-0.004 -1.93	-0.007 -2.14
Inflation	-	-	0.003 0.74	-	-	-0.003 -0.4	-	-	-0.00 -1.29
Undervaluation	-0.2 -0.76	-0.3 -0.89	-0.12 -0.17	-0.5 -0.71	-0.81 -0.84	-1.81 -0.97	-0.03 -2.1	-0.01 -0.76	-0.05 -0.7
Overvaluation	0.06 0.32	-0.003 -0.01	-0.12 -0.17	0.3 0.61	0.43 0.68	-0.2 -0.26	-0.04 -3.15	-0.05 -3.26	0.01 0.11
Number of Countries	48	38	20	48	38	20	48	38	20
Number of Observations	1056	836	440	1056	836	440	1056	836	440
Adjusted R^2	0.25	0.34	0.36						

This table shows that the ratio of foreign debt in the GDP, the degree of openness and the lagged capital outflow, have a positive and significant effect on the capital outflow in the developing countries. On the other hand, the debt service, the differential interest and corruption have a negative effect on the capital outflow in these countries. The results also show that the inflation rates and the GDP growth have no significant effect on the capital outflow in the developing countries.

Concerning the effect of overvaluation and undervaluation on the capital flight, this table shows that these two variables have generally no effect on the capital flight. This can be explained by the fact that the investors take into account factors such as corruption, the ratio of the foreign debt in the GDP other than the misalignment of the real exchange rate.

According to the economic theory, the investor decides to leave the country and invest abroad after a strong real overvaluation, where he anticipates local currency depreciation. To take into account this situation, we have created two new variables "HighUnder" and "HighOver". The first variable takes the value of the misalignment lower than 20%, which indicates an undervaluation of more than 20%.

However, the variable "HighOver" will take the value of the misalignment superior to 20%, which indicates an overvaluation of more than 20%. Table 4 recapitulates the results of the estimation of the specifications by introducing lagged "HighUnder" and a lagged "HighOver" in the estimated models. It shows that a strong undervaluation can decrease the capital outflow whereas a strong overvaluation can stimulate it. Given that the countries of our sample generally present characteristics of an overvalued currency, this overvaluation makes the developing countries import more than they export. Such a situation exerts a pressure of depreciation on the currency of these countries. From then, we will have capital outflows and that the individuals will prefer to take theses assets abroad. As a result, an overvaluation of the currency of the developing countries will doubtless incite a rational agent to avoid the shock by converting his currency in advance.

To take into account the persistence dimension, we construct two new variables: Persistent Undervaluation (PersistUnder) and Persistent Overvaluation (PersistOver). If during the past five years, the exchange rate was always undervalued (overvalued) "PersistUnder" ("PersistOver") takes as a value of the average undervaluation (overvaluation) in the five years. Otherwise, the variable takes the value 0.

Table 4. *The Separate Effect of REER Persistent Undervaluation and Overvaluation on the capital flight*

	OLS with fixed effects			Dynamic estimator (Blundell-Bond)			Non-stationary estimator PMG		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Capital flight {1}	0.34 3.8	0.39 4.1	0.4 4.29	0.31 4.56	0.35 6.54	0.38 5.9	0.52 4.68	0.56 5.41	0.51 5.27
Ratio change debt/gdp	0.003 4.59	0.004 4.62	0.003 3.51	0.002 4.69	0.002 4.26	0.003 4.34	0.004 4.33	0.005 4.68	0.02 5.69
Growth	-0.006 -1.13	-0.01 -1.51	-0.008 -0.67	-0.001 -0.32	-0.007 -0.93	-0.004 -0.29	-0.002 -1.31	-0.003 -1.21	-0.004 -1.46
Open	0.005 2.98	0.006 2.63	0.01 2.78	0.009 1.73	0.008 1.69	0.013 1.68	0.001 2.02	0.003 1.67	0.004 1.71
Service dette	-0.11 -1.14	-0.07 -0.66	-0.01 -0.84	-0.03 -1.98	-0.02 -1.72	-0.02 -1.67	-0.02 -1.04	-0.04 -1.66	-0.03 -1.68
Differential interest	-	-0.00 -0.54	-0.005 -0.89	-	0.00 0.36	0.00 0.51	-	0.00 0.86	0.00 0.67
Corruption	-	-0.6 -1.83	-0.10 -1.76	-	-0.03 -0.43	-0.01 -1.3	-	-0.02 -1.98	-0.07 -2.71
Inflation	-	-	0.002 0.91	-	-	0.002 0.77	-	-	0.00 0.98
PersistUnder	-0.46 -1.57	-0.5 -1.4	-0.6 -1.13	-0.4 -1.15	-0.45 -1.48	-0.32 -0.94	-0.27 -1.24	-0.31 -1.43	-0.37 -1.51
PersistOver	0.4 1.68	0.41 1.66	0.3 1.65	0.28 2.28	0.39 2.15	0.41 1.81	0.38 2.03	0.41 1.78	0.47 1.81
Number of Countries	48	38	20	48	38	20	48	38	20
Number of Observations	1056	836	440	1056	836	440	1056	836	440
Adjusted R^2	0.41	0.38	0.4						

Table 4 summarizes the results of the estimation of the five specifications with variables “PersistOver” and “PersistUnder”. From this table, we can conclude that a persistent overvaluation can increase the capital flights into the developing countries. Indeed, the coefficient of the variable “PersistOver” is positive and significant for all the specifications. Thus, we can conclude that a persistent overvaluation can discourage the investors.

Conclusions

Since the debt crisis, which occurred at the beginning of 1980s, capital outflow has been a phenomenon which attracted the attention of several economists. It is an important characteristic of the developing economies. Therefore, we tried to examine the effect of misalignment of the real exchange rate on the capital flight for a sample of developing countries over the period 1980-2010.

Firstly, we estimated the impact of overvaluation and undervaluation on the capital flight. The results indicate that, for these developing countries, the misalignment of the real exchange rate is not the main determinant of capital outflow. Secondly, we determined only the impact of a strong overvaluation and a strong undervaluation on the capital flight. We considered that there is a strong overvaluation (undervaluation respectively) if the value of misalignment is superior to 20% (inferior to 20%). Our econometric results show that a strong undervaluation may discourage capital outflow, while a strong overvaluation can stimulate it.

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Appendix A

Table A1. *Countries in the Sample Used to Compute the EREER*

Africa	Latin America	Asia
Algeria	Argentina	China
Benin	Bolivia	Iran
Burkina-Faso	Brazil	Thailand
Cameroon	Columbia	Pakistan
Chad	Costa-Rica	India
Comoros	Ecuador	Philippines
Congo, Rep	Mexico	Malaysia
Cote d'Ivoire	Paraguay	Jordan
Egypt	Venezuela	Syria
Gabon	Haiti	
Gambia	Honduras	
Ghana	Panama	
Guatemala	Uruguay	
Guinea-Bissau	Chile	
Kenya		
Lesotho		
Madagascar		
Malawi		
Mali		
Mauritania		
Mauritius		
Morocco		
Niger		
Panama		
Rwanda		
Senegal		
Sierra-Leone		
Sri Lanka		
Swaziland		

Appendix B. Co-integration analysis

To present co-integration simply, consider two time series x and y that are integrated of order one; I (1). This means that their first differences (i.e. Δx and Δy) are stationary; I (0). If the regression of x on y (that are I (1)) gives a time series of residuals that is I (0), the two series are called co-integrated. This is means that there exists a long term relationship between them. The latter is given by the regression coefficients of x on y. However, the OLS estimate of the coefficient is convergent but not efficient and other estimation techniques need to be used. The methodology comprises 3 major steps. First, test whether the variables are I (1). Second, test whether the variables are co-integrated. Third, estimate the long term relationship.

First developed in a "pure" time series context, co-integration analysis has been subsequently extended to data combining both the time series and the cross-section (commonly referred to as panel data) dimensions. The 3 steps for the analysis are the same as above except that the nature of the data (i.e. time series and the cross-section) involves a preliminary check regarding whether individuals (e.g. countries) are interdependent or not. This is important for the tests to be used in the co-integration analysis. This Appendix applies the panel-data-co-integration analysis to Equation (1).

To examine whether individuals are interdependent, we use a test suggested by Pesaran (2004). The test is based on the average of the correlations between the residuals from a regression on each individual separately. Practically, consider the variable y_i pertaining to the individual i. The variable is regressed on its first lag and the residuals are collected to compute ρ_{ij} which is the correlation coefficient between the residuals from individual i and j regressions. The statistics:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \qquad \text{(B.1)}$$

is shown to have a N (0,1) distribution under the null hypothesis of independence. Where N is the number of individuals and T is the number of years.

The results of the test applied to our sample are presented in Table B1. For all variables, the tests reject the null hypothesis of independence of individuals at the 1% level.

Table B1. *Tests of the independence of the variables across individuals*

Variables	Calculated statistics
REER	5.98
Balassa	13.17
Open	8.32
Gov	4.13
Capinf	3.71
Debtser	10.41
Tot	8.12

B.1. Stationarity tests

To examine stationarity, we should, therefore, use a test that incorporates the interdependence of individuals. Among the existing test, the one by Pesaran (2007) is the most adequate because it is targeted toward situation where N (the number of individuals) is higher than T (the number of years). In addition, the test allows analyzing non-stationarity within a heterogeneous panel framework, i.e. a panel in which each country is allowed to evolve according to its own dynamics.

The test builds on the well-known augmented Dickey-Fuller regressions. Practically, consider y_{it} pertaining to the individual i at time t. Run the regression:

$$\Delta y_{it} = \alpha_i + \rho_i y_{it-1} + \gamma_i \bar{y}_{t-1} + \delta_i \Delta \bar{y}_t + \vartheta_{it} \quad \text{(B.2)}$$

and take the calculated Student statistics of ρ_i ; t_i. Where $\hat{y}_t$ is the average of y_{it} over all individuals at time t. The statistics:

$$CIPS\ (N,T) = \frac{1}{N}\sum_{i=1}^{N} t_i\ (N,T) \quad \text{(B.3)}$$

is used to test for stationarity but it does not have a standard distribution. We follow Pesaran (2007) and simulate the critical values using the Monte Carlo approach. If the computed statistics (*CIPS*) is above the critical value, one can not reject the null hypothesis of stationarity.

Table B2. *Test of the stationarity of the variables*

Variable	Stationarity in	
	Level	First difference
Capital Inflow / GDP	-1.79	-5.93***
Openness	-2.01	-4.85***
Debt Services	-1.98	-5.39***
Government Consumption / GDP	-1.92	-4.52***
Terms of Trade	-1.53	-5.13***
REER	-2.06	-4.51***
Balassa Samuelson	-1.98	-4.21***
	Critical values: -2.11 (5%) -2.20 (1%)	

** = Significant at 5%, *** = Significant at 1%

Table B2 presents the results. The tests reveal that all variable are I (1). Hence, if we find a relationship among the variables which gives stationary residuals, these variables will be considered as co-integrated.

B.2. Co-integration tests

The best known tests are due to Pedroni (1995, 2004). They allow taking account of heterogeneity among individuals. The author proposed 7 versions of the co-integration test: 4 are suitable when studying the relationship of the variables within countries and 3 pertain to the relationship between variables of different countries. The former set of tests is the most suitable for our study.

Pedroni (1995, 1997) showed that, with a slight correction, the statistics converge toward a normal distribution. Actually:

$$\frac{x_{NT} - \mu\sqrt{N}}{\sqrt{v}} \rightsquigarrow N(0,1)$$

where x_{NT} is one of the 4 statistics and μ and v are tabulated by Pedroni (1999). The results of the co-integration tests applied to Equation 1 are presented in Table B3. Two tests suggest that the variables are co-integrated but two others suggest the reverse. We follow Pedroni (2004) who being faced with the same type of results concluded that the variables are co-integrated.

Table B3. *Test of co-integration*

Statistics	Calculated value
Panel *v*- statistic	-3.9***
Panel ρ- statistic	4.35***
Panel t- statistic	-0.83
Panel ADF statistic	-0.14
	Critical values: 1.65 (5%) 2.33 (1%)

** = Significant at 5%, *** = Significant at 1%.