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PARIS-JOURDAN SCIENCES ECONOMIQUES
LABORATOIRE D'ECONOMIE APPLIQUÉE - INRA

48, BD JOURDAN – E.N.S. – 75014 PARIS
TÉL. : 33(0) 1 43 13 63 00 – FAX : 33 (0) 1 43 13 63 10
www.pse.ens.fr

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Capital Inflows and Exchange Rates in LDCs: The Dutch Disease Problem Revisited *

Mouhamadou Sy and Hamidreza Tabarraei

Paris School of Economics †
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Abstract

In this paper, the link between capital inflows and real exchange rate movements in LDCs is revisited theoretically and empirically. On the theoretical side we present a simple model to show that the real exchange rate depends mainly on "real fundamentals" such as terms of trade or productivity differentials. Empirically, we take into account the heterogeneity of the sample, the dynamics of the RER and the non stationary nature of the data. Capital inflows can be oil revenues, foreign aid, remittances or FDI. We show that real fundamentals are the main driving forces of real exchange rate movements in LDCs and not capital inflows. The Balassa-Samuelson effect by itself accounts for 57% of the RER variations while capital inflows account only for 19% of RER variations. The Dutch Disease theory is not rejected but its effect on RER movements in LDCs is weak.

Keywords: Dutch disease, capital inflows, exchange rate, heterogeneous panel
JEL Classification: F31, F35, F41

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†Paris School of Economics (PSE), 48 Boulevard Jourdan, 75014 Paris. Emails: sy@pse.ens.fr and tabarraei@pse.ens.fr, phone: +33(1)43136306.

1 Introduction

Many papers have been written on the impact of capital inflows on economic development. However, we observe that while there are big capital inflows toward developing countries, the impact on their growth rate is ambiguous. Capital inflows are defined as foreign aid, foreign direct investment, remittances and oil revenues. These capital inflows can be very substantial. For example, to achieve the millennium development goals, developed countries should spend more than 50$ billions before 2015 for foreign aid. The studies which have assessed the impact of foreign aid on the economic growth present an ambiguous picture. Recently, some studies with convincing methodologies find a slow impact of foreign aid on growth. Burnside and Dollar (1997) concluded that aid is efficient under certain conditions whereas Rajan and Subramanian (2005) showed that foreign aid has no impact on growth. The same pattern is repeated for the oil exporting countries.

The aim of this paper is to study the link between capital inflows and growth via the exchange rate. Theoretically, we show that exchange rates depend on real factors such as the productivity differential. This is conform to the literature by Balassa (1964), Samuelson (1964), Dornbusch (1980) and Edwards (1988) which postulates that real fundamentals affect the real exchange rate only through the relative price of nontraded goods. Empirically, we also show that the real exchange rate in LDCs is mainly explained by real factors and not so much by financial factors.

The negative consequences of capital flows on economic development are called the *Dutch disease* problem. The Dutch disease theory states that capital inflows have a negative impact on economic growth through real exchange rate over-valuation. The term Dutch disease was used first by the magazine *The Economist* in 1977, to describe economic problems in the Netherlands following the discovery of natural resources in the North Sea. Subsequently, economists used this term to describe an export slowdown caused by real exchange rate over-valuation due to the exploitation of natural resources such as gas or oil (Barder 2006). Now the term is used to explain all kinds of economic problems in developing countries following the discovery of natural resources or huge capital inflows like foreign aid, foreign direct investment or problems linked to huge sovereign debt. This paper aims to assess the impact of four international capital inflows: foreign aid, oil revenues, remittances and foreign direct investment on the real exchange rate of developing countries. For oil revenues the discussion remains mainly descriptive and theoretical due to the lack of data.

How can these capital inflows cause a Dutch disease? The answer is that they raise the amount of available non-tradable goods in the economy at the expense of tradable goods. When a government receives foreign currencies due to these capital inflows, it converts them at the central bank into the domestic currency. Recipient countries mainly use capital inflows in the social sector (Yano and Nugent 1999), for example on education and health. By building roads, hospitals or other

social infrastructure, an excess demand for non-tradable goods is generated. If the supply side is not flexible enough to cope with this new demand due to, for example, supply constraints, limited capacity of factor utilization or a lack of skilled manpower, the production cost in the non-tradable sector goes up. Consequently, the production cost of the tradable sector, which is measured in local currency, goes up whereas their prices, which are fixed by international markets, remain constant. The production and income in the tradable sector go down which results in a rise of non-tradable goods at the expense of tradable goods. The real exchange rate is the relative price between non-tradable and tradable goods. As we have seen above, theoretically, capital inflows cause a rising demand in non-tradable goods at the expense of tradable goods. This in turn increases non-tradable prices relative to tradable prices and an appreciation in the real exchange rate.

Two other aspects of the Dutch Disease are its *redistributive effect* and its link to the *transfer paradox*. Like any mechanism which changes the relative prices, the Dutch disease can also cause important redistributive effects within a country. The over-valuation of the real exchange rate due to capital inflows penalizes exporters and favors national producers of non-tradable goods. In developing countries, exported goods are mainly agricultural products and raw materials. This means that the real exchange rate over-valuation affects mainly peasants and government incomes. Contrarily, the national producers of non-tradable goods, particularly the suppliers of the government, are the main winners of relative price changes due to the Dutch disease.

The transfer paradox theory is developed by the discussions between J. M. Keynes and B. Ohlin over the consequences of German compensations at the end of the second world war. Keynes argued that theses war compensations would deteriorate in the long run the competitiveness of the winner countries by raising the prices of their tradable goods which would result in an appreciation in their real exchange rates. Later, in the early fifties, P. A. Samuelson formalized the question and showed that, under some conditions (mainly the stability of the Walrasian equilibrium), the transfer paradox cannot exist. Capital inflows are in fact transfers between countries, therefore, we can ask whether these transfers can cause a particular form of Dutch disease. Foreign aid as a form of capital inflows is studied by Yano and Nugent (1999). They showed that in a small open economy, foreign aid can cause a transfer paradox if and only if it is mainly spent on non-tradable goods.

The remainder of the paper is organized as follow: In the next section, we present our data and give some stylized facts on the Dutch disease. In section 3, we compare the related empirical literature to our work. In section 4, a simple model is presented in order to explain the links between the real exchange rate and the fundamentals. Section 5 contains the empirical part. Finally the last section gives economic insights of the results and then we conclude.

2 Data and the Stylized Facts

2.1 Data Sources

The data come mainly from the World Development Indicators (WDI, World Bank), the Penn World Table (PWT), the Organization of the Petroleum Exporting Countries (OPEC) and the Organization for Economic Cooperation and Development (OECD). Table 6 in the appendix summarizes our data sources and their definitions. The real exchange rate index is constructed in order to take the global competitiveness of each country into account. For a given country, this index is computed as a weighted average of different bilateral real exchange rates. The weighting variable is the importance of a commercial partner, i.e., import plus export over GDP. An arithmetic average is used despite of its drawbacks due to the lack of data. Results are the same for the original RER variable and the RER index, so we use the former variable. The sample is composed of 39 countries including annual data for the period 1970 - 2004 so $N = 39$ and $T = 35$. Table 4 and 5 list the descriptive statistics of these variables and the bi-variate correlation coefficients. Given the requirements of the econometric methodology used in this part, we follow Loayza and Rancière (2006) and include only countries that have at least 20 consecutive observations. For this reason our sample is restricted to 39 countries, see the appendix for a complete list.

2.2 The Stylized Facts

Figure 4 shows the evolution of our three capital inflow variables between 1970 and 2004. We see a break in trend since the beginning of the 1990s: The share of remittances and foreign direct investment grows rapidly to more than 2% of GDP while the share of foreign aid declines to well below 1% of GDP. In the appendix, we present bivariate scatterplots between the real exchange rate and its determinants in order to illustrate the Dutch disease phenomenon descriptively. Figure 3 shows the relationship between the logarithm of the real exchange rate and the logarithm of foreign aid in 2004, i.e., the last year in our sample. It is clear from the figure that a rise in foreign aid results in a real exchange rate appreciation. As a first approximation, this is what the Dutch disease theory predicts: Capital inflows such as foreign aid have a negative impact on economic growth through the real exchange rate appreciation.

Figure 5 in the appendix shows the trend of the bivariate link between the RER and foreign aid for the full sample period. Panel (5b) depicts the link between the trend in foreign aid and the RER movements (appreciation or depreciation). The former variable is computed using the coefficient of variation (standard deviation over the mean) in order to make comparison across countries meaningful. The

panel shows that the trend in foreign aid has no impact on the variation of the real exchange rate in LDCs and the R^2 is zero. Panel (5d) shows that foreign aid variation can affect exchange rate movements even at very low levels and the R^2 is equal to 2%. The same figure is depicted for the relationship between the real exchange rate and remittances in 2004, see panel (5e). This panel shows that a rise in remittances is associated with a small real exchange rate appreciation (the curve is almost flat, the R^2 is equal to one). In theory, remittances are associated to exchange rate appreciation since they are mainly spent on non-tradable goods.

The same analysis is done by using fundamentals other than capital inflows (foreign aid, oil revenues, remittances and FDI). Panel (a) and panel (c) of figure 5 show the relationship between exchange rate movements and the terms of trade. In contrast to foreign aid, the trend in the terms of trade is strongly correlated to exchange rate movements and the R^2 is equal to 11% (panel (a)). The terms of trade variations explain a huge exchange rate variation in which the R^2 is equal to 30% (b). Without other control variables, the effect of capital inflows on exchange rate movements doesn't appear to be very strong in LDCs. The strong relathionship between the real exchange rate and the Balassa-Samuelson effect is well documented by Rogoff (1996), where GDP per capita is used as the proxy of the B-S effect. In the following, we try to understand if this pattern can be confirmed theoretically and econometrically.

3 Related empirical literature

The main transmission channels of the Dutch disease are summarized in figure 1, an adapted and extended version of a figure by Rajan and Subramanian (2009), page 5. It gives a broader view on the link between capital flows and economic growth. The direct link between foreign aid (B) and economic growth (F) has been studied with different and sometimes contradictory results. By contrast, the transmission channels of capital inflows on economic growth are less studied. The main focus of this paper is the link between capital flows (A, B) and the real exchange rate (D).

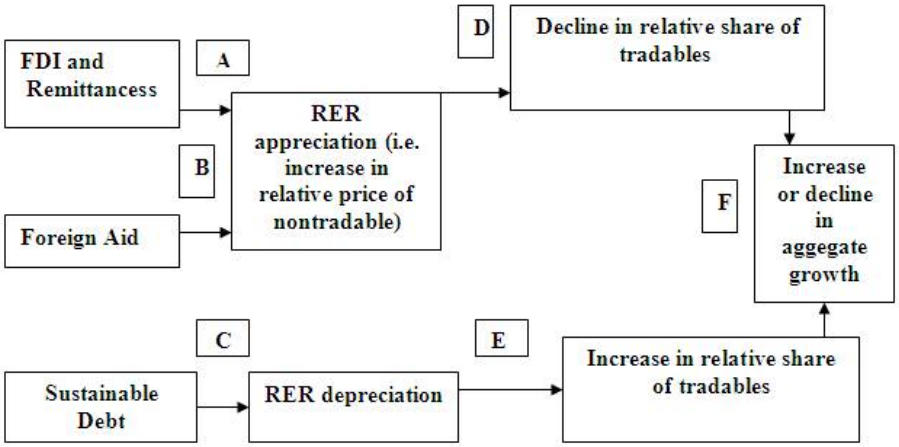

Figure 1: Link between Capital inflows, Real Exchage Rate and Growth

The results of papers are very different from each other. Some of them find the Dutch disease phenomena only in the short term while some of them find no evidence either for the short term or for the long term. For example, using cointegration techniques *à la* Engel and Granger, Elbadawi and Soto (1994) concluded that only long term capital inflows caused a real exchange rate over-valuation in the case of Chile, whereas there is no impact on the short run. In another paper, Nyoni (1998) showed that for Tanzania, a 10% increase caused a 5% depreciation in its real exchange rate, thus an absence of Dutch disease phenomenon in this country. Outtara and Strobl (2008) examined the link between foreign aid and real exchange rate in the CFA zone for in the short run and concluded that there is no Dutch disease. An increase in foreign aid by 10% is associated by an increase of only 1% in the real exchange rate.

Among the papers which use cross-country panels to study the Dutch disease are Lartey (2007) and Nwachukwu (2007) in which the focus is on the Sub-Saharan Africa. The first paper examined the capital inflows in a disaggregated way and, using GMM à la Arellano and Bond (1991), it concludes that foreign aid caused an exchange rate over-valuation, i.e. an increase in foreign aid by 1% caused an appreciation of 0.1% of the real exchange rate. The second paper also has the same conclusion using the same technique. The papers mentioned above have different results mainly because of the limitations of the methodology not because of sample differences. In a more microeconomic approach, Rajan and Subramanian (2009) looked into a manufacturing panel for a number of different countries. They find, foreign aid causes a loss in competitiveness through real exchange rate appreciation, which penalizes the export sectors, especially manufacturing industries. Theoretically, Pratti, Shahay and Tressel (2003) built a calculable general equilibrium model and after calibrating their model, they concluded that foreign aid causes a small

appreciation of the real exchange rate. The following table depicts some influential studies on the Dutch disease.

Authors	*Dutch disease cause*	*Sample and regions*	*Methods*	*Main finding*
Rajan and Subramannian (2009)	Aid flows	33 developing countries during 1980 and 1990	OLS and IV	Aid causes a loss of competitiveness through RER appreciation
Prati, Sahay and Tressel (2003)	Aid flows	All developing countries with no missing data on aid during 1960-1998	Calibration and GMM methods	Aid causes a small appreciation of RER
Elbadawi and Soto (1994)	Capital flows	Chile	Cointegration techniques	Depreciation of RER only in the long run
Nyoni (1998)	Aid flows	Tanzania	Cointegration techniques	Depreciation of the RER (no dutch disease effect)

Source: Authors' construction

Table 1: Selected influential empirical studies on the Dutch disease

4 Theoretical Framework

This section presents a model on the relationship between capital flows and the real exchange rate. Capital flows are defined as oil revenues, foreign direct investment or foreign aid. The model can be used for all three types of capital flows, but is best suited for an oil exporting economy.

There are two countries labelled as home and foreign. The firms in the each country produce in tradable and non-tradable sectors. Suppose that the home country is a developing country and therefore its technical progress level is relatively low. In this country, capital (from oil revenues) and labor are used to produce non-tradable goods, but only labor is used in the tradable sector (agricultural sector). We suppose that the foreign country is an advanced country, thus capital (the imported oil) and labor are used in the tradable sector, while only labor is used in producing non-tradable goods (services).

Home country The production function for the home country has a Cobb-Douglas form in the non-tradable sector:

$$Y_N = A_N L_N^{\beta} Q_N^{1-\beta}$$

Where A_N is the productivity in the non-tradable sector, L_N is labor in the non-tradable sector and Q_N is the capital used in the production process. Therefore, the profit of a representative active firm in this sector is

$$\pi_N = P_N Y_N - W L_N - (1-s) Q_N P^O$$

P^O can be interpreted as the price of one unit of capital or the international oil price, s is the government subsidy to domestic firms and W is the wage rate. The first order conditions are:

$$\beta P_N A_N \left(\frac{Q_N}{L_N}\right)^{1-\beta} = W \tag{1}$$

$$(1-\beta) P_N A_N \left(\frac{L_N}{Q_N}\right)^{\beta} = (1-s) P^O \tag{2}$$

In the tradable sector, the production function is a linear function of the labor force:

$$Y_T = A_T L_T$$

The price of tradables is normalized to one. Thus the profit is

$$\pi_T = A_T L_T - W L_T$$

The first order condition is:

$$A_T = W \tag{3}$$

Wages are equal in the tradable sector and non-tradable sector, hence the right hand side of equations (1) and (3) are equal. Combining this result with equation (2) yields:

$$P_N = \left(\frac{A_T}{\beta A_N}\right)^{\beta} \left(\frac{(1-s)P^O}{(1-\beta)A_N}\right)^{1-\beta} \tag{4}$$

Foreign country The tradable sector in the foreign country uses the imported resources (imported oil) from the home country and labor. Technology of production is Cobb-Douglas. The profit can be written as:

$$\pi_T^* = P_T^* Y_T^* - W^* L_T^* - e p^O Q^x$$

with

$$Y_T^* = A_T^*(L_T^*)^\gamma (Q^x)^{1-\gamma} \ .$$

The asterisk indicates the value in the foreign country and e is the nominal exchange rate. The first order conditions are:

$$\gamma P_T^* A_T^* \left(\frac{Q^x}{L_T^*}\right)^{1-\gamma} = W^* \tag{5}$$

$$(1-\gamma) P_T^* A_T^* \left(\frac{L_T^*}{Q^x}\right)^{\gamma} = eP^O \tag{6}$$

Under the assumption that the law of one price holds for the tradables we have $P_T^* = eP_T = e$ as we normalized the price of tradables in the home country. Equation (6) therefore can be simplified to:

$$(1-\gamma) A_T^* \left(\frac{L_T^*}{Q^x}\right)^{\gamma} = P^O \tag{7}$$

The non-tradable sector uses only labor as a production factor:

$$\pi_N^* = P_N^* Y_N^* - W^* L_N^*$$
$$Y_N^* = A_N^* L_N^*$$

The first order condition imposes $P_N^* A_N^* = W^*$. As in the home country, wages should be equal in the two sectors. Combining these conditions yields:

$$P_N^* = \gamma e \frac{A_T^*}{A_N^*} \left(\frac{(1-\gamma)A_T}{P^O}\right)^{\frac{1-\gamma}{\gamma}} \tag{8}$$

If we suppose that the price index is a geometric average of the prices of the tradables and non-tradables then the real exchange rate can be written as $RER = \frac{eP}{P^*}$ where

$$P = P_N^\theta P_T^{1-\theta}, \qquad P^* = P_N^{*\theta} P_T^{*1-\theta} \ . \tag{9}$$

By replacing equations (4) and (8) in the above equation, we get

$$RER = \left[\frac{\left(\frac{A_T}{\beta A_N}\right)^\beta \left(\frac{(1-s)P^O}{(1-\beta)A_N}\right)^{1-\beta}}{\gamma \frac{A_T^*}{A_N^*} \left(\frac{(1-\gamma)A_T}{P^O}\right)^{\frac{1-\gamma}{\gamma}}} \right]^\theta \ . \tag{10}$$

P^O is the price of oil or, the price of a unit of capital. However, since we normalized the price of tradables to 1, it is the terms of trade as well.
Log-linearization of the above equation yields:

$$\tilde{rer} = \theta \left[\left(\beta \tilde{a_T} - \frac{1}{\gamma} \tilde{a_T^*} \right) - \left(\tilde{a_N} - \tilde{a_N^*} \right) + \tilde{p^o} \left(\frac{1}{\gamma} - \beta \right) \right] \ . \tag{11}$$

This equation states that a positive change in the terms of trade, i.e. the price of capital, affects the real exchange rate positively (since $\frac{1}{\gamma} - \beta \geq 0$). In addition, the home country will experience a RER appreciation if its productivity growth advantage in tradable goods is bigger than its productivity growth advantage in the non-tradables. This represents the Balassa-Samuelson effect. The terms of trade and the Balassa-Samuelson effect therefore are the main driving forces of exchange rate movements in the long run. Even if our model is very simple, it successfully reproduces the literature by Balassa (1964), Samuelson (1964), Dornbusch (1980) and Edwards (1989) which postulates that real fundamentals are the main driving forces of the real exchange rate in developing countries. In the empirical part, we will add our capital inflow variables in order to check if the theoretical conclusion holds.

5 Econometric Analysis

5.1 Determinants of RER in developing countries

Our control variables are those obtained from the theoretical model plus the capital inflow variables. *Balassa-Samuelson effect*: The price gap between developed and developing countries is explained by the productivity gaps between tradable and non-tradable sectors which was first introduced by Balassa and Samuelson. An appreciation of the real exchange rate is predicted by the Balassa-Samuelson effect as developing countries economically converge toward developed countries. During this process, the productivity in the tradable sector rises more than the productivity in the non-tradable sector since the former is more exposed to international competition than the latter. Therefore, the Balassa-Samuelson effect is expected to cause a RER appreciation. We follow Rogoff (1996) and Rodrick (2008) by using gross domestic product per capita as the proxy for the Balassa-Samuelson effect but we build a a relative GDP in which the USA is the reference.

Terms of Trade is defined as the relative price of export and import. Terms of trade measure the impact of demand and supply of external factors on the tradable sector (Opoku-Afari et al 2004). An improvement in the terms of trade causes a rise of wages in the tradable sector as predicted by the Dutch disease theory. Generally, an improvement in the terms of trade can be decomposed into a substitution and an income effect: Due to the income effect more goods can be bought as the terms of trade improve. The substitution effect is due to the fall of relative prices of imported goods and a fall in demand for non-tradable goods, which reflects in the depreciation of the real exchange rate. Consequently, an improvement in the real exchange rate causes an appreciation of the real exchange rate if the income effect dominates the substitution effect.

Foreign aid causes a rise of demand for non-tradable goods relative to tradable goods. When supply is constrained prices of non-tradables go up relative to tradables which results in a real exchange rate appreciation. We used the official development assistance (net disbursements) calculated by the OECD. *Foreign direct investment*: Ceteris paribus, a rise in foreign direct investment increase the real exchange rate. We used net FDI inflows in percent of GDP calculated by the World Bank. *Remittances*: We use the percentage of workers' remittances, compensation of employees, and migrant transfers over GDP in current USD.

5.2 Methodology and Results

5.2.1 Pitfalls when studying exchange rates

The literature review in section 2 highlights the weaknesses of estimation methods in some studies. Most studies on the Dutch disease use panel data. Considering the heterogeneity of countries in the panel, and non-stationarity of most macroeconomic variables, standard panel estimators introduce many biases.

Heterogeneity remains an unresolved issue despite panel data techniques: In panel literature generally and in literature on the Dutch disease in particular, heterogeneity has not been treated in a convincing way. Cross-country comparisons must take heterogeneity into account explicitly. Standard panel estimators which homogenize the countries, give a very biased result (Pesaran and Smith 1995). The main goal of our study is to assess the impact of capital inflows on the real exchange rates of LDCs. By definition, the RER is the relative price of tradables and non-tradables, so not only the relative prices are different between countries but also between sectors within countries. These disparities are due to substitutability, tradability and transport cost differences (Imbs et al 2005). So the heterogeneity of the sample must be explicitly token into account.

Models of exchange rates must take its dynamics into account: Another problem which is often ignored by the literature on the Dutch disease is the dynamics of the real exchange rate in developing countries. In fact, many countries have fixed nominal exchange rates but their real exchange rates are subject to huge variations due to huge inflation movements. We must take into account the convergence of each RER toward its PPP. The main method used to take this problem into account, is to introduce lagged variables of the independent variable in the specification of the exchange rate. This introduces a new problem of endogeneity, and thus a new source of bias. However, we need to introduce these lagged variables on the explained variables in order to compute the rate of exchange rates convergence toward their equilibrium values (Rogoff 1996). Standard panel techniques (fixed effect or compound errors) don't allow to overcome these problems (Pesaran and Smith 1995). One way to do this is to use GMM techniques *à la* Arellano and Bond (1991). But even in this

case, under the heterogeneity assumption, estimated coefficients are biased (Imbs et al 2005).

Stationarity is a convenient assumption but often gives spurious results: The last problem which we discuss is the non-stationarity of most macroeconomic time series. As noted by Nelson and Plosser (1982), most economic time series are non-stationary and working with classical econometric techniques which assume data stationarity give spurious regression results.

The main contribution of the empirical part consists in the application of recent advances in time series and panel econometrics to the link between capital inflows and real exchange rates. The robustness of our conclusions depends mainly on the explicit consideration of sample heterogeneity and the dynamics and the non-stationarity of our variables.

5.2.2 Solutions by Pesaran and Smith (1999)

Table 6 and table 8 show that our variables are not stationary (see the appendix for a more detailed explanation of the stationarity tests). Standard econometric techniques give biased results when data are non-stationary (Granger and Newbold 1974). In last few years, most time series techniques have been adapted into panel econometric methodology. For the stationarity problem, Pesaran and Smith (1999) propose a flexible estimator for panels which allows to estimate stationary and non-stationary data. It also addresses the problem of heterogeneity.

Heterogeneity used to be taken into account by estimating each unit of the panel separately before estimating an unweighted average of coefficients. This is known as the Mean Group (MG) estimator, Pesaran et al (1995). At the other extreme, the Dynamic Fixed Estimator (DFE) imposes a parameter homogeneity both in the short and in the long run.

The Pooled Mean Goup (PMG) estimator by Pesaran and Smith (1999) is a more flexible method. It imposes the long term parameters to be the same and allows short term and convergence coefficients to vary across the different units of the panel. Under the assumption of long term coefficient homogeneity, PMG offers a more efficient estimators than MG. With the Hausman test, it is also possible to check if the assumption of homogeneity in long term parameters is restrictive or not.

In our case, we can simplify the PMG estimator (see Pesaran and Smith (1999) for a more formal treatment). We can write our equation of interest as

$$rer_{i,t} = \beta'_{i,j} X_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \ .$$

$t = 1, 2 \cdots T$, $i = 1, 2 \cdots N$, μ_i is a constant, δ_t is the time effect and X_{it} is a set of control variables. In this form, the model is not very different from fixed effect panel methodology. To introduce dynamics, an unrestricted AutoRegressive Distributed Lag (ARDL) is added (p, q$\cdots$q) where p is the number of lags of the endogenous

variable and q the number of lags of different explanatory variables. So the latter equation can be written as

$$rer_{i,t} = \sum_{j=1}^{p} \alpha_{ij} rer_{i,t-j} + \sum_{j=0}^{q} \beta'_{i,j} X_{i,t-j} + \mu_i + \delta_t + \varepsilon_{i,t} \ .$$

When the above equation is rewrited in a form of Vector Error Correcting Model (VECM) by imposing long term parameters to be the same and allowing short term and convergence coefficients to vary across the different units of the panel, we have the following equation:

$$\Delta rer_{i,t} = \phi_i (rer_{i,t-1} - \theta_{0i} - \sum_{s=0}^{S} \theta_{1i} X_{si,t}) - \sum_{s=0}^{S} \delta_{r1i} \Delta X_{si,t} + \varepsilon_{i,t}$$

where terms in the brackets are long term coefficients. If we impose only one lag in each variable, we can identify the parameters of interest. The coefficient of adjustment ϕ is given by $\phi = -(1 - \lambda_i)$ and the long term coefficients are $\theta_{0i} = \frac{\mu_i}{1-\lambda_i}$ and $\theta_{ri} = \frac{\delta_{r0i}+\delta_{r1i}}{1-\lambda_i}$. The Pooled Mean Group estimator imposes equality of the θ_i across countries.

5.2.3 Empirical Results

The methodology described above is applied to explain the determinants of real exchange rate movements. Effects of each variable in the short and long run are computed. Results are presented in Tables 9 and 10. We focus on the results of the Pooled Mean Group (PMG) estimator since the Dynamic Fixed Effect (DFE) gives theoretically and empirically biased results under the heterogeneity assumption. We don't present results of the Mean Group (MG) estimator since the Hausman test allows us choose between these two estimators.

The fist column in the Table 9 is the real exchange rate regression with respect to all variables. The second column is the regression on capital inflow variables (foreign aid, remittances and foreign direct investment) and the last column, is the regression of the real exchange rate on real fundamentals (gross domestic product per capita and terms of trade). Column 1 of the Table 9 contains the main result of this work. The Hausman test shows that we cannot reject the hypothesis of long run homogeneity which means that the PMG estimator is more efficient than the MG estimators.

For the proxy of the Balassa-Samuelson effect, a rise in GDP per capita causes a real exchange depreciation in the short run and in the long run. For the terms of trade, these increases also cause a depreciation in the short run and in the long run. The substitution effect therefore dominates the income effect in the short and in the

long run. We observe a deterioration in terms of trade for the period 1970-2004. All capital inflow variables have a significant impact on the real exchange rate: Foreign aid and foreign direct investment are associated to an exchange rate appreciation in the short run and in the long run which means that Dutch disease theory is validated. We will see below the relative size of these effects compared to other fundamentals. Remittances are associated to a real exchange rate appreciation only in the short run.

Considering the role of capital inflows as the only main determinant of the real exchange rate (Column 2 Table 9) gives the same results. However, the Hausman test rejects the homogeneity of the long run capital inflow elasticities. This implies a heterogeneous impact of capital inflows on the real exchange rate in developing countries. Another important result is the low speed of adjustment toward its long term value (-0.15), which emphasizes the persistence of the RER in LDCs.

A comparison between the results of the PMG estimator (Table 9) with those obtained by the DFE estimator (Table 10), reveals a bias in the DFE estimator. DFE is the generalization of the Fixed Effects (FE) estimator. It takes into account only the dynamics and not the non-stationarity. Under heterogeneity assumptions, it gives inconsistent estimates which reflects in the different results between the PMG and the DFE estimators. This explains the limitations of previous studies on the Dutch disease which use traditional panel data technique (fixed effects or error components) directly.

Even if the computation of elasticities and the discussion of their significance are important, they are not useful for economic policy. Following Elbadawi and Soto (2005), it is now common to compute the implied net effect. The results of our analysis are checked by computing the implied net effect of each determinant of the exchange rate movements. This is the product of the estimated long run coefficient and the standard deviation. We focus on the effect of one standard deviation change on the level of the variable. For the PMG estimator, we use long run elasticities. The result is depicted in figure 2. It shows that capital inflows have a low impact on exchange rate movements even if statistically they impact it significantly.

The main variables which explain real exchange rate variations in developing countries are the "real fundamentals": the Balassa-Samuelson effect and the terms of trade. In short, the results state that the Dutch disease channel can not explain the link between capital inflows and growth. Foreign aid, foreign direct investment and remittances are irrelevant as an explanation of real exchange rates in developing countries.

5.3 Robustness analysis

The main finding of the empirical part is that the Dutch disease exists but has no strong effect on the real exchange rate compared to other fundamentals like the

gross domestic product per capita or the terms of trade. As a robustness check, we do a variance decomposition of the real exchange rate. Using a Panel Vector AutoRegression (PVAR) of order three we calculate the explained share of each variable in the variance of the real exchange rate. The most general form of the model can be written as:

$$\Pi_{i,t} = \mu_i + \Theta(L)\Pi_{i,t-1} + \epsilon_{i,t}, i = 1, \cdots, N, t = 1, \cdots, T$$

where $\Pi_{i,t}$ contains six variables (real exchange rate, gross domestic product per capita, terms of trade, foreign direct investment, remittances and foreign aid). μ_i is the country idiosyncratic effect, $\epsilon_{i,t}$ is the residual error and $\Theta(L)$ is a lag operator with $\Theta(L) = \Theta_1 L + \Theta_2 L^2 + \cdots\cdots + \Theta_p L^p$.

Shocks are identified using Choleski decomposition in order to compute impulse response functions (IRF) [1]. This decomposition introduces some restrictions on contemporaneous correlations between variables. PVAR methodology is also useful to take into account the endogeneity problem and the interactive dynamics between the variables. Helmert transformation is used in order to remove the individual effects, i.e., the difference between each variable and its forward mean [2]. The result of the variance decomposition is summarized in the Table 2. According to this table, the terms of trade and the gross domestic product are the main factors which explain the real exchange movements (appreciation or depreciation). Capital inflows account for 19% of the variation of the RER in developing countries. In other words, using various recent econometric techniques doesn't change the results: The Dutch disease problem exists but its effect on the real exchange rate in developing countries is not very strong.

Table 2: Variance decomposition of RER in LDCs - 1970-2004

B-S Effect	TOT	Foreign aid	FDI	Remittances
57%	24%	9%	9%	1%

Source: Authors' calculation using a PVAR(3)

6 Discussion and Conclusion

Our main result is that capital inflows explain a small share of exchange rate movements in less developed countries, roughly 19%. This does not mean that capital

[1] Not reported here but available upon request.

[2] The variance decomposition is computed by using STATA code routines developed by Inessa Love.

inflows do not matter. Our conjecture is that capital inflows affect the real exchange rate in the short run and mainly the productivity in the long run. In other words, the impact of capital inflows on RER in the long run is another aspect of the Balassa-Samuelson effect. This is the reason for which theorically and empirically, productivity differentials is the main driving forces of real exchange rate movements in LDCs. To some extent, this finding is similar to Christopoulos et al (2008). They showed theoretically that in constrained economies, RER depends on productivity differentials and net foreign assets and on productivity only in unconstrained economies. We interpret this in a broader way, distinguishing the short run and the long run and evaluating the size effect of capital inflows on exchange rate movements.

The goal of this paper is to explain the effect of capital inflows such as foreign aid, remittances and foreign direct investment on the real exchange rate movements in developing countries. Dutch disease theory states that foreign aid impacts growth negatively through an appreciation of the real exchange rate. We tried to decompose the variation of the exchange rate by the variation of its individual components. Using recent techniques, developed in time series and panel data econometrics, we successfully disentangled exchange rate variation from variations due to real fundamentals to variations due to capital inflows. Roughly, 19% of real exchange variation in developing countries is explained by capital inflows and the rest by real fundamentals. Thus, our results do not reject the Dutch disease theory, but estimate that its effect on real exchange appreciation or depreciation is low compared to other factors which affect the RER. We believe this finding is important because the Dutch disease literature features contradictory results. Some papers find that capital inflows such as foreign aid are associated with real exchange rate appreciation, and some find the opposite.

Capitals inflows appear to impose a trade-off between some short run negative consequences following a real exchange rate appreciation as competitiveness reduces and long run economic growth through investments in education, health, etc. Foreign aid, by financing social infrastructures (Hall and Jones 1999) generates productivity gains which spread to the whole economy. From this point of view, capital inflows impact economic growth positively in the long run.

Note that the way on which capital inflows impact economic growth through the real exchange rate or other factors, depend mainly on how they are used (Nkusu 2004). The impact of capital inflows on economic growth in the long run depends mainly on its capacity to improve productivity and to relax the supply constraints (Barder 2006).

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7 Appendix

7.1 Descriptive Statistics

Table 3: Summarize Statistics for the Panel

Variable	**Mean**	**Std. Dev.**	**N**
RER	2.618	1.049	1412
FDI	1.449	2.368	1388
Foreign aid	4.605	6.794	1356
Remittances	2.453	3.248	1330
Terms of Trade	109.953	36.803	1272
GDP per capita	3935.216	2618.232	1412

Table 4: Correlation matrix between the different variables

	RER	GDP	TOT	AID	FDI	Remittances
RER	1.0000					
GDP	-0.3396*	1.0000				
TOT	-0.225*	-0.0826	1.0000			
AID	0.4317*	-0.6791*	-0.1201*	1.0000		
FDI	0.0184	0.1624*	-0.0858*	-0.0261	1.0000	
Remittances	0.3371*	-0.2976*	-0.1401*	0.4388*	0.0319	1.0000

Note: $*$ significant at 5%.

Foreign aid & FDI as capital inflows: Algeria, Argentina, Bolivia, Botswana, Brazil, Burkina Faso, Chile, Colombia, Congo Republic, Ecuador, Egypt, El Salvador, Gambia, Guatemala, Haiti, Honduras, Indonesia, Iran, Jamaica, Kenya, Madagascar, Malawi, Malaysia, Mexico, Morocco, Nicaragua, Niger, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, South Africa, Sri Lanka, Togo, Tunisia, Uruguay, Venezuela.

Oil Revenus, Foreign aid & FDI as capital inflows: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Qatar, Nigeria, Saudi Arabia, Venezuela.

7.2 Data description

Variables	*Definitions*	*Sources*
Foreign Aid	Ratio of aid to GDP	Development Assistant Committee
GDP per capita	GDP per capita relative to USA	Penn World Table 6.2 (PWT 6.2) and authors's calculations
Terms of Trade	Ratio of export price to import price	World Development Indicators 2006
Real Exchange Rate	Ratio of exchange rate to PPP conversion factors	Penn World Table 6.2 (PWT 6.2)
Real Exchange Rate Index	Arithmetic weighted average	Author's construction using PWT 6.2
Foreign Direct Investment	Ratio of net FDI to GDP	World Development Indicators 2006
Oil revenues	Net Oil Export Revenues	Organization of the Petroleum Exporting Countries
Remittances	Worker's remittances and migrant transfers	BoP Statistics (IMF), WDI 2006 and and authors's calculations

Source: Author's construction

Table 5: Data Sources and Definitions

7.3 Panel Unit Roots Tests used in the paper

We use three tests to check for stationarity in the variables. The first two are of the first generation and the third of the second generation.

Levin-Lin-Chu's test (2002): It is among the first generation of stationarity tests of panel data. Define y_{it} such that $i = 1, \cdots, N$ and $t = 1, \cdots, T$ where i and t are individual and time dimension. Levin, Lin and Chu (2002, page 4) consider that the data generating process of y_{it} is one of the following three models:

$$\begin{aligned}
&\text{Model 1 } \Delta y_{it} = \delta y_{i,t-1} + \varepsilon_{it} \\
&\text{Model 2 } \Delta y_{it} = \alpha_{0i} + \delta y_{i,t-1} + \varepsilon_{it} \\
&\text{Model 3 } \Delta y_{it} = \alpha_{0i} + \alpha_{i,t} + \delta y_{i,t-1} + \varepsilon_{it}
\end{aligned}$$

where ε_{it} are the errors terms which follow an ARMA process, $\varepsilon_{it} = \sum_{j=0}^{\infty} \varepsilon_{i,t-j} + \zeta_{it}$. So, in this test, the idiosyncratic constant (α_{0i}) and the trends ($\alpha_{i,t}$) vary across

individuals. The procedure of the test is sequential and goes from general to specific. The general model is

$$\Delta y_{it} = \delta y_{i,t-1} + \sum_{L=1}^{P_i} \theta_{iL} \Delta y_{i,t-L} + \alpha_{mi} d_{mt} + \varepsilon_{it}, m = 1, 2, 3.$$

and the statistic of the test is

$$LLC = \sqrt{1.25} \left[t_\delta - \frac{\sqrt{N} \varphi_{1T}}{\sqrt{\varphi_{2T}}} \right]$$

with $t_\delta = \frac{\hat{\delta}}{\hat{\sigma}_\delta}$, $\varphi_{1T} = -\frac{1}{2} - \frac{1}{2} T^{-1}$ et $\varphi_{2T} = \frac{1}{6} + \frac{5}{6} T^{-2}$
Non-stationarity is tested versus stationarity:

$$H_O : \delta = 0 \ VS \ H_A : \delta < 0$$

Im-Pesaran-Shin (2003): This test is an extension of the ADF test in a panel context. Let y_{it} be the variable for which we want to test for stationarity. The general model can be written as:

$$\Delta y_{i,t} = \mu_i + \alpha_i t + \rho_i y_{i,t-1} + \sum_{j=1}^{p} \phi_{ij} \Delta y_{i,t-j} + \varepsilon_{i,t}$$

whereas the previous test considered that ρ is homogeneous across countries, the IPS estimates each panel separately and computes the average of individual statistics, i.e., $t - bar_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{iT}$.

Under the null hypothesis, the authors show that the statistic of the test is (Im, Pasaran and Shin (2003), page 6.)

$$Z_{tbar} = \frac{\sqrt{N}(tbar_{NT} - N^{-1} \sum_{i=1}^{N} E(t_{T_i}))}{\sqrt{N^{-1} \sum_{i=1}^{N} Var(t_{T_i})}} \Longrightarrow N(0, 1)$$

null hypothesis is the non-stationarity

$$H_O : \rho_i = 0 \ \forall \text{ i } \ VS \ H_A : \rho_i < 0 \ \forall \text{ i}$$

The following figure gives the results of the different panel unit root tests. All variables are tested in level and in difference, with trend and without trend.

Table 6: Panel Unit Root Test: LLC & IPS

Levels: with intercept and trend			
variables	LLC (t-val.)	IPS (t-bar)	O-I
log(RER)	-21.67	-1.922	$I(1)$
log(Aid)	-22.60	-2.002	$I(1)$
log(TOT)	-14.37	-1.805	$I(1)$
log(FDI)	-29.20	-2.533	$I(1)$
log(GDP)	-14.05	-0.971	$I(0)$or$I(1)$
log(Remittances)	-11.89	-2.080	$I(1)$
First differences: with intercept			
variables	LLC (t-val.)	IPS (t-bar)	O-I
Δ(RER)	-32.63	-2.673	$I(1)$
Δ(Aid)	-39.06	-3.320	$I(1)$
Δ(TOT)	-40.16	-3.572	$I(1)$
Δ(FDI)	-48.81	-4.064	$I(1)$
Δ(GDP)	-16.34	-1.426	$I(0)$or$I(1)$
Δ(Remittances)	-17.31	-3.075	$I(1)$

Note: For IPS and LLC panel unit root tests, the 5 % critical value is - 1.645.

Pesaran (2007): Since many years ago, researchers have paid too much attention to the problem of unit root tests in heterogeneous panels. However, they assume that each time-series is independent from other cross-section time series in the panel. Many studies have proposed new panel unit root tests to overcome this problem, among them are Chang (2002), Choi (2002), Bai and NG (2004), Breitung and Das (2005) and Moon and Perron (2005).

The one we use here is proposed by Pesaran (2007). The suggested estimator in this article is cross-section augmented ADF or CADF. It is the cross-section averages of lagged levels and first difference of the individual series. A truncated version of the test is also used where the individual CADF statistics are suitably truncated to avoid undue influences of extreme outcomes that could arise when T is small (10-20).

Specifying the null-Hypothesis: Let y_{it} be the observation on the ith cross section unit at time t and suppose that is generated by the following process

$$y_{it} = (1 - \phi_i)\mu_i + \phi_i y_{i,t-1} + u_{it}, \quad i = 1, \ldots, N; \quad t = 1, \ldots, T \tag{12}$$

The error term has the single factor structure:

$$u_{it} = \gamma_i f_t + \sigma_{it} \tag{13}$$

Equations (12) and (13) can be combined as follow

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \gamma_i f_t + \varepsilon_{it} \tag{14}$$

where $\alpha_i = (1-\phi_i)\mu_i$, $\beta_i = -(1-\phi_i)$ and Δy_{it} is the first difference. The null hypothesis is therefore

$$H_0 : \beta_i = 0 \text{ for all } i \tag{15}$$

against

$$H_1 : \beta_i < 0 \quad i = 1, 2, \ldots, N_1, \beta_i = 0, i = N_1 + 1, N_1 + 2, \ldots, N \tag{16}$$

However the test is based on the t-ratio of the OLS estimate of b_i in the following cross-sectionally augmented DF (CADF) regression:

$$\Delta y_{it} = a_i + \beta_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + e_{it} \tag{17}$$

The limit distribution of the t-ratio is given by the formula (26) in Pesaran (2007). This is also the CADF statistic used in the test. Also critical values for the test for different cases including with intercept and with trend and intercept are shown in tables I to III in the article. Since this CADF statistics are asymptotically independent from the nuisance parameter, one possibility would be to consider a cross sectionally augmented version of the IPS test based on

$$CIPS(N,T) = t - \text{bar} = \frac{1}{N} \sum_{i=1}^{N} t_i(N,T) \tag{18}$$

in which $t_i(N,T)$ is the ith cross-section t-ratio of the coefficient of $y_{i,t-1}$ in the CADF regression defined in (17). IPS statistic is:

$$IPS(N,T) = \frac{\sqrt{N}\left\{t - \text{bar}_{NT} - E[t_{iT} \,|\beta_i = 0]\right\}}{\sqrt{\text{var}[t_{iT}|\beta_i = 0]}} \Rightarrow N(0,1) \tag{19}$$

where $t - \text{bar}_{NT} = N^{-1} \sum_{i=1}^{N} t_{iT}$ and t_{iT} is the t-ratio of the estimated coefficient of $y_{i,t-1}$ in the OLS regression of Δy_{it} on an intercept and $y_{i,t-1}$.

The above tests can be generalized for higher-order processes. For example for an $AR(p)$ the relevant individual CADF will be given by the OLS t-ratio of b_i in the following pth order cross-section augmented regression:

$$\Delta y_{it} = a_i + \beta_i y_{i,t-1} + c_i \bar{y}_{t-1} + \sum_{j=0}^{p} d_{ij} \Delta \bar{y}_{t-j} + \sum_{j=1}^{p} \delta_{ij} \Delta \bar{y}_{i,t-j} + + e_{it} \tag{20}$$

However it is useful to look at the cross-section dependence (CD) test statistics proposed by Pesaran (2004). The CD statistic is

$$CD = \left(\frac{TN(N-1)}{2}\right)^{1/2} \bar{\hat{\rho}} \tag{21}$$

where

$$\bar{\hat{\rho}} = \left(\frac{2}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right)$$

and $\hat{\rho}_{ij}$ is the pair-wise cross-section correlation coefficients of the residuals from these regressions. The null-hypothesis is zero dependence ($\gamma_i = 0$). The CD test is carried out at the 5% 2-sided nominal significant level. The null is rejected if $|CD| \geqslant 1.96$.

The CD test statistics are reported in table 7:

Table 7: CD statistics for the log value and first difference of variables

CD/Variables	ln(RER)	ln(Aid)	ln(TOT)	ln(FDI)	ln(GDP)	ln(Remittances)
$p = 1$	14.38	6.67	10.75	5.65	7.51	3.17
$p = 2$	10.83	7.05	10.79	4.67	6.81	3.16
$p = 3$	10.86	6.86	9.73	4.49	7.22	3.48
$p = 4$	11.25	5.74	9.26	4.90	6.18	2.83
CD/Variables	Δ(RER)	Δ(Aid)	Δ(TOT)	Δ(FDI)	Δ(GDP)	Δ(Remittances)
$p = 1$	7.99	5.42	10.74	2.88	7.14	3.98
$p = 2$	8.18	5.69	7.52	3.9	7.72	4.37
$p = 3$	7.84	5.76	8.45	3.98	6.17	4.11
$p = 4$	7.11	6.5	8.6	4.58	6.81	4.97

As it can be seen, the null hypothesis is rejected for all variables with first to forth order of generating process. Therefore the IPS and the LLC statistics reported in table 6 should be revised. In this case we should consider the CIPS test that allows for cross-section dependence.

Table 8: Panel unit root test with cross-section dependency using CIPS statistics for the log value and first difference of variables with intercept

CIPS/Variables	ln(RER)	ln(Aid)	ln(TOT)	ln(FDI)	ln(GDP)	ln(Remittances)
$p = 1$	-2.19	-2.297	-3.074	-3.667	-1.716	-2.042
$p = 2$	-2.283	-2.033	-3.075	-2.785	-2.028	-2.226
$p = 3$	-2.104	-1.824	-2.754	-2.515	-1.782	-1.885
$p = 4$	-2.299	-1.728	-2.543	-2.266	-1.791	-1.913
CIPS/Variables	Δ(RER)	Δ(Aid)	Δ(TOT)	Δ(FDI)	Δ(GDP)	
$p = 1$	-5.093	-6.288	-5.279	-7.136	-4.638	-4.323
$p = 2$	-4.068	-4.396	-4.559	-4.843	-3.732	-3.456
$p = 3$	-2.843	-3.563	-3.929	-4.122	-2.922	-3.005
$p = 4$	-2.724	-3.209	-3.509	-3.364	-2.564	-2.663

Table 8 shows the result for the CIPS statistics. The critical values for this test are calculated in table II of Pesaran (2007). The critical value of the CIPS statistic for $N = 38$ and $T = 34$ is around -2.14. Therefore according to the CIPS test the null hypothesis of unit root can be rejected at 5% level irrespective of the value of p for all variables except ln(GDP).

These result shows in order to investigate Dutch Disease problem in the LDCs countries, one should care about the non-stationarity of these variables.

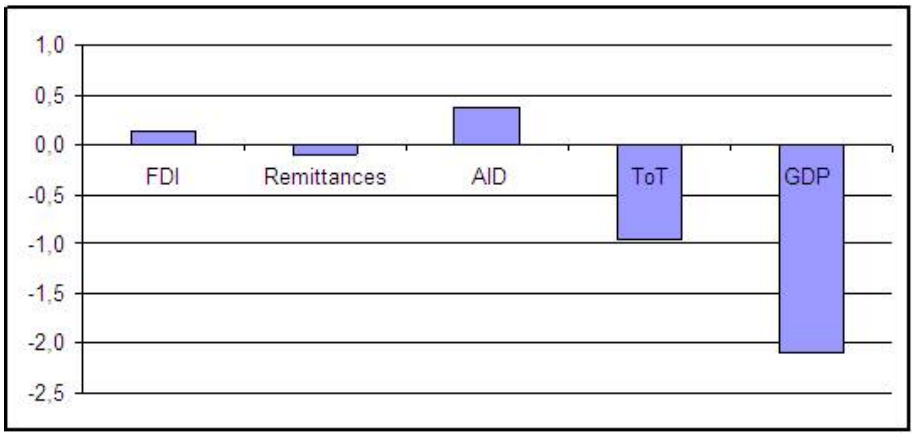
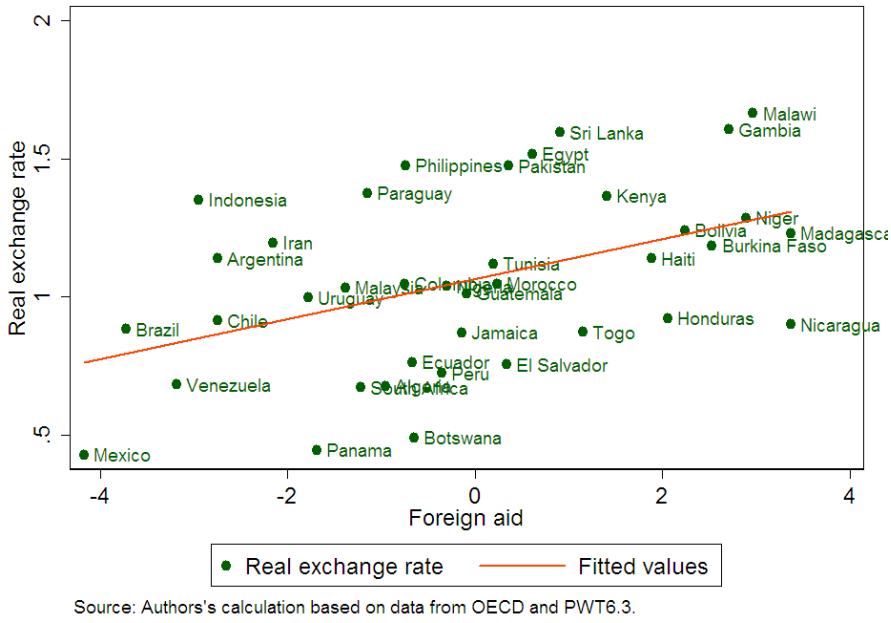


Figure 2: Implied net effect of each variable on RER



Source: Authors's calculation based on data from OECD and PWT6.3.

Figure 3: Unconditional correlation - RER and Foreign Aid in 2004.

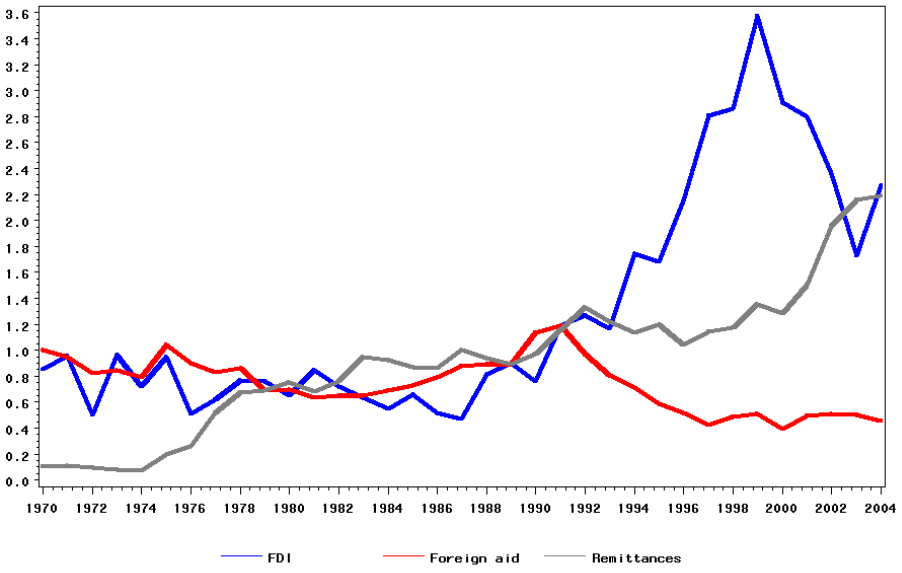


Figure 4: Capital inflows in LDCs - percent of GDP - 1970-2004

Table 9: Pooled Mean Group Parameters for the Real Exchange Rate.
Notes: Estimator includes Time Effect - 1970-2004. Newton-Raphson method is used to compute the log-likelihood function.

	All variables		**Capital variables**		**Real variables**	
Variables	Coef.	St. Er.	Coef.	St. Er.	Coef.	St. Er.
Long-Run Coefficients						
Time Effect	Yes		Yes		Yes	
FDI	0.092^{***}	0.015	0.080^{***}	0.015		
Foreign Aid	0.176^{***}	0.021	0.219^{***}	0.025		
Remittances	-0.06^{***}	0.017	-0.015	0.012		
Terms of Trade	-0.12	0.080			-0.974^{***}	0.109
GDP per capita	-0.33^{***}	0.080			-0.145^{*}	0.085
Joint Hausman Test	$h = 12.67$	$p = 0.03$	$h = 1.14$	$p = 0.76$	$h = 16.40$	$p = 0.0003$
Speed of Adjustment						
ϕ	-0.151^{***}	0.027	-0.156^{***}	0.031	-0.158^{***}	0.026
Short-Run Coefficients						
ΔFDI	0.008^{*}	0.005	0.0067	0.005		
ΔForeign Aid	0.055^{***}	0.012	0.057^{***}	0.013		
ΔRemittances	0.069^{**}	0.036	0.074^{**}	0.021		
ΔTerms of Trade	-0.009	0.067			0.070	0.057
ΔGDP per capita	-0.322^{***}	0.112			-0.409^{***}	0.111
	*** p<0.01, ** p<0.05, * p<0.1					
No Countries		39		39		39
No Observations		1365		1365		1365

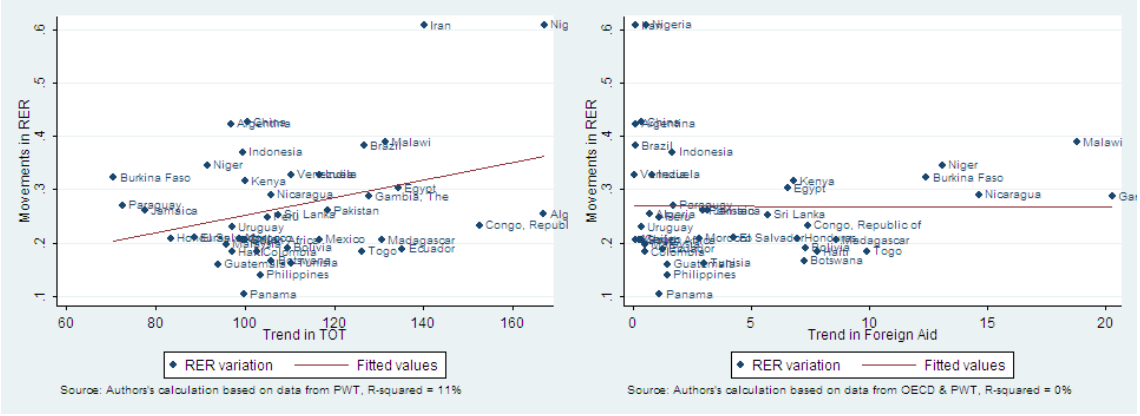
Source: Authors's estimations

Table 10: Dynamic Fixed Effect Parameters for the Real Exchange Rate.

Notes: Estimator includes Time Effect - 1970-2004. Heteroskedasticity corrected standard errors are used for the DFE and Newton-Raphson method is used to compute the log-likelihood function.

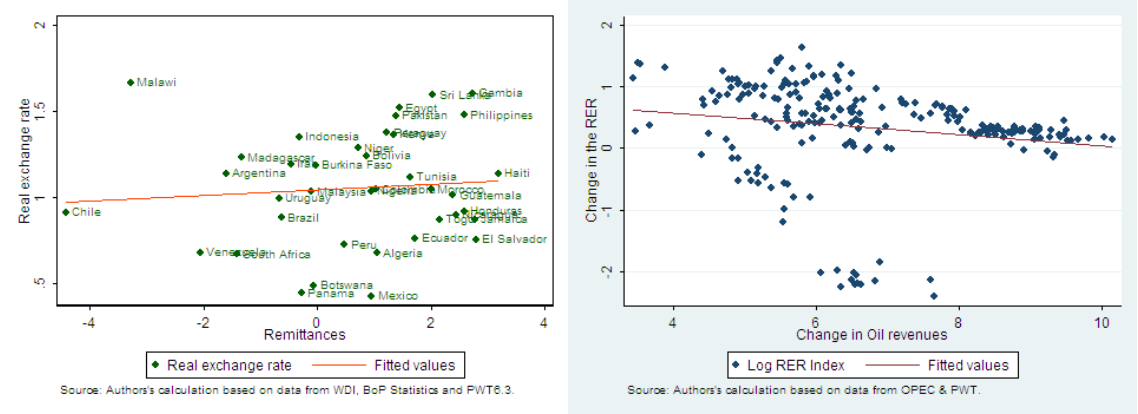
	All		**Capital variables**		**Real variables**	
Variables	Coef.	St. Er.	Coef.	St. Er.	Coef.	St. Er.
Long-Run Coefficients						
Time Effect	Yes		Yes		Yes	
FDI	0.027**	0.015	0.026*	0.016		
Foreign Aid	0.043	0.037	0.057	0.041		
Remittances	0.016	0.028	0.038	0.024		
Terms of Trade	−0.268**	0.142			−0.325***	0.144
GDP per capita	−0.208	0.180			−0.320***	0.155
Speed of Adjustment						
ϕ	−0.231***	0.044	−0.22***	0.047	−0.229***	0.042
Short-Run Coefficients						
ΔFDI	−0.007	0.007	−0.007	0.007		
ΔForeign Aid	0.041**	0.016	0.046**	0.018		
ΔRemittances	0.0317**	0.015	0.034**	0.014		
ΔTerms of Trade	−0.002	0.090			−0.007	0.088
ΔGDP per capita	−0.270*	0.150			−0.289*	0.158
		*** p<0.01, ** p<0.05, * p<0.1				
No Countries		39		39		39
No Observations		1365		1365		1365

Source: Authors's estimations



(a) RER variation vs TOT 1970-2004 (b) RER variation vs AID 1970-2004

(c) RER variation vs TOT variation 1970-2004 (d) RER variation vs AID variation 1970-2004



(e) RER and Remittances in 2004 (f) RER and Oil revenues 1970-2004

Figure 5: Bivariate scatterplots between RER and some of its determinants.