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14 January 2014

AFRICAN GOVERNANCE AND DEVELOPMENT INSTITUTE

A G D I Working Paper

WP/14/019

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 WP/19/14

AGDI Working Paper

Research Department

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Abstract

We assess the behavior of real effective exchange rates (REERs) of members of the CEMAC zone with respect to their long-term equilibrium paths. A reduced form of the fundamental equilibrium exchange rate (FEER) model is estimated and associated misalignments are derived for the period 1980 to 2009. Our findings suggest that for majority of countries, macroeconomic fundamentals have the expected associations with the exchange rate fluctuations. The analysis also reveals that, only the REER adjustments of Cameroon and Gabon are significant in restoring the long-term equilibrium in event of a shock. The Cameroonian economic fundamentals of terms of trade, government expenditure and openness have different long-term relations with the REER in comparison to those of other member states. Ultimately, there is no need for an adjustment in the level of the peg based on the present quantitative analysis of REER paths.

JEL Classification: F31; F33; F42; F61; O55
Keywords: Exchange rate; Macroeconomic impact; CEMAC zone

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1. Introduction

The euro area has come under immense pressure after its first decade. Triggered by adjustments in the fiscal accounts of Greece, the crisis which initially spread to Ireland and Portugal has become a threat to the euro zone's existence after Spain and Italy's sovereigns began experiencing funding pressures. This crisis reflects banking sector fragilities and intertwined public debt made worse by apparently weak growth outlooks, as well as substantial gross and net external liabilities[2]. German firms have continued their outward integration by setting-up production platforms in emerging Europe in order to take advantage of higher return on capital and lower wage costs which boosted competitiveness and exports. This easy financing continued until the crisis erupted and allowed deficit countries to sustain appreciating real effective exchange rates (which have also been driven by the nominal appreciation of the euro) and has delayed the adjustment needed to end the growing divergence of trade performance within the monetary union (Chen et al., 2012). The debate in the literature on structural adjustment and macroeconomic stabilization has emphasized the crucial role played by real exchange rate (owing to the importance of export promotion) for the generation of optimal paths of employment and output (Mussa, 1974; Edwards & Van Wijnbergen, 1986; Obstfeld & Rogoff, 1996; Acemoglu et al., 2003; Abdih & Tsangarides, 2010). The maintenance of exchange rates at an appropriate level has been credited for the success of certain developing countries. In the same vein, it is believed that a distinguishing feature of East and Southeast Asia's success with sustainable growth has been the consistent avoidance of overvaluation (Abdih & Tsangarides, 2010).

The spectre of the Euro crisis is hunting existing and embryonic monetary unions. Recent studies have shown that proposed African monetary unions of East and West Africa are not optimal currency areas (Asongu, 2012a). In the same light; real, monetary and fiscal policy

[2] For instance, net external liabilities of close to 100% of GDP in Greece, Ireland, Portugal and Spain.

convergence is absent within the Central African Economic and Monetary Community (CEMAC) CFA franc zone (Asongu, 2012b). The CFA franc arrangement dates back to the mid-1940s and is one of the longest-standing fixed exchange rate regimes in the world. This currency was devalued once in 1994, when a 50% adjustment in the nominal rate reversed domestic and external disequilibria that had built-up since the mid-1980s. Over the period 2002 to 2005, the CFA franc appreciated (by more than 30% in nominal terms vis-à-vis the US dollar) along with the euro to which it is pegged. This appreciation has led to a renewed interest in the prospects of and outlook for the CFA franc and reignited the debate on the sustainability of the peg, including whether the same peg to the euro for both monetary unions continues to be appropriate (Abdih & Tsangarides, 2010).

In light of the above, assessing the competitiveness of the CFA zone requires quantitative analysis of the actual and equilibrium exchange rates as well as adjustments of macroeconomic fundamentals to corresponding exchange imbalances. Previous empirical work on the CFA franc currency valuation has focused on the first few years after the 1994 devaluation, with particular interest of some studies in how real exchange rate misalignments were corrected by the 1994 change in parity (Clément et al., 1996; Devarajan, 1997; Baffes et al., 1999; Ahlers & Hinkle, 1999). To the best of our knowledge, studies on the effects of the recent appreciation of the euro on the CFA franc are scanty. Abdih & Tsangarides (2010) have recently evaluated whether the CFA franc is currently significantly over-valued from its equilibrium rate and concluded that the currency is not over-valued. While panel-based results as presented by Abdih & Tsangarides (2010) are important, they fail to account for country-specific dynamics that could have relevant policy implications. This is because, like in the current euro crisis, macroeconomic fundamentals maybe different across CFA franc countries. Hence, the need for country-specific analyses to complement existing literature.

In this article, we analyze the movements of the actual real effective exchange rate (REER) for countries within the CEMAC zone vis-à-vis long-term values. The rest of the paper is organized as follows. Section 2 presents the theoretical framework, data and methodology. Empirical analysis and corresponding discussion are covered in Section 3. Section 4 concludes.

2. Theoretical framework, Data and Methodology

2.1 FEER model specification

We estimate the reduced form of the Fundamental Equilibrium Exchange Rate (FEER) model (Edwards, 1989) using the Johansen's (1995) cointegration methodology in order to derive the equilibrium paths and corresponding misalignments for the period 1980-2009. The FEER approach is particularly appropriate in assessing if the movement of the REER represents a misalignment or if the Equilibrium Real Effective Exchange Rate (EREER) itself has shifted because of changes in the macroeconomic fundamentals (Abdih & Tsangarides, 2010). Consistently, we define equilibrium as the rate that results in the simultaneous attainment of internal and external equilibrium in the economy. Hence, internal equilibrium is achieved when the market for non-tradable goods clears in the present (and expected to clear in the future) as price and wage flexibility ensure that the condition of internal balance is satisfied (that is, demand equals to supply). Conversely, external equilibrium is achieved when the current account balance is at a 'sustainable' level as given by a sustainable threshold of capital flows. Accordingly, the long-run determinants of the EREER are defined by the following fundamentals. (1) 'Government spending' of which the expected sign is ambiguous in the absence of a breakdown of government spending into tradable and non-tradable goods[3]. (2)

[3] If government spending is primarily directed towards non-tradable (tradable) goods, an increase in government consumption will result in an appreciation (depreciation) of the REER.

'Productivity' with an expected positive sign that captures the Balassa-Samuelson effect[4]. (3) 'Terms-of-trade (TOT) in goods with also an expected positive sign that captures the wealth-effect[5]. (4) 'Investment' (of an ambiguous sign) which is included in the theoretical model because of supply-side effects that are dependent on the relative factor intensities across sectors[6]. (5) 'Degree of trade controls/restrictions' for which the sign is ambiguous[7].

2.2 Data and Methodology

We examine a sample of 4 CEMAC countries (Cameroon, Central African Republic, Gabon and Equatorial Guinea) due to constraints in data availability. The data include the following variables: the REER, productivity, government expenditure, TOT, investment and openness. The first two variables are presented in terms of natural logarithm to ease comparability and compatibility. Definition of variables (with corresponding) sources is presented in the Appendix.

Consistent with Abdih & Tsangarides (2010), we employ a Vector Error Correction Model (VECM). Application of the VECM presupposes the exhibition of unit roots in levels and the existence of a long-run equilibrium (cointegration). First, we employ the Augmented Dickey Fuller (ADF) test for unit roots or the order of integration of the series. Next, the Johansen (1988, 1991, 1995) maximum likelihood procedure is used to test for the corresponding long-run cointegration relationships between the exchange rate and its fundamentals. Then, the equilibrium levels of the fundamentals are computed specifically by extracting the permanent component from the fundamentals' series. Finally, the vector of long-

[4] An increase in the productivity of tradables vis-à-vis non-tradables of one country relative to a foreign country increases its relative wage, which leads to an increase in the relative price of non-tradables and hence, causes a REER appreciation.

[5] An appealing TOT shock induces an increase in the domestic demand, a corresponding increase in the price of non-tradable goods which leads to a REER appreciation. Alternatively from an internal-external balance angle, an increase in the TOT leads to an increase in real wages of the export sector and a trade surplus. For the external balance to be restored, the REER must appreciate.

[6] Since investment in a developing country may have a high import content, a rise in the investment share of GDP could shift spending towards traded goods, thus depreciate the REER. Hence, we expect a negative sign.

[7] As trade controls and barriers are lifted, increase in trade may either be import or export skewed and hence the need for depreciation or appreciation of the REER respectively.

term parameters and the extracted permanent component are combined to calculate the EREER, with misalignment estimated as the shift of the REER from its value in equilibrium.

3. Empirical analysis

3.1 Integration analysis

We perform the standard ADF tests both in levels and first differences of the variables under consideration. Optimal length selection for goodness of fit in the ADF specification is by the Akaike Information Criterion (AIC). From the reported t-ADF statistics in Table 1, but for investment in the Central African Republic (CAR), we cannot reject the null hypothesis of a unit root for all the variables in levels. However, the null of a unit root in first difference is strongly rejected. Hence, we conclude that the variables are overwhelmingly integrated in the first order; this is, they can be differenced once to obtain stationarity.

Table 1: ADF unit root test for variables

Countries	Variables	Level		First difference	
		c	ct	c	ct
Cameroon (1980-2009)	REER(ln)	-1.421	-2.020	**-3.828*** **	**-3.750** **
	TOT	**-2.693***	-2.636	**-5.185*** **	**-5.201*** **
	Gov't Spending	-2.491	-2.575	**-4.441*** **	**-4.497*** **
	Openness	-1.593	-1.182	**-3.327** **	**-3.764** **
	Productivity(ln)	-1.424	-2.105	**-3.401** **	**-3.391***
	Investment	-1.912	-1.243	**-3.324** **	**-3.429** **
Central African Republic (1980-2009)	REER(ln)	-1.287	-0.964	**-4.064*** **	**-4.181*** **
	TOT	-1.962	-1.988	**-4.735*** **	**-4.656*** **
	Gov't Spending	-0.547	-2.511	**-5.413*** **	**-5.833*** **
	Openness	-2.178	-2.746	**-5.916*** **	**-6.020*** **
	Productivity(ln)	-1.424	-2.105	**-3.401** **	**-3.391***
	Investment	**-3.030** **	**-3.444** **	n.a	n.a
Gabon (1980-2009)	REER(ln)	-1.085	-1.099	**-3.931*** **	**-3.986*** **
	TOT	-2.216	**-3.336***	**-5.428*** **	**-5.322*** **
	Gov't Spending	-1.861	**-3.384***	**-3.901*** **	**-3.752** **
	Openness	-2.057	-1.999	**-3.792*** **	**-3.721** **
	Productivity(ln)	-1.424	-2.105	**-3.401** **	**-3.391***
	Investment	-2.179	-2.586	**-5.600*** **	**-5.507*** **
Equatorial Guinea (1985-2009)	REER(ln)	-1.476	-1.311	**-3.223** **	**-4.455*** **
	TOT	-0.666	-2.193	**-2.617***	**-**2.259
	Gov't Spending	-0.639	-2.529	**-4.763*** **	**-4.581*** **
	Openness	-1.689	-1.441	**-2.871** **	-2.839
	Productivity(ln)	-1.429	-2.454	**-3.379** **	**-3.304***
	Investment	-1.243	-1.504	-2.553	-2.692

Notes. ***, **, *: denote significance at 1%, 5% and 10% respectively. 'c' and 'ct': 'constant' and 'constant and trend' respectively. REER: Real Effective Exchange Rate. TOT: Terms of Trade. Gov': Government. ln: logarithm.

3.2 Cointegration analysis

Let us specify a vector of variables Y_t as a vector autoregressive (VAR) equation in the form:

$$\boldsymbol{Y}_t = \pi_0 + \sum_{i=1}^{p} \pi_i \boldsymbol{Y}_{t-i} + \psi \boldsymbol{D}_t + \varepsilon_t \qquad (1)$$

Where Y_t is a (6×1) vector:

$$Y_t = \begin{pmatrix} REER_t \\ Terms\text{-}of\text{-}trade\ of\ goods_t \\ Government\ spending_t \\ Openness_t \\ Productivity_t \\ Investment_t \end{pmatrix}$$

where π_0 is a (6×1) vector of constants; π_i are (6×6) matrices of coefficients of lags of Y_t; D_t is a vector of the dummy-type variables; p is the lag length; and ε_t is the (6×1) vector of independent and identically distributed error terms that are assumed to be normal with zero mean and covariance matrix Ω. As such, the VAR is made up of a system of six equations where the right-hand side of each equation comprises a common set of lagged and deterministic regressors. The VAR specification in Eq. (1) provides the basis for cointegration analysis. Hence, adding and subtracting various lags of Y_t yields an expression for the VAR in first difference:

$$\Delta \boldsymbol{Y}_t = \pi_0 + \pi \boldsymbol{Y}_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta \boldsymbol{Y}_{t-i} + \psi \boldsymbol{D}_t + \boldsymbol{e}_t \qquad (2)$$

where Δ denotes the difference operator, $\Gamma_i = -(\pi_{i+1}+,...,+\pi_p)$ is a (6×6) coefficient matrix, and $\pi \equiv \left(\sum_{i=1}^{P} \pi_i\right) - I$

(i) If (rank) $\pi = 6$ or (rank) $\pi = 0$, then cointegration exist among the variables. In this case, it is appropriate to estimate the model in levels for [for rank $\pi = n$] and first difference [for rank $\pi = 0$].

(ii) If (rank) $\pi > 0$ or (rank) $\pi \equiv r < 6$, then there are r cointegrating vectors/relationships. In this case, matrix π can be expressed as the outer product of two full column rank $(6 \times r)$ matrices α and β where $\pi = \alpha\beta$.

From the results presented in Table 2 below, the second condition (ii) for cointegration above is satisfied. Hence, there is evidence of a long-run relationship between the REERs and their identified fundamentals for all the four countries under consideration.

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Table 2: Johansen cointegration test

		Eigenvalue	Trace test	Max-Eigen test
Cameroon	None	0.905	**164.96*** **	**61.428*** **
	At most 1	0.793	**103.53*** **	**43.332*** **
	At most 2	0.675	**60.202** **	**30.593** **
	At most 3	0.440	29.609	16.069
	At most 4	0.308	13.541	7.943
	At most 5	0.183	5.597	5.597
Central African Republic	None	0.675	**81.161** **	31.477
	At most 1	0.553	49.685	22.573
	At most 2	0.410	27.112	14.817
	At most 3	0.277	12.295	9.114
	At most 4	0.107	3.180	3.180
	At most 5	n.a	n.a	n.a
Gabon	None	0.833	**128.97*** **	**50.269*** **
	At most 1	0.606	**78.703** **	26.138
	At most 2	0.581	**52.565** *	24.377
	At most 3	0.457	28.188	17.145
	At most 4	0.200	11.043	6.271
	At most 5	0.156	4.771	4.771
Equatorial Guinea	None	1.000	**1362.2*** **	**612.74*** **
	At most 1	1.000	**749.46*** **	**600.96*** **
	At most 2	0.985	**148.50*** **	**71.804*** **
	At most 3	0.950	**76.695*** **	**51.212*** **
	At most 4	0.665	**25.483*** **	**18.604** **
	At most 5	0.332	6.879	6.879

Notes. ***, **, *: denote significance at 1%, 5% and 10% respectively. 'c' and 'ct': 'constant' and 'constant and trend' respectively. Model specification is by AIC with 2 maximum lags.

With condition (ii) satisfied, the VAR can be expressed as a VECM:

$$\Delta Y_t = \pi_0 + \alpha\beta' Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \psi D_t + e_t \qquad (3)$$

The matrix β' contains the cointegrating vector(s) and the matrix has the weighting elements for the rth cointegrating relation in each equation of the VAR. The matrix rows of

$\beta' Y_{t-1}$ are normalized on the variable(s) under consideration in the cointegrating relation(s) and interpreted as deviations from the long-term equilibrium condition(s). In this context, the column of α represents the speed of adjustment to the long-term equilibrium. The estimated vector can be used to provide a measure of the EREER and also quantify the misalignment margin between the prevailing exchange rate and its equilibrium level. The estimated α associated with the REER captures the speed at which the real exchange rate convergences to the equilibrium state. Optimal lag selection for goodness of fit in model specifications is in line with the recommendations of Liew (2004)[8].

3.3 Cointegration coefficients and adjustments

We have observed from Table 2 that, there is evidence of a long-term relationship between the REERs and their identified fundamentals in the four CEMAC countries investigated. Table 3 contains the results from estimating the VAR/VECMs in Eq. (3) for each of the four countries. The table is divided into two panels, with Panel A reporting estimates for the cointegrating vectors (the βs) together with their standard errors and Panel B reporting the adjusting (feedback) coefficients estimates (the αs) and their t-statistics. The resulting cointegration equations have some signs that are consistent with the predictions from economic theory, while some do not. These asymmetric country-specific dynamics cannot be obtained from a panel-based analysis and thus, provide justification for our problem statement and the complementary character of the present study with respect to Abdih & Tsangarides (2010).

[8] "*The major findings in the current simulation study are previewed as follows. First, these criteria managed to pick up the correct lag length at least half of the time in small sample. Second, this performance increases substantially as sample size grows. Third, with relatively large sample (120 or more observations), HQC is found to outdo the rest in correctly identifying the true lag length. In contrast, AIC and FPE should be a better choice for smaller sample. Fourth, AIC and FPE are found to produce the least probability of under estimation among all criteria under study. Finally, the problem of over estimation, however, is negligible in all cases. The findings in this simulation study, besides providing formal groundwork supportive of the popular choice of AIC in previous empirical researches, may as well serve as useful guiding principles for future economic researches in the determination of autoregressive lag length"* (Liew, 2004, p. 2).

From Panel A, the following could be established. (1) But for Cameroon, the TOT are positively correlated with the REER indicators such that, an improvement in the TOT would result in an appreciation of the long-run EREER through a possible wealth-effect. The Cameroonian case implies that, an increase in the TOT does not lead to an increase in non-tradables through the wealth-effect. (2) With the exception of the CAR, government consumption has a positive (appreciating) impact on REER, suggesting that most government spending is directed towards non-tradables. (3) But for Cameroon, increases in openness are associated with depreciation of the REER through increases in imports. (4) The relative high long-term impact of technological progress (proxied by the relative real GDP per capita) confirms the Balassa-Samuelson effect for Gabon and Equatorial Guinea. Hence, productivity in Cameroon and the CAR does not lead to an increase in the export of tradables and corresponding increase in wages and demand for non-tradables that ultimately appreciate the REER. (5) Investment is negatively correlated with the REER only in Cameroon, confirming the hypothesis that investment has a high import content and increases spending towards tradable goods. This is not the case with the other countries.

Panel B of Table 1 shows the feedback coefficients for the cointegrating vectors or the short-run relationships of the REER and its fundamentals. Some adjustments are significantly different from zero, implying that these fundamentals are not weakly exogenous with respect to the parameters of the cointegration relationship. In the face of any deviation from the long-term equilibrium, these variables jointly respond and adjust the system back to equilibrium. The fundamentals of Cameroon are significantly strong in adjusting the system to the equilibrium. Openness and productivity are not significant fundamentals in adjusting the REER of all countries under consideration. Conversely, the TOT is a significant instrument for adjusting the REER in all countries, followed by government spending and investment in two of the four countries. Furthermore, the feedback coefficient for the REER is only significant for Cameroon

and Gabon, confirming these countries as the backbones of the CEMAC economy. The significant negative adjusting terms of the 'REER change' for these two countries also suggest the stability of the error correction mechanism. As a matter of principle, the speed of adjustment of the parameters should be between zero and 'minus one' (0, -1). If the Error Correction Terms (ECTs) are not within this interval, then either the model is misspecified (and needs adjustment) or the data is inadequate (perhaps owing to issues with degrees of freedom)[9].

Table 3: Cointegration and short-term adjustment coefficients

	Cameroon	Central A. R	Gabon	Equatorial G.
	Panel A: Estimates of cointegration relationships			
TOT	-3.557[0.641]	1.886[0.232]	2.678[0.508]	0.862[0.000]
Gov't Spending	0.262[0.040]	-0.039[0.009]	0.364[0.044]	0.097[0.000]
Openness	0.026[0.009]	-0.017[0.004]	-0.030[0.014]	-0.006[0.000]
Productivity(ln)	-0.306[0.213]	-0.049[0.108]	2.425[0.281]	0.392[0.000]
Investment	-0.151[0.033]	---	0.030[0.027]	0.024[0.000]
constant	1.523[3.213]	-4.396[1.276]	-35.844[3.654]	-11.525[0.000]
	Panel B: Estimates of short term adjustment coefficients			
D[REER(ln)]	**-0.153(-4.083)*** **	0.009(0.049)	**-0.074(-2.355)** **	-0.036(-0.852)
D[TOT]	**0.143(2.169)** **	**-0.352(-2.660)** **	**-0.196(-1.868)***	**-0.501(-2.874)** **
D[Gov't Spending]	**-0.918(-1.951)***	**14.281(4.771)*** **	-0.723(-0.949)	2.081(0.606)
D[Openness]	3.940(1.525)	13.06(1.223)	-0.086(-0.029)	37.100(1.603)
D[Productivity(ln)]	0.038(0.866)	0.072(0.504)	0.000(0.035)	-0.009(-0.304)
D[Investment]	**-2.073(-2.817)** **	---	2.210(1.120)	**20.479(1.952)***

Notes. *, **, ***: denote significance levels at 10%, 5% and 1% respectively. Model specification is by AIC with 2 maximum lags. The deterministic trend assumption is a restricted constant. [ ]: standard errors. ( ): t- statistics. D[ ]: First difference.

4. Conclusion and policy recommendations

With the help of a dynamic model of a small open economy and the Johansen cointegration methodology, the EREERs have been analyzed for countries in the CEMAC zone. The objective has been to analyze REERs imbalances and assess whether the movements in the aggregate real exchange rates are consistent with the underlying macroeconomic fundamentals. We have shown that, from country-specific perspectives the long-term behavior

[9] "*The error correction term tells us the speed with which our model returns to equilibrium following an exogenous shock. It should be negatively signed, indicating a move back towards equilibrium, a positive sign indicates movement away from equilibrium. The coefficient should lie between 0 and 1, 0 suggesting no adjustment one time period later, 1 indicates full adjustment. The error correction term can be either the difference between thedependent and explanatory variable (lagged once) or the error term (lagged once), they are in effect the same thing*" (Babazadeh & Farrokhnejad, 2012, p.73).

of the REERs can be explained by fluctuations in government expenditure, terms of trade, openness, productivity and investment. We have found evidence of significant misalignments in the REER only in Cameroon and Gabon. The negative feedback terms of the exchange rates suggest that adjustments will restore the long-run equilibrium. Had the adjustments been positively significant, this would have implied a further deviation from the long-run equilibrium to a new equilibrium. Hence, we can infer that based on the available weight of evidence, there is yet no need for an immediate adjustment in the level of the peg. In theory, fixed exchange rate regimes can be sustainable as long as actual deviations from long-term equilibrium rates are small and mean reverting. Conversely, if deviations are one-sided and build up to longer-term significant misalignments, it is generally argued that (in addition to demand-side management policies) real exchange rate action may be required to restore balance. Hence, based on the estimated paths there is yet not a very clear pattern of over-valuation as was the case prior to the 1994 devaluation.

As a policy implication, there is no need for an adjustment in the level of the peg based the present country-specific quantitative analysis of the path of the REERs in the CEMAC zone. However, exhaustive analysis of the environment that affects the overall sustainability of the CFA franc arrangement necessitates an examination of possible pressures on balance of payment flows, reserve levels, losses of competitiveness, sustained deviations from country-specific EREERs and unfavorable market perceptions. We have also observed that, but for a few exceptions, the impact of the fundamentals on the REER are similar across countries. For fundamentals that did not meet expected signs (with respect to the REER), it is up to the authorities in place to adopt relevant measures to adjust the tendencies. This is particularly the case of Cameroon with respect to the terms of trade, government expenditure and openness.

Appendix

Appendix 1: Variable definitions

Variables	Signs	Variable definitions	Source
Real Effective Exchange Rate	REER	Natural Log. of REER	WDI (World Bank)
Terms of Trade	TOT	Exportable Commodities/Importable Commodities	WDI (World Bank)
Government Spending	Gov't	Government final consumption expenditure (% of GDP)	WDI (World Bank)
Openness	Trade	Imports plus Exports of Commodities (% of GDP)	WDI (World Bank)
Productivity	Prod.	Natural Log. of real GDP per capita.	WDI (World Bank)
Investment	Invt.	Gross Fixed Capital Formation (% of GDP)	WDI (World Bank)

Log: Logarithm. GDP: Gross Domestic Product. WDI: World Domestic Indicators.

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