A Work Project, presented as part of the requirements for the Award of a Master's Degree in Economics from the Nova School of Business and Economics

The Accommodation of Terms of Trade Shocks under Different Exchange Rate Regimes: an empirical investigation using a panel of 40 emerging economies along the period 2000-2019

Maria Almeida Dias Leite

50705

Work Project carried out under the supervision of:

Miguel Lebre de Freitas

20-12-2023

The Accommodation of Terms of Trade Shocks under Different Exchange Rate Regimes: an empirical investigation using a panel of 40 emerging economies along the period 2000-2019

Abstract

Using a panel of 40 emerging economies along the period from 2000 to 2019, we assess whether the short-term adjustment of per capita income to an estimated long-run path in response to a terms of trade shock is conditional on the exchange rate regime. We find that countries under crawling peg tend to be more affected by terms of trade shocks. Our findings are mixed, not giving a clear support to the conventional wisdom that floating regimes provide a better insulation of domestic output to terms of trade shocks than fixed exchange rate regimes. Our model was estimated correcting for heteroskedasticity and autocorrelation.

Keywords:
Exchange rate regimes; Terms of trade; Growth; Emerging economies

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

1. Introduction

In this paper, we use a panel regression analysis to investigate whether the exchange rate regime matters for the output adjustment to terms of trade shocks.

Deciding which exchange rate regime a country should adopt impacts the country's economic dynamics and its performance. Not only are the monetary policy conduction and interest rates affected by this choice, but so are trade competitiveness, inflation, foreign direct investment, capital flows, crises management, and economic growth. Authors who endorse flexible exchange rate regimes claim that they deliver greater ability to adjust to shocks (Friedman, 1953). However, there are some authors who rejected such claim (Baillieu et al., 2003; Chinn and Wei, 2013; Gylfason, 2000). Regarding growth, there are many theoretical considerations on the implications that the exchange rate regime plays on output growth, either through trade, investment, or productivity (Ghosh et al., 1997). Therefore, it becomes an empirical issue. However, empirical works have failed to reach a consensual conclusion (Baxter and Stockman, 1989; Mundell, 1995).

This paper focuses on the question as to whether fixed exchange rate regimes weigh on the adjustment to terms of trade shocks. Using a panel of 40 emerging economies along the period from 2000 to 2019, we investigate whether the exchange rate regime matters for the output adjustment to terms of trade shocks. More specifically, we focus on the short-term adjustment of per capita GDP to an estimated trend, controlling for long-term determinants of economic growth (Barro, 1991). Our aim is to assess whether convergence of actual output to the long-run output trend occurs at different paces across different exchange rate regimes.

We observe a non-linear efficiency pattern in response to terms of trade shocks across the exchange rate regimes. Countries under the crawling peg regime appear to be more significantly affected by changes in terms of trade. Additionally, our analysis reveals asymmetrical output responses to positive and negative shocks. Depending on the sign of the shock, either the fixed regime or the float regime emerges as the most efficient in absorbing the shocks. Moreover, restricting our analysis to meaningful values, we find that the float regime exhibits the highest rate of output convergence.

The rest of the paper structure is as follows. Section 2 reviews the related literature. Section 3 describes the methodology used, presenting the model estimated and the data. Section 4 shows the estimation results. Section 5 concludes.

2. Literature Review

There is a debate on the advantages of each exchange rate regime, nevertheless the exchange rate regime is relevant for macroeconomic performance.

The claim that the macroeconomic adjustment to terms of trade shocks is easier under float goes back from Meade (1951). This author argued that countries under floating exchange rate regimes are able to mitigate real external shocks. This holds an advantage, because the adjustment process after facing a shock will represent a lower cost. Along the same avenue, Friedman (1953) contended that the adjustment derived from a real shock is dependent on the nominal exchange rate flexibility, once relative price changes are faster. That is, the real exchange rate must appreciate (depreciate) when a country faces a positive (negative) real shock, which is easily succeeded when the nominal exchange rate is allowed to float, in an economy with sticky prices.

In a contrasting view, a number of authors pointed the outcomes of fixed regimes. Ghosh (1997) stated that hard pegs are associated with lower inflation and lower output growth, thus opting for a fixed exchange rate is prudent when the country has historical high levels of inflation, and when it is deeply connected in current account transactions to other country or a group of countries (Fisher, 2001).

Eichengreen and Haussman (1999) explored a discussion coined as the “balance-sheet effect”, that presents a case in which it is possible to observe not only the failure of exchange rate flexibility to insulate the economy from external shock, but also the existence of greater consequences in countries under flexible exchange rate regime due to external shocks. It states that letting the exchange rate float in countries whose liabilities are denominated in a foreign currency, will possibly result in a higher debt value when denominated in domestic currency.

The question whether flexible exchange rate regimes have in fact the ability to work as shock absorbers was examined by Broda (2003), who tested whether the response of real GDP, real exchange rate and prices to terms of trade shocks differ across exchange rate regimes, in emerging economies, and realized significant differences, in support of Friedman’s hypothesis. Edwards and Levy-Yeyati (2005) confirmed the floating regimes proponents claims, showing strong results that a flexible exchange rate regime reduces the real impact of terms of trade shocks, they also established that the real growth sensitivity to terms of trade shocks is asymmetric, presenting a higher sensitivity to negative shocks than to positive shocks. Martin (2016) found evidence of a faster current account adjustment process in countries with flexible exchange rate regimes. Ghosh et al. (2019) claimed that the use of multilateral exchange rate regime classifications was the reason behind the no robust evidence that previous papers had ran into, but also reached the conclusion that there is a strong connection between exchange rate flexibility and efficient external adjustments. To study the effect of exchange rate regimes on the output response to terms of trade shocks, Carrière-Swallow et al. (2021) performed a PVAR estimation and showed how the adjustment of the real exchange rate occurs when the nominal exchange rate is allowed to adjust, while also finding strong evidence of the presence of a shock absorbing property in flexible exchange rate regimes.

Chinn and Wei (2013) found no evidence of an association between exchange rate regime flexibility and the current account reversion rate. They stated that real exchange rate matters for current account adjustments, but they failed to verify a relationship between the flexibility of a nominal exchange rate regime and the pace of convergence in real exchange rates, criticizing policies aiming the nominal exchange rate. So, while exchange rate regime flexibility is often associated with the absorption and rapid adjustment of external shocks, this work highlighted the complexity of factors influencing external dynamics, and suggested that, at least in their analysis, nominal exchange rate flexibility didn't play a role in determining the speed and efficiency of responses, opposing Friedman's claims.

The buffering role that flexible exchange rate regimes play is highlighted as a valuable tool during booms, facilitating adjustments in response to positive terms of trade shocks through expenditure switching, which means that the exchange rate adjustment induces the reallocation of the increased spendings, in contrast, in terms of trade busts episodes, the exchange rate flexibility is less critical, since a rapid external adjustment is achieved even under hard pegs (Adler et al., 2018).

The most relevant empirical models constructed to evaluate the adjustment to terms of trade shocks between different exchange rate regimes were estimated utilizing different strategies. Carrière-Swallow et al. (2021) used a PVAR framework with interacted terms proposed by Towbin and Weber (2013), which allowed the coefficients to vary deterministically with the exchange rate regime classification. Broda (2003) used a PVAR. Edwards and Levy-Yeyati (2005) formulated a two-equation model to capture real GDP per capita growth dynamics that was estimated using a feasible generalized squares (FGLS) proposed by Beck and Katz (1995), resulting in asymptotically efficient estimators. In this paper, we follow the Edwards and Levy- Yeyati (2005) approach.

3. Methodology

3.1. Model

In this paper, our goal is to answer which exchange rate regime accommodates terms of trade shocks more efficiently, leading to less fluctuations in economic growth. The empirical analysis is carried out through the two-equation model proposed by Edwards and Levy-Yeyati (2005). This model captures the dynamics of real GDP per capita growth of country i in year *t* and is formulated as follows. Equation (1) represents the long-run rate of real per capita GDP growth and Equation (2) represents the growth dynamics process.

$$g_i^* = \alpha + X_i\beta + \varepsilon_i \tag{1}$$

Where g_i^* is the long-run rate of real per capita GDP growth, X_i stands for the vector of control variables, β is the vector of coefficients and ε_i is a heteroskedastic error term. Disentangling the variables inside X, we adopt the following formulation:

$$g_i^* = \alpha + \beta_1 \ln(GDPin_i) + \beta_2 pop_i + \beta_3 inv_i + \beta_4 educ_i + \beta_5 inst_i + \beta_6 openness_i + \beta_7 tropics_i + \varepsilon_i \tag{1a}$$

Where $\ln(GDPin_i)$ is the natural logarithm of the initial per capita GDP in country i, pop_i is the averaged population growth, inv_i is the averaged gross fixed capital formation as a percentage of GDP, $educ_i$ is our proxy for human capital, $inst_i$ is the variable measuring institutional quality, $openness_i$ is a variable that indicates the economic openness of country i, and $tropics_i$ is a geographic variable. We estimate equation using a cross-country dataset estimation for 40 emerging economies and 21-year averaged data, correcting for heteroskedasticity and autocorrelation.

Equation (2) represents the adjustment dynamics to the long-run equilibrium.

$$\Delta g_{it} = \delta\left[g^{*} - g_{i,t-1}\right] + \varphi v_{it} + \omega_{it} \tag{2}$$

Regarding equation (2), $g_{i,t}$ is the rate of real per capita GDP growth in country i in year t, v_{it} represents external terms of trade shocks, δ can be understood as the convergence rate, φ is the coefficient that measures the importance of terms of trade shocks, and ω_{it} is a heteroskedastic error term. This equation translates how the GDP per capita growth dynamics change, with concerns to the deviations from the long-term GDP per capita growth rate and the existence of terms of trade shocks.

To the aim of this paper, the equation (2) can be written as follows.

$$\Delta g_{it} = (\delta_0 + \delta_1 D)\left[g_i^{*} - g_{i,t-1}\right] + (\varphi_0 + \varphi_1)v_{it} + \omega_{it} \tag{2a}$$

Where the parameters δ_0 and φ_0 are the coefficients for countries with a fixed exchange rate regime, and $(\delta_0 + \delta_1 D)$ and $(\varphi_0 + \varphi_1)$ represent the coefficients for countries with a more flexible exchange rate regime.

This way, by assessing if φ_1 is not zero, we are studying the hypothesis of countries with a different exchange rate regime presenting a different parameter that describes the impact of changes in terms of trade on the dynamics of the output growth. We will also explore whether the exchange rate regime plays a role in defining the rate at which the country i converges to the long-run growth rate. If δ_1 is zero, it means that the exchange rate regime doesn't influence the convergence rate.

3.2. Data

Firstly, we want to explain the long-run real GDP per capita growth, so that these results can be used to capture mismatches between the actual real GDP per capita growth rate and the long-run one.

For this purpose, the dataset has 40 emerging economies and covers data from 1999 until 2019. This is a cross-country dataset containing the averaged data of the period.

The real per capita GDP growth rate is calculated using the per capita GDP in constant 2017 international dollars expressed in purchasing power parities (PPP). The initial GDP is computed using the level of per capita GDP in 1999 expressed as mentioned above.

Population growth is written as the annual percentage, and the data is from de world development indicators. From the world development indicators, we also obtained information on gross capital formation as a percentage of GDP and used it as the investment variable.

Human capital, namely through investments in education, is a factor that enhances economic growth (Becker, 1964). We used an education variable as a proxy for human capital, as it is widely done. Barro and Lee (2013) presents a dataset providing information on schooling across a large group of countries, the use of this dataset is well established in empirical studies on economic growth. We used the variable "the total enrollment in tertiary education as a percentage of the population aged between 15 and 64" by Barro and Lee (2013), 2021 version.

We also added an institutional quality variable that accounts for "corruption", "law and order" and "bureaucracy quality" constructed by The PRS Group (2023). This is variable is scaled from 0 to 1, with higher values meaning higher quality of the government.

Trade openness of an economy can also play a role in defining a country's GDP growth, so it was measured as the sum of exports and imports divided by GDP, and then regressed the ratio as a function of GDP, so to take into consideration the fact that bigger countries have a smaller ratio.

Regarding geography, we chose a variable that states the distance from the tropics presented by Sala-i-Martin (1997).

Equation (2) uses unbalanced panel data for the same 40 emerging economies spanning the years 2000 to 2019. This means that not all countries have available data for every year within the specified period, resulting in variations in observations across country.

The variable that describes terms of trade shocks in this paper is the percentage change in the relative price of exports to imports. For this purpose, the world development indicators variable "exports as capacity to import" was employed, as done by Edwards and Levy-Yeyati (2005).

It is commonly assumed that the IMF's exchange rate regime classification can't be used uncritically, once this *de juro* classification relies on the official statements done by governments, despite the documented inconsistencies with the actual policies (Levy-Yeyati and Sturznegger, 2002). So, authors typically choose a different classification system, one that uses a de facto classification or a combination of both.

Levy-Yeyayti and Struznegger works on classifying regimes are based on data of the actual behavior of nominal exchange rates and international reserves, and they are broadly chosen to study the role of exchange rate regimes. Edwards and Levy-Yeyati (2005) used the classification from Levy-Yeyati (2001), Chinn and Wei (2013) applied both Levy-Yeyati and Sturznegger (2003) and Reinhart and Rogoff (2004). Adler er al. (2018) employed Ilzetzki et al. (2019) and Carrière-Swallow et al. (2021) used Ilzetzki et al. (2019). Broda (2003) used Ghosh et al. (1997).

We chose to rely on Levy-Yeyati and Sturznegger (2023) dataset which classifies the exchange rate regimes as fixed, crawling peg, dirty float or float. To evaluate the differences in the terms of trade shocks between different exchange rate regimes, our dataset is divided in two using three different approaches. At first, we studied the differences between fixed and non-fixed regimes, then between pegs (fixed and crawling pegs) and more flexible regimes (dirty float and float), and finally between float and non-float regimes.

With the purpose of considering a more adjustable variable across time, we also ran equation (2) with the real GDP per capita growth rate trend, $\tilde{g}_{it}$, instead of the one obtained in equation (1), g_i^*. The variable $\tilde{g}_{it}$ is obtained applying the Hodrick-Prescott filter.

Table 1: Descriptive statistics

VARIABLES	SAMPLE	N	MEAN	SD	MIN	MAX
$\boldsymbol{ln(GDPin)}$	Full	40	8,5451	0,9131	6,4564	9,9632
$\boldsymbol{pop}$	Full	40	0,0184	0,8288	0,0031	0,0367
$\boldsymbol{inv}$	Full	40	0,2200	0,056	0,091	0,3834
$\boldsymbol{educ}$	Full	40	9,5669	7,9114	0,9733	39,468
$\boldsymbol{inst}$	Full	40	0,4420	0,1117	0,2645	0,7457
$\boldsymbol{openness}$	Full	40	0,2977	0,1366	0,1156	0,7318
$\boldsymbol{tropics}$	Full	40	0,695	0,4254	0	1
$\boldsymbol{g^*}$	Full	40	0,0204	0,0137	-0,0136	0,0491
$\boldsymbol{g_{i,t}}$	Full	773	0,0207	0,0350	-0,2534	0,1786
$\boldsymbol{\Delta tt}$	Fixed	268	0,0492	0,1255	0,5802	-0,4509
	Crawl	63	0,0928	0,1339	-0,3710	0,5680
	Dirty	129	0,0287	0,1114	-0,2698	0,4708
	Float	313	0,0539	0,1252	-0,6234	0,9348
$\Delta\boldsymbol{g_{it}}$	Full	773	0,0002	0,04231	-0,2730	0,3020

4. Results

4.1. Long-term growth

Table 2 shows the estimation results of the long-run real GDP per capita growth regression, correcting for heteroskedasticity. The estimated coefficients have the expected sign, and many are statistically significant. The natural logarithm of initial real GDP per capita impacts negatively the growth rate, in line with the conditional convergence hypothesis. Population also has a statistically significant negative coefficient. Gross capital formation and Education have the positive sign as expected, but they aren't statistically significant. Notably, the proxy for the quality of institutions has a positive and significant coefficient, expressing how better institutions and governmental quality translates into higher GDP growth rates. Also, openness contributes positively to economic growth, in line with the conventional wisdom that more open economies are more expected to the global technological change.

Table 2: Real long-run GDP per capita growth rate regressions

VARIABLES	(1) g*	(2) g*	(3) g*
ln(GDPin)	-0.0180***	-0.0188***	-0.0182***
	(0.0036)	(0.0044)	(0.0043)
pop	-1.0463***	-1.1585***	-1.0944***
	(0.3550)	(0.3663)	(0.3204)
inv	0.0554	0.0783	0.0759
	(0.0523)	(0.0535)	(0.0525)
educ	0.0001	0.0003	0.0003
	(0.0003)	(0.0003)	(0.0003)
inst	0.0471*		
	(0.0247)		
open	0.2760**	0.3299*	0.2957*
	(0.1364)	(0.1662)	(0.1581)
tropics	0.0057	0.0024	
	(0.0044)	(0.0042)	
Constant	0.0736**	0.0826**	0.0881**
	(0.0329)	(0.0362)	(0.0354)
Observations	40	40	40
R-squared	0.5788	0.5190	0.5153

Notes: Robust standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

4.2. Short-term dynamics

The estimation proceeded to the second step, making use of the fitted values from the specification in column (1) of table 2. All estimations reported in tables 3 to 9 were obtained using the fixed effect methodology and corrected for heteroskedasticity and serial correlation.

Firstly, we divided our sample into fixed and non-fixed regimes to study whether having a fixed exchange rate regime translates into having a greater response to external shocks. Non-fixed regimes combine crawling pegs, dirty floats and floats. Table 3a reports the dynamic regressions for such dataset division. The results show positive coefficients and a convergence rate lower than one, as expected. All the same, terms of trade shocks present a smaller coefficient for countries under the fixed regime, which goes against the conventional claims that floating exchange rate regime deliver a smoother transition of outputs in face of terms of trade shocks.

Table 3b presents the results with an alternative classification of exchange rate regimes: i) fixed and crawling pegs and ii) dirty floats and floats. The rationale is that crawling pegs may not allow the nominal exchange rate to float satisfactorily and accommodate shocks effectively, being, therefore closer to fixed regimes. The results reveal that the most flexible regimes still present a higher coefficient of the terms of trade shocks variable than hard and crawling pegs, meaning that pegs actually respond to terms of trade shocks more efficiently, demanding less fluctuations in terms of economic growth.

Lastly, we divided the sample into floats and non-floats. The results obtained are presented in table 3c. Now, it can be observed that terms of trade shocks play a bigger role in the dynamics of output growth under non floating regimes than under floats, this may imply that nominal exchange rate needs to be fully free to vary in order to satisfy the beliefs of regime flexibility advocates. However, we must note that the convergence rate of countries under non-floating regimes is unexpectedly bigger than 1, which merits further considerations.

A consideration that is also important to make, as mentioned in Section 3.1., is the parameter δ_1. A parameter δ_1 equal to zero would denote a non-existing difference between the convergence rates in different exchange rate regimes. This is obtained by subtracting the two coefficients for the $[g_i^* - g_{i,t-1}]$ variable. The most noteworthy difference is obtained when comparing fixed and non-fixed regimes. The same logic can be applied to the parameter φ_1, that can be obtained by calculating the difference between the two terms of trade shocks coefficient.

Table 3a: Real GDP per capita growth dynamics regressions (fixed vs non-fixed)

VARIABLES	(1) fixed	(2) non-fixed
$[g_i^* - g_{i,t-1}]$	0.8832***	0.9962***
	(0.1083)	(0.0635)
Δtt	0.0556*	0.0721***
	(0.0305)	(0.0171)
Constant	-0.0032	0.0010
	(0.0035)	(0.0018)
Observations	191	362
R-squared	0.5628	0.7288
Number of countries	29	31

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 3b: Real GDP per capita growth dynamics regressions (fixed and crawling pegs vs dirty floats and floats)

VARIABLES	(1) fixed+ crawl	(2) dirty + float
$[g_i^* - g_{i,t-1}]$	0.9154***	0.8419***
	(0.0447)	(0.0323)
Δtt	0.0735***	0.1136***
	(0.0207)	(0.0257)
Constant	0.0007	-0.0042***
	(0.0020)	(0.0012)
Observations	310	442
R-squared	0.7088	0.5538
Number of countries	30	31

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 3c: Real GDP per capita growth dynamics regressions (non-float vs float)

VARIABLES	(1) non-float	(2) float
$[g_i^* - g_{i,t-1}]$	1.0259***	0.9683***
	(0.1093)	(0.0422)
Δtt	0.0731***	0.0642**
	(0.0221)	(0.0254)
Constant	-0.0034	0.0024
	(0.0024)	(0.0025)
Observations	323	230
R-squared	0.6242	0.7934
Number of countries	39	30

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4 computes the growth dynamic regressions for the four different exchange rate regimes separately. We can state that the fixed regime is the one accommodating the external shocks more efficiently, followed by the dirty-float regime, with crawling pegs presenting the lower level of efficiency. Regarding the coefficients of $[g_i^* - g_{i,t-1}]$, that can be read as the rate at which the economy converges to its long-run growth rate, crawling pegs present a value higher than 1, which will be object of further examination. Subsequently, the dirty-float regime exhibits the highest convergence rate, indicating that countries under this regime might reach the long-run rate more rapidly.

There are scarce observations with crawling peg, which becomes more severe when we consider the sign of the terms of trade shock. For this reason, I won't comment the results corresponding to this regime, once, in this case, results may be highly affected by the presence of outliers.

Tables 5a and 5b depict the dynamic regressions specified in table 4, categorized into positive and negative terms of trade shocks, respectively. When encountering positive shocks, dirty-floats exhibits the highest coefficient for the terms of trade variable, suggesting the need for more fluctuations on economic growth after the shock taking place, when terms of trade shocks are negative, float is the one exhibiting the highest coefficient. The outcomes in tables 5a and 5b reveal substantial differences, indicating asymmetrical responses to positive and negative terms of trade shocks. Across all regimes, positive shocks consistently yield smaller coefficients, showing a higher output sensitivity to negative terms of trade shocks than to positive ones, aligned with existing literature, because, as Edwards and Levy-Yeyati (2005) reminds, prices tend to respond asymmetrically to shocks. These variations are notable under crawling pegs, dirty floats, and floats. However, in the fixed regime, the disparities in reactions between positive and negative shocks are less pronounced.

As a result, we repeated the analysis reported in tables 3b and 3c, focusing solely on positive terms of trade shocks. The output can be observed in table 6, where we find that countries under float or dirty float regimes are slightly more efficient in accommodating positive terms of trade shocks than the countries with hard or crawling pegs. When comparing the float regime to non-float regimes, we observe a more significant difference between coefficients, displaying a more efficient accommodation of terms of trade shocks process by floats. Nevertheless, the convergence rate still poses a problem, in both cases, so we will present a different approach we took.

Table 4: real GDP per capita growth dynamics regressions (under each regime)

VARIABLES	(1) fixed	(2) crawl	(3) dirty	(4) float
$\boxed{g_i^* - g_{i,t-1}}$	0.8702***	1.2779***	0.8776***	0.8490***
	(0.1005)	(0.2115)	(0.1274)	(0.0428)
Δtt	0.0638***	0.1909***	0.1040**	0.1102***
	(0.0152)	(0.0489)	(0.0411)	(0.0266)
Constant	-0.0049***	-0.0118**	-0.0101***	-0.0015
	(0.0007)	(0.0048)	(0.0013)	(0.0014)
Observations	268	63	129	313
R-squared	0.5291	0.7519	0.4366	0.6041
Number of countries	30	15	22	30

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5a: real GDP per capita growth dynamics regressions – positive shocks

VARIABLES	(1) fixed	(2) dirty	(3) float
$[g_i^* - g_{i,t-1}]$	0.8832***	0.9283***	0.9683***
	(0.1083)	(0.2794)	(0.0422)
Δtt	0.0556*	0.0847*	0.0642**
	(0.0305)	(0.0411)	(0.0254)
Constant	-0.0032	-0.0023	0.0024
	(0.0035)	(0.0039)	(0.0025)
Observations	191	80	230
R-squared	0.5628	0.5326	0.7934
Number of countries	29	17	30

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5b: real GDP per capita growth dynamics regressions – negative shocks

VARIABLES	(1) fixed	(3) dirty	(4) float
$[g_i^* - g_{i,t-1}]$	0.8357***	0.9055***	0.4643**
	(0.1199)	(0.1880)	(0.2142)
Δtt	0.0867**	0.4369*	0.2535*
	(0.0342)	(0.2189)	(0.1316)
Constant	-0.0053*	0.0035	0.0101
	(0.0030)	(0.0137)	(0.0091)
Observations	77	49	83
R-squared	0.3784	0.4596	0.3596
Number of countries	18	19	24

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6: real GDP per capita growth dynamics regressions (fixed and crawling pegs vs dirty floats and floats; non-float vs float) – positive shocks

VARIABLES	(1) fix+crawl	(2) dirty+float	(3) non-floats	(4) floats
$[g_i^* - g_{i,t-1}]$	1.0651***	0.9154***	1.0259***	0.9683***
	(0.1256)	(0.0447)	(0.1093)	(0.0422)
Δtt	0.0751**	0.0735***	0.0731***	0.0642**
	(0.0280)	(0.0207)	(0.0221)	(0.0254)
Constant	-0.0045	0.0007	-0.0034	0.0024
	(0.0033)	(0.0020)	(0.0024)	(0.0025)
Observations	243	310	323	230
R-squared	0.6599	0.7088	0.6242	0.7934
Number of countries	33	30	39	30

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The unexpected discovery of a convergence rate exceeding 1 prompted a reevaluation of our analyses. We recognized that a more nuanced variable that adjusts over time could benefit the work. As for a robustness check, we employed the Hodrick-Prescott filter, a method that separates a time series into its trend and a cyclical component. We substituted the fitted values for the long-run output growth rate obtained in equation (1) by the trend component. The outcomes are detailed in the Appendix, revealing subtle differences that may not be particularly prominent. In this new estimation, the issue of convergence rate exceeding 1 persisted. As this would denote that such countries were in fact diverging from the long-run rate or the output trend, then the dataset itself emerges as a potential source of the observed discrepancy.

5. Conclusion

The goal of this paper was to investigate which exchange rate regime better smooths the impact of terms of trade shocks, leading to less fluctuations in the output. Our focus is on emerging economies. Although, there is no consensus in the literature, the conventional wisdom is that flexible exchange rate regimes allow for a smoother adjustment to terms of trade shocks.

In contrast to the conventional wisdom, our findings point to a nuanced reality. The empirical results showcase a fixed regime performing more efficiently, overall. The relation between the regime flexibility and the accommodation of terms of trade shock appears as non-linear, since when comparing dynamics of countries under each exchange rate regime, the most efficient is fixed, followed by dirty-float, followed by float, and, lastly, by crawling-peg. Crawling pegs stood out, once countries under this regime were the ones reacting more significantly to terms of trade shocks during the entire analysis.

Moreover, our analysis uncovers asymmetrical output responses to positive and negative shocks, with economies being significantly more sensitive to negative shocks, under any exchange rate regime. The fixed regime continued to be presented as the most efficient exchange rate regime absorbing shocks, but the float regime exhibited a similar efficiency when leading with positive terms of trade shocks. Floats overperformed non-floats when shocks were positive, implying that the situation in which float regime is more efficient is the benign one.

We also studied the output convergence dynamics, and we were taken by surprise when we found a convergence rate exceeding 1. This occurred in crawling peg adopters and prevented us from commenting the convergence rate when the sample was divided into two types of exchange rate regimes. Nonetheless, we were able to assess the results of the regression under the four different exchange rate regimes, and we observed that regarding positive shocks, the float regime presents a higher convergence rate, followed by the dirty-float regime. However, when the shock is negative, dirty-floats present a faster convergence to the long-run rate, followed by the fixed regime, and floats present a significantly lower convergence rate than the other two regimes.

Future research could try to enlarge the data, as it may represented some limitations of this analysis. A 5-year cumulative overlapping growth dynamics model could be an alternative method, that avoids cyclical movements.

References

Adler, Gustavo, Nicolas Magud, and Alejandro Werner. 2018. Terms-of-Trade Cycles and External Adjustment. *International Review of Economics & Finance* 54, no. C: 103-22.

Bailliu, J., Lafrance, R. and Perrault, J.F. 2003. Does Exchange Rate Policy Matter for Growth? *International Finance*, 6(3), p.381-414.

Barro, Robert. 1991. Economic Growth in a Cross Section of Countries.The Quarterly *Journal of Economics* 106 (2):407–43.

Barro, R. J., & Lee, J. W. 2013. A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics*, 104: 184–198.

Baxter, M. and Stockman, A.C. (1989) Business Cycle and the Exchange rate Regime: Some International Evidence. Journal of Monetary economics, 23, p.377-400.

Beck, Nathaniel, and Jonathan N. Katz. 1995. What to Do (and Not to Do) with Time-Series Cross-Section Data. *The American Political Science Review* 89, no. 3: 634-47.

Becker, Gary S. 1964. Human capital: A theoretical and empirical analysis, with special reference to education. University of Chicago press.

Broda,C., 2003. Terms of trade and exchange rate regimes in developing countries. *Journal of International Economic*s 63: 31–58.

Broda, Christian. 2003. Terms of Trade and Exchange Rate Regimes in Developing Countries. *Journal of International Economics* 63, no. 1: 31-58.

Carrière-Swallow Y, Magud NE, Yépez JF. 2021. Exchange rate flexibility, the real exchange rate, and adjustment to terms-of-trade shocks*. Rev Int Econ* 29: 439–483.

Chinn, Menzie D., and Shang-Jin Wei. 2013. A Faith-Based Initiative Meets the Evidence: Does a Flexible Exchange Rate Regime Really Facilitate Current Account Adjustment?. *The Review of Economics and Statistics* 95, no. 1: 168-84.

Edwards, Sebastian, and Eduardo Levy Yeyati. 2005. Flexible Exchange Rates as Shock Absorbers. *European Economic Review* 49, no. 8: 2079-105.

Eichengreen, B., Haussman, R., 1999. Exchange rates and financial fragility. NBER Working Paper No. 7418.

Eguren Martin, F. (2016). Exchange rate regimes and current account adjustment: An empirical investigation. *Journal of International Money and Finance*, 65, 69–93.

Fischer, S., 2001. Exchange rate regimes: Is the bipolar view correct? Journal of Economic Perspectives 15 (2): 3–24.

Friedman, M., 1953. The case for flexible exchange rates. Essays in Positive Economics.University of Chicago Press, Chicago, 157–203.

Ghosh, A., Gulde, A., Ostry, J., Wolf, H. 1997. Does the nominal, exchange rate matter? IMF Working Paper 95/121.

Ghosh, A. R., Qureshi, M. S., & Tsangarides, C. G. 2019. Friedman Redux: External adjustment and exchange rate flexibility. *Economic Journal*, *129*(617): 408–438.

Gylfason, T. (2000) Fix or Flex? Alternative Exchange Rate Regimes in an Era of Global Capital Mobility, North American Journal of Economics and Finance, 11(2), p. 173-89.

Ilzetzki, E., Reinhart, C., & Rogoff, K. 2019. Exchange arrangements entering the 21st century: Which anchor will hold? *Quarterly Journal of Economics.* 134(2): 599–646.

Levy-Yeyati, E., Sturzenegger, F., 2001. Exchange rate and economic performance. IMF Staff Papers 47: 62–98.

Levy-Yeyati, E., Sturzenegger, F., 2003. To float or to trail: evidence on the impact of exchange rate regimes. *American Economic Review* 93: 1173–1193.

Levy-Yeyati, Eduardo y Federico Sturzenegger. 2023. Exchange Rate Regimes 20 years later: The prevalence of floats. Documento de trabajo RedNIE 182.

Meade, J., 1951. The Theory of International Economic Policy, 2 volumes.

Mundell, R. (1995) Exchange Rate Systems and Economic Growth. In: Marcuzzo, M.C., Officer, L.H. and Rosselli, A. (1996) Monetary Standards and Exchange Rates, p.13-37.

Reinhart, C. M., and K. Rogoff. 2004. The Modern History of Exchange Rate Arrangements: A Reinterpretation. *Quarterly Journal of Economics* 119: 1–48.

Sala-i-Martin, Xavier. 1997. I Just Ran Two Million Regressions. American Economic Review 87(2): 178-83.

The PRS Group and others. 2023. International Country Risk Guide. Political Risk Services

Towbin, Pascal, and Sebastian Weber. 2013. Limits of Floating Exchange Rates: The Role of Foreign Currency Debt and Import Structure. *Journal of Development Economics* 101: 179-94.

Appendix

1. *List of countries*

Argentina
Bangladesh
Bolivia
Botswana
Brazil
Cameroon
Chile
Colombia
Congo, Rep
Costa Rica
Dominican Republic
Ecuador
Egypt, Arab Rep.
El Salvador
Gabon
Guatemala
Honduras
India
Indonesia
Iran, Islamic Rep.
Kenya
Korea, Rep.
Malaysia
Mali
Morocco
Mozambique
Niger
Pakistan
Paraguay
Peru
Senegal
Sierra Leone
South Africa
Tanzania
Thailand
Togo
Tunisia
Turkey
Uganda
Zimbabwe

2. *Results with the hp filter*

Table 7a: real GDP per capita growth dynamics regressions (fixed vs non-fixed)

VARIABLES	(1) fixed	(2) non-fixed
$[g_i^* - g_{i,t-1}]$	0.9941***	0.9887***
	(0.0824)	(0.0371)
Δtt	0.0554***	0.1143***
	(0.0137)	(0.0218)
Constant	-0.0032***	-0.0061***
	(0.0007)	(0.0011)
Observations	268	505
R-squared	0.5837	0.6130
Number of countries	30	31

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 7b: real GDP per capita growth dynamics regressions (fixed and crawling pegs vs dirty floats and floats)

VARIABLES	(1) fixed+crawl	(2) dirty+float
$[g_i^* - g_{i,t-1}]$	1.1019***	0.9054***
	(0.0997)	(0.0304)
Δtt	0.0756***	0.1066***
	(0.0231)	(0.0247)
Constant	-0.0040***	-0.0056***
	(0.0013)	(0.0011)
Observations	331	442
R-squared	0.6167	0.5815
Number of countries	33	31

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 7c: real GDP per capita growth dynamics regressions (non-float vs float)

VARIABLES	(1) Non-floats	(2) floats
$[g_i^* - g_{i,t-1}]$	1.0407***	0.9212***
	(0.0822)	(0.0562)
Δtt	0.0849***	0.1061***
	(0.0193)	(0.0255)
Constant	-0.0060***	-0.0037**
	(0.0010)	(0.0014)
Observations	460	313
R-squared	0.5675	0.6341
Number of countries	39	30

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 8: real GDP per capita growth dynamics regressions (under each regime)

VARIABLES	(1) fixed	(2) crawl	(3) dirty	(4) float
$[g_i^* - g_{i,t-1}]$	0.9941***	1.3414***	0.9007***	0.9212***
	(0.0824)	(0.1992)	(0.0826)	(0.0562)
Δtt	0.0554***	0.1917***	0.0933**	0.1061***
	(0.0137)	(0.0491)	(0.0385)	(0.0255)
Constant	-0.0032***	-0.0128**	-0.0097***	-0.0037**
	(0.0007)	(0.0048)	(0.0011)	(0.0014)
Observations	268	63	129	313
R-squared	0.5837	0.7653	0.4459	0.6341
Number of countries	30	15	22	30

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 9a: real GDP per capita growth dynamics regressions – positive shocks

VARIABLES	(1) fixed	(2) crawl	(3) dirty	(4) float
$[g_i^* - g_{i,t-1}]$	0.9879***	1.3494***	0.9947***	1.0306***
	(0.0980)	(0.1528)	(0.2230)	(0.0394)
Δtt	0.0504	0.1115***	0.0726*	0.0671***
	(0.0298)	(0.0295)	(0.0366)	(0.0205)
Constant	-0.0026	-0.0042	-0.0039	-0.0003
	(0.0033)	(0.0037)	(0.0033)	(0.0021)
Observations	191	52	80	230
R-squared	0.6207	0.8500	0.6054	0.8361
Number of countries	29	15	17	30

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 9b: real GDP per capita growth dynamics regressions – negative shocks

VARIABLES	(1) fixed	(2) crawl	(3) dirty	(4) float
$[g_i^* - g_{i,t-1}]$	0.9780***	2.0028	0.8497***	0.4624*
	(0.0875)	(2.4474)	(0.2492)	(0.2648)
Δtt	0.0908**	0.6913***	0.4079*	0.2477*
	(0.0341)	(0.1299)	(0.2210)	(0.1331)
Constant	-0.0001	0.0518	0.0065	0.0079
	(0.0032)	(0.0422)	(0.0143)	(0.0097)
Observations	77	11	49	83
R-squared	0.4269	0.9154	0.3954	0.3433
Number of countries	18	7	19	24

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1