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Fall and Convergence of World Inflation Rates (1998-2019)

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Abstract

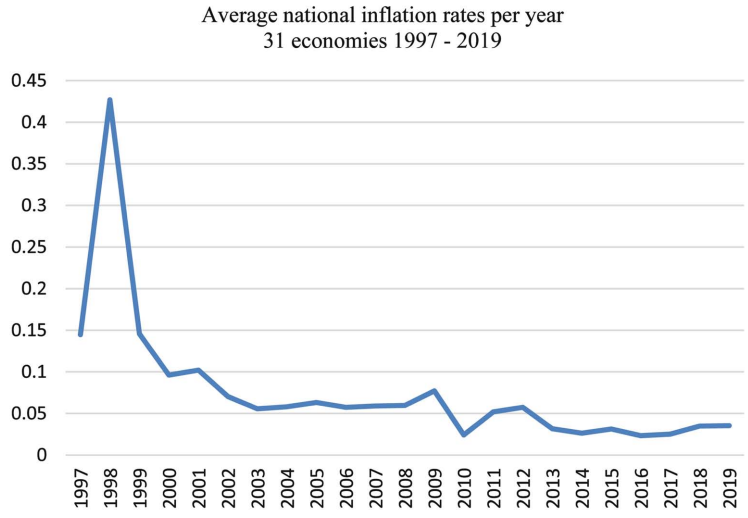
The trend observed from 1998 until 2019 over world disinflation and over the stabilization of national inflations at low levels is due to the behavior of US inflation. This can be said in the light of econometric results with quarterly US figures and other 30 countries of different continents. Indeed, these results favor such a hypothesis and do not favor alternative hypotheses that would emphasize the national monetary policies or deflationist shocks of "real" origin (non-monetary). Besides, the empirical evidence indicates that, in general terms, national monetary policies have been lax in this sense: monetary policy makers have taken advantage of the disinflationary trend from the US to execute lax policies by foreseeing related benefits (over the economic activity, for instance).

Keywords

Inflation, Convergence, Open Economy, Monetary Policy, VECM, Panel Data

1. Introduction

In the past 23 years, falling and stabilization of inflation national rates have become evident. These facts suggest a common behavior among them, even if countries and their inflation rates present idiosyncratic features. Graph 1 shows the annual average inflation rates of 31 countries with different income levels, development stages, institutional structures, and geographic localization, including the United States (see **Annex**: Country list and data source). Considering the peak in 1998, it is clear that there exists a decreasing trend, from which it can be assumed the existence of forces driving toward the reduction and further stabilization of inflation, even in economies with really high initial inflations. As shown in Graph 1, it is worth pointing out that there may be a major force,



Graph 1. Average national inflation rates per year 31 economies 1997-2019. Source: International Financial Statistics, MIF.

an attractor, which produces this behavior.

In Section II of this paper, we consider this regularity, or the apparent falling trend in national inflations and their convergence into a unique low and stable rate, as a hypothesis to be submitted to empirical contrast. In Section III, we propose a simple macroeconomic model that may allow for understanding the common driving force that has led the economies samples to an international convergence and the stabilization of their inflations in the last 23 years. In this section, we also refer to the international literature on this issue. Sections IV and V describe our strategy and the methods involved in the contrast of our hypotheses of the macroeconomic model, as well as a summary of the conclusions of this work. The annex section contains the list of countries sampled for our work.

2. The Behavior of Inflation throughout Time

Affirming that the average inflation of the countries studied tends to stabilize means that, in the long term, the national price indexes have a similar trend, and therefore, its difference with respect to the average throughout time tends to become lower.

More concretely, if we define $\ln P_{jt}$ as the price index logarithm of the economy j for each t period, and if we define $\overline{\ln P_t}$ as the average in a cross-cut dimension for each t period, our first affirmation should be fulfilled:

$$\ln P_{jt} - \overline{\ln P_t} = \mu_j, \frac{\mathrm{d}|\mu_j|}{\mathrm{d}t} < 0 \quad \text{for} \quad j = 1, 2, \cdots, N \tag{1}$$

Testing this hypothesis implies a unit root contrast in panel form as follows:

$$\ln P_{jt} - \overline{\ln P_t} = \mu_j, \frac{\mathrm{d}|\mu_j|}{\mathrm{d}t} < 0 \quad \text{for} \quad j = 1, 2, \cdots, N \tag{2}$$

It should be noted that in Equation (2), it is implied the assumption that all series have the same root, which is why in hypothesis *Ho* all price levels diverge

and, therefore, $|\rho| \geq 1$ while hypothesis H_1 implies that these converge. Thereby $|\rho| < 1$.

Table 1 summarizes the unit root tests under the assumptions of common unit root and individual unit root (deterministic trend and constants different between regions in the regression). For the difference between the price level logarithm observed and the average, the statistic tests designed under the assumption of normality suggest the non-existence of unit root in either common or individual fashion for every significance level.

Using a panel method, Weber and Beck (2005) found evidence of beta convergence, or mean reversion in the inflation of the European Economic and Monetary Union countries for all the periods analyzed. Meanwhile, only until 1999 evidence of sigma convergence has been found by the authors, without evidence of additional reductions in inflation dispersion thereafter. In the same line, Ndiaye (2021) by using beta test for convergence finds evidence of no convergence of the inflation rates between WAEMU and WAMZ countries.

Similarly, using a panel methodology, for the prior and subsequent periods to the creation of the Euro, Busetti et al. (2007) found evidence of convergence in the inflation of the countries within the Eurozone between 1980 and 1997. This was found using panel unit root tests, and they highlighted the preponderant role of the exchange-rate policies, while between 1997 and 2004 their results evince divergence in inflations and the conformation of two country groups: one of low inflations and one of high inflations. Karanasos et al. (2016) found similar results for the 1980-2013 period.

3. Literature and Model

Almost simultaneously, along with disinflation processes of different (and important) world economies since the mid-80s of the last century until present,

Table 1. Unit root tests (tri-monthly frequency).

Variable	Test	Statistic	Prob.**	Cross-sections	Obs.
DIFlndefGDP	*Ho*: Unit root (Common Unit Root)				
	Levin, Lin & Chu t*	−13.3912	0.0000	30	2670
	Breitung t-stat	2.17924	0.9853	30	2640
	Ho: Unit Root (Individual Unit Root)				
	Im, Pesaran and Shin W-stat	−7.99003	0.0000	30	2670
	ADF-Fisher Chi-square	209.274	0.0000	30	2670
	PP-Fisher Chi-square	240.585	0.0000	30	2730

Note: The Breitung test has as *Ho* the stationarity of the variables. *t-value; **Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Source: International Financial Statistics, MIF and authors' calculations.

being the USA the most outstanding, several economists have observed disinflations in detail. Some of them have shown concern for the possibility for transformation of deflations into deflationist trends, while others have aimed to explain factors that have caused either such processes or, at least, the different potential determinants of a reduction of the inflation rate.

As for the first group of countries, Calvo (2016) has shown great interest. In Calvo's work, there has been emphasis on factors impacting the demand of cash and other liquid assets beyond what could be explained in terms of economic activity and the cost-opportunity of keeping highly active liquid assets, thus generating tendencies towards the creation of situations characterized by "liquidity traps" and, sooner or later, reducing permanently the inflation rate.

As for the second group, Razin (2004) was one of the first scholars to highlight the existence of a clearly international process caused, according to the author, by other process: the globalization, thanks to its influence over the national monetary policies to make them more anti-inflationary (Razin, 2004). Forbes (2019) also laid emphasis on the globalization to explain the tendency towards lower inflation, but with a focus on the US case.

Aizenman et al. (2008) found econometric evidence of the negative impact of the restrictive monetary policy over the inflation in the cases of 16 emergent economies. Their findings were made in the framework of a specific hypothesis: the monetary policy is reactive; it is subjected to a reaction function with two arguments: product gap and inflation gap.

In a most recent work, but restricted to the US case, Heise at al. (2020) emphasized another factor that, from their perspective, would be important for explaining the disinflationary process: the weakening of the "transmission mechanism" operating from the salaries to the prices. These issues (i.e. the ones referring to the eventual roles of the monetary policy and the salaries), in accordance with Calvo (2016), would seem to be relatively secondary.

Our departure point to explain the disinflationary process of 30 economies, some developed and other developing, and almost parallel to the USA's process, is a highly simplified theoretical model. Some of the hypotheses are simple and unreal, if judged in isolation, but their reduced form accounts for a clear and intuitive interpretation, which in turn generates contrastable theories in econometric terms. The model has a narrow relationship with models used by Dornbusch (1985) and Álvarez et al. (2016) in their econometric exercises on (statistic) dependency of price levels (as in Dornbusch's case), inflation (as in Álvarez et al.'s case), nominal exchange rate with respect to the dollar, or the external devaluation of the national currency (percentual variation). This will be detailed in the subsequent lines.

The present model is designed for an open economy that only produces and commercializes internationally tradable goods, faces an unlimited demand over production, and has a flexible exchange rate. The structural form comports three equations as follows:

$$P_t = \lambda_t P_t^* E_t \tag{3}$$

$$E_t = \alpha E_{t-1} + (1-\alpha)\,{}_t^e E_{t+1} + \mu_{1,t}; \tag{4}$$

$$0 < \alpha < 1;\ \mu_{1,t} \sim \mathrm{N};\ \overline{\mu_1} \approx 0$$

$${}_t^e E_{t+1} = {}_t^e \tau_{t+1} + \mu_{2t}; \tag{5}$$

$$\mu_{2t} \sim \mathrm{N};\ \overline{\mu_2} \approx 0$$

Being $P, \lambda, P^*, E, {}_t^e E, {}_t^e \tau, \mu_{k(k=1,2)}$ the level of domestic prices, a scale factor (which results from the long-lasting effects of real shocks in aggregated supply and aggregated demand, as well as cash demand, which affect the real exchange rate; this scale factor is the inverse real exchange rate), the external price level (USA), the nominal exchange rate (with respect to the dollar), the expected tomorrow's nominal exchange rate, the expected one-day component of the relative monetary policy, and one surprise factor (random).

Given that there no independent estimations of the scale factor λ, we have estimated it as a residual from Equation (3). Therefore, we may consider that this equation is a mere identity. A particular case disregarded in this work consists of assuming that λ equals or tends to 1. In such a case, Equation (3) (after adding a random component) would be the purchasing power parity hypothesis, or of a constant value (at least trendlly) of the real exchange rate.

The sense of Equation (3), pertinent for our purposes, it this: For the case of any economy of the 30 in the sample (different to the USA), their price levels (left side) depend upon, in first instance, the price levels in the USA and the nominal exchange rate, given a certain level of the real exchange rate. In Wickens' (2011) Chapter 7, it can be found a detailed explanation of the sense, scope, and limitations of Equation (3) (although we go further with by assuming that the price levels of the USA and the nominal exchange rate are, in first instance, causal factors of the price levels of any other economy). Dornbusch (1985) used his Equation (5a), similar to our Equation (3), in a primer approximation to his interpretation of the evolution of commodities prices[1]. Meanwhile, Álvarez et al. (2016) used Equation (4) in their work to predict inflation in a group of economies with moderate inflation and flexible nominal exchange rates, which could derive from Equation (1)[2].

Equation (4) is a simplified form of expressing one hypothesis to be known: The exchange rate observed is a combination of an adaptive expectation (backward-looking) and a rational expectation. Why backward-looking? There are at least two possible reasons: imperfect information (e.g. given that capturing and analyzing related information is subjected to growing marginal costs of information) and the belief that the capacity of monetary authority may intervene at any moment in an *ad hoc* manner (and unforeseen) in order to stop any ups and downs in the exchange rate.

[1]Notwithstanding, Donbursch's equation incorporates possible effects of the domestic and external production levels over the price level of such commodities.

[2]Álvarez et al. (2016) followed Burstein and Gopinath (2014) for their Equation (4).

Furthermore, the observed exchange rate may include surprise factors. One of these factors is derived from a monetary policy capable of influencing capital flows, and then has an incidence over the exchange rate. Thus, a surprising increase of the local interest rate derived from the policy, given the external rate, causes an excess of currency supply, which is almost instantly eliminated by adjusting downwards the exchange rate. Therefore, it is expected that the difference between the observed exchange rate and the resulting exchange rate, after combining adaptive and rational expectations, while considering possible surprise factors as the ones aforementioned, accounts for an approximately similar behavior to that of a random variable.

Equation (2) might seem, at first sight, contradictory with regard to a well-known and grounded hypothesis as this: In an economy with open capital mobility (in short, free of non-payment risks), the expected nominal depreciation rate of the local currency is, after complete arbitrament, equal to the difference between the internal and the external interest rates:

$$\log\left({}_{t}^{e}E_{t+1}\right)-\log\left(E_{t}\right)=\log\left(1+{}_{t}^{e}i_{t+1}\right)-\log\left(1+{}_{t}^{e}i_{t+1}^{*}\right)+\zeta_{t} \tag{6}$$

Being i, i^{*}, ζ the domestic interest rate, the external interest rate, and a completely random component (i.e. the case of perfect capital mobility). Nevertheless, Equation (4) is compatible with Equation (6), since it affirms that if the monetary authority changes surprisingly the interest rate of the policy, there exists a subsequent opportunity of transitory arbitration that alters the net flow of capital until the modification in the exchange rate entailed in such surprise factor completes the arbitration. Once the arbitration is completed, the final effect of the surprise factor is that of increasing the right of Equation (6) and, clearly, increase its left side by means of reducing E_t with an absolute magnitude higher than to the reduction of ${}_{t}^{e}E_{t+1}$.

Equation (5) is another hypothesis, which upholds that the exchange rate expected between today and tomorrow depends on one presumably exogenous factor: the expected component of the monetary policy, and this expectation is subjected to a random error.

Our indicator of the expected component of the relative monetary policy of an economy *j*, different to the US, is defined as Equation (7):

$${}_{t}^{e}\tau_{j}=\left(\frac{1+i_{EEUU,t}}{1+i_{j,t}}\right)\left(\frac{1+\pi_{j}}{1+\pi_{EEUU}}\right) \tag{7}$$

Being i the interest rate of the policy and π the long-term average of the inflation rate for the USA as well as for the economy *j*. Therefore, the higher the level of this variable, the greater the laxness degree of its monetary policy.

In absence of surprise factors, and expectation errors, it is then simple to demonstrate that Equation (5) implies that as Equation (8):

$$E_{t}=\tau_{t} \tag{8}$$

The model of Equations (3)-(5) for a stable state (i.e. in absence of surprise fac-

tors and expectation errors) is then reduced to Equation (9)[3]:

$$P = \lambda P^* \tau \tag{9}$$

The equivalent equation, in logarithmic terms (natural logarithms) is:

$$\ln P = \ln \lambda + \ln P^* + \ln \tau \tag{10}$$

Based on this model, we can establish the following hypothesis:

Hypothesis I: World disinflation has been a process subdued, fundamentally, to USA's disinflation; other factors have been of little or null significance.

Hypothesis II (alternative): World disinflation has significantly depended upon the restrictive monetary policies of countries different to the USA, OR upon "real" shocks of deflationist effects (i.e. shocks different to the ones caused by the monetary policy, but affecting the real exchange rate).

4. Econometric Strategy and Results

The equation below is derived from Equation (9) (which in turn nests Hypotheses I and II), but includes a constant and a deterministic trend, to achieve not only a complete statistical specification, but also because prices might bear a temporal trend whose significance would have to be supported (or not) by the information within the variables:

$$\ln P_{j,t} = \beta_0 + \beta_1 \ln \lambda_{j,t} + \beta_2 \ln \tau_{j,t} + \beta_3 \ln P_t^* + \beta_4 tendencia + \epsilon_{j,t} \tag{11}$$

The group j of countries ($j = 1, 2, \cdots, 30$) does not include US (whose price level is P^*). Statistical series have a quarterly frequency. Table 2 contains the unit root tests over the variables involved in Equation (11).

Based on Equation (11), the exercise comported the estimation of a Vector Error Correction Model (VECM) in panel form with series of quarterly frequency using the Johansen methodology. For a matrix system, the model is:

$$\Delta Y_t = C + \alpha\beta' Y_{t-1} + \sum_{k=1}^{p} \Pi_k \Delta Y_{t-k} + \epsilon_t$$

$$Y_t = \begin{bmatrix} \ln P_{j,t} \\ \ln \tau_{j,t} \\ \ln \lambda_{j,t} \\ \ln P_t^* \\ t \\ 1 \end{bmatrix}, \quad \alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix}, \quad \beta = \begin{bmatrix} 1 \\ \beta_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix}$$

Table 3 shows the results of a first estimation exercise of the cointegration equation, which will be referred to as "Model A". In this exercise, we assumed

[3]In other words, a model for an economy with a monetary authority that has an inflation target and is completely credible (assuming that this target is exogenous) might have Equation (4') instead of 2:

$$\log\left({}_t^e E_{t+1}^{1-\alpha}\right) = \log\left(1+\bar{\pi}\right) + \log\left(E_t\right) + \epsilon_t \tag{4'}$$

Being $\bar{\pi}$ the inflation target. However, a reduced form may be generated, one similar to Equation (9).

Table 2. Unit root tests. Variables expressed in logarithmic forms, quarterly frequency.

A Common Unit Root Is Assumed			An Individual Unit Root Is Assumed		
Prueba	Levin, Lin & Chu t*	Breitung t-stat	Im, Pesaran and Shin W-stat	ADF-Fisher Chi-square	PP-Fisher Chi-square
	Ln (deflactor)				
Statistic	−3.49603	−3.97062	−1.2286	126.36	259.403
Prob.**	0.0002	0	0.1096	0	0
	Ln (tao)				
Statistic	3.81365	−6.09313	−5.14049	123.466	110.279
Prob.**	0.9999	0	0	0	0
	Ln (lambda)				
Statistic	0.96041	−2.48024	1.4689	50.0037	77.9399
Prob.**	0.8316	0.0066	0.9291	0.8178	0.0597
	Ln (deflactor USA)				
Statistic	5.19499	−5.37324	5.31662	9.20578	63.9513
Prob.**	1	0	1	1	0.3396
	Dif_i_inflations				
Statistic	0.02304	−15.9809	−13.4669	292.865	231.086
Prob.**	0.5092	0	0	0	0

Note: Specification in these models includes a constant and individual deterministic trends; The Breitung test is built upon the null hypothesis of stationarity. *t-value; **Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. Source: International Financial Statistics, MIF and authors' calculations.

the existence of a certain cointegration vector in this way: exogeneity of variables $\ln \lambda_{j,t}$, $\ln \tau_{j,t}$ and $\ln P_t^*$ (at long term) has been imposed in virtue of their exogenous nature with regard to the system, in accordance with our theoretical model. Table 3 shows the results of the estimation of the cointegration equation for Model A. After estimation, it has been permitted that all short-term adjustment coefficients were different to zero. Based on this estimation, we found different results. First, the coefficient corresponding to the relative laxness of the monetary policy results to be significative, but with a sign contrary to the expectation (i.e. it was expected that greater laxness in the monetary policy would mean greater prices). Second, the price index coefficient has a positive sign and is statistically significant, which supports the hypothesis wherein an economy's price levels attract other price levels worldwide. The effect of shocks affecting the real exchange rate over the world price levels, measured by means of the coefficient of $\ln \lambda_{i,t}$, is not statistically significant. The deterministic trend has a positive effect and is statistically significant, although its coefficient is markedly small. In the following lines, we will refer to this positive effect as "inertia", although considering it could be somewhat different to true inertia, for

Tabla 3. Cointegration panel. Dependent variable: $\ln\left(P_{jt-1}\right)$.

	A	B
$\ln \tau_{j,t-1}$	−0.369457	−0.356656
	[−1.67669]	[−1.62109]
$\ln \lambda_{j,t-1}$	−0.001661	−0.001609
	[−0.14066]	[−0.13645]
$\ln P^{*}_{t-1}$	1.433144	1.434209
	[5.71356]	[5.72662]
@trend (1997Q1)	0.00012	0.00012
	[3.26154]	[3.26034]
C	−0.147854	−0.147142
α_1	−0.020226	−0.020263
	[−10.0293]	[−10.0341]
α_2	−0.000136	-
	[−0.09215]	-
α_3	0.006075	0.006108
	[1.61490]	[1.64558]
α_4	−0.000272	−0.00027
	[−1.61169]	[−1.60243]
Determinant Resid. Covariance (Dof. Adj.)	1.17E−14	1.17E−14
Determinant Resid. Covariance	1.14E−14	1.14E−14
Log Likelihood	26740.81	26740.8
Akaike Information Criterion	−20.69368	−20.69368
Schwarz Criterion	−20.51875	−20.51875
Number of Coefficients	77	77

Source: International Financial Statistics, MIF and authors' calculations.

instance: the effect of an omitted variable.

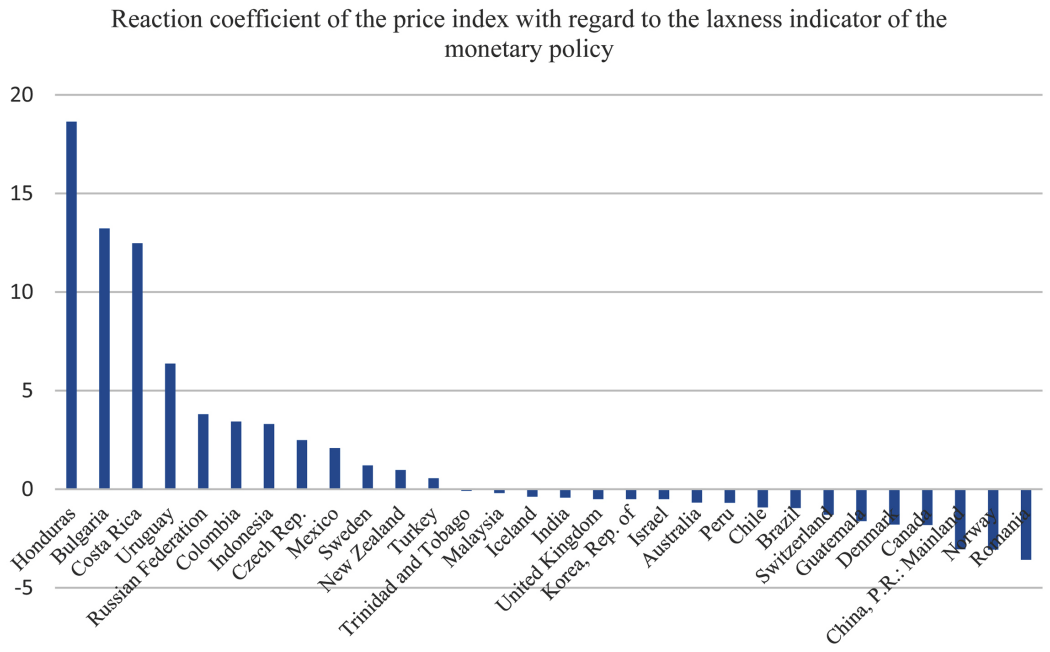
Results in Table 3 pose a series of questions with respect to the sign of the variable associated with the monetary public policy and its influence other the price index of the economies sampled in our exercise:

1) Given the fact this is a panel of economies, is there a chance that some of them influence the global results of the cointegration exercise? and

2) Does the monetary policy work by means of a mechanism different to the one initially proposed in our hypothesis?

To answer the first question, we carried out individual VECM estimations. To answer the second question, we estimated a new VECM excluding the variable that indicates the laxness degree of the monetary policy. In addition, we tested one additional hypothesis, in which the monetary policies of the countries sampled are subjected to one rule or one reaction function.

Graph 2 shows the cointegration coefficients for the laxness indicator of the monetary policy of each country in the panel. As expected, many of them turned



Graph 2. Reaction coefficient of the price index with regard to the laxness indicator of the monetary policy. Source: Authors' calculations.

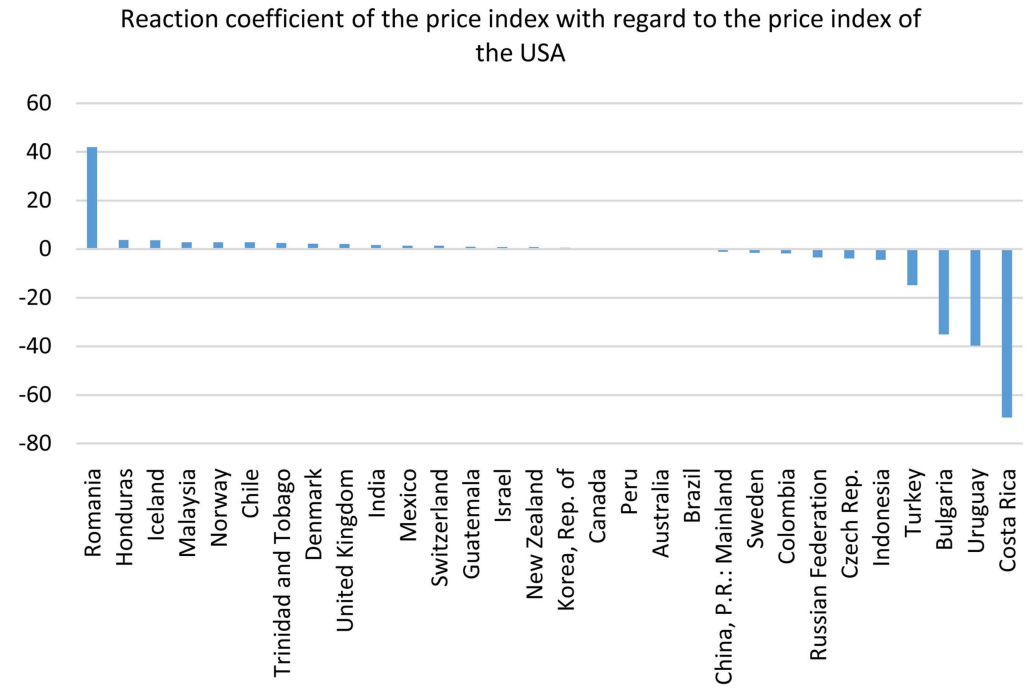
out to be negative, but others positive (as suggested by our model). Plus, they have significantly higher values (absolute value) than the negative ones; these are: Honduras, Costa Rica, Bulgaria, Uruguay, Russia, Colombia, Indonesia, Czech Republic, México Sweden, New Zealand and Türkiye.

Furthermore, the reaction coefficients, with regard to US prices, are negative for this very group of countries (**Graph 3**).

The results in **Graph 2** and **Graph 3** suggest that the cointegration exercises should be made flexible using interaction dummy variables for this group of countries, which might allow for differentiating adequately the coefficients, without having the need for sample segmentation, and thus losing freedom degrees in the estimations. Then, by defining a dummy equal to 1 for the countries with positive individual coefficients, and 0 for the rest, the reformulated VECM model would be:

$$\Delta Y_t = C + \alpha\tilde{\beta}' Y_{t-1} + \sum_{k=1}^{p} \Pi_k \Delta Y_{t-k} + \epsilon_t$$

$$Y_t = \begin{bmatrix} \ln P_{j,t} \\ \ln \tau_{j,t} \\ \ln \lambda_{j,t} \\ \ln P_t^* \\ D_j \ln \tau_{j,t} \\ D_j \ln \lambda_{j,t} \\ D_j \ln P_t^* \\ t \\ 1 \end{bmatrix}, \quad \alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix}, \quad \tilde{\beta} = \begin{bmatrix} 1 \\ \beta_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \\ \beta_5 \\ \beta_6 \\ \beta_7 \end{bmatrix}$$



Graph 3. Reaction coefficient of the price index with regard to the price index of the USA. Source: Authors' calculations.

Table 4 contains the estimations of the model including the interaction dummies. The results here are ampler. Again, for those countries whose dummy variable is 0, namely those that correspond to negative individual coefficients for the lax monetary policy ($\log\tau$), coefficients continue to have a negative value. This flexibilization in the model's estimation permits that the variable associated to shocks of the real exchange rate ($\log\lambda$) results to be significant and bear a positive sign, namely shocks that generate movements toward the same direction of the prices of countries involved in this exercise. On the other hand, when the dummy is activated (taking a value of 1), the effect of the lax monetary policies over the prices is now as expected (positive), but small and statistically significant, nonetheless. We find this very result for the effect of $\log\lambda$ and $\log P^*$ (US price levels). In both exercises, the deterministic trend (inertia) was non-significant.

Even though the results of the estimations shown in Table 4 permit to capture the negative effect of lax monetary policies over the prices in some countries (as expected theoretically), the question remains as to why for the other group of countries the regression persists a negative sign in this effect.

In the light of the persistence of the counter-intuitive result of the lax monetary policy variable ($\log\tau$), we proceeded with the re-estimation of the model excluding this variable among the explanatory ones. Table 5 shows the VECM estimations obtained after excluding this variable. The estimation of the model, without using interaction dummies, shows that despite the statistical significance, the $\log\lambda$ variable (whose changes are associated to real exchange rate

Table 4. Cointegration panel, interaction dummies. Dependent variable: $\ln\left(P_{J,t-1}\right)$.

	A		B	
	All Countries	Countries with Dummy Activated	All Countries	Countries with Dummy Activated
$\ln \tau_{j,t-1}$	−1.824868	0.061863	−1.803103	0.12829
	[−5.79338]		[−5.63678]	
DUM(−1)* $\ln \tau_{j,t-1}$	1.886731		1.931393	
	[3.92069]		[3.95214]	
$\ln \lambda_{jt-1}$	0.047137	0.015561	0.039499	0.020415
	[3.09670]		[2.55523]	
DUM(−1)* $\ln \lambda_{jt-1}$	−0.031576		−0.019084	
	[−1.48283]		[−0.88250]	
$\ln P_{t-1}^{*}$	2.073976	1.281408	1.815131	1.540613
	[5.63127]		[4.85311]	
DUM(−1)* $\ln P_{t-1}^{*}$	−0.792568		−0.274518	
	[−1.72408]		[−0.58803]	
@TREND (97Q1)	1.79E−05	1.79E−05	1.90E−05	1.90E−05
	[0.46100]	[0.46100]	[0.48156]	[0.48156]
C	0.126822	0.126822	0.128091	0.128091
α_1	−0.019819		−0.019903	
	[−9.82960]		[−10.0910]	
α_2	−0.003578		−0.003274	
	[−2.43222]		[−2.78638]	
α_3	0.009433		0.007757	
	[2.49469]		[3.00283]	
α_4	−0.000286		−0.000162	
	[−1.69524]		[−1.48347]	
α_5	−0.000362		---	
	[−0.41469]			
α_6	0.000959		---	
	[0.34061]			
α_{87}	−0.00021		---	
	[−1.59103]			

Continued

Determinant Resid. Covariance (Dof Adj.)	2.11E−27	2.11E−27
Determinant Resid. Covariance	1.94E−27	1.94E−27
Log Likelihood	53652.79	53651.98
Akaike Information Criterion	−41.47054	−41.46991
Schwarz Criterion	−40.97529	−40.97466
Number of Coefficients	218	218

Source: International Financial Statistics, MIF and authors' calculations.

shocks) has the expected effect (positive) upon the price level. $\log P^*$ (US price index) as well as the deterministic trend are significant with positive signs, which highlights the importance of US inflation as an influential common factor upon the prices of the other economies and the (apparent) inertial trend in price formation.

When including the interaction dummies (Column B), we obtain the same results and, indeed, for the countries under the dummy there is an increase in the reaction coefficient values of $\log \lambda$ and $\log P^*$. Column C contains the results after refining Model B by imposing the restrictions over the coefficients α_4 y α_5. These turned out to be non-significant. In brief, for any specification of this model's variation, the price levels of these economies have two remarkable determinants in the long term: US price levels and the inertial trend.

There is yet for us to examine the issue related to the relative laxness indicator of the monetary policy: τ. To examine this, we did an exercise, in which we assumed that the dependent variable is the lax monetary policy indicator, while the other variables are exogenous. In other words, this new model considers that the monetary policy is subjected to a "reaction function". Results are shown in Table 6.

In accordance with the results presented in Table 6, the increase in the price levels of countries different to the USA have a negative effect, as well as significant, upon the laxness degrees of their monetary policies (they are reduced, namely, such increases would make them less lax). Meanwhile, the rise in US price levels increases the laxness degrees of the monetary policies of the rest of the economies, whose price levels remain constant in a likely search for a positive impact on the economic activity, while taking advantage of the disinflationary impact of the US[4]. Now, the variations of the variable λ (real exchange rate shocks) have an effect lacking statistical significance. Considering the existence of differential effects in previously identified countries, we have included an interaction dummy to capture these differential effects, in a similar fashion to the estimation in Table 4.

[4]In other words, we can find some evidence of a reaction function of the monetary authorities facing inflation. Aizenman et al. (2008) found related evidence for the case of 16 emerging economies with *Inflation Targeting* regimes.

Table 5. Cointegration panel, excluding $\ln\left(\tau_{jt-1}\right)$.

	A	B		C	
Dependenent Var.: $\ln P_{j,t-1}$	All Countries	All Countries	Countries with Dummy = 1	All Countries	Countries with Dummy = 1
$\ln \lambda_{j,t-1}$	0.000764	0.007229	0.015459	0.008758	0.013337
	[0.06576]	[0.46695]		[0.56873]	
DUM(−1)* $\ln \lambda_{j,t-1}$		0.00823		0.004579	
		[0.36765]		[0.20565]	
$\ln P^{*}_{t-1}$	1.36278	0.87583	1.631229	0.933973	1.538649
	[5.64248]	[2.33124]		[2.49915]	
DUM(−1)* $\ln P^{*}_{t-1}$		0.755399		0.604676	
		[1.61449]		[1.29918]	
@TREND (1997Q1)	0.000117	0.000101	0.000101	9.92E−05	9.92E−05
	[3.20300]	[2.79062]	[2.79062]	[2.75935]	[2.75935]
C	−0.145284	−0.0964	−0.0964	−0.098636	−0.098636
α_1	−0.020689	−0.020465		−0.020906	
	[−10.0616]	[−10.2163]		[−10.4924]	
α_2	0.005666	0.005552		0.003605	
	[1.46513]	[1.46338]		[1.36026]	
α_3	−0.00027	−0.000251		−0.000261	
	[−1.56377]	[−1.48348]		[−2.35341]	
α_4		0.002196		0	
		[0.77862]		[NA]	
α_5		2.89E−05		0	
		[0.21748]		[NA]	
Determinant Resid. Covariance (Dof Adj.)	2.31E−11	3.87E−20		3.87E−20	
Determinant Resid. Covariance	2.27E−11	3.71E−20		3.71E−20	
Log Likelihood	20607	39365.74		39365.49	
Akaike Information Criterion	−15.95732	−30.46157		−30.46138	
Schwarz Criterion	−15.85281	−30.19805		−30.19785	
Number of Coefficients	46	116		116	

Source: International Financial Statistics, MIF and authors' calculations.

From the above, we can deduce that the empirical evidence seems to be favorable for Hypothesis I and unfavorable for Hypothesis II. Moreover, it is favorable for an additional hypothesis: The monetary policy of the countries sampled, under our estimation methodology, does not seem to be exogenous. Rather,

Table 6. Cointegration panel. Dependent variable: $\ln \tau_{jt-1}$.

	All Countries	All Countries	Countries with Dummy = 1
$\ln P_{j,t-1}$	−2.706674	−1.356653	−0.055522
	[−9.70857]	[−10.9530]	
$\text{Dum}_{t-1}{}^{*} \ln P_{j,t-1}$		1.301131	
		[5.66663]	
Log de $\lambda_{j,t-1}$	−0.004496	0.033755	−0.011249
	[−0.13851]	[2.02985]	
$\text{Dum}_{t-1}{}^{*} \ln \lambda_{j,t-1}$		−0.045004	
		[−1.93042]	
$\ln P^{*}_{t-1}$	3.879054	2.242201	−0.216123
	[4.27996]	[4.33572]	
$\text{Dum}_{t-1}{}^{*} \ln P^{*}_{t-1}$		−2.458324	
		[−3.55828]	
@trend (1997Q1)	0.000326	0.000107	0.000107
	[3.25242]	[2.89751]	[2.89751]
C	−0.400192	−0.111125	−0.111125
α_1	−5.03E−05	−0.001599	
	[−0.09215]	[−1.22817]	
α_2	−0.007472	−0.013164	
	[−10.0293]	[−7.38405]	
α_3	0.002245	0.006104	
	[1.61490]	[1.83682]	
α_4	−0.0001	−0.000308	
	[−1.61169]	[−2.06309]	
α_5		−0.001865	
		[−1.33062]	
α_6		−0.001122	
		[−0.45913]	
α_{87}		−0.000318	
		[−2.71184]	
Determinant Resid. Covariance (Dof Adj.)	1.17E−14	4.02E−27	
Determinant Resid. Covariance	1.14E−14	3.70E−27	
Log Likelihood	26740.81	52823.93	
Akaike Information Criterion	−20.69368	−40.82726	
Schwarz Criterion	−20.51875	−40.33201	
Number of Coefficients	77	218	

Source: International Financial Statistics, MIF and authors' calculations.

it presents a behavior of a variable subjected to a reaction function. Our analysis captures two of the variables that monetary policy makers would consider in the assumed reaction function: domestic as well as USA price levels. A finding that seems to be compatible with ours has been Ball and Sheridan's (2003) in this sense: once the mean reversion of the 23 OECD countries is captured, the countries adopting the monetary schemes with inflation targets (11 in the sample) did not obtain significantly better results than those which did not adopt such monetary scheme[5].

5. Summary and Conclusion

The world disinflationary trend observed in the last 23 years and the inflation stabilizations at low levels corresponds to a process led by the US. This is what we can conclude in the light of econometric exercises with US data of quarterly frequency and 30 other countries sampled from different continents. The results show favorability for Hypothesis I and unfavourability for alternative hypotheses drawing emphasis on apparently anti-inflationary national monetary policies, or deflationist shocks of "real" origin, namely different to the ones of the monetary policy.

Furthermore, the empirical evidence seems to indicate that, in general terms, the national monetary policies have been lax in this sense: monetary policymakers of countries different from the US have taken advantage of the disinflationist forces stemming from this country in order to execute lax policies while foreseeing some related benefits (for instance, over the economic activity) without fearing, apparently, the cost in terms of higher inflation rates.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Aizenman, J., Hutchison, M., & Noy, I. (2008). *Inflation Targeting and Real Exchange Rates in Emerging Markets.* NBER Working Paper 14561. National Bureau of Economic Research. https://doi.org/10.3386/w14561

Álvarez, F. E., Lippi, F., & Passadore, J. (2016). *Are State and Time Dependent Models Really Different?* NBER Working Paper 22361. National Bureau of Economic Research. https://doi.org/10.3386/w22361

Ball, L., & Sheridan, N. (2003). *Does Inflation Targeting Matter?* NBER Working Paper 9577. National Bureau of Economic Research. https://doi.org/10.3386/w9577

Burstein, A., & Gopinath, G. (2014). International Prices and Exchange Rates. In G. Gopinath, E. Helpman, & K. Rogoff (Eds.), *Handbook of International Economics* (Vol. 4,

[5]In order to verify whether inflation convergence at low and stable rates was a generalized behavior in an ample group of economies, Hyvonen (2004) did an exercise and found that between 1960 and 1980 this phenomenon did not occur consistently in the OECD countries. It occurred, nonetheless, in the case of US metropolitan areas, which is why, from a historical perspective, the author was able to partially conclude that the adoption of inflation targets influences the reduction of inflation.

pp. 391-451). North Holland. https://doi.org/10.1016/B978-0-444-54314-1.00007-0

Busetti, F., Forni, L., Harvey, A., & Vendittia, F. (2007). *Inflation Convergence and Divergence within the European Monetary Union*. International Journal of Central Banking, Working Paper Series No.574.

Calvo, G.A. (2016). *From Chronic Inflation to Chronic Deflation: Focusing on Expectations and Liquidity Disarray since WWII.* NBER Working Paper 22535. National Bureau of Economic Research. https://doi.org/10.3386/w22535

Dornbusch, R. (1985). *Inflation, Exchange Rates and Stabilization.* NBER Working Paper 1739. National Bureau of Economic Research. https://doi.org/10.3386/w1739

Forbes, K. (2019). *Inflation Dynamics: Dead, Dormant, or Determined Abroad?* NBER Working Paper 27746. National Bureau of Economic Research. https://doi.org/10.3386/w26496

Heise, S., Karahan, F., & Şahin, A. (2020). *The Missing Inflation Puzzle: The Role of the Wage-Price Pass-Through.* NBER Working Paper 27663. National Bureau of Economic Research. https://doi.org/10.3386/w27663

Hyvonen, M. (2004). *Inflation Convergence across Countries.* Research Discussion Paper 2004-04. Bank of Australia.

Karanasos, M., Koutroumpis, P., Karavias, Y., Kartsaklas, A., & Arakelian, V. (2016). Inflation Convergence in the EMU. *Journal of Empirical Finance, 39,* 241-253. https://doi.org/10.1016/j.jempfin.2016.07.004

Ndiaye, A. (2021). Exchange Rates and Inflation Rates Convergence in ECOWAS. *Modern Economy, 12,* 1726-1747. https://doi.org/10.4236/me.2021.1212088

Razin, A. (2004). *Globalization and Disinflation: A Note.* NBER Working Paper 10954. National Bureau of Economic Research. https://doi.org/10.3386/w10954

Weber, A. A., & Beck, G. W. (2005). *Price Stability, Inflation Convergence and Diversity in EMU: Does One Size Fit All?* CFS Working Paper 2005/30. Center for Financial Studies.

Wickens, M. R. (2011). *Macroeconomic Theory: A Dynamic General Equilibrium Approach* (2nd ed.). Princeton University Press. https://doi.org/10.1515/9781400842476

Annex: Countries and Data Source

Selection Criteria

Own currency, no hyperinflation, statistic availability (quarterly frequency series) between 1998 and 2019.

31 countries: 30 sampled and the US

Australia	Colombia	Iceland	México	Sweden
Brazil	Costa Rica	India	New Zealand	Switzerland
Bulgaria	Czech Republic	Indonesia	Norway	Trinidad and Tobago
Canada	Denmark	Israel	Perú	Türkiye
Chile	Guatemala	South Korea	Romania	UK
China (*Mainland*)	Honduras	Malaysia	Russia	Uruguay

Statistic sources: 1) *International Financial Statistics* (*IFS*), IMF, and 2) *World Development Indicators* (*WDI*), World Bank.