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INFLATION IN A DOLLARIZED ECONOMY: THE ROLE OF FISCAL POLICY

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Inflation in a dollarized economy: the role of fiscal policy

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Abstract

This study analyzes the price gap between Ecuador, a dollarized economy, and the United States. As Ecuador´s public spending has increased, the price gap has also widened. Therefore, we focus on Ecuador's public spending as the factor that generates price divergence between the two economies. We rely on cointegration analysis to study the long-run relationship between government spending and the price differential. Using an SVEC model, we find that shocks to the Ecuadorian public expenditure predominantly explain the price gap variance. This shock has a long-lasting effect on the price gap. We also briefly analyze the role of oil prices in public spending and find a significant impact on Ecuadorian public expenditure.

1 Introduction

Ecuador has adopted the U.S. dollar as its official currency. Considering that the country shares the same monetary system as U.S, one would think that the prices of both economies would converge. However, we did not find evidence of that, so this study focuses on finding out which factor generates divergence. Some empirical results favor price convergence, while others find a prevailing gap among countries.

The heterogeneity of empirical evidence of price and inflation convergence has questioned the factors influencing price divergence. Some studies focused on supply-side theories such as the Balassa–Samuelson effect (Balassa, 1964) and the Purchasing Power Parity (PPP) theory (Cassel, 1918), while others justify the lack of price convergence based on demand-based factors. For example, Froot and Rogoff (1991) explain how public spending shocks could lead to a permanent price divergence in a neoclassical model. Finally, the literature also provides empirical evidence favoring the potential effect of fiscal policy on price gaps (see Froot and Rogoff (1991);De Gregorio et al. (1994);Galstyan and Lane (2009)). In this framework, we study the price gap between the U.S. and a fully-dollarized economy such as Ecuador and test the price divergence between the two countries and the potential factors explaining this gap.

Our research question and hypothesis are based on the behavior of Ecuadorian public expenditure after the transition period to dollarization. Ecuadorian 2007 public spending significantly expanded, rising from 16% to 23.5% of GDP Cueva and Díaz (2021). Over the same period, the price gap between Ecuador and the U.S. has been widening, which leads us to believe that Ecuador´s public expenditure could be a significant price-divergent factor.

Our research question and primary goal in this paper are to test whether government expenditure explains why Ecuadorian and U.S. prices (hence their inflation rates) do not converge relatively. The proposed hypothesis establishes a long-term relationship between the price gap and public expenditure, such that public expenditure shocks generate permanent impacts on the price gap that prevent the price level convergence in equilibrium.

To test our hypothesis, we determine the price equilibrium relationship using two cointegration tests and incorporate it into a Structural Vector Error Correction (SVEC) model to measure the long-run impact of the shocks from 2003 to 2019. To measure the price gap, we use the Consumer Price Index (CPI) for Ecuador and the U.S. We also use Ecuador´s public expenditure as a share of the country´s GDP. The data used in this article is provided by the National Institute of Statistics and Census of Ecuador, the U.S. Bureau of Labor Statistics, and the Central Bank of Ecuador.

We find a cointegration relationship between the price gap and government expenditure and report empirical evidence of a common trend in the long run between both variables. The SVEC model suggests that shocks to the Ecuadorian public expenditure predominantly explain the price gap variance between the US and Ecuador, with this contribution growing over time. This shock has a long-lasting effect on the price gap, which does not converge to zero. We also analyze the role of oil prices in public spending and find a significant impact of oil prices on Ecuadorian public expenditure in both the short and long term.

This study aims to contribute to the literature in two ways. First, we seek to understand better the factor that generates a divergence between Ecuadorian and U.S. prices. Lastly, our results could be a reference in related literature and help to understand the price convergence for dollarized economies and the role that fiscal policy has in the price dynamics of these economies.

This study is structured as follows. Section 2 provides a detailed review of the literature related to price convergence. Section 3 describes the data and methodology used in our empirical analysis. Section 4 presents the main results of our SVEC model. Section 5 contains robustness approach to ensure our cointegration results. Section 6 presents a brief discussion of our results with observed data and theoretical framework, as well as the econometric approach involving public spending and oil prices. Finally, we highlight the main conclusions in Section 7.

2 Literature Review

This section addresses research delivering economic theory around relative prices and their convergence. We also explain the transmission mechanisms between fiscal policy and inflation. Finally, we refer to empirical studies on price convergence in developed and emerging countries, which motivate our paper. Last, we describe our significant contribution to this literature, considering the recent interest in price dynamics and dollarization in some Latin American countries.

Common currencies, or monetary systems, mainly drove the interest in price convergence or divergence. Thus, price differential is an extensively researched topic in related literature in the wake of economic integration, especially around European countries (Cecchetti et al., 2002)(Goldberg and Verboven, 2005)(Méjean and Schwellnus, 2009).

Empirical findings are mixed. Some authors report results in favor of price convergence (Fan and Wei, 2006)(Parsley and Wei, 1996)(Chaudhuri and Sheen, 2004). However, as countries become more interrelated, these studies conclude that convergence is not as clear as it used to be. On the other hand, early studies have not found price convergence in either the short or long term (Beck, 2003)(Engel and Rogers, 1994). Also, studies such as Garcia-Hiernaux et al. (2023) focus on finding the date, shape, and velocity of price convergence/divergence in the European Monetary Union (EMU).

Focusing on the later findings, studies have addressed the discussion of the reasons that explain these deviations. To link theoretical foundations and empirical results, the authors have relied on theories such as the Balassa–Samuelson effect, the Purchasing Power Parity (PPP) theory, the border effect, and demand factors, which are of interest.

The Balassa–Samuelson effect states that price deviations occur due to productivity gaps across countries (Balassa, 1964). In turn, the PPP theory explains that the gap is due to price inequivalence between countries, which could relate to differences in the trade sector (Officer, 1976)(Cassel, 1918). Regarding the border effect (Parsley and Wei, 2001), it determines that the distance between economies, shipping costs, and exchange rates could justify the price differentials.

The fundamentals mentioned above belong to the supply side of the economy, with minor reference to the role/impact of expenditure. Regarding demand factors, ahead of the European Monetary System (EMS), Froot and Rogoff (1991) explain some drivers that link fiscal policy and price divergence based on a neoclassical model. The authors explain how a government expenditure shock generates a permanent deviation in the price gap between the two countries.

As Obstfeld and Rogoff (1995) denote, the model assumes an economy that produces only two goods, one tradable and one non-tradable. Fixed production factors condition the economy. Also, the traded good in the international market faces an elastic demand, while the non-tradable good has an inelastic local demand. Assuming that the government expenditure directly and immediately affects the non-tradable good, a positive shock will shift the demand curve, causing local prices to increase.

However, since the supply is conditioned, prices will rise and keep at a certain level in the long term. This means that a spending shock could cause a permanent price increase, which leads to a higher gap between the countries (Froot and Rogoff, 1991). Notice that the impact on price differential will hold if only the production factors remain fixed across sectors (Cheung and Lai, 2000).

Based on this perspective, some studies have questioned the impact of fiscal policy on the price gap in countries with similar monetary systems. For example, (Froot and Rogoff, 1991) find that government expenditure has a positive and persistent effect on the price ratio of eight EMS countries, which is maintained in the long term. Nevertheless, the short-term effects are not conclusive. For members of the Organisation for Economic Co-operation and Development (OECD), De Gregorio et al. (1994) finds a similar result. More recently, Galstyan and Lane (2009) find a significant effect of government consumption on the relative price for OECD members as well.

Some cointegration studies have analyzed the long-run behavior of price differential. The main interest of this analysis is to estimate at what rate the gap returns to zero in the steady state (if it returns at all). Pesaran and Shin (1996) explain the interpretation of long-run models (e.g., Vector Error Correction (VEC) models) and how it can be applied in the context of relative price divergence. The authors find an increasingly predominant divergence of relative prices, with a slow return to a gap equal to zero. Similar results were found for Indian cities in Morshed et al. (2006) study. The theoretical background on the role of fiscal policy explained by Froot and Rogoff (1991) and the cointegration findings motivate us to question whether there is a long-run relationship between Ecuador´s public spending and the price gap in comparison with the U.S.

In the scenario of low output levels and high inflation rates, since 2000, Ecuador, a Latin American emerging economy, adopted the American dollar as its official currency of transactions, officially dollarizing the economy. This dollarization strategy successfully curtailed the inflation rate. After reaching peaks during the '90s, inflation began steadily to decline, falling to single-digit levels by 2003 (Quispe-Agnoli and Whisler, 2006). However, to be fully dollarized puts Ecuador in a compromise scenario with limited monetary policy.

Later, in 2007, the government emphasized raising state participation in the Ecuadorian economy. Public spending significantly expanded, rising from 16% to 23.5% of Ecuador's GDP, which could link with pressures on overall demand (Cueva and Díaz, 2021). Then, the government relied heavily on borrowing to cover deficits resulting from increased expenditures. The immediate scale in Ecuador's public expenditure as a percentage of GDP suggests that a divergence in prices between Ecuador and the United States could be explained by fiscal policy.

Generally, evidence of the price gap in emerging Latin American economies has been scarce. Mainly, research on Ecuador as a study economy has been minimal. One possible reason is the monetary system that the country has adopted; since not having its own currency makes monetary policy lose its impact in multiplying throughout the economy, and therefore, inflationary pressures are drastically reduced (Cueva and Díaz, 2021). With no inflation targeting and having reflected single-digit inflation rates, studies for Ecuador turn out to be few.

Some studies have included the country in the analysis. For instance, an early study of price convergence by Cheung and Lai (2000) includes Ecuador as part of its panel data. However, the time period does not include the country's dollarization process, nor does it make any inference from it. More recently, Quispe-Agnoli and Whisler (2006) publication address the impact of dollarization on Ecuador's macroeconomic variables, where the authors briefly discuss the divergence of local prices and what was the role of fiscal policy in the gap. Also, Cueva and Díaz (2021) article provides a wide Ecuadorian background of the macroeconomic challenges the country has faced as a result of the fiscal expansion, especially in committing local prices.

These contributions motivate our study, analyzing the price gap between Ecuador and the US price levels and testing whether public expenditure as a percentage of Ecuador's GDP can explain this gap. The literature emphasizes some criteria to consider so that the price differential is not biased (Papell, 1997) (Chmelarova and Nath, 2010). However, our research focuses on the price difference on a bilateral basis. Therefore, although both countries differ in their economic size, their common monetary system justifies their comparison as far as prices are concerned.

Our contribution to the literature focuses on two purposes. First, we seek to better understand the differential factor that generates a divergence between Ecuadorian and U.S. prices through the role of fiscal policy. Second, and more importantly, we believe that the results of this research will help us understand price convergence for dollarized economies and what the main challenges are in the face of spending shocks.

3 Methodology

3.1 Theoretical model

This subsection shows the intuition and derivation behind the price gap model between Ecuador and the USA. Under the assumptions that will be imposed, which are supported by economic theory such as the PPP theory (Officer, 1976) and Froot and Rogoff (1991) demand-based theory, the proposed model would contemplate this study's hypothesis.

Let us denote country i and country j. Both share the same currency in their monetary system. In the absence of structural differences between the two economies and a scenario of perfect competition, prices should converge to the same level. In other words, prices should converge in absolute terms.

Absolute price convergence:

$$\begin{aligned} P_i &= P_j + u \\ \Delta P_i &= \Delta P_j \\ \pi_i &= \pi_j \end{aligned} \tag{1}$$

Where $P_{i,j}$ is the price level of each country expressed in logarithm, and u is a white noise term. If both prices tend to the same value, then their variations (inflation) will also converge. However, the absolute price convergence expressed by the expression (1) implies very rigid and unrealistic assumptions in economic reality.

The differences in the economic structure of both countries do not justify the equivalence of prices in country i and country j, but since both economies share the same monetary system, the convergence argument is still valid under certain scenarios. For example, let us determine s as the structural factor(s) that economy j has. This term can be interpreted as a price differential factor between both countries:

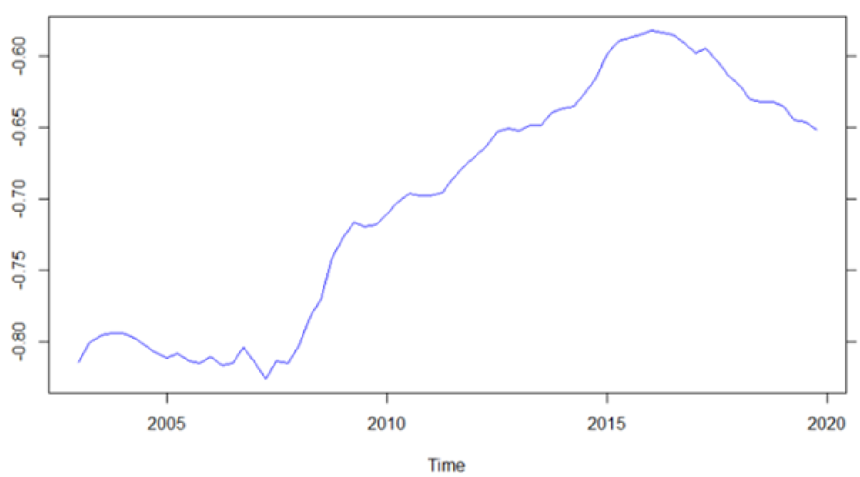
Relative price convergence:

$$\begin{aligned} P_i &= P_j + s + u \\ \Delta P_i &= \Delta P_j \\ \pi_i &= \pi_j \end{aligned} \tag{2}$$

First, we notice that prices in expression (2) are not equal due to the structural term. However, there could be a sense of convergence only if this factor remains constant or time-invariant. Therefore, the price variations (inflation) could still converge to the same level. This can be understood as relative price convergence. However, it does not mean that price levels are the same. On the contrary, if this term varies over time, the inflation rates of both countries will not tend to a common value, even if the economies share the same currency.

Empirically, price convergence can be evidenced by analyzing the price gap between economies. On the one hand, if the price gap behaves as a stationary series, it would suggest that prices or inflation rates converge to the same level, as expression (2) shows. On the other hand, if the price gap contains a unit root (non-stationary), then price convergence cannot be concluded.

Figure 1: Price gap between Ecuador and USA
In logarithm, 2003 Q1 - 2019 Q4



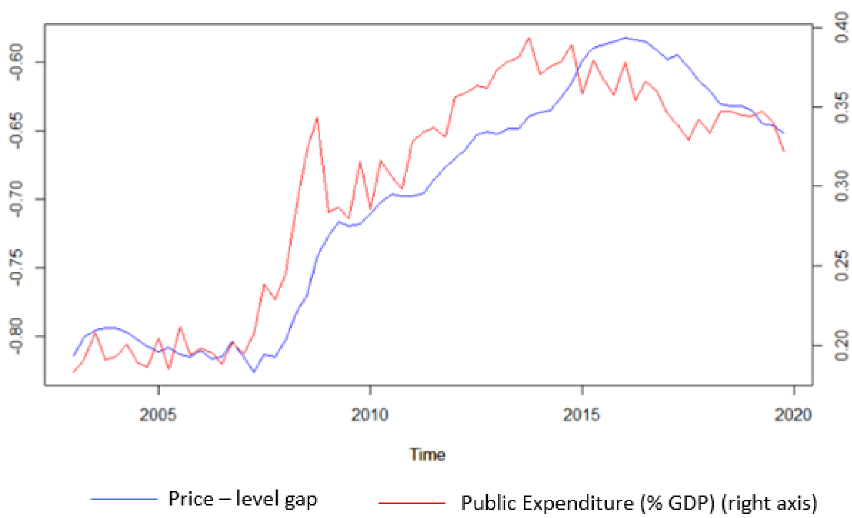
Note: The gap is the ratio between Ecuador's CPI and U.S. CPI, both in logarithms.
Sources: INEC and U.S. Bureau of Labor Statistics.

Considering the previous explanation, our case study analyzes the price gap between

Ecuador and the USA. As mentioned, Ecuador has fully adopted the U.S. dollar as its legal and only currency since 2000. This means that both economies share the same currency. Therefore, the question that arises is whether both prices (or inflation rates) converge.

Figure 1 shows the evolution of the price gap (measured by the CPI) between Ecuador and the USA, where it is evident that the price difference behaves as a non-stationary series. Therefore, it cannot be concluded that there is convergence. Now, the question arises: what is the differential factor that deviates the price level?

Figure 2: Price gap and Ecuador's Public Spending
In logarithm, 2003 Q1 - 2019 Q4



Notes: The gap is the ratio between Ecuador's CPI and U.S. CPI, both in logarithms. Public spending is expressed as a share of Ecuador's GDP.
Sources: Central Bank of Ecuador, INEC and U.S. Bureau of Labor Statistics.

As a dollarized economy with no local currency, Ecuador has limited monetary policy instruments, as it cannot issue money that can stimulate the economy. Therefore, their fiscal policy becomes a key tool. Empirically, some studies address factors that could justify the non-convergence price between economies that share the same monetary system (Froot and Rogoff, 1991) (De Gregorio et al., 1994), including the role of fiscal policy. This background supports our belief that public expenditure is the differentiating factor that diverts local prices to converge to U.S. prices. If this is the case, the price gap would be a function of public spending:

$$\begin{aligned} P_{EC} &= \beta_0 + \beta_1 P_{USA} + \beta_2 G + u \\ GAP = P_{EC} - P_{USA} &= \beta_0 + \beta_2 G + u \end{aligned} \tag{3}$$

Where P_{EC} is the price level of Ecuador, P_{USA} is the price level of USA, G is Ecuador's public spending, β_0 is a constant term and u is a white noise term. Notice that the price gap could be represented as expression (3) if β_1 does not differ from 1.

Figure 2 shows the evolution of the price gap between Ecuador and the USA and Ecuador's public spending as a share of the country's GDP. Visually, it would appear that both time series share a trend component. If this is the case, their linear combination is stationary, meaning that the price gap and the public expenditure could have a long-term relationship.

3.2 Estimation method

3.2.1 Testing for cointegration

Two or more $I(1)$ time series are cointegrated of rank k if their linear combination is $I(0)$. As mentioned in Section (3.1), if GAP and G are both $I(1)$, and there is a vector β such that their linear combination:

$$\beta' Y_t = \begin{pmatrix} \beta_1 & \beta_2 \end{pmatrix} \begin{pmatrix} GAP_t \\ G_t \end{pmatrix} = \beta_1 GAP_t + \beta_2 G_t \sim I(0) \tag{4}$$

then GAP and G are cointegrated with cointegration vector β. This means that time series co-moved in the long run, which indicates a long-term relationship (Engle and Granger, 1987).

To determine the existence of cointegration between the price gap and public spending (as shown in expression (4)), we use the Johansen Trace test. Since the backward estimation strategy is the maximum likelihood (ML), the test estimates all possible cointegration relationships (Johansen, 1988).

The null hypothesis is that the rank of cointegrating relationships is 0 (r_0). The likelihood ratio test (LR) statistic is:

$$LR(r_0, n) = -T \sum_{i=r_0+1}^{n} \ln(1 - \lambda_i) \quad (5)$$

where λ_i are the estimated eigenvalues. This expression is known as the Johansen trace statistic, which is compared with the critical value at a certain significance level. We consider a significance level of 5% (or 95% confidence level) for every test. This will determine the specification of the model proposed. If there is no statistical evidence of cointegration relationships, then the model should not include a long-run relationship. Conversely, if the results suggest cointegration exists, a term representing equilibrium relationships should be considered when modeling the series.

3.2.2 Structural Vector Error Correction (SVEC) model

In most cases, macroeconomic variables are series constructed under aggregation methods, which implies a certain level of endogeneity. Therefore, it is common to model a system of equations to analyze the relationships between variables. For instance, consider a Vector Autoregressive (VAR) model[1] in its reduced-form expression with $I(1)$ series:

$$\Delta Y_t = \sum_{i=1}^{p} \theta_i \Delta Y_{t-1} + \epsilon_t \quad (6)$$

where Y_t is a vector of endogenous variables, θ_i is a matrix of lag coefficients of endogenous variables, and ϵ_t represents a disturbance vector. Excluding any deterministic terms, notice that the model only considers the past values of the time series. It should be noted that, for the system to have adequate inference, all variables must comply with stationarity[2].

[1] VAR models capture the dynamics of various time series through equations that model each variable as a function of its past values, and the other´s variables lags (Sims, 1980).

[2] A time series is strictly stationary if the joint distribution in t period is the joint distribution in $t + k$ periods. A time series is weak stationarity if the first and second moments do not rely on time (Hamilton,

Based on the analysis in Section (3.2.1), if there is statistical evidence of long-term relationships between the endogenous variables, then it implies that the linear combination of these variables is stationary. Therefore, it could be included as part of the equation system. This specification converts the VAR model into a Vector Error Correction (VEC) model, as follows:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p} \theta_i \Delta Y_{t-1} + \epsilon_t \tag{7}$$

where $\beta' Y_{t-1}$ is known as the model's error correction (EC) term, which is expressed in its first lag. The matrix α is the loading matrix, which contains weights of the long-term relationships. Note that, although the linear combination of the cointegrated variables is stationary, the series in levels are still I(1).

Considering the above expression, if the price gap and public spending are cointegrated, then the model to be estimated contains the following equations, with all variables in logarithms:

$$\begin{aligned}
\Delta GAP_t &= \beta_0 + \alpha\beta'(GAP_{t-1} - G_{t-1}) + \sum_{i=1}^{3} \eta_i \Delta GAP_{t-1} + \sum_{i=1}^{3} \rho_i \Delta G_{t-1} + \sum_{i=1}^{3} \theta_i \Delta X_{t-1} + \gamma NX_t + \epsilon_t \\
\Delta G_t &= \beta_0 + \alpha\beta'(GAP_{t-1} - G_{t-1}) + \sum_{i=1}^{3} \eta_i \Delta GAP_{t-1} + \sum_{i=1}^{3} \rho_i \Delta G_{t-1} + \sum_{i=1}^{3} \theta_i \Delta X_{t-1} + \gamma NX_t + \epsilon_t \\
\Delta X_t &= \beta_0 + \sum_{i=1}^{3} \eta_i \Delta GAP_{t-1} + \sum_{i=1}^{3} \rho_i \Delta G_{t-1} + \sum_{i=1}^{3} \theta_i \Delta X_{t-1} + \gamma NX_t + \epsilon_t
\end{aligned} \tag{8}$$

where GAP represents the difference between Ecuador´s CPI and U.S. CPI, G represents the public expenditure as a share of Ecuador´s Nominal Gross Domestic Product (GDP), X is the total transfers (includes remittances received), and NX is the trade balance, which we consider it as an exogenous stationary variable[3]. The vector β_0 contains a constant term,

2020)

[3] The trade balance is the gap between exports and imports. Section 3.4 reports the unit root test. Since it is a stationary series, we include it at its logarithmic level in the model. We tested and concluded that

η, β, θ represent the coefficient matrices, and ϵ_t represents a vector of disturbances of the variables.

As indicated, the EC terms of our model corresponds to the multiplication of the linear combination $(GAP_{t-1} - G_{t-1})$, and the cointegration vector β. Their equations are as follows:

$$\begin{aligned} ec_{1,t-1} &= \beta_{1,1} GAP_{t-1} + \beta_{2,1} G_{t-1} \\ ec_{2,t-1} &= \beta_{1,2} GAP_{t-1} + \beta_{2,2} G_{t-1} \end{aligned} \tag{9}$$

Notice that the EC term only appears in the ΔGAP_t and ΔG_t equations. This implies that there is no long-run relationship between the three variables, only in 2 of them, which is supported by our hypothesis and can be tested as well. Therefore, such a relation should have no effect on X_t. As Lütkepohl and Krätzig (2004) indicate, the EC term can be restricted on β under a justified criterion.

The expression (7) is the reduced form of a Structural Vector Error Correction (SVEC) model. An SVEC model contains the contemporary relationships between variables derived from economic theory. Based on the B-model, the SVEC is represented as follows:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p} \theta_i \Delta Y_{t-1} + B\epsilon_t \tag{10}$$

where B contains the shocks/disturbances in period t of each variable. Because these parameters are not observed directly, some restrictions are required (Kilian and Lütkepohl, 2017). The model needs at least $\frac{1}{2}K(K-1)$ restrictions, that is, 3 assumptions. To have an identified model, we consider the following assumptions:

1. A contemporaneous shock from total transfers has an effect on the price gap, but not vice versa. In one hand, and based on the chapter of Feld (2021), received short-term shocks less influence transfers because economic agents perceive these disruptions as transitory. In addition, transfers flow is most likely to be influenced by income

the variable satisfies the weak exogeneity requirement, which is that estimates hold relatively well when including or not the variable (Lütkepohl and Krätzig, 2004).

and employment shocks (Fullenkamp et al., 2008). On the other hand, factors such as individuals behaviour, altruism and insurance, have been considered the primary influence of received transfers (Azizi, 2017)(Hagen-Zanker and Siegel, 2007).

2. Public expenditure is not influenced by shocks from the price differential or transfers received. Since most government expenditures are executed under a budget planning, Garcia-Macia (2023) explain that it could react to expected or forecast prices only. However, the authors do not find any significant effects on spending. In addition, as Quispe-Agnoli (2002) point out in their article about dollarized economies, expenditure decisions are more influenced by fiscal and budgetary restrictions rather than local prices since the government supposes remained prices due to dollarization.

Permanent and transitory shocks

Going back to expression (7), the model contains the linear combination of variables (also known as the error correction term), considering that cointegration relationships exist between variables. Therefore, in its moving average (MA) representation, the impulse-response functions (IRF) will be expressed as follows (Lütkepohl and Krätzig, 2004):

$$y_t = \Xi \sum_{i=1}^{t} u_i + \sum_{j=0}^{\infty} \phi_j u_t + y_0^*, \tag{11}$$

where $\Xi \sum_{i=1}^{t} u_i$ represents the shared trend of the model, which reflects the long-term effects, y_0^* are the initial values, and $\sum_{j=0}^{\infty} \phi_j u_t$[4] contains the transitory effects. As Pfaff (2008) states, the long-term effect will determine the y_t responses, so to obtain the transitory effects, we should equal the first term to zero:

$$y_t = \sum_{j=0}^{\infty} \phi_j u_t + y_0^*, \tag{12}$$

In other words, to analyze the permanent (long-term) effects of the variables, the IRFs

[4]Note that $\sum_{j=0}^{\infty} \phi_j = (I_k - A_1 - ... - A_p)$, where A are the coefficient matrices.

must be constructed as expression (11), while the transitory effects will be determined as expression (12).

3.3 Data

We consider quarterly data for each of the variables. The information covers the first quarter of 2003 through the fourth quarter of 2019 to omit possible biases regarding the dollarization process that occurred in Ecuador[5] and impacts derived from the COVID-19 pandemic. The Consumer Price Index (CPI) is the primary indicator to measure an economy's general prices. In the case of Ecuador, this index is calculated by the National Institute of Statistics and Census of Ecuador on a monthly basis. On the other hand, the U.S. indicator is published by the U.S. Bureau of Labor Statistics.

The GDP and consumption deflator data were also collected for robustness purposes, respectively. The source of information was the Central Bank of Ecuador and the Federal Reserve Economic Data. Non-financial public sector spending as a percentage of nominal GDP was considered a measure reflecting the participation of the public sector in the Ecuadorian economy. It should be noted that all data were seasonally adjusted before any analysis using the X-13 method.

To measure the differential, or gap, between Ecuadorian and USA prices, we took into account the first difference between Ecuador's CPI and the USA's CPI, both on a logarithmic scale. To have accurate and standardized comparisons between Ecuadorian and U.S. prices, both indexes were standardized by using the Purchasing Power Parity (PPP) published by the World Bank. Diewert (2002) suggests that harmonizing price indexes could address the representativeness of an economy in the global market, as well as the substitution biases.

Table 1 shows some descriptive statistical measures of each variable, including the price gap between the CPI of Ecuador and the CPI of the USA. It should be noted that all

[5]Since 2000, Ecuador began a process of dollarization. That is, the country adopted the U.S. dollar as the official currency. Therefore, the study period begins in 2003 to avoid the structural economic change of previous years.

variables in this study are considered on a logarithmic scale. In addition, Appendix A. shows graphically the historical evolution of each variable, from the first half of 2003 to the fourth quarter of 2019.

Table 1: Summary statistics

Variable	Mean	Min	Max	Std. Dev.
CPI_{EC}	3.75	3.45	3.96	0.17
CPI_{USA}	4.46	4.27	4.61	0.09
PS_{EC}	8.67	7.32	9.39	0.69
Total transfers	6.43	6.05	6.83	0.18
DEF_{EC}	3.79	3.32	4.00	0.21
DEF_{USA}	4.49	4.32	4.63	0.08
$DEF_{C,EC}$	3.77	3.32	3.98	0.19
$DEF_{C,USA}$	4.49	4.32	4.61	0.08
Tax revenue	0.11	0.09	0.16	0.01
WTI price	4.15	3.34	4.78	0.35
NX	-0.04	-0.33	0.14	0.08
GAP_{CPI}	-0.70	-0.82	-0.58	0.08
G	0.29	0.18	0.39	0.07

Notes: CPI_i : Consumer Price Index of country i, DEF_i : GDP deflactor of country i, $DEF_{C,i}$: Consumption deflactor of country i, PS_{EC} : Ecuador´s public spending, GAP_{CPI} : Price difference between CPI_{EC} and CPI_{USA}, G : PS_{EC} as a share of Ecuador´s GDP.

3.4 Time series diagnosis

Prior to the methodological specifications, we perform statistical stationary tests to determine the presence of unit roots in each time series. If tests suggest that a time series has no unit root, it is determined to be stationary, indicating that its first and second statistical moments do not rely on time (Kilian and Lütkepohl, 2017).

Table 2 shows the results obtained from the unit root test for each time series. In absolute value, the test statistic of each variable is less than the critical value at 5% (3.41), except for the trade balance NX. The results suggest that there is no statistical evidence to reject the null hypothesis of the Augmented Dickey-Fuller (ADF) test, which means that each time series has a unit root, except for the trade balance NX.

In order to verify whether the variables are integrated of order 1, the first difference of each variable was considered. Table 3 shows the ADF test for each series. The third column of the table contains the values of the test statistic, which in every case exceeds the critical value at 5% (2.86) in absolute terms. The results suggest that there is statistical evidence to reject the null hypothesis of the ADF test, which means that the series is stationary at their first log difference (or each series is $I(1)$). From now on, when modeling the series, they must be introduced to the system at their first logarithmic difference to meet the stationarity criterion.

Table 2: Unit root test for time series (stationary test) - Logarithm

	Lags	Test statistic	Portmanteau test	Ljung & Box test
CPI_{EC}	4	0.42	0.89	0.83
CPI_{USA}	5	-2.69	0.97	0.95
PS_{EC}	1	-0.67	0.98	0.98
DEF_{EC}	2	-0.96	0.47	0.35
DEF_{USA}	1	-2.86	0.65	0.53
$DEF_{C,EC}$	5	0.49	0.79	0.69
$DEF_{C,USA}$	2	-2.15	0.69	0.59
$WTIoilprice$	1	-2.89	0.75	0.66
$Transfers$	1	-2.59	0.93	0.90
Tax revenue	1	-2.37	0.96	0.93
NX	1	-5.84	0.84	0.76

Note: The table reports results around the Augmented Dickey Fuller (ADF) Test. The test includes the trend specification, due to the time evolution of the variables (see Appendix A). The null hypothesis is that time series has a unit root. The critical values are -3.96 (1%), -3.41 (5%) and -3.13 (10%). Lags were selected under information criteria. To validate results, we test whether estimates have no serial autocorrelation using Portmanteau and Ljung-box test

Table 3: Unit root test for time series (stationary test) - First differences

	Lags	Test statistic	Portmanteau test	Ljung & Box test
CPI_{EC}	3	-2.97	0.86	0.79
CPI_{USA}	3	-4.68	0.72	0.63
PS_{EC}	1	-6.06	0.97	0.96
DEF_{EC}	1	-6.36	0.59	0.46
DEF_{USA}	1	-3.42	0.70	0.61
$DEF_{C,EC}$	1	-4.09	0.18	0.10
$DEF_{C,USA}$	1	-5.58	0.80	0.73
$WTIoilprice$	1	-5.42	0.72	0.62
$Transfers$	1	-7.24	0.89	0.84
Tax revenue	1	-6.93	0.78	0.69

Note: The table reports results around the Augmented Dickey Fuller (ADF) Test. The test includes the constant specification. The null hypothesis is that time series has a unit root. The critical values are -2.86 (5%).

4 Results

4.1 Unit root for relative variables

Prior to deciding on the appropriate model, we need to verify whether or not the relative variables introduced into the model have unit roots. As we mentioned in Section (3.2.1), to infer about cointegration, the related variables must be stationary in their first difference. That is, their order of integration must be I(1).

Table (4) reports the values of test statistics of three unit root/stationary tests: Augmented Dickey-Fuller (ADF), KPSS, and Schmidt-Phillips. The results suggest that the relative variables in their logarithmic scale are not stationary or that they have unit roots.

Table 4: Stationary tests - In logarithms

	ADF test	KPSS test	Schmidt-Phillips test	Stationary
GAP_{CPI}	-1.31	0.16	-1.05	No
$GAP_{GDP}{}^{a}$	-0.81	0.55	-1.49	No
$GAP_{C}{}^{b}$	-1.00	0.66	-0.70	No
G^{c}	-0.67	0.65	-1.54	No
Tax revenue (%GDP)	-2.37	0.32	-3.18	No

Notes: The table reports the values of the statistics, respectively. All tests were estimated including a trend term. The ADF tests for unit root, with a 5% critical value of -3.41. The KPSS tests for stationarity, with a 5% critical value of 0.146. The Schmidt-Phillips tests for unit root, with a 5% critical value of -3.02
[a] The gap between the GDP deflator for Ecuador and U.S.
[b] The gap between the consumption deflator for Ecuador and U.S.
[c] Ecuador´s public spending as a share of the country´s GDP.

Table (5) reports the test statistic values of the same three tests for the first differences of each series. After differentiating them, the results suggest that the relative variables are stationary. This means that each series is $I(1)$, which gives way to a proper cointegration analysis between price gaps and public expenditure.

Table 5: Stationary tests - First difference

	ADF test	KPSS test	Schmidt-Phillips test	Stationary
GAP_{CPI}	-2.75	0.31	-25.06	Yes
GAP_{GDP}	-6.58	0.40	-59.40	Yes
GAP_{C}	-4.52	0.91	-38.75	Yes
G	-6.06	0.26	-83.08	Yes
Tax revenue (%GDP)	-6.93	0.07	-90.88	Yes

Notes: The table reports the values of the statistics, respectively. All tests were estimated including a constant term. The ADF tests for unit root, with a 5% critical value of -2.86. The KPSS tests for stationarity, with a 5% critical value of 0.46. The Schmidt-Phillips tests for unit root, with a 5% critical value of -18.1

4.2 Cointegration

After verifying that both variables, the price gap and Ecuador´s public expenditure (as a share of the country´s GDP) are $I(1)$ in Table (5), we test if there is any cointegration relationship. For this, we considered the Johansen Trace Test and the Saikkonen & Lütkepohl Test—both tests for r cointegrated relationships between both series.

As we mentioned, Figure (2) suggests that the price gap and public spending may share a common trend. If this applies, both time series may have a long-run relationship. This means their linear combination could stabilize around a constant value, indicating a persistent and stable connection between the variables over time.

Table (6) shows the results of the two cointegration tests. Regarding the Johansen test, we find enough statistical evidence to reject the null hypothesis of no cointegration relationship. Then, we find statistical significance not to reject the null hypothesis of one cointegration relationship, with a 95% confidence level. The same result we obtain when applying the Saikkonen & Lütkepohl Test.

The results show that the gap between Ecuador´s prices and U.S. prices and government expenditure could have a common trend in the long run. Therefore, both variables co-move simultaneously as they head toward a steady state. This finding suggests that an SVEC model is appropriate to show the transitory and permanent relationships between the time series.

Table 6: Cointegration tests

(a) Johansen Trace Test

Null hypothesis	Trace statistic	p-value	95% confidence level
$H_0 : r = 0$	30.56	0.00	20.16
$H_0 : r \leq 1$	4.37*	0.37	9.14

(b) Saikkonen & Lütkepohl Test

Null hypothesis	LR statistic	p-value	95% confidence level
$H_0 : r = 0$	24.31	0.00	12.26
$H_0 : r \leq 1$	0.01*	0.94	4.13

Notes: Both table (a) and (b) report results regarding cointegration tests. The variables considered in the tests are $GAP_{CPI} = \ln\left(\frac{CPI_{EC}}{CPI_{USA}}\right)$ and $G = (1 + \ln\left(\frac{PS_{EC}}{GDP_{EC}}\right))$. The Column 1 shows the null hypothesis, which stands for how many number of cointegration relationships may exist (denoted as r). Statistical significance at 5%, or 95% confidence level, is denoted by *.

4.3 SVEC model

In this section, we show the main results of our model specified in expression (8). To capture enough structure, we incorporate lags for each variable based on information criteria. Table (7) shows the optimal lags of each criterion, where the Akaike Info Criterion (AIC) and the Final Prediction Error (FPE) find three ideal lags.

Table 7: Optimal lags from information criteria

Deterministic term	AIC	FPE	HQ	SC
None	3	3	1	0
Constant	3	3	1	0
Trend	3	3	1	1

Notes: AIC: Akaike Info Criterion, FPE: Final Prediction Error, HQ: Hannan-Quinn Criterion, SC: Schwarz Criterion.

SVEC model estimates

$$\begin{bmatrix} \Delta GAP_{CPI,t} \\ \Delta GAP_t \\ \Delta X_t \end{bmatrix} = \begin{bmatrix} \underset{(0.037)^{***}}{-0.098} \\ \underset{(0.117)}{-0.074} \\ \underset{(0.617)^{**}}{1.518} \end{bmatrix} + \begin{bmatrix} \underset{(0.034)^{***}}{-0.091} \\ \underset{(0.109)}{-0.072} \\ \underset{(0.573)^{**}}{1.377} \end{bmatrix} \begin{bmatrix} 1.000 & \underset{(0.097)^{***}}{-1.273} & 0 \end{bmatrix} \begin{bmatrix} GAP_{CPI,t-1} \\ G_{t-1} \\ X_{t-1} \end{bmatrix}$$

$$+ \begin{bmatrix} \underset{(0.113)}{0.091} & \underset{(0.060)}{0.018} & \underset{(0.007)}{0.003} \\ \underset{(0.357)}{-0.217} & \underset{(0.191)}{-0.269} & \underset{(0.023)}{0.003} \\ \underset{(1.876)}{-1.563} & \underset{(1.005)}{0.513} & \underset{(0.118)^{***}}{-0.506} \end{bmatrix} \begin{bmatrix} \Delta GAP_{CPI,t-1} \\ \Delta G_{t-1} \\ \Delta X_{t-1} \end{bmatrix} + \begin{bmatrix} \underset{(0.114)}{-0.019} & \underset{(0.057)^{**}}{0.138} & \underset{(0.008)}{-0.002} \\ \underset{(0.360)}{0.345} & \underset{(0.180)}{0.065} & \underset{(0.024)}{0.011} \\ \underset{(1.890)}{-0.086} & \underset{(0.944)}{-0.049} & \underset{(0.126)^{***}}{-0.426} \end{bmatrix} \begin{bmatrix} \Delta GAP_{CPI,t-2} \\ \Delta G_{t-2} \\ \Delta X_{t-2} \end{bmatrix}$$

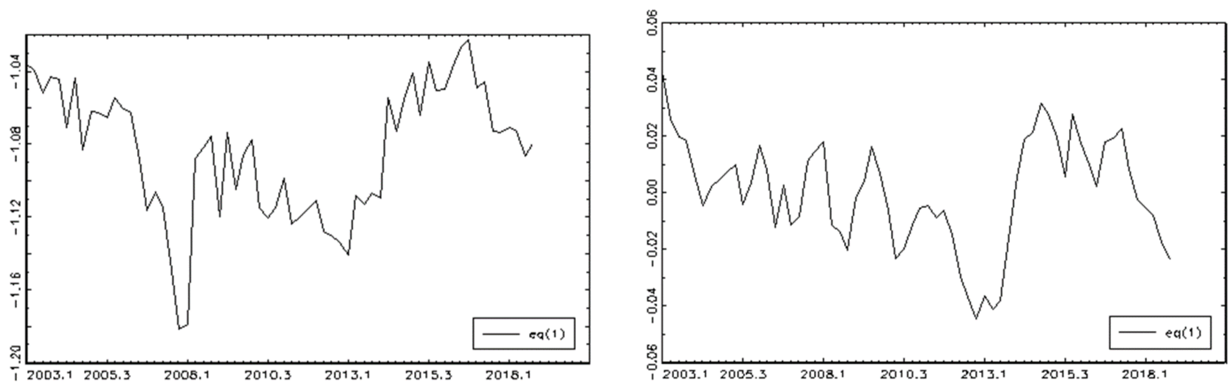
$$+ \begin{bmatrix} \underset{(0.103)^{**}}{0.262} & \underset{(0.045)^{**}}{0.092} & \underset{(0.007)}{-0.002} \\ \underset{(0.327)}{0.053} & \underset{(0.142)}{-0.017} & \underset{(0.023)}{0.022} \\ \underset{(1.718)}{-1.637} & \underset{(0.747)}{0.921} & \underset{(0.119)^{**}}{-0.306} \end{bmatrix} \begin{bmatrix} \Delta GAP_{CPI,t-3} \\ \Delta G_{t-3} \\ \Delta X_{t-3} \end{bmatrix} + \begin{bmatrix} \underset{(0.009)}{0.004} \\ \underset{(0.027)^{**}}{0.055} \\ \underset{(0.144)}{0.134} \end{bmatrix} \begin{bmatrix} NX_t \end{bmatrix} + \begin{bmatrix} u_{1,t} \\ u_{2,t} \\ u_{3,t} \end{bmatrix} \tag{13}$$

Notes: Standard errors in parentheses. $*p < 0.10, **\,p < 0.05, ***p < 0.01$.

The expression (13) shows the estimated coefficients of the SVEC model. Focusing on the long-run results, the estimated cointegration vector (β') is $[1 - 1.273]$, with a 1% significance level. As expression (9) denotes, our hypothesis states for one cointegration relationship between the price gap and public expenditure only. Therefore, we impose a zero on the last term of the vector, which corresponds to X_{t-1}. We tested the significance of this restriction by performing the Wald Test[6].

In respect to the loading matrix (α), it has two significant coefficients ($GAP_{CPI,t-1}$ and X_{t-1} coefficients). The cointegration vector and the loading matrix build the linear combination of the cointegrated variables, also known as the EC term of our model. Figure (3) shows the estimated EC term, which appears to be a stationary series. These estimates align with the results obtained in Table (6).

Figure 3: Estimated error correction (EC) term



Notes:
Figure (a) represents the estimated EC term without the loading matrix: $\beta\ Y_{t-1}$.
Figure (b) represents the estimated EC term with the loading matrix: $\beta\ Y_{t-1}\ \alpha$

4.4 Model diagnosis

To ensure the validity and reliability of the results obtained, we validate that our model does not suffer from autocorrelation. Table 8 shows the Breusch–Godfrey test results, which examine if the model does not have autocorrelation. At a 1% significance level, there is insufficient statistical evidence to reject the null hypothesis of no autocorrelation. Figure 4 shows the residuals plot for each equation, where they seem like white noise. Similar results we find when calculating the Autocorrelation Functions (ACF) in Appendix B.

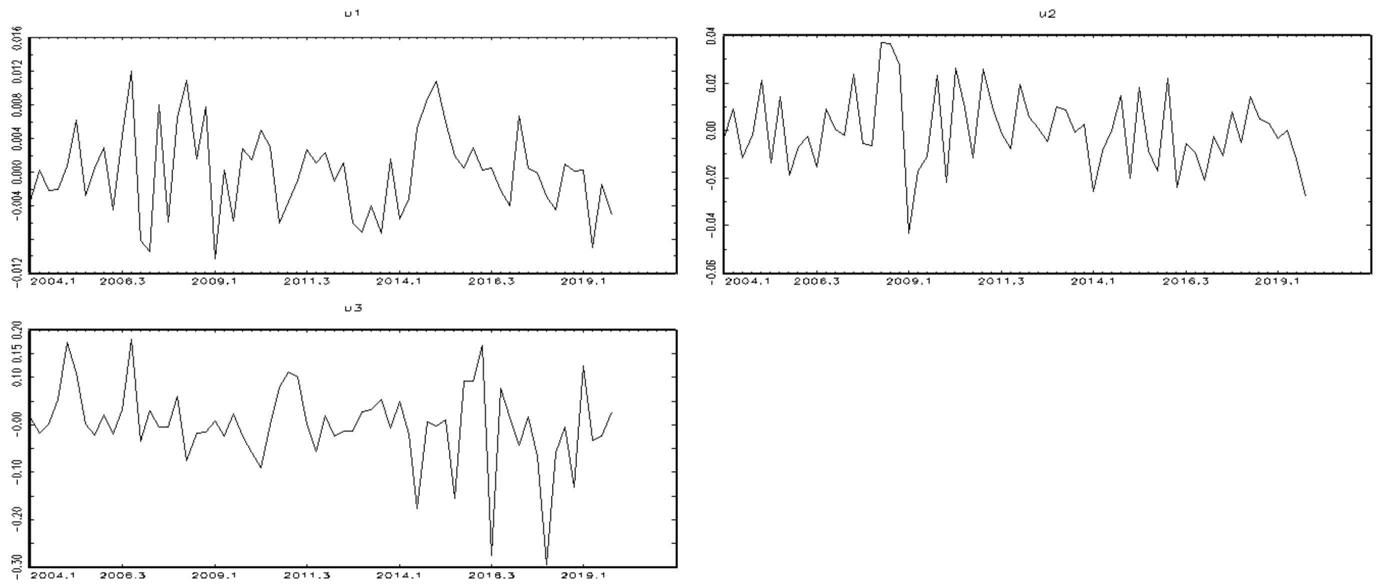
[6] We performed the Wald test to verify whether the restriction imposed on the cointegration vector is valid. The null hypothesis stands for $H_0 : \beta_{32} = 0$, which refers to the value of the cointegration vector of the variable X. The p-value is 0.0445, suggesting that the restriction is valid at 10% statistical significance.

Table 8: Breusch–Godfrey test for Autocorrelation

LM statistic	52.55
p-value	0.20
Degrees of freedom	45.0

Note: The null hypothesis specifies for no autocorrelation in the model.

Figure 4: Residuals from the SVEC model



Notes: Each graph plots the residuals of each equation of the model. The u_1 graph corresponds to GAP_{CPI} equation, u_2 corresponds to G equation, and u_3 corresponds to X equation.

The model (13) is expressed in the reduced form of an SVEC. Some assumptions are necessary for the model to be identified with the structural parameters. The restrictions of the contemporaneous relationships are based on two criteria: (i) economic theory and (ii) causality analysis between the variables. As mentioned above, we impose three restrictions. We assume that a contemporaneous shock from total transfers affects the price gap, but not vice versa (Feld, 2021) (Fullenkamp et al., 2008) (Azizi, 2017)(Hagen-Zanker and Siegel, 2007). Also, we state that public spending is not influenced by shocks from the price differential or transfers received (Garcia-Macia, 2023) (Quispe-Agnoli, 2002). Empirically, we backed up the theoretical assumptions with causality tests.

Table (9) shows the results of causality tests in the Granger sense. Table (9a) suggests that there is enough statistically significant evidence that G cause in the Granger sense GAP_{CPI} and X.

Table 9: Causality tests

(a) Test for Granger-causality

Variable	Test statistic	p-value
GAP_{CPI}	0.33	0.95
G	3.42	0.0013
X	1.00	0.43

(b) Test for contemporary causality

Variable	Test statistic	p-value
GAP_{CPI}	7.35	0.02
G	7.36	0.02
X	0.01	0.99

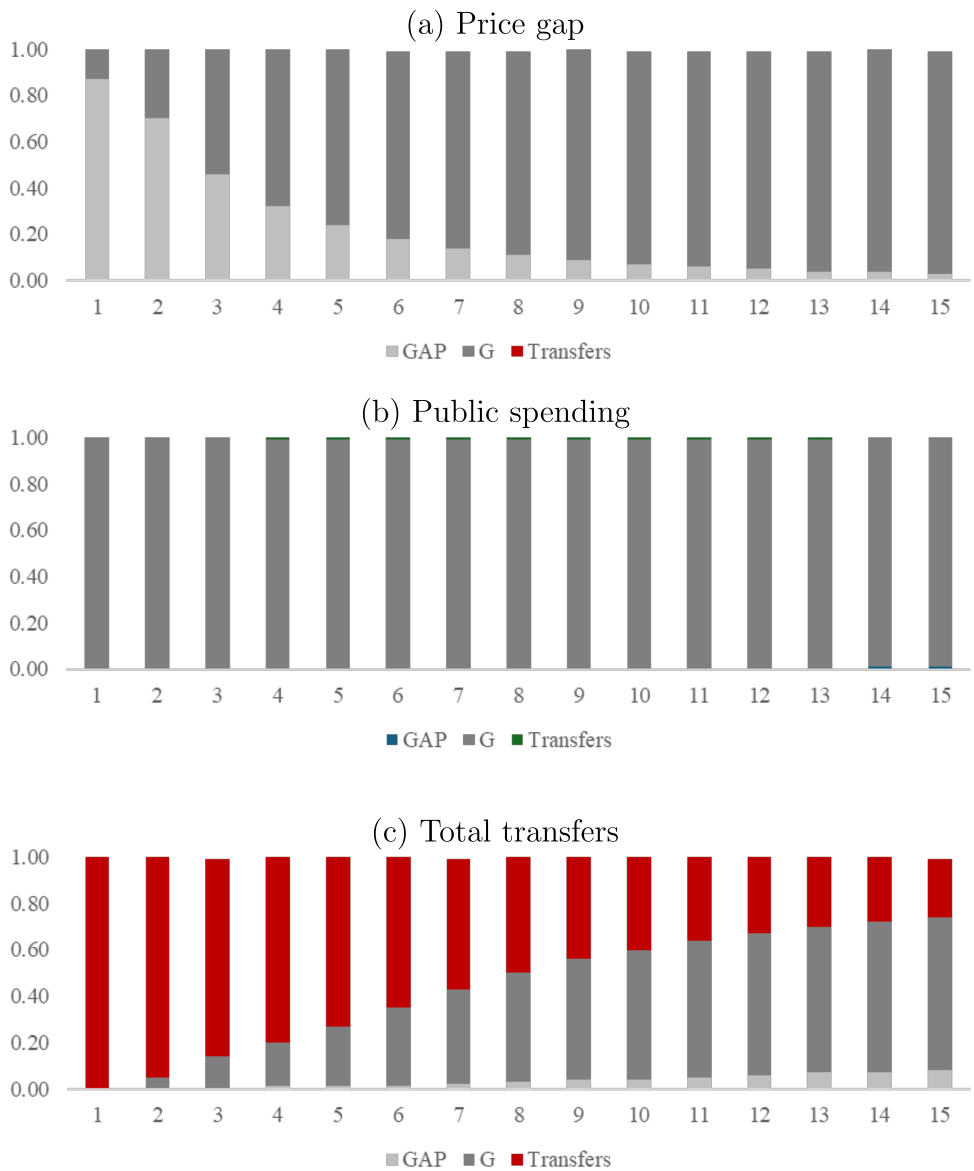
Notes: The null hypothesis for Table (a) is that the variable in Column 1 do not Granger-cause the rest of the variables. The null hypothesis for Table (b) is that there is no instantaneous causality between variable in Column 1 and the other variables.

Both theoretical and empirical criteria allow us to impose the three aforementioned assumptions, in a B-model structure. By Maximum Likelihood (ML) method, the matrix B looks as follows:

$$Bu = \begin{bmatrix} \underset{(0.0007)}{0.0048} & \underset{(0.0007)}{0.0018} & \underset{(0.0006)}{0.0000} \\ \underset{(0.00)}{0.0000} & \underset{(0.0023)}{0.0161} & \underset{(0.00)}{0.0000} \\ \underset{(0.00)}{0.000} & \underset{(0.0081)}{-0.0025} & \underset{(0.0143)}{0.0848} \end{bmatrix} \begin{bmatrix} u_{1,t} \\ u_{2,t} \\ u_{3,t} \end{bmatrix} \tag{14}$$

4.5 Permanent shocks

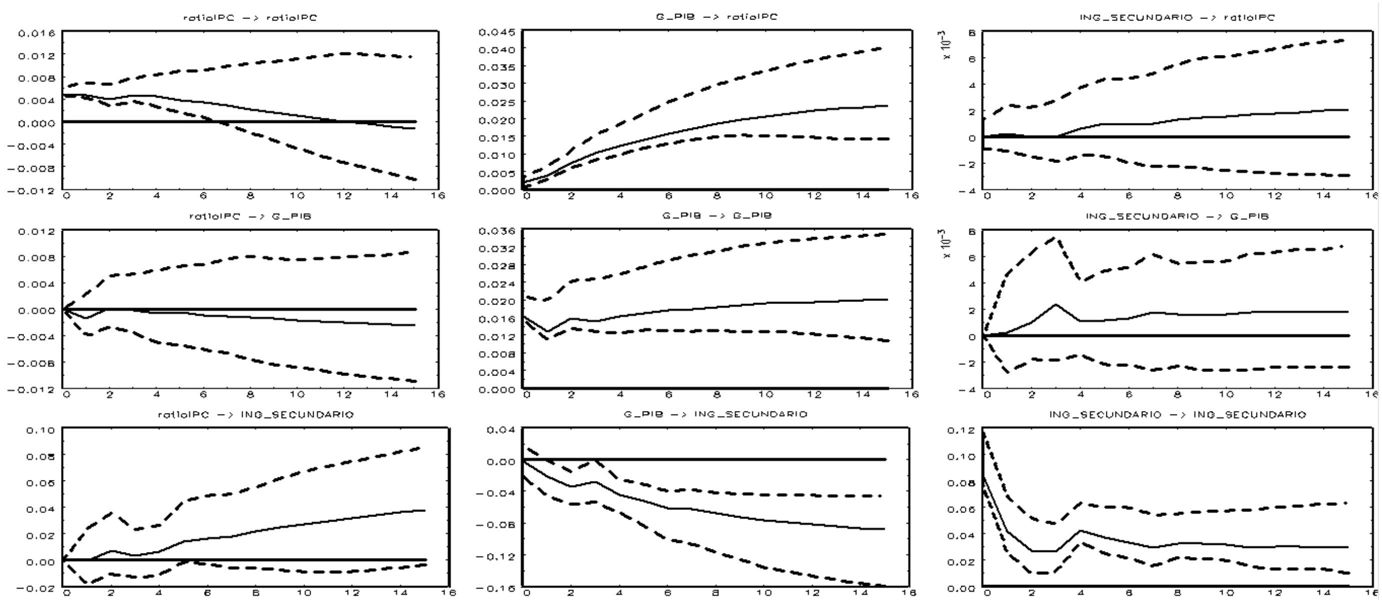
Figure 5: Forecast Error Variance Decomposition (FEVD) analysis



As we mentioned, the Impulse Response Functions (IRF) of the SVEC model contain both permanent and transitory effects, expressed as (11). However, the IRF will be driven by the long-run shocks since it contains the common trend of the cointegrated relationships (Pfaff, 2008). Therefore, the structural analysis derived directly from the SVEC model will reflect the long-run responses.

Figure (5) shows the Forecast Error Variance Decomposition (FEVD), which reflects how much of the variable variance is explained by its own and other variable´s shocks. Figure (5a) suggests that most of the price gap variance is explained by spending shocks. This contribution increases gradually over time. We find a similar result in Figure (5c). Lastly, Figure (5b) indicates that spending shocks contribute almost entirely to its variance.

Figure 6: Permanent Impulse Response Functions (IRF)



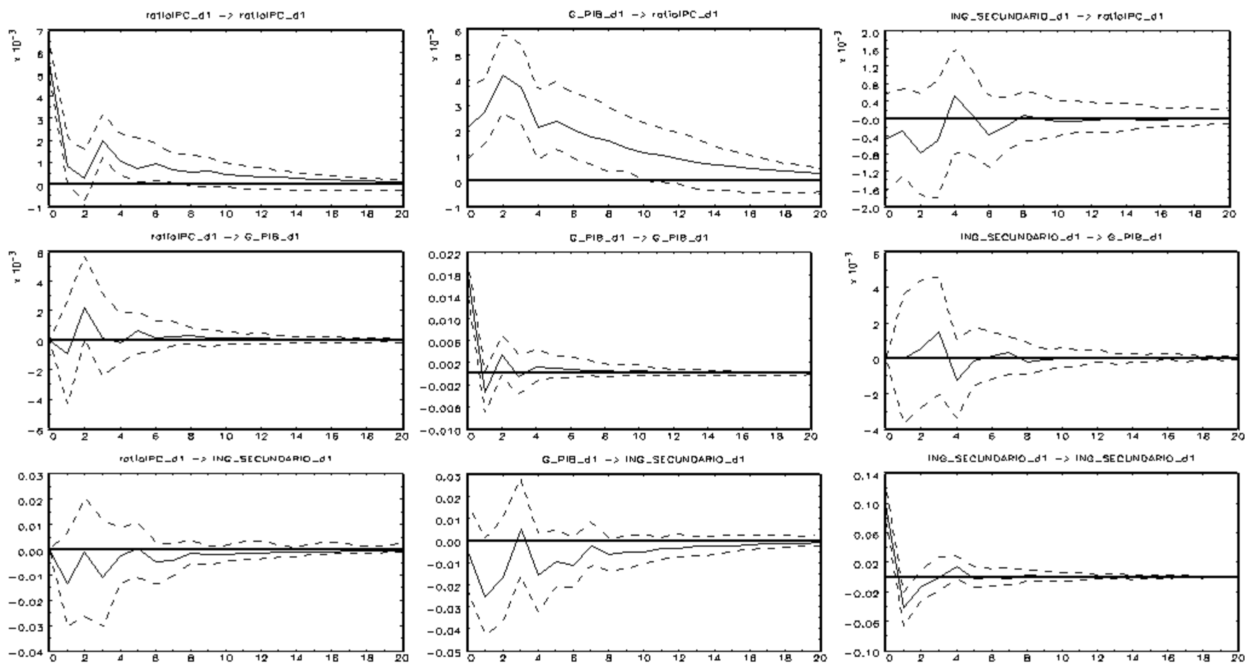
Notes: Based on expression (7), the IRF´s correspond to permanent shocks from the impulse variable to the response variable. The computed confidence intervals are 95% Hall Percentile CI. The first row shows the GAP_{CPI} responses. The second row shows the G responses. The third row shows the X responses.

The long-term IRF´s are reported in Figure (6). We find that a spending shock permanently affects the price gap. Notice that the response does not converge to zero as time passes, meaning that the price differential shifts upwards after a spending shock. This result indicates an impact on gap´s long-term trend, which is by the historical evolution between spending and the price differential (as Figure (2) shows).

We also find a permanent effect in total transfers, driven by a spending shock. The result has an economic explanation since an increase in public spending is good news for the economic situation of the majority of citizens, so immigrants will send fewer remittances. In contrast, we did not find statistically significant impulses from the price gap or from total transfers.

4.6 Transitory shocks

Figure 7: Transitory Impulse Response Functions (IRF)

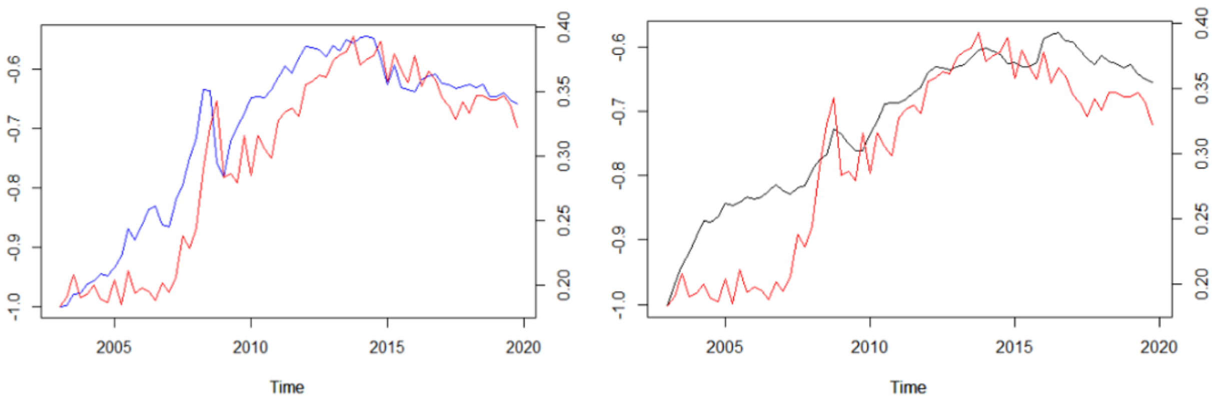


Notes: Based on expression (8), the IRF´s correspond to transitory shocks from the impulse variable to the response variable. The computed confidence intervals are 95% Hall Percentile CI. The first row shows the GAP_{CPI} responses. The second row shows the G responses. The third row shows the X responses.

With respect to short-term IRFs (Figure 7), known as the transitory effects expressed (12), we find that a spending shock increases the price gap up to 10 quarters. In other words, there is an immediate effect that lasts up to 2.5 years. As for the other variables, we don't find statistically significant impulses.

5 Robustness check

Figure 8: Deflactor gaps and Ecuador's Public Spending
In logarithm, 2003 Q1 - 2019 Q4



Notes:
Figure (A) shows the GDP´s deflactor gap and public spending. The gap is measured by the ratio between Ecuador's and U.S. GDP deflactors, both in logarithms.
Figure (B) shows the consumption´s deflactor gap and public spending. The gap is measured by the ratio between Ecuador's and U.S. consumption deflactors, both in logarithms.
Sources: Central Bank of Ecuador, INEC and Federal Reserve Economic Data.

This segment will reinforce the cointegration results that we previously presented. In Section 4.2, we find that the price differential between Ecuador and the U.S. and Ecuador´s public spending (as a share of GDP) are cointegrated, which means that both series have a long-term relationship. Since the price gap uses the CPI as a price measure, we question whether other pricing measures have the same result.

We consider two additional metrics: the GDP and consumption deflator. The main difference with the CPI is that the index is built under a basket of household products. The GDP deflator contains all goods and services produced in an economy, while the consumption deflator contains all goods and services consumed by households, including imports (Blanchard and Johnson, 2017)(Mankiw, 2016). Both deflators are calculated as the quotient between nominal and real variables, respectively.

Figure (8) shows the historical evolution of the price differential, measured through deflators and public expenditure. It would appear that price gaps share a common trend with Ecuador´s public expenditure, suggesting cointegration relationships. Notice that the deflator gaps behave very similarly to the CPI gap, as shown in Figure (2).

To infer whether the gaps are cointegrated with public spending, we perform a cointegration test[7] for both price differentials. The results of the Johansen Trace Test are presented in Table (10), where we find enough statistical evidence to (i) reject the null hypothesis of no cointegration relationship and (ii) not reject the null hypothesis of one cointegration relationship, with a 95% confidence level.

Table 10: Johansen cointegration test

(a) GDP deflator gap and public spending

Null hypothesis	Trace statistic	p-value	95% confidence level
$H_0 : r = 0$	23.74	0.014	20.16
$H_0 : r \leq 1$	7.40*	0.109	9.14

(b) Consumption deflator gap and public spending

Null hypothesis	Trace statistic	p-value	95% confidence level
$H_0 : r = 0$	22.74	0.02	20.16
$H_0 : r \leq 1$	4.15*	0.40	9.14

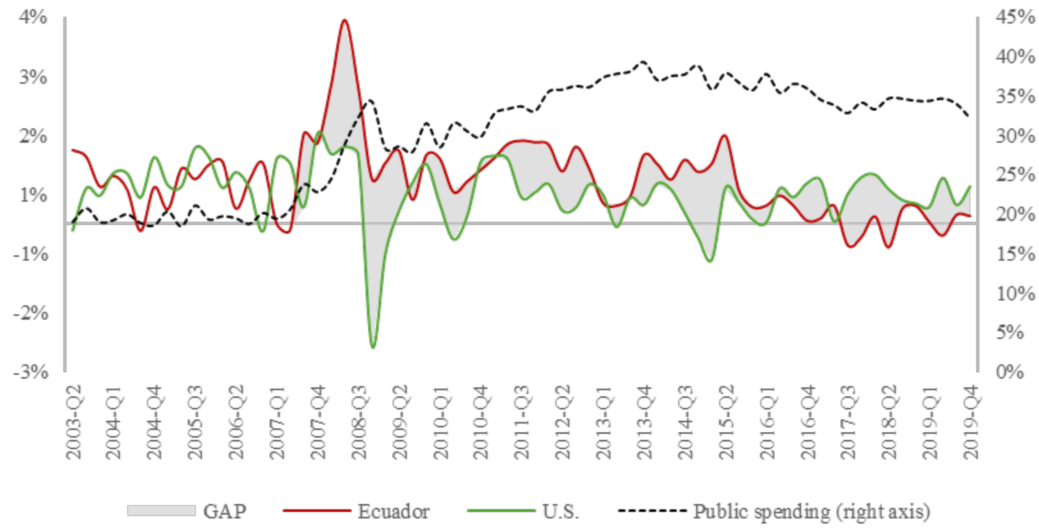
Notes:
Table (A) reports cointegration results for $GAP_{PIB} = \ln\left(\frac{DEF_{EC}}{DEF_{USA}}\right)$ and $G = (1 + \ln\left(\frac{PS_{EC}}{GDP_{EC}}\right))$.
Table (B) reports cointegration results for $GAP_C = \ln\left(\frac{DEF_{C,EC}}{DEF_{C,USA}}\right)$ and $G = (1 + \ln\left(\frac{PS_{EC}}{GDP_{EC}}\right))$.
The Column 1 shows the null hypothesis, which stands for how many number of cointegration relationships may exist (denoted as r). Statistical significance at 5%, or 95% confidence level, is denoted by *.

These results strengthen our hypothesis of a long-run relationship between the price differential, whether measured through the CPI or deflators, and Ecuador's government spending. Also, these findings support our belief that public expenditure could be the factor that diverts Ecuadorian prices to converge to U.S. prices, as expressed in (3).

[7]Previously, we conclude that each one of the series is $I(1)$, as shown in Table (5). Therefore, this order of integration allows us to infer about cointegration.

6 Discussions

Figure 9: Monthly inflation rates and Ecuador´s public spending
In logarithm, 2003 Q2 - 2019 Q4



Notes: Monthly inflation rates are calculated through the first difference of CPI logarithms. Public spending is expressed as a share of Ecuador's GDP.
Sources: Central Bank of Ecuador, INEC and U.S. Bureau of Labor Statistics.

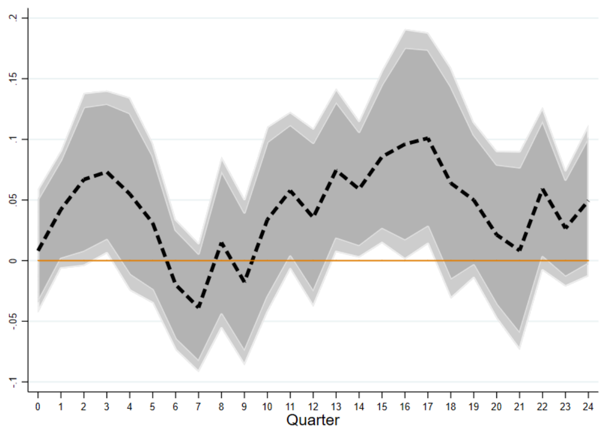
The results previously found suggest that public expenditure is the factor that generates price divergence between Ecuador and the US. We find significant evidence in favor of permanent and transitory spending shocks in the price gap. This analysis gives us insights into the pass-through of government consumption to a relative divergence between two countries that share the same currency.

The data observed in Figure (9) shows that, from 2003 to early 2007, Ecuador´s and U.S. inflation rates have remained stable. However, in 2007, Ecuador´s inflation experienced an upturn. As mentioned, this was also when public spending (as a share of GDP) almost doubled (Cueva and Díaz, 2021). Since then, the inflation gap between both countries has been notorious until recently.

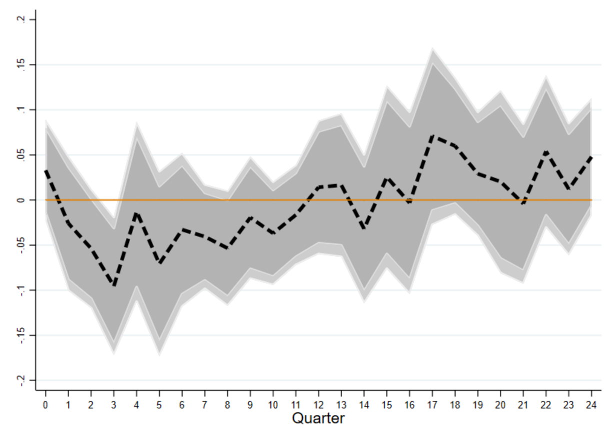
Our results are consistent with the theoretical framework mentioned in Section (2). A government spending shock could directly increase the demand for non-tradable goods. Assuming that the supply of these goods remains fixed (at least in the short term), these shocks could lead to a permanent increase in Ecuador´s prices and, therefore, a wider price gap.

Financing of public expenditure

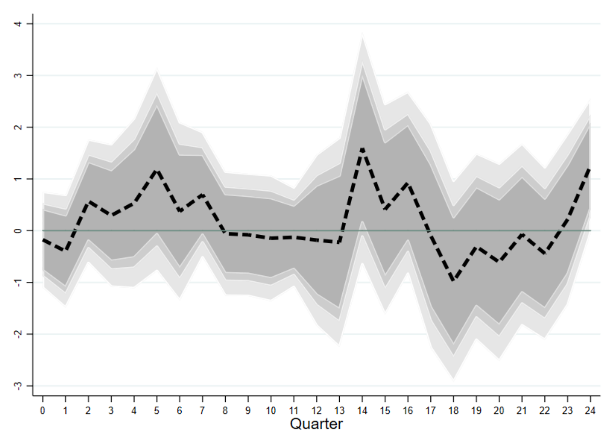
Figure 10: Ecuadorian public spending IRF



Positive WTI shock



Negative WTI shock



Positive tax revenue shock

Notes: Light gray shade: Confidence interval at 1% significance.
Light-dark gray shade: Confidence interval at 5% significance
Dark gray shade: Confidence interval at 10% significance.

Since Ecuador is an oil exporter, which has accounted for 51% of the total income of this economy in the last 20 years, we want to find out the primary source of financing for public spending. We used the WTI oil price as the primary explanatory variable to perform a brief econometric exercise. For this analysis, we estimate impulse response functions through Local Projections[8] (Jordà, 2005). Figure 10 shows the IRF of the model, where the impulse for Figure 10a and 10b comes from WTI, while the impulse for Figure 10c comes from the tax revenue (as a share of Ecuador´s GDP) shock.

The results suggest that a positive WTI shock impacts public spending in the short and long term. Predominantly, a sustained impact was found in the long term (from the third year onwards), and the effect is maintained for about one year (see Figure 10a). Conversely, we find that a negative WTI shock slightly impacts spending in the third quarter (see Figure 10b). Regarding tax revenues, we do not find significant results of a shock of the variable on government spending (see Figure 10c).

This analysis infers a predominantly oil-based financing. This result is consistent with previous studies that determine that the oil price is the primary influence of macroeconomic variables for Ecuador (Bunce and Carrillo-Maldonado, 2023). Likewise, this result suggests that oil price shocks could be linked to the price differential through shocks in public spending, indicating that the reason for the price gap between Ecuador and the U.S. is purely due to oil sources.

[8]First introduced by Jordà (2005); this method estimates a series of a single equation at each forecast horizon to get impulse response functions from the data itself. The estimated model can be expressed as:

$$\Delta^h G_t = \beta_h^+ \times \Delta WTI_t \times S_t^+ + \beta_h^- \times \Delta WTI_t \times S_t^- + a \times X_t + \varepsilon_{t+h}$$

where X_t represents tax revenue (as a share of Ecuador´s GDP)

7 Conclusions

This document investigates the long-term relationship between the price gap between Ecuador and the U.S. and Ecuador's public spending. Since both countries share the same monetary system, we question the divergence between prices and, therefore, their inflation rates. Both Ecuador's and the U.S.'s inflation rates were stable from 2003 to early 2007. However, in 2007, Ecuador experienced a surge in inflation concurrent with a significant increase in public spending. Since then, the inflation gap between the two countries has remained pronounced.

Our cointegration tests reveal that the price gap and government expenditure share a common trend in the long run, indicating that these variables are cointegrated. We find a similar result when considering other price measures. Applying an SVEC model, we find out that the cointegration vector of the model is negative and above -1, which means a slow convergence of the price gap reaching the equilibrium state. The FEVD analysis shows that spending shocks predominantly explain the variance in the price gap, with this contribution growing over time.

We derive two types of shocks from the SVEC model: permanent and transitory. The permanent IRF's suggest that spending shocks have a lasting effect on the price gap, meaning that the price gap response does not converge to zero. This indicates a permanent upward shift in the price differential, which supports the historical trend observed between government spending and the price gap. The transitory (or short-run) IRFs suggest that spending shocks increase the price gap for up to 10 quarters (2.5 years).

Since Ecuador's economy largely relies on oil exports, we analyzed the role of oil prices in public spending by performing a brief econometric model using Local Projection, with WTI oil price being the primary explanatory variable. We find that a positive oil price shock significantly impacts public spending in both the short and long term. This implies that oil price shocks could impact the price differential through their influence on public expenditure.

Our findings highlight the significant role of government spending and oil price shocks in shaping the long-term price differential between Ecuador and the U.S. The results align with the theoretical neoclassical notions, where a public spending shock can increase demand for non-tradable goods, leading to a permanent rise in prices and widening the price gap when assuming a fixed supply.

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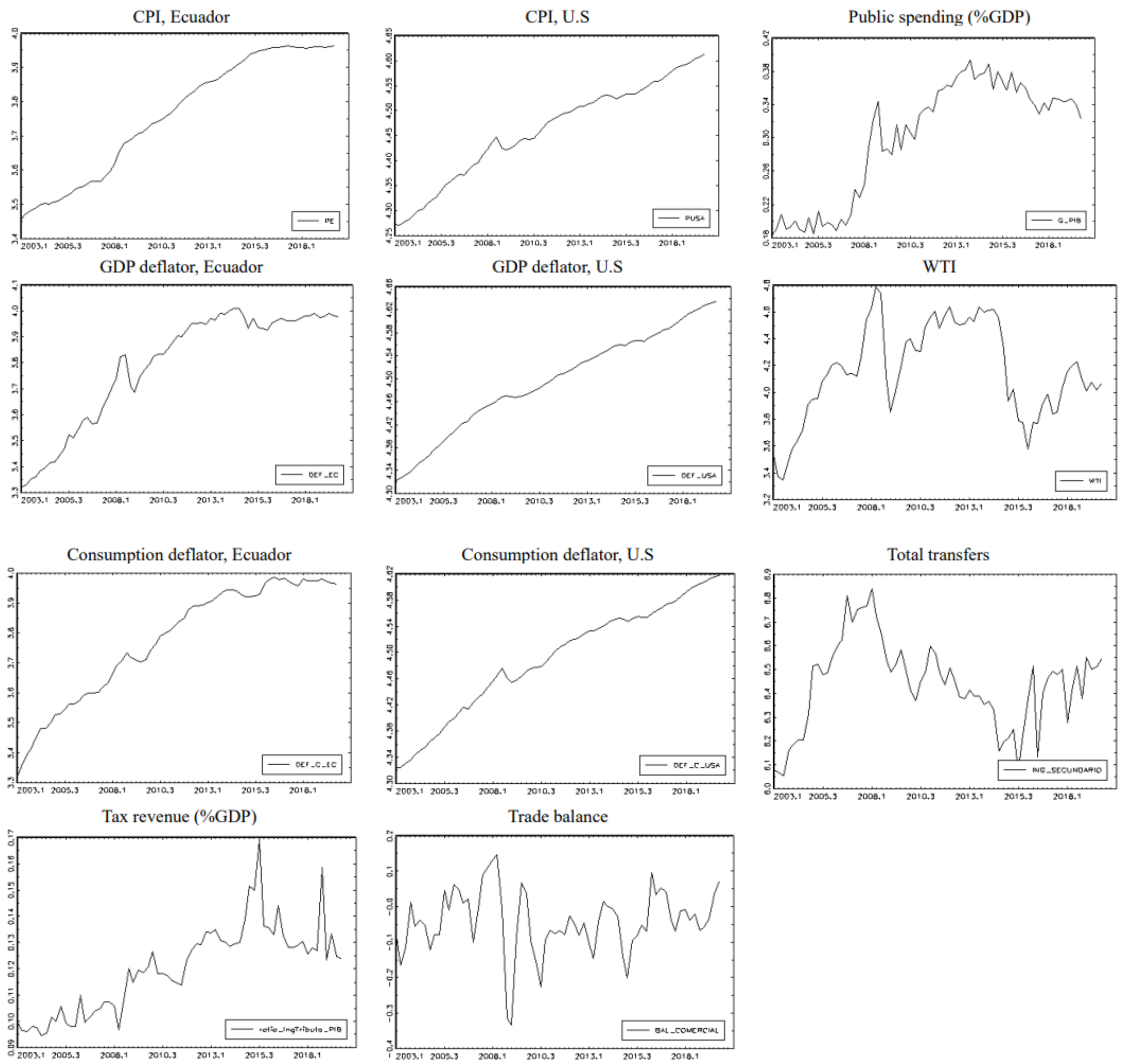
Appendix A. Time series plots

Figure 11: Evolution of time series
In logarithm, 2003 Q1 - 2019 Q4



Appendix B. Autocorrelation functions (ACF)