Inflation and Public Debt

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Abstract

This article aims to determine if a deterioration in public finances, understood as an increase in public debt, tends to increase inflation. We study the relation between public debt, economic growth, money supply growth and inflation. To do this we follow the methodology proposed by Kwon et al. (2009), who perform a panel data estimation using a sample of net debtor countries. We find that for countries whose public debt is already high, further increases in public debt are inflationary.

Keywords: fiscal policy, monetary policy.
JEL classification: E60, E63.

1. INTRODUCTION

Inflation is considered a monetary phenomenon, meaning its control is conditional on monetary policy. The quantity theory of money argues that inflation is solely determined by changes in the relative supply of money and goods. Thus, policies aimed at reducing inflation have focused on constraining monetary expansion to keep it in line with the expansion in nominal income. Nevertheless, it has been propounded

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that money demand also depends on inflation expectations, suggesting that a purely monetary effort at reducing inflation might not the only factor worth considering. As a consequence, growing attention has been given to the role of fiscal policy in determining inflation.

The seminal work of Sargent and Wallace (1981) states that the effectiveness of monetary policy in controlling inflation depends critically on its coordination with fiscal policy. The authors argue that, even when the traditional connection between money and the price level holds, tight monetary policy could lead to increases in inflation. This is due to the fact that, with the demand for government bonds given and in the absence of changes in future fiscal policy, a part of government obligations would have to be covered by seignorage at some point in the future.

A similar school of thought lies behind the so-called fiscal theory of the price level (FTPL). This not only focuses on seignorage financing, but also on traditional analysis of the fiscal impact, particularly on Keynesian aggregate demand type factors, public wage spillovers to private sector wages, and taxes affecting marginal costs and private consumption (Elmendor and Mankiw, 1999).

The FTLP also identifies the wealth effect of government debt as an additional channel of fiscal influence on inflation. This theory contends that increased government debt adds to household wealth and, therefore, to demand for goods and services, leading to price pressures (Buiter, 1999; Niepelt, 2004; Sims, 1994; Woodford, 1994 and 2001; Loyo, 1999; Christiano and Fitzgerald, 2000; Canzoneri et al., 2001; Cochrane, 2001 and 2005; Gordon and Leeper, 2002). The higher size of the debt also results in higher sovereign risk premiums being charged by government creditors, which can increase interest rates in the economy as a whole and unleash the well-known crowding out effect with its accompanying impact on macroeconomic stability.

High levels of public debt and recurring fiscal deficits in Costa Rica might generate inflationary pressures under the reasoning mentioned above. Thus, in order to foster domestic stability, it is necessary to understand the link between public finances and inflation. Furthermore, the possible implementation of fiscal reforms to redress Costa Rica's public finances could affect the aforementioned relation due to its impact on economic growth as well as on the fiscal deficit and the size of government debt. A lack of information on fiscal reforms in Costa Rica limits the analysis, making it necessary to use approaches based on other fiscal variables such as government debt.

This paper aims to determine if a deterioration in public finances, understood as an increase in public debt, tends to increase inflation. We study the relation between public debt, economic growth, money supply growth and inflation. To do this we follow the methodology proposed by Kwon *et al.* (2009), who perform a panel data estimation using a sample of net debtor's countries. We find that for countries whose public debt is already high, further increases in public debt are inflationary.

Section 2 describes the literature on the relation between public finances and inflation. Section 3 then explains the methodology used, the theoretical and econometric approaches, the data employed, and the estimation process followed. The outcomes are presented in Section 4. Finally, Section 5 gives the main conclusions.

2. ANTECEDENTS

The size and persistence of fiscal deficits together with their variations over time and across countries is a topic that has drawn attention in theoretical and empirical fields, above all, with respect to the causes of these persistent deficits and their corresponding impact on public debt. Such deficits are considered a cause of money supply growth, persistent inflation and macroeconomic instability (Saleh and Harvie, 2005; Catão and Terrones, 2005; Tekin-Koru and Özemen, 2003; Hossain

and Chowdhury, 1998). Tanzi (1993) even argued that, especially in developing countries, the public sector, far from being a balancing factor, has contributed to generating larger macroeconomic imbalances. Along the same lines, Fisher and Easterly (1990) point to the fact that rapid inflation is almost always a fiscal phenomenon and that controlling inflation requires monetary and fiscal policy coordination.

Ghura and Hadjimichael (1996) demonstrate that there is an inverse relation between economic growth and macroeconomic stability measured by the inflation rate and the fiscal deficit as a proportion of gross domestic product (GDP). Empirical evidence suggests persistent deficits are without any ambiguity whatsoever detrimental to economic growth (Easterly et al., 1994). Nevertheless, other studies find that only inflation in excess of 10% to 20% poses any real threats to economic growth (Gylfason and Herbertsson, 2001; Loungani and Swagel, 2003). Even so, there is no doubt that price stability–that is, low and stable inflation–is a basic requirement for sustained economic growth, while fiscal deficits and public debt should be maintained at levels in line with other macroeconomic targets, including controlling inflation (Easterly et al., 1994).

Despite the large body of research on the relation between debt, money, and inflation, no theoretical or empirical consensus exists on the exact economic consequences of large budget deficits on inflation (Darrat, 2000; Narayan et al., 2006). According to Sargent and Wallace (1981), inflation is associated to the way budget deficits are financed, it means, the extent to which deficits are monetized. The degree to which monetary policy is independent and budget policy dependent o vice versa is key to knowing whether fiscal deficits would lead to higher rates of inflation (Sargent and Wallace, 1981).

Elaborating on this theme, Vamvoukas (1998) and Saleh and Harvie (2005) mention the existence of two transmission channels of the deficit to inflation. First, when a central bank purchases government bonds, which increases high-powered money, the money supply, and thereby the price level. Second,

when deficits put an upward pressure on interest rates that then require an increase in the money supply to keep them stable, in which case deficits cause inflation by encouraging higher rates of monetary growth. As Vamvoukas (1998) posits, in a world without a Ricardian regime,[1] increases in the real value of bond assets increase perceived private wealth that, added to income obtained from interest rates, makes bond holders feel richer, inducing them to increase their consumption spending. This leads to higher national income, but, this expansion of national income leads to an increase in the demand for money and with that inflation (Keynesian perspective).

In contrast, Barro (1996) and other proponents of the Ricardian equivalence contend that government deficits do not matter given that current tax cuts will be financed by proportionate future tax hikes, ensuring that the government deficit does not affect the economy. As opposed to the Keynesian viewpoint, current tax cuts and future tax hikes will offset each other, meaning tax cuts will not make economic agents wealthier and do not encourage them to increase their consumption of goods and services. Hence, fiscal deficits do not matter because they do have any effect on aggregate demand, interest rates, and the price level. For Barro (1996) the net value of private sector wealth remains unchanged by taxes or debt financing, which is the reason why deficits do not cause inflation. On the contrary, deficits would be the result of inflation.

Another channel by which a government deficit might directly affect inflation is through the output gap. The reasoning behind this is that the public sector also demands goods and services produced by the private sector. Nevertheless, such

[1] In a non-Ricardian regime agents do not believe that changes in the shape or size of government financing lead to corresponding future alterations. Agents do not, therefore, include government budget restrictions in their decision-making. This means the method used to finance government expenditure affects intertemporal consumption decisions and, therefore, aggregate demand.

effect can be positive or negative depending on the type of public expenditure. For instance, if the public deficit is the result of greater current expenditure on goods and services, the expected effect would be positive. However, if said expenditure is used to construct infrastructure, the effect could be negative (at least over the long run), given that it would tend to improve productivity and lower production costs for the private sector.

In a similar way to theory, empirical evidence does not exhibit consensus with respect to the direction of the causal relation between inflation, fiscal deficit, and money. Choudhary and Parai (1991) find that budget deficits as well as the rate of growth of money supply have a significant impact on inflation in Peru. Meanwhile, Hondroyiannis and Papapetrou (1997) find bidirectional causality between inflation and budget deficits in Greece. In the case of Turkey, Metin (2012) finds that fiscal expansion is a determining factor for inflation and that budget deficits (as well as real income growth and debt monetization) significantly affect inflation. Likewise, for the case of South Africa, Anoruo (2003) shows evidence that deficits have a positive impact on the growth rate of money supply and inflation.

Catão and Terrones (2005) find a strong positive association between deficits and inflation among high-inflation and developing country groups. On the other hand, for low-inflation advanced economies the authors do not find a relation between budget deficits and inflation. Wolde-Rufael (2008) obtains empirical evidence for a long-run cointegrating relation between inflation, money, and budget deficits in Ethiopia, with a unidirectional Granger causality running from money supply to inflation and budget deficits to inflation, while monetary policy does not seem to have any impact on the growth of money supply. Meanwhile, Barro (1989), Abizadeh et al. (1996), Vieira (2000), and Wray (2005) argue that the inflation-deficit nexus does not exist because larger deficits do not cause inflation.

Moving away from a budget deficit focused approach, Castro et al. (2003) estimate the degree of interdependence between fiscal and monetary policies in developed countries by using

government debt in itself rather than the budget deficit. These authors find that debt plays a minor role in determining the price level in developed countries. Along the same lines, Kwon et al. (2009) use panel dataset, separating developed and developing countries, as well as net debtor or net credit countries based on their balance of payments data and classification of the World Economic Outlook 2005 (IMF, 2005). They find that the relation between debt and inflation is statistically significant and strong in indebted developing countries, weak in other developing countries and generally not valid in developed economies (Kwon et al., 2009). The outcomes of Castro et al. (2003), as well as those of Kwon et al. (2009), are in line with the fiscal theory of the price level (FTPL) described previously.

3. RESEARCH METHODOLOGY

This paper follows the methodology of Kwon et al. (2009) and uses a panel dataset of annual data for 52 countries spanning 1965 to 2014. We employ a forward-looking model of inflation that is based on rational expectations, Cagan-type money demand[2] and a non-Ricardian[3] regime that takes government bonds as net wealth.

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[2] Cagan-type money demand takes the following form: $m_t^d - p_t = -\alpha E_t\left(p_{t+1} - p_t\right)$, where m_t^d is the log of nominal money held at the end of period t, p is the log of the price level, and α is the semielasticity of real money demand with respect to expected inflation. The exclusion of real variables such as output and interest rates is justified by arguing that during hyperinflation expected inflation cancels out all other influences on the demand for money (Cagan, 1956).

[3] As mentioned previously, in a non-Ricardian regime agents do not take into consideration government budget constraints because from their viewpoint current tax cuts or hikes will not necessarily be offset by any equivalent future taxes imposed by the government. Thus, the method used to finance government expenditure affects wealth and therefore agents' intertemporal consumption decisions and aggregate demand.

A functional relation can be derived for the price level with respect to debt, money, and real GDP, which is written in the following form (see Annex 4 for its foundations):

1 $$P_t = \left(\frac{M_t + \delta B_t}{\gamma(i) w} \right).$$

where,

1a $$\gamma(i) = \beta \left(\frac{1 + i_t}{i_t} \right) + \alpha\delta.$$

and, P is the price; M, money; B, government debt; w, real income or wealth; α and β are functions of the structural parameters of the household maximization problem; i, yields on the debt; and δ is a part of the government debt that is not guaranteed by the government's current or future primary surpluses.

Equation 1 nests the quantitative theory of money and the unpleasant monetary arithmetic[4] of Sargent and Wallace (1981). The price level is proportionate to the monetary aggregate broadly defined as $M_t + \delta B_t$, which is the sum of high-powered money demanded by agents for transactions and by the government for debt monetization, with δ reflecting the extent of the budget deficit, that is, the coordination between monetary and fiscal policy.

To clarify Equation 1, suppose the government pursues a policy of not monetizing its debt and runs a balanced budget over the long term. The monetization factor δ then reduces to zero and the equation simplifies into the conventional quantity theory of money. Along the same lines, if fiscal policy is undertaken flexibly in ways to keep the debt-to-GDP ratio fixed all the time, then the monetization factor will remain at

[4] The purpose of that paper was to argue that even when monetarist assumptions are satisfied, the list of items monetary policy cannot control should be widened to include inflation.

zero and public debt will have no impact on the price level. Alternatively, if the policy arrangement is full monetization of public debt, then δ becomes 1, meaning that the issuance of the public debt influences inflation as strongly as money supply does. In reality, this parameter should vary between 0 and 1, with the exact scale depending on the capacity and willingness of the government to service public debt, which, in turn, depends on the debt size, policy credibility, and institutional and political constraints.

Although, following Kwon et al. (2009), the wealth effect of government debt is not explicitly included, as set forth by the FTPL (Leeper and Yun, 2006), Equation 1 is still consistent with the predictions of the FTPL. However, this means that the establishment of a positive significant relation between public debt and the price level does not necessarily answer whether it stems from debt monetization as suggested by Sargent and Wallace (1981) or the wealth effects postulated by the FTPL.

For Equation 1 the following generalized prices function can be used:

$$P_t = f\left(X_t\right) = f\left(M_{t,} B_t, w_t\right), \text{ where } f_1 > 0,\ f_2 > 0,\ f_3 < 0. \quad (2)$$

Equation 2 can be log-linearized around the equilibrium values X^* to obtain the following specification:

$$\log P_t = f\left(X_t^*\right) + X_t^* f'\left(X_t^*\right) x_t, \text{ where } x_t = \log X_t - \log X_t^*.$$

Therefore,

$$p_t = f\left(X_t^*\right) - \log P_t^* + X_t^* f'\left(X_t^*\right) x_t, \text{ where } p_t = \log P_t - \log P_t^*. \quad (3)$$

3.1 Empirical Approach

The previous transformation establishes a linear relation between inflation and increases in money supply, public debt, and output. Equation 3 can be modified to a dynamic setting that includes a process of restoration to the equilibrium (Hendry et al., 1984):

$$\hat{p}_t = \alpha \hat{p}_{t-1} + \beta_1 \hat{m}_t + \beta_2 \hat{b}_t - \beta_3 \hat{w}_t, \quad (4)$$

where $\hat{p}, \hat{m}, \hat{b}$ and $\hat{w}$ represent deviations from equilibrium values in logarithms of prices, money, debt, and real income, respectively.

To model Equation 4 we used a panel dataset that allows for variability of individual countries while preserving the dynamics of adjustment within countries. The following dynamic model, the formulation of which is based on Equation 4, is employed:

$$d\log cpi_{it} = \alpha d\log cpi_{it-1} + \beta_1 d\log money_{it} + \\ + \beta_2 d\log debt_{it} - \beta_3 d\log GDPreal_{it} + n_i + t_t + v_{it}. \quad (5)$$

for $i = 1,...,N$, and $t = 2,...,T$, where n_i and v_{it} have the standard error component structure

$$E[n_i] = E[v_{it}] = E[n_i v_{it}] = 0, \quad (6)$$

and where errors are serially uncorrelated:

$$E[v_{it} v_{is}] = 0, \text{ for } s \neq t, \text{ for } i = 1,\ldots,N, \text{and } t = 2,\ldots,T. \quad (7)$$

Where $d\log cpi$ refers to inflation, and $d\log money$, $d\log debt$ and $d\log GDP\ real$ refer to changes in money, public debt, and

real GDP, respectively, all in first-difference logarithms; t_t is a set of temporary dichotomous variables to control for possible structural changes in the inflationary process of the countries analyzed, which did not occur in this research, and n_i represents unobserved country-specific effects that seek to capture cross-country heterogeneity in the debt-inflation nexus.

3.2 Data

Data was obtained from the World Bank[5] database and the IMF's International Financial Statistics[6] database. These correspond to a total of 52 countries (20 net-debtor countries of Latin America, including Costa Rica) for the period 1965 to 2014. Classification into developed and developing countries, as well as into creditor or debtor countries was obtained from the *World Economic Outlook 2014* (IMF, 2014).

The variables used in the estimations are described below:

- Gross domestic product at constant 2005 prices in United States dollars, equal to real GDP comparable across countries.
- Historical series for public debt as a percentage of GDP, transformed into real term values by multiplying by the respective real GDP.
- Money and quasi-money (M2) as a percentage of GDP, in the same way as debt, its level is obtained by multiplying by the corresponding GDP.
- Inflation obtained by the GDP deflator, data taken directly from the World Bank for each country.
- Inflation obtained through the log difference of the consumer price index (CPI). This CPI is taken from IMF database for each country and has 2010 as its base year (2010=100).

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[5] See <http://databank.worldbank.org/data/reports.aspx?source=2&Topic=3>.

[6] See <http://data.imf.org/?sk=5804C5E1-0502-4672-BDCD-671BCDC565A9>.

- Country classification: 1, developed countries; 2, net-creditor developing countries; and 3, net-debtor developing countries.

3.3 Estimation Process

The conceptual framework reflected in Equations 1 and 4 posits that the coefficients for debt and money should be positive, and negative for output. In the specifications we assume that β coefficients are constant for each country group.

We also assume that all the explanatory variables for preceding periods represented by X_{it-s} (that is, $d\log cpi_{it-s-1} + d\log money_{it-s} + d\log debt_{it-s} - d\log GDPreal_{it-s}$) are predetermined as follows:

8 $$E\left[X_{it-s}v_{it}\right] = 0, \text{ for } s \geq 0,$$

9 $$E\left[X_{it-s}\Delta v_{it}\right] = 0, \text{ for } s \geq 1.$$

These two moment conditions allow the use of lagged variables as instruments, once the equation has been first differenced to eliminate specific-country effects (Arellano and Bond, 1991). Given that the variables used in the regressions are not persistent, as shown by the panel data unit root test (Annex 1), we consider instruments in the first differences to be appropriate and that they do not suffer from the weak instrument problem.[7] Hence, we can use the general method of moments estimator (GMM) proposed by Arellano and Bond (1991).

Meanwhile, to test consistency of the estimators for the parameters in Equation 5, besides the first difference GMM estimator, we use a dynamic fixed effect estimator to calculate

[7] Although a weak instrument is exogeneous, it not very important because it is poorly correlated with the endogenous variable it is meant to explain.

an error correction model (ECM) that allows for observing the long-run relations between the variables in a similar way to the GMM estimator, adding estimation of the speed of adjustment from short-run to long-run dynamics. The ECM requires the presence of cointegrating relations between the variables employed, which is verified for the panel of countries studied (Annex 2).

The size of the sample employed means the extent of possible biases in the specification are reduced given that T is higher than 30 for the fixed effects estimator and N is greater than 20 for the GMM estimator (Judson and Owen, 1999). We prefer two-step GMM estimates because the sample size prevents small sample biases. Furthermore, this allows better estimation when regression errors are not distributed identically across countries. The possible existence of serial correlation of errors is handled by using the robust version of each estimator.

Regressions are performed separately for different country groups in order to address a potential problem of slope heterogeneity without sacrificing efficiency gains from panel data. Countries are grouped according to their level of economic development and, among subgroups, sovereign indebtedness as classified by the *World Economic Outlook* 2014 (IMF, 2014) that takes into account balance of payments data[8] from 1972 to 2013. This grouping was considered coherent with the aims of the paper because the criteria is objective and broadly responds to the institutional strength and political credibility of the country sample. Annex 5 shows a detailed list of the countries used and their grouping.

[8] Countries are classified as net debtors when the current account of the balance of payments has accumulated deficits from 1972 to 2013.

4. RESULTS OF THE ESTIMATION

The estimations that include developed countries were not significant and are therefore not shown in the results. The estimations that only include net-debtor developing countries present the best adjustment and significance. The countries included in those estimations are show in Table 1. This group of countries is the most interesting for the study because it allows us to see how inflation reacts in indebted developing countries, such as Costa Rica, to changes in their deficit.

Table 1

COUNTRIES USED IN THE NET-DEBTOR ESTIMATION

Barbados	Hungary
Brazil	Jamaica
Chile	Mexico
Colombia	Nicaragua
Costa Rica	Panama
Dominican Republic	Paraguay
Ecuador	Peru
El Salvador	Poland
Guatemala	Turkey
Honduras	Uruguay

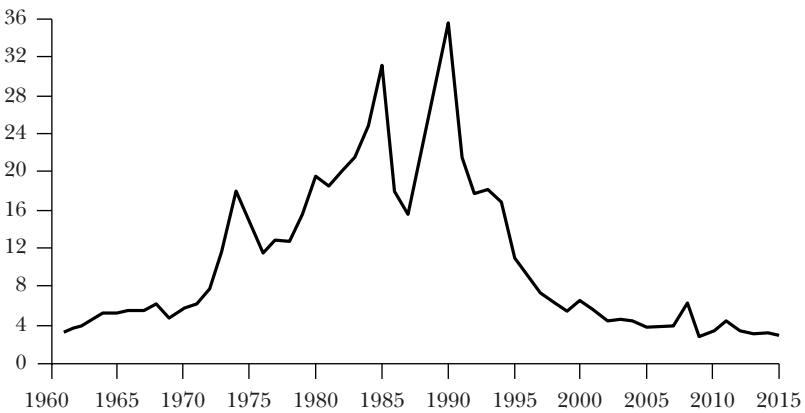
Source: Own elaboration.

One important aspect to take into account when using time series is the possible existence of structural breaks in the evolution of the variables. Given our use of panel data, we present the average temporal evolution for inflation measured by the CPI (Figure 1), inflation obtained from the GDP deflator (Figure 2), public debt (Figure 3), money, and quasi-money (M2, Figure 4), and economic growth (Figure 5).

Figure 1

AVERAGE OF CPI INFLATION, 1960-2014

Percentages

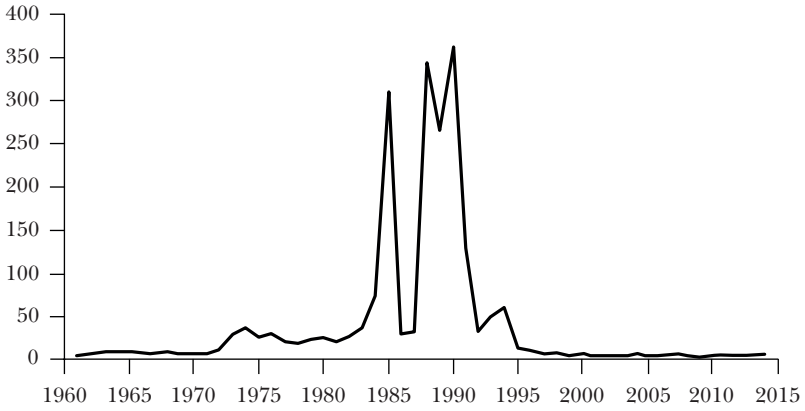


Source: Own elaboration.

Figure 2

AVERAGE OF INFLATION, BY GDP DEFLATOR, 1960-2014

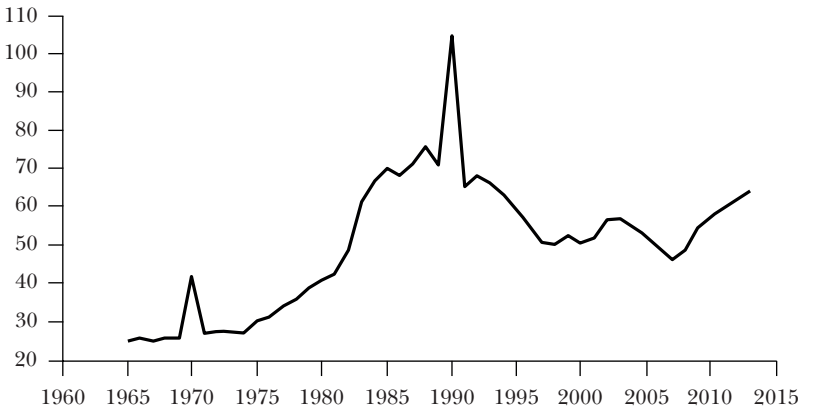
Percentages



Source: Own elaboration.

Figure 3

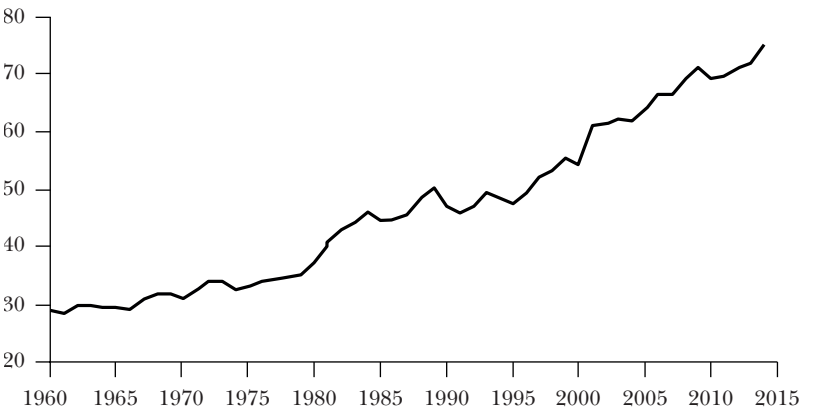
AVERAGE OF PUBLIC DEBT, 1960-2014
As percentage of GDP



Source: Own elaboration.

Figure 4

AVERAGE OF MONEY AND QUASI-MONEY (M2), 1960-2014
As percentage of GDP

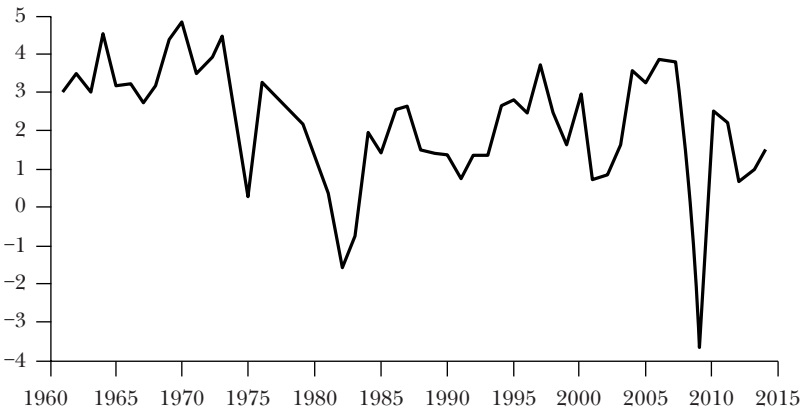


Source: Own elaboration.

Figure 5

AVERAGE ECONOMIC GROWTH, 1960-2014

Percent



Source: Own elaboration.

As can be seen, the variables employed do not, on average, show evidence for the existence of a structural change in the period studied. The previous figures, together with the descriptive statistics (Annex 3) by year and by country, show that although there are periods of significant hyperinflation, these do not represent a structural change in the inflation data generation process because they are short and followed by downward shifts in inflation, which on average returns to similar levels observed in the period preceding the hyperinflations (Figures 1 and 2). A comparison of this evolution with that of public debt shows that the highest peaks in debt are between the decades of the 1980s and 1990s, corresponding to the periods of greatest hyperinflations. This suggests a direct association between both variables that we seek to test by estimating a panel data model. Although the periods of high debt and hyperinflation are evident, it is important to mention that the use of temporal dichotomous variables to control for said periods

would absorb the variability of data in the debt-inflation nexus (stronger during said periods), which could result in the non significance of the relation when it actually might be so. For this reason, temporal dichotomous variables are not used.

Table 2

EXPLANATORY ESTIMATIONS FOR INFLATION
Dependent variable: Inflation as CPI logarithm difference (dlogCPI) or calculated with the GDP deflator

Dependent variable	*Inflation (CPI)*		*Inflation (GDP deflator)*	
Specification	*Dynamic fixed effects panel*	*Arellano-Bond*	*Dynamic fixed effects panel*	*Arellano-Bond*
Speed of adjustment to long run	−0.73[a]	NA	−0.74[a]	NA
Money (M2)	3.65[a] (1.49)	1.95 (5.3)	3.29[a] (1.11)	3.46[c] (1.84)
Total debt	2.9[a] (0.80)	3.56[b] (1.59)	1.76[a] (0.48)	0.95[b] (0.46)
Real GDP	−6.89[a] (2.58)	−5.94 (7.39)	−7.99[a] (1.86)	−6.94[b] (3.49)
Number of observations	424	424	424	424
Number of countries	19	19	19	19

Note: all variables are expressed in logarithms (except inflation). Equations for fixed effects. Standard error in parenthesis. Results in terms of elasticities.
Significance at: [a] 1%, [b] 5%, [c] 10 percent.
Source: Own elaboration.

Table 2 summarizes the results of the estimations performed. First, the CPI logarithmic difference is used as a dependent variable that represents inflation. Next, inflation measured by the GDP deflator is employed as a variable to be explained, which is included in levels. Given that explanatory variables are included in log differences, the first estimations produce statistics regarding the price level, while the second ones give semielasticities. In Table 2 the results were transformed in order for them all to be presented as elasticities and allow for their direct comparison. The table also includes the speed of adjustment from short-run dynamics to long-run equilibrium, given by the correction error coefficient of the ECM estimated through the dynamic fixed effects panel. These long-run adjustment values demonstrate that around 74% of an imbalance is corrected during the first year if inflation measured by the GDP deflator is taken as the explanatory variable of inflation, while it would be 73% if the percentage change in the consumer price index is used.

Interpretation of the coefficients gives the relation between the growth rates of explanatory variables and the growth rate of the price level (inflation). An increase of one percentage point (pp) in the growth rate of debt is associated with an increase of between 1 pp and 3.5 pp in the price level over the long-term, it means, if inflation was 3% it would shift to being between 4% and 6.5%. Meanwhile, an increase of 1 pp in the growth rate of money is linked to an increase of between 3.25 pp and 3.65 pp in the growth rate of the price level, again by way of example, a long-term inflation of 3% would shift to being between 6.25% and 6.65% over the long-term. Finally, an increase in the economic growth rate of 1 pp is associated with a decrease of between 6 pp and 8 pp in the inflation rate over the long-term, this means an inflation rate of 10% would shift to being between 4% and 2% in the long run.

These outcomes were in line with other empirical studies on inflation. Many studies report the existence of a positive relation between debt or budget deficits and inflation, mainly in

developing countries, but not in developed ones (Feldstein, 1986; Orr et al., 1995; Fischer et al., 2002; Engen and Hubbard, 2004; Catão and Terrones, 2005). In the case of developed economies, numerous studies have even found that there is no link between money and inflation (Dwyer, 1982; Christiano and Fitzgerald, 2003).

Annex 2 shows other estimations performed to provide additional information on the effect of a larger debt on inflation and include the short-term outcomes for error correction estimates (Table A.1) where a relatively greater impact of demand on inflation (GDP) can be seen than that observed in the long-term estimations of Table 2. We also perform the same estimations run for emerging economies, but this time for advanced economies (Annex 2, Table A.2). In this case the amount of money does not have a significant impact on inflation in any of the estimations (dynamic fixed effects or Arellano-Bond), with both measures of inflation. This can be explained by the fact that the monetary channel is less important in such countries because fiscal dominance is much lower. Moreover, the only significant variable, and solely in the dynamic fixed effects estimations, is real GDP, highlighting a greater demand channel effect, as would be expected for advanced economies.

Besides the specifications mentioned above, we attempted to include different types of taxes to observe their effect on inflation. This is important in the context of the need for fiscal reform in Costa Rica. However, none of the tax variables were significant. Likewise, a VAR model was estimated to analyze the transmission channels of the debt, inflation, economic growth, and money supply nexus for Costa Rica, which did not produce positive outcomes either.

5. CONCLUSIONS

This paper provides empirical evidence supporting the hypothesis that, with a net debtor country given, increases in government debt tend to increase inflation, above all in countries with

high levels of public debt. The regression results show that an increase in the debt/GDP ratio is significantly and strongly associated with high inflation in indebted developing countries, after controlling for money growth and real output growth. In contrast, this relation is not significant for developed countries.

The outcomes allow for concluding that forward-looking models of inflation are valid for countries such as Costa Rica, in the sense that fiscal policy regimes matter in the debt-inflation nexus. Moreover, certainty regarding cointegrating relations between debt, money, growth, and inflation, even for the panel group of countries, demonstrate that the appropriate conduction of fiscal policy is crucial for macroeconomic stability over the short and long terms.

These findings highlight challenges for price stabilization in highly indebted developing countries because the expansion of public debt affects variables that are sensitive for economic agents' decision making, such as inflation, income, and interest rates. Moreover, despite the important role of monetary policy in managing inflation expectations, fiscal policy could be a dominant factor for the evolution of inflation in highly indebted developing countries. This implies, in general, and for Costa Rica in particular, that price stability achieved through the issuance of central bank instruments could be sustainable only if accompanied by fiscal consolidation and structural reforms that promote monetary policy independence.

Several other aspects are important for future lines of research. First, defining a specification and an appropriate estimation method to study the relation between fiscal variables and inflation in the Costa Rican economy. Second, determining whether the debt-inflation nexus is symmetrical, that is, if increases or decreases in debt have equivalent upward or downward effects on inflation, or if said impact varies in size depending on the direction. Third, investigating the possibility of a non-linear relation between both variables, given that the effect identified in this paper could be much greater for high levels of debt, where governments usually have less credibility

and do not have access to credit markets, meaning their only option is to resort to financing from the central bank. Finally, measuring the impact of debt structure, particularly the currency and maturity of sovereign bonds, on inflation dynamics.

ANNEXES

Annex 1. Panel Data Unit Root Test

Panel Data Unit Root Test for Log Public Debt

H_0: All panels contain unit roots	Number of panels	52
H_a: At least one panel is stationary	Average number of periods	42.35
	Augmented Dickey-Fuller	*Phillips-Perron*
Panel statistics	p *value*	p *value*
Inverse χ^2 (102)	0.37	0.89
Inverse normal	0.51	0.97
Inverse logit t(259)	0.47	0.95
Modified inverse χ^2	0.39	0.88

Unit Root Test for Log Money (M2)

H_0: All panels contain unit roots	Number of panels	39
H_a: At least one panel is stationary	Average number of periods	46.87
	Augmented Dickey-Fuller	*Phillips-Perron*
Panel statistics	p *value*	p *value*
Inverse χ^2 (102)	0.21	0.40
Inverse normal	0.07	0.25
Inverse logit t(259)	0.09	0.27
Modified inverse χ^2	0.22	0.42

Unit Root Test for Log GDP

H_0: All panels contain unit roots	Number of panels	52
H_a: At least one panel is stationary	Average number of periods	49
	Augmented Dickey-Fuller	*Phillips-Perron*
Panel statistics	p *value*	p *value*
Inverse χ^2 (102)	0.99	0.99
Inverse normal	0.99	0.99
Inverse logit t(259)	0.99	0.99
Modified inverse χ^2	0.99	0.99

Unit Root Test for Inflation Measured by GDP Deflator

H_0: All panels contain unit roots	Number of panels	52
H_a: At least one panel is stationary	Average number of periods	48.81
	Augmented Dickey-Fuller	*Phillips-Perron*
Panel statistics	p *value*	p *value*
Inverse χ^2 (102)	0.00	0.00
Inverse normal	0.00	0.00
Inverse logit t(259)	0.00	0.00
Modified inverse χ^2	0.00	0.00

Unit Root Test for Log CPI

H_0: All panels contain unit roots	Number of panels	51
H_a: At least one panel is stationary	Average number of periods	49.18
	Augmented Dickey-Fuller	*Phillips-Perron*
Panel statistics	p *value*	p *value*
Inverse χ^2 (102)	1.00	0.16
Inverse normal	1.00	1.00
Inverse logit t(259)	1.00	1.00
Modified inverse χ^2	1.00	0.16

Unit Root Test for Public Debt Log Difference

H_0: All panels contain unit roots	Number of panels	51
H_a: At least one panel is stationary	Average number of periods	41.98
	Augmented Dickey-Fuller	*Phillips-Perron*
Panel statistics	p *value*	p *value*
Inverse χ^2 (102)	0.00	0.00
Inverse normal	0.00	0.00
Inverse logit t(259)	0.00	0.00
Modified inverse χ^2	0.00	0.00

Unit Root Test for Money (M2) Log Difference

H_0: All panels contain unit root	Number of panels	38
H_a: At least one panel is stationary	Average number of periods	47
	Augmented Dickey-Fuller	*Phillips-Perron*
Panel statistics	p *value*	p *value*
Inverse χ^2 (102)	0.00	0.00
Inverse normal	0.00	0.00
Inverse logit t(259)	0.00	0.00
Modified inverse χ^2	0.00	0.00

Unit Root Test for GDP Log Difference

H0: All panels contain unit root	Number of panels	51
Ha: At least one panel is stationary	Average number of periods	48.94
	Augmented Dickey-Fuller	*Phillips-Perron*
Panel statistics	p *value*	p *value*
Inverse χ^2 (102)	0.00	0.00
Inverse normal	0.00	0.00
Inverse logit t(259)	0.00	0.00
Modified inverse χ^2	0.00	0.00

Unit Root Test for CPI Inflation Log Difference

H0: All panels contain unit root	Number of panels	51
Ha: At least one panel is stationary	Average number of periods	48.18
	Augmented Dickey-Fuller	*Phillips-Perron*
Panel statistics	p *value*	p *value*
Inverse χ^2 (102)	0.00	0.00
Inverse normal	0.00	0.00
Inverse logit t(259)	0.00	0.00
Modified inverse χ^2	0.00	0.00

Source: Own elaboration.

Annex 2. Panel Cointegration Tests and Other Estimations

Table A.1

SHORT-TERM INFLATION ESTIMATIONS

Dependent variable: inflation as the first difference of the log of the CPI or calculated with the GDP deflator

Dependent variable	*Dynamic fixed effects panel: short-term*	
Specification	*CPI*	*Deflator*
Money (M2)	0.33[a] (0.08)	0.34[b] (0.13)
Total debt	0.15[a] (0.05)	0.04 (0.06)
Real GDP	−1.56[a] (0.33)	−1.85[a] (0.52)
Number of observations	424	424
Number of countries	19	19

Note: all variables are expressed in logarithms (except inflation). Fixed effect equations. Standard error in parenthesis. Results in terms of elasticities.
Significance at: [a] 1%, [b] 5%, [c] 10 percent.
Source: Own elaboration.

Table A.2

ADVANCED ECONOMIES: EXPLANATORY VARIABLES FOR INFLATION
Dependent variable: inflation as the first difference of the log of the CPI or calculated with the GDP deflator

Dependent variable	*CPI*		*Inflation (GDP Deflator)*	
Specification	*Dynamic fixed effect panel*	*Arellano-Bond*	*Dynamic fixed effect panel*	*Arellano-Bond*
Speed of adjustment	−0.39[a]	na	−0.30[a]	na
Money (M2)	0.266 (0.39)	0.02 (0.03)	0.262 (0.74)	0.49 (2.06)
Total debt	0.44[b] (0.19)	0.09 (0.19)	0.47 (0.38)	1.87 (2.36)
Real GDP	−1.66[b] (0.74)	−0.49 (0.67)	−2.69[b] (1.35)	−0.53 (0.92)
Number of observations	331	331	331	331
Number of countries	16	16	16	16

Note: all variables are expressed in logarithms (except inflation). Fixed effect equations. Standard error in parenthesis. Results in terms of elasticities.
Significance at: [a] 1%, [b] 5%, [c] 10 percent.
Source: Own elaboration.

Pedroni Panel Cointegration Test		
H_0: *No-cointegration*		
H_a: *Common AR coefficients (within dimensions)*	*Non-weighted*	*Weighted*
Panel statistics	*p* value	*p* value
Panel v statistic	0.00	0.51
Panel ρ statistic	0.00	0.00
Panel PP statistic	0.00	0.00
Panel ADF statistic	0.00	0.00
H_a: *Individual AR coefficients (within dimensions)*		p *value*
Group ρ statistic		0.00
Group PP statistic		0.00
Group ADF statistic		0.00

Source: Own elaboration.

Annex 3. Descriptive Statistics of Inflation, Public Debt, Money (M2) and Economic Growth by Country and by Year

Descriptive Statistics of Public Debt (as a percentage of GDP) by Country

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Argentina	40.8	36.3	137.7	9.3	28.0	43
Australia	23.4	22.7	41.2	9.7	7.6	48
Austria	49.0	56.2	82.3	12.8	22.5	48
Barbados	46.4	46.4	96.3	15.8	17.2	41
Belgium	92.6	100.3	138.4	38.8	32.9	48
Bolivia	83.9	79.0	205.2	32.5	39.0	44
Brazil	58.7	62.6	102.9	29.9	17.5	36
Canada	69.9	71.1	100.8	42.8	17.0	49
Chile	44.6	28.9	165.5	3.9	44.5	44
Colombia	26.0	28.3	44.7	9.2	10.4	49
Costa Rica	43.0	33.3	110.3	18.1	26.3	49
Czech Republic	25.6	27.8	45.1	11.6	10.5	21
Denmark	39.1	45.0	78.6	4.3	23.1	49
Dominican Republic	30.1	25.6	60.7	12.7	13.6	44
Ecuador	58.2	29.7	661.2	14.6	92.3	49
El Salvador	39.2	32.4	108.3	10.2	23.9	49
Estonia	6.1	5.7	9.9	3.7	1.8	19
Finland	26.6	17.0	57.6	1.7	19.5	47
France	41.4	34.2	92.3	14.4	23.9	49
Germany	44.0	40.4	80.6	17.6	19.5	49
Greece	65.1	56.2	175.0	0.0	45.8	49
Guatemala	25.3	21.5	55.6	10.1	13.4	48
Honduras	52.9	48.1	243.4	6.5	41.4	49
Hungary	80.3	78.3	127.6	51.8	21.5	30
Iceland	40.2	34.3	95.1	11.8	22.1	42
Ireland	60.3	53.0	120.2	23.6	25.4	49
Israel	113.0	98.4	284.0	62.1	49.5	40

Descriptive Statistics of Public Debt (as a Percentage of GDP) by Country

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Italy	82.6	93.3	128.5	28.4	29.8	49
Jamaica	90.1	92.5	181.3	14.2	48.8	48
Japan	93.6	71.2	242.6	5.2	71.6	49
Korea	17.0	16.8	34.5	2.3	8.3	49
Luxemburg	8.6	7.1	23.0	2.2	4.7	42
Mexico	39.4	41.8	78.1	5.7	16.5	47
Netherlands	57.8	55.6	78.5	37.8	12.5	49
New Zealand	43.4	46.4	76.0	14.6	16.3	49
Nicaragua	177.3	92.6	2,092.9	0.7	315.8	49
Norway	34.3	32.5	52.6	22.3	9.2	48
Panama	62.1	64.8	115.8	17.8	26.0	49
Paraguay	28.0	22.2	67.0	13.0	13.6	44
Peru	37.9	37.1	63.4	19.0	11.6	44
Poland	53.9	49.6	90.1	36.8	14.5	28
Portugal	48.9	52.7	129.7	13.5	27.1	49
Slovakia	37.8	38.6	54.6	21.4	9.5	22
Slovenia	29.5	26.3	70.5	16.8	13.1	21
Spain	37.4	40.0	92.1	7.3	22.0	49
Sweden	47.0	47.7	70.9	16.1	16.8	47
Switzerland	43.2	45.6	67.0	7.0	14.7	48
Turkey	37.5	34.6	77.9	19.0	12.8	49
United Kingdom	54.2	48.7	94.6	31.0	17.5	49
United States	56.1	57.4	104.8	32.2	19.1	49
Uruguay	52.0	42.3	111.5	16.6	27.7	44
Venezuela	30.7	31.6	71.9	4.6	19.6	47
All	51.5	42.0	2,092.9	0.0	60.8	2,300

Descriptive Statistics of Public Debt (as a Percentage of GDP) by Year

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1965	24.8	18.4	94.6	5.2	21.3	28
1966	25.8	19.1	91.9	4.4	21.0	31
1967	24.9	19.5	89.1	3.7	19.8	34
1968	25.4	19.9	88.5	2.7	19.6	34
1969	25.4	22.0	82.8	0.7	18.9	33
1970	41.9	22.3	661.2	2.3	99.3	42
1971	26.8	22.4	65.7	4.6	15.6	42
1972	27.3	23.4	77.7	2.2	17.5	45
1973	27.1	21.6	100.9	2.5	19.8	45
1974	26.9	22.6	79.8	1.7	17.5	44
1975	30.1	24.1	108.3	2.0	20.9	44
1976	31.1	26.3	97.4	0.0	20.7	44
1977	33.8	28.2	142.0	0.0	24.8	45
1978	35.8	31.6	133.6	0.0	24.4	46
1979	38.7	32.3	155.5	7.1	28.6	46
1980	40.6	30.9	154.3	6.4	31.6	46
1981	42.4	35.4	149.1	6.7	30.2	44
1982	48.4	38.5	159.1	6.9	32.6	46
1983	61.1	48.2	260.5	7.4	47.8	47
1984	66.1	53.6	284.0	7.7	50.8	47
1985	70.2	56.5	218.0	6.3	49.5	47
1986	68.0	56.3	169.6	7.9	39.7	48
1987	71.2	59.9	266.6	6.7	45.3	48
1988	75.9	59.3	629.2	5.1	87.5	48
1989	70.8	58.9	477.0	4.0	67.7	47

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1990	105.2	55.9	2,092.9	4.7	295.7	48
1991	65.1	51.8	333.7	4.0	50.8	48
1992	68.1	49.5	448.6	4.8	64.4	48
1993	66.1	52.6	445.9	6.0	63.3	49
1994	63.2	50.1	446.6	5.5	62.6	50
1995	59.3	54.1	362.7	8.9	51.7	51
1996	55.2	55.2	222.4	7.4	36.8	52
1997	50.4	49.4	123.6	6.1	28.5	52
1998	50.1	45.5	121.6	5.5	28.3	52
1999	52.5	47.1	135.6	6.0	29.4	51
2000	50.6	46.3	143.8	5.1	28.5	52
2001	51.6	48.4	153.6	4.8	29.1	52
2002	56.7	50.9	164.0	5.7	33.8	52
2003	57.0	48.5	169.6	5.6	32.8	52
2004	54.9	45.9	180.7	5.1	32.4	52
2005	52.4	46.3	186.4	4.5	32.1	52
2006	49.4	42.8	186.0	4.4	31.8	52
2007	46.1	38.1	183.0	3.7	31.6	52
2008	48.5	41.2	191.8	4.5	33.4	52
2009	54.6	45.8	210.2	5.8	37.0	52
2010	57.3	43.5	215.8	6.5	38.7	52
2011	59.7	46.3	229.7	5.9	42.1	52
2012	62.1	50.2	236.6	9.5	42.8	52
2013	64.3	53.3	242.6	9.9	43.8	52
All	51.5	42.0	2,092.9	0.0	60.8	2,300

Descriptive Statistics of Money (M2, as a Percentage of GDP) by Country

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Argentina	22.0	22.4	31.8	10.6	4.7	55
Australia	59.2	48.6	109.5	37.7	20.6	55
Barbados	67.0	55.4	118.9	37.8	27.4	30
Bolivia	32.9	21.0	81.2	6.4	22.0	55
Brazil	36.8	24.8	111.3	10.1	24.3	55
Canada	72.8	65.1	158.1	36.2	33.9	49
Chile	44.9	37.6	96.2	11.2	27.3	54
Colombia	28.9	28.6	46.8	19.6	6.7	53
Costa Rica	33.6	31.9	56.9	14.6	12.6	55
Czech Republic	63.3	61.8	78.2	53.4	7.5	22
Denmark	51.7	50.5	70.1	40.0	8.0	55
Dominican Republic	26.9	26.9	50.2	14.4	7.0	55
Ecuador	17.5	15.7	33.3	7.8	5.8	55
El Salvador	36.0	37.4	52.8	20.0	9.4	50
Estonia	39.7	31.6	62.4	16.2	17.8	16
Guatemala	26.7	23.0	47.2	12.9	10.8	55
Honduras	33.1	30.9	56.8	14.9	13.0	55
Hungary	51.7	49.9	63.3	44.1	6.5	24
Iceland	43.8	37.0	102.8	19.6	23.1	55
Israel	64.7	72.8	133.4	21.7	25.5	55
Jamaica	46.9	48.6	73.1	17.7	14.1	55

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Japan	163.4	181.1	251.3	48.5	58.1	55
Korea	54.2	33.3	139.9	8.9	42.5	55
Mexico	27.9	27.1	38.7	11.0	4.5	55
New Zealand	49.7	30.6	93.5	19.8	27.1	50
Nicaragua	28.9	28.0	69.9	12.1	14.7	55
Norway	51.8	51.4	59.4	47.7	3.2	47
Panama	50.0	42.0	87.2	16.2	23.5	55
Paraguay	24.7	24.2	50.6	9.5	9.0	55
Peru	25.8	24.2	43.1	16.6	7.1	55
Poland	43.2	42.3	61.6	30.4	9.7	25
Slovakia	59.8	59.8	65.1	55.3	2.7	16
Sweden	51.4	51.1	67.1	38.2	7.8	55
Switzerland	118.8	110.7	188.6	90.6	24.3	45
Turkey	30.4	25.6	60.6	14.6	12.5	55
United Kingdom	72.7	56.1	170.2	30.5	44.4	55
United States	70.7	69.8	90.4	59.5	7.4	54
Uruguay	38.9	39.5	63.9	14.5	11.9	55
Venezuela	28.1	28.4	52.9	16.4	8.7	54
All	47.5	37.9	251.3	6.4	34.7	1,909

Descriptive Statistics of Money (M2, as a Percentage of GDP) by Year

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1965	29.8	20.8	96.0	7.8	20.3	33
1966	29.7	20.6	95.8	9.2	20.2	33
1967	31.1	21.2	95.6	10.2	20.2	33
1968	31.8	20.9	99.7	12.6	20.6	33
1969	32.1	21.1	101.2	11.8	20.2	33
1970	31.3	22.7	103.2	11.3	19.0	31
1971	32.5	24.4	116.5	13.7	20.3	32
1972	34.1	26.0	127.1	14.7	21.1	32
1973	34.2	26.7	124.2	14.5	20.9	32
1974	32.9	26.4	118.7	13.0	20.4	32
1975	33.5	28.6	125.7	12.9	21.2	32
1976	34.3	27.3	129.3	15.2	21.1	32
1977	34.5	28.7	131.9	14.5	21.7	32
1978	34.9	28.2	137.1	14.5	22.4	32
1979	35.5	28.8	140.6	15.1	22.9	32
1980	37.3	29.6	142.2	11.9	24.3	34
1981	40.9	32.7	147.8	11.3	26.6	34
1982	43.1	35.3	153.9	10.1	28.2	34
1983	44.2	35.6	160.5	10.2	29.9	34
1984	46.1	37.6	162.9	11.5	32.4	34
1985	44.8	39.5	164.9	12.1	30.5	34
1986	44.8	39.6	172.1	10.7	30.7	33
1987	45.8	35.2	181.1	13.8	32.0	34
1988	48.6	36.8	183.7	11.0	33.1	34
1989	50.3	38.4	189.3	10.2	35.4	33
1990	47.3	34.1	187.4	11.5	32.4	35

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1991	46.1	35.6	186.5	10.6	31.8	36
1992	47.2	37.5	188.1	13.0	31.3	36
1993	49.6	40.4	195.2	18.2	32.3	38
1994	48.5	42.9	201.4	13.9	32.3	38
1995	47.6	36.9	207.2	15.7	33.6	39
1996	49.5	40.1	210.7	18.4	34.4	39
1997	52.2	42.3	218.2	14.7	36.1	39
1998	53.2	44.2	229.8	14.6	38.1	39
1999	55.6	47.8	239.7	13.1	40.0	39
2000	54.5	45.0	240.6	17.4	38.7	39
2001	61.2	48.4	200.8	19.7	37.5	39
2002	61.5	47.0	205.2	17.4	38.6	39
2003	62.1	50.2	206.5	18.2	38.1	39
2004	62.0	49.4	205.7	21.1	38.2	39
2005	64.0	52.7	206.6	22.3	38.9	39
2006	66.5	55.1	204.0	22.3	39.8	39
2007	66.7	56.9	202.8	24.2	38.3	38
2008	69.2	56.6	209.1	21.0	41.3	38
2009	71.1	60.2	227.0	22.4	43.3	36
2010	69.3	58.2	226.1	23.2	42.7	35
2011	69.5	56.3	238.0	22.9	45.0	33
2012	71.0	56.6	241.3	25.8	46.0	33
2013	71.9	58.6	247.8	26.7	47.1	32
2014	75.1	61.0	251.3	26.6	47.4	32
All	47.5	37.9	251.3	6.4	34.7	1,909

Descriptive Statistics for CPI Inflation (as Percentage) by Country

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Australia	4.8	3.3	14.1	−0.3	3.6	55
Austria	3.3	3.0	9.1	0.5	1.9	55
Barbados	6.0	4.9	32.9	−1.3	5.8	49
Belgium	3.5	2.7	12.0	−0.1	2.7	55
Bolivia	28.4	7.6	477.5	−0.7	74.9	55
Brazil	76.2	8.6	341.7	3.1	103.5	35
Canada	3.8	2.7	11.7	0.2	2.9	55
Chile	3.0	3.1	4.3	1.4	1.2	6
Colombia	13.9	15.5	29.1	2.0	8.0	55
Costa Rica	11.3	9.6	64.2	−0.7	10.3	55
Czech Republic	3.8	2.6	10.1	0.1	3.2	22
Denmark	4.7	3.4	14.2	0.5	3.3	55
Dominican Republic	10.2	7.4	41.5	−4.0	11.0	55
Ecuador	16.8	11.0	67.3	2.3	15.7	55
El Salvador	7.3	4.5	27.7	−2.7	7.2	55
Estonia	9.8	4.0	64.1	−0.5	15.0	23
Finland	4.8	3.9	16.4	−0.2	4.1	55
France	4.2	2.7	12.8	0.0	3.5	55
Germany	2.0	2.3	6.8	−35.4	5.4	55
Greece	8.2	4.6	23.8	−1.8	7.2	55
Guatemala	7.7	6.6	34.5	−0.8	7.3	55
Honduras	8.0	6.5	29.2	1.1	6.2	55
Hungary	9.1	6.6	29.4	−0.2	7.3	43
Iceland	14.4	9.3	61.1	1.5	14.1	55
Ireland	5.5	3.9	19.0	−4.6	5.2	55
Israel	21.3	8.6	155.6	−0.6	33.3	55

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Italy	5.9	4.3	19.3	0.0	5.1	55
Jamaica	13.0	9.2	57.3	1.4	10.4	55
Japan	3.1	2.0	20.8	−1.4	4.0	55
Korea	7.1	4.6	25.2	0.7	6.1	49
Luxemburg	3.4	2.8	10.2	−0.1	2.5	55
Mexico	16.6	6.7	84.1	0.6	19.9	55
Netherlands	3.4	2.6	9.7	−0.7	2.4	55
New Zealand	5.6	3.4	15.8	0.2	4.8	55
Nicaragua	7.3	6.9	18.1	3.6	3.5	16
Norway	4.5	3.4	12.8	0.5	3.1	55
Panama	2.8	1.6	15.1	−0.1	3.1	55
Paraguay	10.4	8.8	31.7	−0.9	7.8	55
Peru	39.6	9.1	432.8	0.2	79.9	55
Poland	19.0	6.8	188.0	−1.0	34.3	45
Portugal	8.1	4.9	25.3	−0.8	7.4	55
Slovakia	5.1	4.4	12.6	−0.3	3.6	22
Slovenia	6.4	5.4	28.4	−0.5	6.6	23
Spain	6.6	5.1	21.9	−0.5	5.1	55
Sweden	4.4	3.4	12.8	−0.5	3.6	55
Switzerland	2.6	1.9	9.3	−1.2	2.3	55
Turkey	26.4	17.6	74.3	0.4	21.5	55
United Kingdom	2.6	2.3	7.3	0.1	1.7	27
United States	3.8	3.1	12.7	−0.4	2.7	55
Uruguay	31.8	29.3	81.2	4.3	22.5	55
Venezuela	36.2	24.8	79.6	19.1	21.5	7
All	10.7	4.7	477.5	−35.4	25.7	2,457

Descriptive Statistics for CPI Inflation (as Percentage) by Year

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1965	5.1	3.6	44.8	−1.9	7.3	38
1966	5.5	3.8	55.1	−1.2	8.8	38
1967	5.4	3.3	63.8	0.5	9.8	40
1968	6.2	3.8	81.2	0.0	12.6	40
1969	4.7	3.2	20.0	−0.2	4.2	40
1970	5.7	4.8	15.1	−0.9	3.4	40
1971	6.2	5.7	21.5	−0.5	4.0	41
1972	7.7	6.3	56.8	−0.1	8.4	41
1973	11.7	9.5	67.8	2.4	10.2	42
1974	18.0	15.2	57.2	1.8	10.9	42
1975	14.8	13.0	59.6	2.2	10.1	42
1976	11.5	9.3	41.0	1.7	8.0	42
1977	13.0	10.6	45.9	1.3	9.4	42
1978	12.7	9.0	45.6	1.1	11.3	42
1979	15.5	10.7	57.8	3.6	13.8	42
1980	19.6	14.0	83.7	3.9	17.3	42
1981	18.5	12.8	77.4	4.4	16.1	43
1982	20.1	10.6	80.4	0.3	22.1	43
1983	21.7	9.0	132.3	1.9	28.9	43
1984	25.0	8.2	262.6	1.6	47.4	43
1985	31.2	8.5	477.5	1.0	75.9	43
1986	18.0	7.4	132.5	−0.1	26.7	43
1987	15.5	8.1	118.9	−0.7	23.4	43
1988	22.9	6.9	203.7	0.4	43.4	43
1989	28.9	6.9	355.5	0.2	67.1	44
1990	35.7	9.1	432.8	0.8	83.8	44

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1991	21.7	8.1	167.3	−35.4	36.5	44
1992	17.8	5.4	235.3	1.0	37.2	44
1993	18.2	4.6	301.0	0.5	45.1	46
1994	16.9	5.6	308.0	0.1	45.0	48
1995	11.1	4.8	63.2	−0.1	13.3	48
1996	9.2	4.4	59.0	0.1	10.8	48
1997	7.4	4.4	61.9	0.3	10.1	48
1998	6.5	2.6	61.3	−1.3	10.0	48
1999	5.4	2.3	50.0	−0.3	9.3	48
2000	6.6	3.4	67.3	−0.7	10.9	49
2001	5.6	4.0	43.4	−0.8	7.3	49
2002	4.4	3.0	37.1	−1.3	5.7	49
2003	4.6	2.6	24.3	0.1	5.4	49
2004	4.4	2.8	41.5	−0.4	6.2	49
2005	3.8	2.7	14.2	−0.3	3.0	49
2006	3.7	3.1	10.9	0.2	2.5	49
2007	3.9	2.8	10.6	0.1	2.6	49
2008	6.2	4.5	19.9	1.4	4.0	49
2009	2.7	1.8	24.0	−4.6	4.2	50
2010	3.4	2.4	24.8	−1.0	3.8	51
2011	4.5	3.5	23.2	−0.3	3.4	51
2012	3.6	3.0	19.1	−0.7	2.9	51
2013	3.1	1.8	34.1	−0.9	4.9	51
2014	3.1	1.6	48.3	−1.3	6.9	51
2015	2.9	0.6	79.6	−1.8	11.2	51
All	10.7	4.7	477.5	−35.4	25.7	2,457

Descriptive Statistics for GDP Deflator Inflation (as Percentage) by Country

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Argentina	178.5	27.0	3,058.0	−2.0	503.4	54
Australia	5.2	5.0	16.0	0.0	3.9	54
Austria	3.3	3.0	10.0	0.0	2.1	54
Barbados	5.9	4.5	31.0	−5.0	7.6	54
Belgium	3.6	3.0	13.0	0.0	2.6	54
Bolivia	277.1	8.0	12,339.0	−5.0	1,684.3	54
Brazil	231.6	32.5	2,700.0	5.0	565.6	54
Canada	4.1	3.0	15.0	−2.0	3.3	54
Chile	49.9	13.5	665.0	0.0	114.8	54
Colombia	16.4	16.5	45.0	2.0	9.7	54
Costa Rica	13.8	11.0	84.0	−1.0	14.4	54
Czech Republic	6.3	3.0	36.0	−1.0	8.2	24
Denmark	4.9	4.0	13.0	0.0	3.4	54
Dominican Republic	12.0	6.0	103.0	−2.0	17.9	54
Ecuador	6.1	5.0	97.0	−26.0	17.2	54
El Salvador	4.8	4.0	18.0	−1.0	4.8	49
Estonia	6.3	5.0	24.0	0.0	5.1	19
Finland	5.3	4.5	22.0	0.0	4.4	54
France	4.4	3.0	14.0	0.0	3.8	54
Germany	2.6	2.0	8.0	0.0	2.0	44
Greece	9.2	5.0	27.0	−3.0	8.1	54
Guatemala	8.1	6.5	41.0	−4.0	9.0	54
Honduras	8.7	6.0	31.0	−3.0	7.4	54
Hungary	9.8	5.0	27.0	2.0	8.0	23
Iceland	17.1	11.0	77.0	0.0	17.0	54
Ireland	6.2	5.0	21.0	−4.0	6.0	44
Israel	33.4	9.0	391.0	−2.0	69.0	54

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Italy	6.8	4.5	21.0	0.0	5.8	54
Jamaica	16.7	12.0	60.0	−5.0	12.8	42
Japan	2.8	2.0	23.0	−2.0	5.0	54
Korea	9.8	6.0	33.0	−1.0	8.5	54
Luxemburg	4.1	4.0	20.0	−4.0	4.3	53
Mexico	21.6	9.5	140.0	1.0	28.4	54
Netherlands	3.5	2.0	13.0	−1.0	2.9	54
New Zealand	5.3	3.0	17.0	0.0	5.2	36
Nicaragua	545.0	10.0	13,612.0	−1.0	2,116.8	54
Norway	5.2	5.0	15.0	−5.0	4.0	54
Panama	3.9	2.0	34.0	−1.0	5.4	54
Paraguay	11.7	10.0	38.0	−2.0	9.4	54
Peru	205.5	10.0	6,261.0	0.0	912.4	54
Poland	11.8	4.0	55.0	1.0	15.0	24
Portugal	8.3	4.0	26.0	0.0	7.9	54
Slovakia	4.6	4.0	16.0	−1.0	4.3	22
Slovenia	4.3	4.0	11.0	−1.0	3.4	19
Spain	7.1	6.0	23.0	0.0	5.4	54
Sweden	4.9	4.0	15.0	0.0	3.6	54
Switzerland	1.8	1.0	7.0	0.0	1.9	33
Turkey	34.6	23.5	138.0	2.0	31.8	54
United Kingdom	5.6	4.0	26.0	1.0	5.0	54
United States	3.4	3.0	9.0	1.0	2.3	54
Uruguay	41.3	30.0	192.0	1.0	36.9	54
Venezuela	22.5	16.5	116.0	0.0	22.4	54
All	40.3	5.0	13,612.0	−26.0	438.2	2,538

Descriptive Statistics for GDP Deflator Inflation (as Percentage) by Year

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1965	10.1	4.0	97.0	−5.0	19.5	40
1966	8.2	4.0	72.0	−2.0	12.9	41
1967	7.0	3.0	79.0	−2.0	13.4	42
1968	8.2	4.0	116.0	−5.0	18.5	42
1969	7.1	5.0	40.0	0.0	7.7	42
1970	7.4	5.0	41.0	−14.0	8.2	42
1971	7.5	6.5	32.0	−9.0	7.5	44
1972	12.2	7.0	86.0	−5.0	17.4	44
1973	28.3	13.0	414.0	5.0	66.1	44
1974	36.4	19.5	665.0	6.0	97.7	44
1975	27.5	14.0	335.0	−1.0	56.0	44
1976	29.6	12.0	438.0	3.0	73.0	44
1977	21.6	12.5	159.0	1.0	27.9	44
1978	19.3	9.0	161.0	1.0	27.1	45
1979	23.6	14.0	147.0	3.0	27.9	45
1980	26.2	18.0	135.0	4.0	27.0	45
1981	22.3	12.5	126.0	3.0	27.4	46
1982	27.0	10.0	208.0	−9.0	43.3	46
1983	36.1	9.0	382.0	−14.0	72.4	46
1984	72.2	8.0	1,443.0	−4.0	232.8	46
1985	312.4	7.5	12,339.0	−2.0	1,815.7	46
1986	29.4	6.5	281.0	−14.0	56.7	46
1987	32.8	7.0	523.0	−9.0	84.4	46
1988	344.9	7.0	13,612.0	−12.0	2,004.2	46
1989	264.3	7.5	4,709.0	−1.0	899.6	46

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1990	364.0	9.5	6,261.0	−1.0	1,246.5	46
1991	129.8	8.0	4,524.0	0.0	652.8	48
1992	32.5	6.0	968.0	−1.0	137.5	49
1993	51.8	5.5	2,001.0	−1.0	281.7	50
1994	61.0	7.5	2,303.0	0.0	324.5	50
1995	12.9	5.0	94.0	−1.0	19.4	50
1996	11.1	4.5	116.0	−1.0	19.3	52
1997	8.0	4.0	81.0	−2.0	12.8	52
1998	8.1	5.0	138.0	−4.0	19.2	52
1999	4.8	3.0	54.0	−26.0	9.6	52
2000	6.5	3.5	49.0	−8.0	9.5	52
2001	5.4	4.0	53.0	−4.0	8.1	52
2002	5.6	3.0	37.0	−2.0	7.9	51
2003	5.5	3.0	35.0	−2.0	7.4	51
2004	6.2	3.0	45.0	−1.0	8.4	51
2005	4.5	3.0	30.0	−1.0	4.7	51
2006	5.0	4.0	18.0	−1.0	4.1	51
2007	5.1	4.0	18.0	−1.0	3.8	52
2008	6.0	4.0	30.0	−2.0	5.7	52
2009	2.8	2.0	12.0	−5.0	3.4	52
2010	4.1	3.0	46.0	−4.0	7.0	52
2011	4.4	3.0	28.0	−3.0	5.2	52
2012	3.2	2.0	19.0	−1.0	3.7	52
2013	3.5	2.0	36.0	−2.0	5.9	52
2014	4.0	2.0	49.0	−3.0	8.0	48
All	40.3	5.0	13,612.0	−26.0	438.2	2,538

Descriptive Statistics for Economic Growth (Percentage) by Country

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Argentina	1.4	2.1	10.6	−12.5	5.6	54
Australia	1.9	2.0	5.0	−3.5	1.7	54
Austria	2.5	2.4	8.6	−4.1	2.1	54
Barbados	1.7	1.5	10.5	−17.1	4.9	54
Belgium	2.3	2.2	7.1	−3.5	2.1	54
Bolivia	0.8	2.1	5.2	−15.3	3.6	54
Brazil	2.3	2.1	10.7	−6.8	3.6	54
Canada	2.0	2.1	6.0	−4.3	2.1	54
Chile	2.6	3.3	9.7	−13.6	4.5	54
Colombia	2.1	2.4	5.8	−6.0	2.0	54
Costa Rica	2.2	2.8	6.8	−10.4	3.2	54
Czech Republic	1.5	1.9	6.4	−12.1	4.0	24
Denmark	1.9	2.0	8.1	−5.8	2.3	54
Dominican Republic	2.9	3.1	13.9	−16.5	5.0	54
Ecuador	1.6	1.7	10.3	−6.9	2.9	54
El Salvador	0.9	1.5	5.7	−14.2	3.9	49
Estonia	4.8	6.9	12.2	−15.7	6.4	19
Finland	2.5	2.5	9.2	−9.1	3.2	54
France	2.2	2.0	6.1	−3.5	1.9	54
Germany	1.9	1.9	5.3	−5.5	2.0	44
Greece	2.3	2.4	10.2	−9.0	4.4	54
Guatemala	1.3	1.5	6.5	−6.0	2.3	54
Honduras	1.1	1.5	6.9	−5.1	3.0	54
Hungary	2.0	3.0	4.9	−6.6	2.8	23
Iceland	2.5	2.8	11.5	−7.0	3.9	54
Ireland	3.1	2.8	9.2	−7.6	3.4	44

Country	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
Israel	2.9	2.5	17.1	−2.6	3.7	54
Italy	2.1	1.9	8.1	−6.1	2.8	54
Japan	3.1	2.3	11.8	−5.7	3.5	54
Korea	5.7	5.9	12.0	−6.6	3.7	54
Luxemburg	2.5	2.5	9.1	−7.9	3.4	53
Mexico	1.8	2.1	8.1	−7.9	3.2	54
Netherlands	2.2	2.1	11.5	−3.9	2.5	54
New Zealand	1.4	1.6	5.1	−5.9	2.1	36
Nicaragua	0.2	1.8	10.2	−33.7	6.5	54
Norway	2.5	2.7	5.6	−2.9	1.9	54
Panama	2.8	3.3	9.6	−16.5	4.3	54
Paraguay	2.3	2.4	11.6	−6.1	3.8	54
Peru	1.5	2.2	9.8	−15.3	4.9	54
Poland	3.6	3.9	7.0	−7.6	2.9	24
Portugal	3.0	3.0	16.2	−8.2	4.0	54
Slovakia	3.8	4.6	10.1	−5.6	3.2	22
Slovenia	2.3	3.4	6.2	−9.0	3.5	19
Spain	2.6	2.3	10.3	−4.5	2.9	54
Sweden	2.1	2.1	9.7	−6.2	2.5	54
Switzerland	1.0	1.0	3.4	−3.4	1.7	33
Turkey	2.5	3.0	8.3	−7.3	3.8	54
United Kingdom	2.1	2.2	9.5	−5.2	2.3	54
United States	2.0	2.1	6.1	−3.7	2.0	54
Uruguay	1.7	1.9	7.8	−11.5	4.3	54
Venezuela	0.0	−0.3	15.0	−11.5	5.1	54
All	2.1	2.3	17.1	−33.7	3.6	2,496

Descriptive Statistics for Economic Growth (Percentage) by Year

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1961	3.0	3.3	10.3	−5.7	3.7	40
1962	3.5	3.4	12.4	−2.8	3.1	40
1963	3.1	3.3	9.3	−7.0	3.4	40
1964	4.5	4.5	10.0	0.2	2.4	40
1965	3.2	3.6	10.5	−16.5	4.2	40
1966	3.2	2.9	9.5	−3.3	3.2	41
1967	2.8	2.5	9.9	−4.7	2.8	41
1968	3.2	3.7	13.0	−15.3	4.7	41
1969	4.4	4.2	10.9	−2.6	3.3	41
1970	4.8	4.1	16.2	−2.9	4.3	41
1971	3.5	3.0	11.5	−1.9	2.7	43
1972	3.9	4.1	10.3	−2.6	2.9	43
1973	4.5	4.5	12.0	−6.8	3.4	43
1974	2.2	2.8	10.2	−7.0	3.4	43
1975	0.3	−0.1	7.7	−13.6	3.9	43
1976	3.3	3.6	11.0	−3.6	2.7	43
1977	2.9	2.6	9.6	−2.3	2.8	43
1978	2.5	2.9	8.8	−11.2	3.6	44
1979	2.2	3.0	8.6	−33.7	6.3	44
1980	1.2	1.6	8.3	−14.2	4.0	44
1981	0.4	0.7	6.4	−12.6	3.6	45
1982	−1.6	−0.6	6.4	−12.5	4.0	45
1983	−0.7	0.3	10.0	−13.4	4.4	45
1984	2.0	2.4	8.2	−4.2	2.6	45
1985	1.4	2.0	6.2	−9.4	3.1	45
1986	2.6	2.4	10.6	−5.8	3.3	45
1987	2.7	2.5	10.6	−4.0	3.0	45
1988	1.5	2.7	10.1	−16.5	5.2	45
1989	1.4	2.1	8.4	−15.3	4.5	45

Year	*Average*	*Mean*	*Max.*	*Min.*	*Standard deviation*	*Obs.*
1990	1.4	1.8	8.0	−7.6	3.5	45
1991	0.8	1.2	10.6	−12.1	4.1	47
1992	1.4	1.0	9.9	−5.4	3.4	48
1993	1.3	1.5	5.8	−2.8	2.4	49
1994	2.6	2.8	9.8	−6.3	2.7	49
1995	2.8	2.5	17.1	−7.9	3.5	49
1996	2.5	2.3	7.9	−2.3	2.2	51
1997	3.7	3.4	12.2	−0.6	2.2	51
1998	2.4	3.0	7.6	−6.6	2.6	51
1999	1.6	2.6	9.5	−8.1	3.7	51
2000	3.0	3.2	8.1	−4.4	2.4	51
2001	0.7	1.0	6.6	−7.3	2.4	51
2002	0.8	1.2	6.6	−12.5	3.5	51
2003	1.6	1.5	7.8	−9.9	2.6	51
2004	3.6	3.2	15.0	−0.2	2.4	51
2005	3.2	2.5	9.6	0.2	2.2	51
2006	3.9	3.4	10.5	1.4	2.1	51
2007	3.8	3.4	10.1	0.4	2.3	51
2008	1.1	1.1	7.7	−5.2	2.6	51
2009	−3.7	−3.9	3.8	−15.7	3.4	51
2010	2.5	1.9	10.6	−5.3	3.0	51
2011	2.3	2.1	8.6	−9.0	2.8	51
2012	0.6	0.8	8.1	−6.5	2.7	51
2013	1.0	1.0	11.6	−17.1	3.5	51
2014	1.5	1.4	5.9	−5.5	1.8	48
All	2.1	2.3	17.1	−33.7	3.6	2,496

Source: Own elaboration.

Annex 4. Derivation of the Relation between Prices, Money, Debt, and Inflation

As proposed by Kwon et al. (2009), a simplified version of Castro et al. (2003) can be used to derive a functional relation between the price level, money, debt and output. In said version, a representative consumer is endowed with fixed resources *(y)* for each period, and allocates their real wealth among real consumption *(c)*, real domestic money $\left(m/p\right)$, and non-indexed real government bonds $\left(b/p\right)$ in order to maximize the following utility function:

A.1
$$\sum_{t=0}^{\infty}\beta^{t}\left(\ln\left(c_{t}\right)+\gamma\ln\left(\frac{m_{t}}{p_{t}}\right)\right).$$

Subject to a resource constraint given by

A.2
$$c_{t}+\frac{m_{t}}{p_{t}}+\frac{b_{t}}{p_{t}}=y_{t}-\tau_{t}+\frac{m_{t-1}}{p_{t}}+\frac{i_{t-1}b_{t-1}}{p_{t}},$$

where τ is the fixed lump-sum tax and i_{t-1} is a nominal gross return of a government bond between periods $t-1$ and t. This maximization problem yields the following standard first-order conditions for consumption and real money demand, respectively:

A.3
$$\frac{c_{t+1}}{c_{t}}=\frac{\beta i_{t}}{\pi_{t+1}},$$

A.4
$$\frac{m_{t}}{p_{t}}=\frac{\gamma c_{t}i_{t}}{i_{t}-1},$$

where $\pi_{t}=p_{t+1}/p_{t}$. These two first order conditions nest a Cagan-type money demand function that is inversely related to inflation expectations.

The government is faced with the following intertemporal budget constraint:

$$\text{A.5} \quad G_t + (i_{t-1} - 1)\frac{B_{t-1}}{p_t} = \tau_t + \frac{(M_t - M_{t-1})}{p_t} + \frac{(B_t - B_{t-1})}{p_t}.$$

Forward iteration on Equation A.5 and no-Ponzi game conditions on the government imply the following long-term constraint of the government:

$$\text{A.6} \quad \frac{i_{t-1}B_{t-1}}{p_t} = \sum_{j=0}^{\infty}\frac{\tau_{t+j}}{R_{t,j}} - \sum_{j=0}^{\infty}\frac{G_{t+j}}{R_{t,j}} + \sum_{j=0}^{\infty}\frac{M_{t+j} - M_{t+j-1}}{p_{t+j}R_{t,j}},$$

where G is real government spending and $R_{t,j}$ is the compounded real discount rate expressed as

$$R_{t,j} = \prod_{h=1}^{j} r_{t+h}$$

where r_{t+h} is the exogenous real interest rate between periods $t+h-1$ and $t+h$. In the case of a fiscal policy rule where part of the debt service $(1-\delta)$ is covered with future primary surpluses and by monetizing the remainder (δ), we obtain the following money supply function:

$$\text{A.7} \quad \frac{M_t}{P_t} = \frac{i_t - 1}{i_t}\left[\frac{\delta i_{t-1}B_{t-1}}{p_t} + \frac{M_{t-1}}{p_t} - \sum_{j=1}^{\infty}\frac{M_{t+j}}{p_{t+j}R_{t,j}}\frac{i_{t+j} - 1}{i_{t+j}}\right].$$

Equation A.7 shows that the path of money supply is determined by the extent of debt monetization (the first variable in parenthesis on the right) and savings in the future interest payments brought about by current monetary financing of the budget deficit (third variable in parenthesis on the right).

Imposing equilibrium conditions on Equations A.4 and A.7, and exploiting the recursive nature of the Euler equation in A.3, we obtain the equilibrium price as follows:

A.8

$$p_t = \frac{(1-\beta)(M_{t-1} + \delta i_{t-1} B_{t-1})}{\gamma c_t}.$$

Given the recursive nature of the equilibrium and no arbitrage between bond and real asset returns $(r_{t+1} = i_t / \pi_t)$, the equilibrium price can be rearranged to:

A.9

$$p_t = \frac{(1-\beta)(M_t + \delta B_t)}{\gamma c_t}.$$

Using real income through real GDP (w) as a proxy variable for consumption in each period t, (c_t), results in Equation A.9 being equivalent to Equation 1.

Annex 5. Countries Analyzed and their Classification into Developed, Developing, Net Creditor and Net Debtor

	Developing		*Developed*
Country	*Net debtor*	*Net creditor*	*Net creditor*
Argentina	X		
Australia			X
Austria			X
Barbados	X		
Belgium			X
Bolivia		X	
Brazil	X		
Canada			X
Chile	X		
Colombia	X		
Costa Rica	X		
Czech Republic			X
Denmark			X
Dominican Republic	X		
Ecuador	X		
El Salvador	X		
Estonia			X
Finland			X
France			X
Germany			X
Greece			X
Guatemala	X		
Honduras	X		
Hungary	X		
Iceland			X

Ireland			X
Israel			X
Italy			X
Jamaica	X		
Japan			X
Korea			X
Luxemburg			X
Mexico	X		
Netherlands			X
New Zealand			X
Nicaragua	X		
Norway			X
Panama	X		
Paraguay	X		
Peru	X		
Poland	X		
Portugal			X
Slovakia			X
Slovenia			X
Spain			X
Sweden			X
Switzerland			X
Turkey	X		
United Kingdom			X
United States			X
Uruguay	X		
Venezuela		X	

Source: Own elaboration based on the World Economic Outlook (WEO) 2014.

References

Abizadeh, Sohrab, Michael Benarroch, and Mahmood Yousefi (1996), "A Multilevel Government Model of Deficits and Inflation," *Atlantic Economic Journal*, Vol. 24, No. 2, June, pp. 118-130.

Anoruo, Emmanuel C. (2003), "An Empirical Investigation into the Budget Deficits-inflation Nexus in South Africa," *The South African Journal of Economics*, Vol. 71, No. 2, June, pp. 282-296, <https://doi.org/10.1111/j.1813-6982.2003.tb01309.x>.

Arellano, Manuel, and Stephen Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, Vol. 58, No. 2, April, pp. 277-297, <https://doi.org/10.2307/2297968>.

Barro, Robert J. (1996), "Inflation and Growth," *Federal Reserve Bank of St. Louis Review*, Vol. 78, No. 3, May-June, pp. 153-169, <https://doi.org/10.20955/r.78.153-169>.

Barro, Robert J. (1989), "The Ricardian Approach to Budget Deficits," *Journal of Economic Perspectives*, Vol. 3, No. 2, Spring, pp. 37-54, < https://pubs.aeaweb.org/doi/pdf/10.1257/jep.3.2.37>.

Buiter, Willem H. (1999), *The Fallacy of the Fiscal Theory of the Price Level*, NBER Working Paper, No. 7302, National Bureau of Economic Research, Cambridge, Massachusetts, <DOI: 10.3386/w7302>.

Cagan, Phillipe (1956), "The Monetary Dynamics of Hyperinflation," in Milton Friedman, *Studies in the Quantity Theory of Money*, University of Chicago Press, Chicago.

Canzoneri, Matthew, Robert E. Cumby, and Behzat T. Diba (2001), "Is the Price Level Determined by the Needs of Fiscal Solvency?," *American Economic Review*, Vol. 91, No. 5, pp. 1221-1238, <DOI: 10.1257/aer.91.5.1221>.

Castro, Rui, Carlos de Resende, and Francisco Ruge-Murcia (2003), *The Backing of Government Debt and the Price Level*, CIREQ Working Paper, No. 16-2003, The Centre for Interuniversity Research in Quantitative Economics.

Catão, Luis, and Marco Terrones (2005), "Fiscal Deficits and Inflation," *Journal of Monetary Economics*, Vol. 52, No. 3, pp. 529-554, <https://doi.org/10.1016/j.jmoneco.2004.06.003>.

Choudhary, Munir A. S., and Amar K. Parai (1991), "Budget Deficits and Inflation, the Peruvian Experience," *Applied Economics*, Vol. 23, pp. 1117-1121, <https://doi.org/10.1080/00036849100000015>.

Christiano, Lawrence J., and Terry J. Fitzgerald (2003), "Inflation and Monetary Policy in the Twentieth Century," *Economic Perspectives,* Federal Reserve Bank of Chicago, Vol. 27, No. 1, January, pp. 22-45.

Christiano, Laurence J., and Terry J. Fitzgerald (2000), *Understanding the Fiscal Theory of the Price Level*, NBER Working Paper, No. 7668, National Bureau of Economic Research, Cambridge, Massachusetts.

Cochrane, John H. (2005), "Money as Stock," *Journal of Monetary Economics*, Vol. 52, No. 3, pp. 501-528, < https://doi.org/10.1016/j.jmoneco.2004.07.004>.

Cochrane, John H. (2001), "Long-term Debt and Optimal Policy in the Fiscal Theory of the Price Level," *Econometrica*, Vol. 69, No. 1, January, pp. 69-116, <https://doi.org/10.1111/1468-0262.00179>.

Darrat, Alí F. (2000), "Are Budget Deficits Inflationary? A Reconsideration of the Evidence," *Applied Economics Letters*, 2000, Vol. 7, No. 10, pp. 633-636, <https://doi.org/10.1080/135048500415914>.

Dwyer, Jr. Gerald P. (1982), "Inflation and Government Deficits," *Economic Inquiry*, Vol. 20, No. 3, pp. 315-329, <https://doi.org/10.1111/j.1465-7295.1982.tb00350.x>.

Easterly, William, Carlos Rodríguez, and Klaus Schmidt-Hebberl (1994), *Public Sector Deficits and Macroeconomic Performance*, Vol. II, Elsevier Science, Amsterdam.

Elmendor, Douglas, and Gregorio Mankiw (1999), "Government Debt," in J. B. Taylor y M. Woodford (eds.), *Handbook of Macroeconomics*, Vol. 1, Elsevier Science, Amsterdam.

Engen, Erik, and Glenn Hubbard (2004), *Federal Government Debts and Interest Rates*, NBER Working Paper, No. 10681, National Bureau of Economic Research, Cambridge, Massachusetts, <DOI: 10.3386/w10681>.

Feldstein, Martin (1986), *Budget Deficits, Tax Rules and Real Interest Rates*, NBER Working Paper, No. 1970, July, National Bureau of Economic Research, Cambridge, Massachusetts, <DOI: 10.3386/w1970>.

Fischer, Stanley, and Easterly William (1990), "The Economics of the Government Budget Constraint," *World Bank Research Observer*, Vol. 5, No. 2, July, pp. 127-142, <https://doi.org/10.1093/wbro/5.2.127>.

Fischer, Stanley, Ratna Sahay, and Carlos Végh (2002), "Modern Hyper- and High Inflations," *Journal of Economic Literature*, Vol. 40, No. 3, September, pp. 837-80, <DOI: 10.1257/002205102760273805>.

International Monetary Fund (2014), *Perspectivas de la economía mundial. Secuelas, nubarrones, incertidumbres,* World Economic Outlook (WEO), IMF, Washington D. C., October.

International Monetary Fund (2005), *Globalización y desbalances externos*, World Economic Outlook (WEO), IMF, Washington D. C., April.

Ghura, Dhaneshwar, and Michael T. Hadjimichael (1996), "Growth in the Sub-Saharan Africa," *IMF Staff Papers*, Vol. 43, pp. 605-634.

Gordon, David, and Eric M. Leeper (2002), *The Price Level, The Quantity Theory of Money, and The Fiscal Theory of the Price Level*, NBER Working Paper, No. 9084, National Bureau of Economic Research, Cambridge, Massachusetts, <DOI: 10.3386/w9084>.

Gylfason, Thorvaldur, and Tryggvi T. Herbertsson (2001), "Does Inflation Matter for Growth?," *Japan and the World Economy*, Vol. 13, No. 4, pp. 405-428, <https://doi.org/10.1016/S0922-1425(01)00073-1>.

Hendry, David F., Adrian R. Pagan, and J. Denis Sargan (1984), "Dynamic Specification," in Zvi Griliches and Michael D. Intriligator (eds.) *Handbook of Econometrics*, Vol. II, Elsevier Science <https://doi.org/10.1016/S1573-4412(84)02010-9>.

Hondroyiannis, George, and Evangelia Papapetrou (1997), "The Budget Deficits Inflationary? A Cointegration Approach," *Applied Economics Letters*, Vol. 4, pp. 493- 496, <https://doi.org/10.1080/758536632>.

Hossain, Akhand A., and Anis Chowdhury (1998), *Open-economy Macroeconomics for Developing Countries*, Edward Elgar Publishing.

Judson, Ruth, and Ann L. Owen (1999), "Estimating Dynamic Panel Data Models: A Guide for Macroeconomists," *Economics Letters*, Vol. 65, No. 1, October, pp. 9-15, <https://doi.org/10.1016/S0165-1765(99)00130-5>.

Kwon, Goohoon, Lavern McFarlane, and Wayne Robinson (2009), "Public Debt, Money Supply, and Inflation: A Cross-Country Study," *IMF Staff Papers*, Vol. 56, No. 3, May, pp. 476-515, < http://www.jstor.org/stable/40377808>.

Leeper, M. Eric, and Tack Yun (2006), "Monetary-fiscal Policy Integration and the Price Level: Background and Beyond," *International Tax and Public Finance*, Vol. 13, No. 4, pp. 373-409, <https://doi.org/10.1007/s10797-006-8599-2>.

Loungani, Prakash, and Phillip Swagel (2003), "Sources of Inflation in Developing Countries," in Elhanan Helpman and Efraim Sadka (eds.), *Economic Policy in International Economy, Essays in Honor of Assaf Razin*, Cambridge University Press.

Loyo, Eduardo (1999), *Tight Money Paradox on the Loose: A Fiscalist Hyperinflation*, mimeo., Harvard University, Cambridge, Massachusetts, <http://sims.princeton.edu/yftp/Loyo/LoyoTightLoose.pdf>.

Metin, Kivilcim (2012), "The Relationship between Inflation and Budget Deficits in Turkey," *Journal of Business and Economic Statistics*, 1998, Vol. 16, No. 4, pp. 412-422, <DOI: 10.1080/07350015.1998.10524781>.

Narayan, Paresh Kumar, Seema Narayan, and Arti Devi Prasad (2006), "Modeling the Relationship between Budget Deficits, Money Supply and Inflation in Fiji," *Pacific Economic Bulletin*, Vol. 21, No. 2, pp. 103-116, < http://hdl.handle.net/10536/DRO/DU:30018536>.

Niepelt, Dirk (2004), "The Fiscal Myth of the Price Level," *Quarterly Journal of Economics*, Vol. 119, No. 1, February, pp. 277-300, <https://doi.org/10.1162/003355304772839597>.

Orr, Adrian, Malcom Edey, and Michael Kennedy (1995), *Real Long-term Interest Rates: The Evidence from Pooled Time-series*, OECD Economic Studies, No. 25, pp. 75-107.

Saleh, Ali Salman, and Charles Harvie (2005), "The Budget Deficits and Economic Performance," *The Singapore Economic Review*, Vol. 50, No. 2, pp. 211-243, <https://doi.org/10.1142/S0217590805001986>.

Sargent, Thomas. J., and Neil Wallace (1981), "Some Unpleasant Monetary Arithmetic," *Quarterly Review,* Vol. 5, No. 3, Fall, Federal Reserva Bank of Minneapolis, pp. 1-17.

Sims, Christopher (1994), "A Simple Model for Study of the Price Level and the Interaction of Monetary and Fiscal Policy," *Economic Theory*, Vol. 4, No. 3, pp. 381-399.

Tanzi, Vito (1993), "Fiscal Issues in Adjustment Programs," en Riccardo Faini and Jaime de Melo (eds.), *Fiscal Issues in Adjustment in Developing Countries*, Palgrave Macmillan, London.

Tekin-Koru, Ayça, and Erdal Özmen (2003), "Budget Deficits, Money and Inflation: The Turkish Experience," *Applied Economics*, Vol. 35, No. 5, pp. 591-596, <https://doi.org/10.1080/0003684022000025440>.

Vamvoukas, George A. (1998), "The Relationship between Budget Deficits and Money Demand: Evidence from a Small Economy," *Applied Economics*, Vol. 30, pp. 375-382, <https://doi.org/10.1080/000368498325895>.

Veira, Carlos (2000), *Are Fiscal Deficits Inflationary? Evidence from EU*, Economic Research Paper, No. 00/7, Loughborough University, Reino Unido.

Wolde-Rufael, Yemane (2008), "Budget Deficits, Money and Inflation: The Case of Ethiopia," *The Journal of Developing Areas*, Vol. 42, No. 1, pp. 183-199, <DOI: 10.1353/jda.0.0028>.

Woodford, Michael (2001), *Monetary Policy in the Information Economy*, NBER Working Paper, No. 8674, National Bureau of Economic Research, Cambridge, Massachusetts, <DOI: 10.3386/w8674>.

Woodford, Michael (1994), "Monetary Policy and Price Level Determined in a Cash-in-Advance Economy," *Economic Theory*, Vol. 4, No. 3, pp. 345-80.

Wray, L. Randall (2015), "Deficits, Inflation, and Monetary Policy," *Journal of Post Keynesian Economics*, Vol. 19, No. 4, pp. 543-571.