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1. Introduction

Anecdotal accounts suggest that hyperinflations leave a long-lasting mark in people’s memories of the hardships introduced by run-away inflation. These memories, the story goes, lead central banks to adopt long-term monetary policies that are more conservative than the average long-term monetary policy observed in the average country lacking a past of hyperinflation.

Most, but not all, of the anecdotal accounts refer to the German experience of the early 1920s and the subsequent long-term conservative stance of monetary policy followed by the Bundesbank, commonly attributed to the trauma caused by the 1923 hyperinflation (see some quotations in section two below). While the importance of the episode is out of question, and even if one takes the story at face value, the doubt remains on how general are the German results. Concretely, has the German experience been repeated in other countries? Furthermore, and to the extent that other countries have indeed repeated the German pattern, how general is the result that hyperinflationary experience leads to lower than average cross-sectional rates of inflation in the long-term? These are the questions examined in the second section of this paper. The findings are both statistically and economically important: the average subsequent long-term rate of inflation is some 5 percentage points lower for countries that have had the experience of hyperinflation than for countries that have not.

A second question that arises naturally after having examined the cross-country empirical evidence is: why? (i.e., why does hyperinflation lead to lower subsequent long-term rates of inflation?). Moreover, what are the mechanisms at play? The third section of this paper proposes a model and suggests a rationale for the outcome: hyperinflations act by reducing the costs of collecting explicit taxes vis-à-vis the costs associated with the collection of seignorage. This is the main lesson that societies that lived through hyperinflation seemed to have learned and internalized: conventional taxes may be evil,
but they are nothing when compared to the costs associated with financing substantial fractions of the government’s budget by resorting to the inflation tax. Section four of this paper discusses the main rationale advanced by the model in light of available evidence from country case studies on the key role that conventional taxation played in terminating hyperinflations. Section five concludes the paper.

2. What the evidence says

This section reviews the evidence concerning the effect of past hyperinflationary experience on subsequent inflation outcomes. First, some anecdotal evidence on the German and Argentine experiences is reviewed. Next, the cross-country data after WWII are examined and discussed.

2.1. Some scattered pieces of evidence from the cases of Germany and Argentina

When the issue of the legacy of hyperinflation in Germany is discussed, even the non-technical literature produces statements along the following lines:

“It (the collapse of the German currency) left a permanent mark on the psyche of the nation, with far reaching effects that the passing of time has not been able to eradicate completely. Thus, on various subsequent occasions, the mere fear of inflation which the trauma of the 1920s had implanted in the minds of the German people was responsible for policies and attitudes, sometimes for better, sometimes for worse. In 1924, for instance, it helped to create the spirit of restraint and self-denial needed to maintain the stability recently brought to the currency. Conversely, during the world economic crisis of the 1930s, it prevented the German authorities from applying even mildly inflationary policies, which might have made the recession less disastrous.” Guttmann and Meehan (1976, p. xi)

The issue is taught to undergraduate students taking the Money and Banking course in a similar way:

“The ghost of the inflation after World War I still frightens many Germans today” Meyer (1986, p. 41)

“Not surprisingly, given Germany’s experience with hyperinflation in the 1920s, Germans have had the strongest commitment to price stability as the primary goal for monetary policy”. Mishkin (2000, p. 457).
And a similar view is held in policy circles, as well:

“...the inflation of 1923 left a terrible legacy for the future fate of our country... The objective of stable money was and is deeply rooted in our society. It is based on a wide consensus in broad sections of our population. It is based on a culture of stability. That is why German public opinion --particularly in critical periods-- again and again proved a loyal ally of a stability-oriented monetary policy”. Tietmeyer (2001, pp. 7-12).

Sometimes, even quantitative comparisons are also advanced:

“Germany has achieved a high degree of price stability. In that respect, the last 50 years have been in distinct contrast to the monetary upheavals of the first half of the twentieth century with their calamitous political and social consequences. A comparison with inflationary developments in other countries during the past fifty years also testifies to how deeply stability awareness is anchored in Germany --something which is undoubtedly due to its specific past experience. The average annual rate of inflation in the UK over the past five decades --based on a broad index of consumer prices- has been 6.4%, for example. By contrast, the corresponding German rate has been 2.8%. Even countries with a traditionally stronger anti-inflationary orientation, such as Switzerland and the United States, have recorded higher rates of monetary erosion than Germany –at 3% and 4.1% respectively”. Konig (2001, p. 56). (Italics added).

For clear and well-justified reasons, the Argentine hyperinflation of 1989-91 has not attracted as much attention. Nonetheless, there has been no lack of speculation on the legacy of hyperinflation. Reflections have gone along similar lines.

“The loyalty of Argentineans since 1991 to the Convertibility Plan...has been similar to the persistent loyalty of Germans to their anti-inflation commitment. Both are rooted in their countries’ bad histories of inflation. Many would argue that low inflation in Germany since 1950 and in Argentina since 1991 are owed to institutional commitments –the independence and legislated commitments of their central banks. But I suspect that such independence and commitments have survived only because of the support of public opinion that has its roots in historical memory”. Corden (2002, p. 181).

Even after the traumatic collapse of the Currency Board arrangements in January 2002 --involving an unprecedented institutional crisis that witnessed the resignation of two different presidents in a period of a month--., not all professional economists agreed with the conventional wisdom of the times concerning the inevitability of a new hyperinflation:

“Many people think that we are headed toward hyperinflation. That can indeed happen, but it is not something inevitable. The inherited economic mess and the colossal policy mistakes of the Duhalde administration are not themselves sufficient to generate a new
hyperinflation. Hyperinflation is a monetary phenomenon that depends on both the demand for and the supply of money. Up until this point (July of 2002) the demand for money has shown a striking resiliency. The stability of the demand for money is all the more surprising if we recall that the Peso has devalued by more than 70% (since January 2002)...Regarding the supply of money...the federal treasury has received only small transfers from the central bank. Memories of the 1989-91 hyperinflation have had a very positive influence via a huge 'fear effect'.” Espert (2002, pp. 2-3)

2.2. Cross-country evidence on hyperinflation and subsequent long-term inflation

This subsection is devoted to analyzing the cross-country evidence on the effects of hyperinflation on subsequent inflation outcomes for the period 1949-2002.

2.2.1. Description of the data

The data are from the International Monetary Fund’s International Financial Statistics (IMF-IFS) database, and consist of averages through time for each country for the period 1949-2002. The main advantage of using averages over a long period of time is that the chance of capturing short-run dynamics (rather than the long-run behavior of inflation) is substantially diminished, if not completely eliminated.

Table 1 presents the summary statistics for the inflation data. From the information reported in Table 1, it is noteworthy that roughly 25% of the observations associated with countries that have not undergone hyperinflation correspond to average inflation rates above 12%, the maximum average inflation rate observed in the aftermath of hyperinflation. Indeed, for countries that have had hyperinflation, annual inflation rates range from roughly 2.5% in the cases of Macedonia and Germany, to 11.9 % in the case of Nicaragua. On the other hand, the maximum rate of inflation for countries that have not experience hyperinflation is 82.79%, corresponding to the case of Zambia (a clear outlier; more on this topic below). Remarkably, even if we concentrate our attention on OECD countries that have not experienced hyperinflation (that is, Germany and Austria are excluded from the OECD group), the average rate of inflation for this group is 8.19%,
higher than the 7.07% mark characterizing the average inflation record in the post-
hyperinflation period for the countries in the sample.

2. 2. 2. Methodological Issues

Table 2 lists the twenty one countries classified as having a hyperinflation and
reports their subsequent average inflation outcome. Two questions arise at this point.
First, what were the criteria that led to the inclusion of the twenty one countries listed in
Table 2? Second, how does the list compare to other relevant studies on
hyperinflations? First, Serbia (Former Yugoslavia) was excluded from the sample for
lack of data in the IMF-IFS database. The same is true of Tajikistan and Turkmenistan.
These three countries were included by Fischer et al. (2002) in their study of hyper and
high inflations. Second, Belarus was excluded from the sample both because it is (still)
living a situation --prevalent for the whole 1990s--, reminiscent of high, chronic inflation,
not of a hyperinflation and because its "market socialism", coupled with authoritarian rule
and inefficient state enterprises operating under soft budgets --financed through the
printing of money-- all within Soviet style planning arrangements, has artificially delayed
reform, precluding stabilization from taking place. Third, Congo (CDR) and Angola,
countries that experienced hyperinflation and for which data are available in the IMF-IFS
database were excluded because until very recently (up to the present day in the case of
the CDR, and until 2002 in the case of Angola) they continued to experience civil wars
that prevented the stabilization of inflation from taking place.

A second important methodological question is how to deal with countries that
experience hyperinflation more than once. When a country experienced hyperinflation at
two different points in time, the following criteria were used to record them:
a) If the two hyperinflations occurred before 1949, then the most recent one is
considered. This is the case of Hungary, with one hyperinflation occurring after WWI and
another one after WWII. b) If one happened before 1949 and another after 1949, then
the less recent hyperinflation is the one considered. This is the case of Russia, with one in the early 1920s and another one in the early 1990s. c) If the two of them occurred after 1949, then the less recent one would be considered (no case like this occurs in the sample, though). The above criteria were set with two ideas in mind. First, to maximize the number of years spanning the post-hyperinflationary period, so as to highlight the role of past hyperinflations on subsequent inflation outcomes, and second to minimize the number of missing observations before 1949, the first year with data in the IMF-IFS database.

2. 2. 3. Regression results

A simple univariate regression shows that a dummy variable for the existence of past hyperinflation has a strong negative (and statistically significant) correlation with the actual cross-country rates of inflation. (Given criticism related to the fact that Taiwan is not universally accepted as a country, it was excluded from the regressions presented in this paper. Results are slightly better if Taiwan is included. The results included Taiwan are available upon request from the author). Countries that experienced hyperinflation tend to have, on average, a rate of inflation 5 percentage points lower than the average rate of inflation for the countries that lacked the same experience. The result is statistically significant at the 0.1% level, with a t-statistic of -3.75 (The t-stat is -3.89 if Taiwan is included). Moreover, this result is relatively robust to the exclusion of sample outliers. If Zambia is excluded from the sample, the estimated coefficient falls, in an absolute value sense, from -5 to -4.39, the t-statistic falls (also in an absolute value sense) from -3.75 to -3.68 (from -3.89 to -3.80 if Taiwan is included), and the coefficient remains statistically significant at the 0.1% level. If all the countries displaying annual average rates of inflation higher than or equal to 50% (Zambia, Uganda, Indonesia, and Chile) are excluded from the sample, the estimated coefficient falls again, in absolute value terms, to -3.24 (-3.35 when Taiwan is included) but remains statistically significant
at the 0.2% level, with a t-statistic of -3.21 (-3.35 if Taiwan is included). If, alternatively, all the countries with annual average rates of inflation higher than or equal to 40% (Zambia, Uganda, Indonesia, Chile, Uruguay) are excluded from the sample, the estimated coefficient is now -2.95 (-3.06 when Taiwan is included) and the statistical significance is still at the 0.3% level with a t statistic of -3.03 (-3.18 in the case Taiwan is included). Even if 6 more countries are deleted from the sample (Guinea Bissau, Turkey, Israel, Ghana, Mozambique and Yemen), so that only countries with average annual rates of inflation lower than or equal to 30% remain, the coefficient remains marginally statistically significant at the 5% level and reveals that countries that experienced hyperinflations display rates of inflation that are on average 1.5 percentage points lower than the one in the average country of the cross-section. (Results when Taiwan is included are as follows: t-statistic, -2.07; p-value, 0.04; coefficient, -1.66).

Table 3 presents the multivariate regressions results for all but one of the countries in the sample: Zambia, a clear outlier among the countries that did not experience hyperinflation, displaying an average rate of inflation of 82% (the results that include Zambia are marginally better and are reported in Guerrero, 2005b). The vector of control variables in Table 3 (and in Table 4 as well) is composed of the following. First, dummy variables for former colonies of Spain and France were included. As discussed in Barro (1997, pp. 113-16), former colonies of Spain tend to display relatively high cross-sectional rates of inflation whereas the converse is true for former colonies of France. Second, following Mc Candless and Weber (1995) and Lucas (1996), two proxies for the average growth of the money supply are alternatively included: the rate of growth of M2 and the rate of growth of Base Money. Third, given that initially richer countries could have had better institutions across the board, the natural logarithm of GDP per capita in 1950 is included to try to shut-off that channel of variation in the cross-sectional rate of inflation. Similarly, both the existence of armed conflicts and a low
The degree of prevalence of the rule of law can lead to poor inflation outcomes that are themselves independent of the existence of hyperinflation in the past. For that reason, proxies for both the degree of prevalence of the rule of law and the existence of wars were also included in the vector of control variables. In doing so, we follow Barro (1997) and Guerrero (2005a). Finally, so as to avoid picking up the effect of globalization on global disinflation during the 1990s (a point stressed in Rogoff, 2003), two alternative proxies for disinflation in the world were included as right-hand side regressors: (i) the absolute difference in the average inflation rate between the 1990s and the 1980s for every country, and (ii) the relative (in percent) difference in the average inflation rate between the 1990s and the 1908s for every country. Recalling that regressions are of a purely cross-sectional variety, these measures do not introduce a problem with the left-hand side variable (the rate of inflation over the period 1949-2002 for every country, except for the ones suffering hyperinflation, for which the average rate of inflation in the post-hyperinflation period is considered).

The results in Table 3 are both economically and statistically important. Countries that experienced hyperinflation have subsequent rates of inflation that are 15 percentage points below the rate of inflation of the average sample country that never experienced hyperinflation. This result is statistically significant at least at the 5% level across different specifications.

How sensitive to the elimination of outliers are the results shown in Table 3? In particular, what happens if all the countries with rates of inflation higher than or equal to 50% (Zambia, Uganda, Indonesia, and Chile) are removed from the sample? Table 4 provides the answer. Results stay statistically significant at the 5% level, but now the quantitative economic impact of a hyperinflationary experience is cut by a third to roughly 10 percentage points. This last result is shown to survive even if the sample is reduced to countries that are members of the OECD. Unsurprisingly, given the loss of
degrees of freedom involved in such an exercise, the statistical significance level is reduced to the 10% level in some specifications (though it remains at the 5% level in the majority of cases). The interested reader can find this and further robustness results in Guerrero (2005b).

3. A model

A standard representative agent model is presented first. It is then converted to a macroeconomic framework by invoking a standard economy-wide equilibrium condition for the market for goods. Finally, the differential equation for the rate of inflation – embedded in the demand for money equation implied by the first order conditions of the model is integrated to obtain an expression for the price level and an assumption of proportionality between the price level and the cost of increasing the collection of conventional taxes is imposed to close the model.

3. 1. Microeconomic optimization by the representative consumer

An endowment economy where real per capita output, \( y_t \), is given (and constant) at every instant: \( y_t = y > 0 \ \forall t \) is assumed. Population is constant and its size is normalized to unity for convenience. Labor is inelastically supplied. The economy is populated by an infinitely lived, forward looking representative agent who is endowed with perfect foresight and maximizes:

\[
\int_{0}^{\infty} [u(c_t) + v(m_t)] e^{-\rho t} dt
\]

Where \( c \) stands for consumption per capita, \( m \) represents real money holdings per capita,

\[ m_t = \frac{M_t}{P_t} \]

\( M_t \) represents the nominal stock of money, the only asset the representative agent holds, at any instant \( t \). \( P_t \) represents the price level at any instant \( t \). \( u(.) \) and \( v(.) \) are known as the instantaneous utility functions (assumed to be strictly increasingly
concave), and the parameter $\rho$ is the rate of time preference, or the subjective discount rate, which is assumed to be strictly positive and equal to the real rate of interest, for simplicity.

It is also assumed that the instantaneous utility function $v(.)$ adopts the following functional form:

$$v(m_t) = m_t \left[ A - B \ln(m_t) \right]; \ A, B > 0$$

The maximization is made subject to the following constraints:

$$\frac{dm}{dt} m = y_t - c_t - \pi_t m_t + g_t$$

$$\lim_{t \to \infty} \lambda_t m_t e^{-\rho t} = 0$$

$$m_t, c_t > 0 \quad \forall t \quad \text{and} \quad m_0 \text{ is given.}$$

Equation (3) is usually called the evolution equation and acts as an intra-period budget constraint. In equation (2), $\pi$ is the rate of inflation (so that the term $\pi_t m_t$ represents the inflation tax on real cash balances), and $g$ denotes lump-sum government transfers per capita (assumed to be given to the representative agent at every time $t$).

Equation (4) is the so-called transversality condition, a condition that guarantees the fulfillment of the lifetime budget constraint of the representative agent. Equation (4), sometimes also called no-Ponzi game or no-bubbles condition, guarantees that the real value of the individual’s assets does not explode as time passes by (recall that $\pi$ is not formally restricted to be positive), thus acting as an intertemporal budget constraint in the optimization program. In equation (4), $\lambda$ represents the shadow value of the representative agent’s lifetime wealth.

Last but not least, (5) describes the initial condition for the stock of money per capita, and the relevant non-negativity constraints.
Making use of Fisher’s parity condition (a condition that holds true in the present context of perfect foresight), the nominal interest rate can be linked to the real interest rate, \( \rho \), and the inflation rate, \( \pi \), as follows:

\[
i_t = \rho + \pi,
\]

(6)

The solution to the maximization problem is obtained by means of Pontryagin’s maximum principle. Setting up the current value Hamiltonian:

\[
H = \{u(c_t) + m_t[A - B \ln(m_t)]\} + \lambda_t[y_t + g_t - c_t - \pi_t m_t] + \lambda_t \rho + \rho \pi
\]

Treating \( c \) as the control variable and \( m \) as the state variable (with \( \lambda \) being the associated costate variable), gives the following first order conditions:

\[
\frac{\partial H}{\partial c} = u'(c_t) - \lambda_t = 0
\]

(8)

\[
\frac{d\lambda_t}{dt} = \lambda_t = -\frac{\partial H}{\partial m_t} + \lambda_t \rho - [(A - B) - B \ln(m_t)] + \lambda_t (\pi_t + \rho)
\]

(9)

Plugging equation (8) into (9) and considering a steady state where \( \frac{d\lambda_t}{dt} \equiv \dot{\lambda} = 0 \) gives:

\[
\ln(m_t) = \frac{A - B}{B} \cdot \left[ \rho + \pi_t \right] \frac{u'(c_t)}{B}
\]

Taking antilogs to (10) yields:

\[
m_t = A e^{-\alpha(t) \left[ \rho + \pi_t \right]} \cdot \frac{A - B}{B} \cdot \alpha(t) \equiv \frac{A - B}{B} \cdot \frac{u'(c_t)}{B}
\]

(11)

3.2. Macroeconomic equilibrium

It is now time to transform this optimizing framework into a macroeconomic model. For that purpose, the following market clearing condition is imposed:

\[
c_t = y_t = y \quad \forall t.
\]

Conceptually, macroeconomic equilibrium can only be achieved if aggregate spending equals aggregate supply at every instant. Plugging this
macroeconomic equilibrium condition back into (11) and redefining the constant term $A$ in such a way that the term involving the discount rate $\rho$ is now a part of a new constant term, $F$, gives the following closed-form solution for money demand:

\[
(12) \quad m_t \equiv \frac{M_t}{P_t} = F e^{-\alpha \pi_t}; \quad F \equiv A e^{-\alpha \rho} > 0; \quad \alpha \equiv \frac{u'(y)}{B} > 0
\]

In other words, Cagan’s money demand (Cagan, 1956) is exactly obtained. Now, normalizing $F$ to unity, taking natural logs to (12), and solving for the rate of inflation

\[
\pi_t = \frac{d\hat{P}}{dt} \quad \text{yields:}
\]

\[
(13) \quad \frac{d\hat{P}}{dt} = \frac{1}{\alpha} [\hat{P} - \hat{M}]
\]

Where a hat sign over a variable denotes the natural log of that variable.

Equation (13) is linear in the logs and can be solved using the integrating factor method. Rewriting (13) to express it in terms of the integrating factor and taking the integral yields:

\[
(14) \quad \hat{P}_t e^{-(1/\alpha)y} + K = -\frac{1}{\alpha} \int_0^t \hat{M}(s) e^{-(1/\alpha)y} ds
\]

Where $K$ is an arbitrary constant of integration, still to be determined.

At this point, modern day macroeconomists’ standard method of solution to the differential equation given by (14) follows a suggestion by Sargent and Wallace (1973), and proceeds by imposing a transversality condition that calls for the limit of the first term in the left hand side of equation (14) to vanish as $t$ approaches infinity. After that, equation (14) is evaluated for $t = 0$, and the constant of integration is thus endogenously obtained. The solution so obtained is indeed very appealing in most contexts where the variable to be determined (typically the price of an asset) can be reasonably assumed to
remain bounded from above. ¹ This is not the case in the present context of hyperinflation. There is no reason to believe that during hyperinflations the price level remains bounded from above. Indeed, the evidence clearly shows that this is not the case (see Cagan, 1956, p. 26, Table 1, and Figures 1 through 7, pp. 28-40). Therefore, a terminal condition as a way to determine the value of $K$ will not be imposed here. Instead, equation (14) is directly evaluated for $t = 0$, which gives: $K = -\hat{P}(0)$. Furthermore, it is also assumed that $\hat{P}(0)$ is exogenously given as of time zero. ² The price level at time zero is thus determined outside the model. This is not a problem in the present context for a few reasons. First, this method is clearly better than the standard alternative in the present context, since the latter involves an assumption (the existence of an upper bound for the price level during hyperinflations) that is easily falsified by all existing empirical evidence. Second, as is shown below, this method of solution highlights the role that different monetary histories play in determining the current price level, the main issue this paper investigates. Moreover, as is shown in page 18, subsection 3. 3., below, the representative agent is assumed to take the predetermined price level as a signal on how costly it is for the government to increase the collection of conventional taxes, with the implication that the price level being a predetermined variable is a reasonable choice in the present context.

Evaluating (14) for $t = 0$ and solving for the (log of) the price level as of time $t$ yields:

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¹ Indeed, Sargent and Wallace proposed this solution in the specific context of models of money and capital (or money and growth models), not in the context of hyperinflationary paths for the price level, despite the fact that they used Cagan’s money demand to motivate their paper. Their use of Cagan’s money demand was a pragmatic choice to assure analytical tractability and simplicity, but it is worth recalling that Sargent and Wallace (1973) were not studying hyperinflationary paths.

² Given the present continuous time setup, the price level is thus a predetermined variable. Further implications from this assumption are discussed in page 18 below.
The first interesting feature worth mentioning about equation (15) is that the second term of the right hand side represents the monetary history of the economy. Given an initial condition for the price level and a given value for $\alpha$, the semielasticity of real money demand with respect to the rate of inflation, the first right-hand side addend implies an exponential trajectory for the price level. Similarly, for given values of the money supply, $\alpha$, and the time periods $s$ and $t$, the second right-hand side addend substracts a constant value from the first addend, and the ‘wilder’ the monetary history of the economy (i.e., the more the money supply has been expanded in the past), the higher the value that is substracted from the first addend. Note in passing that when $s > t$, if the money supply grows at a rate lower than the one implied by the exponential factor $\frac{1}{\alpha}$, the whole second term of the right hand side tends to vanish. Intuitively, the second term of the right hand side is not relevant for countries with monetary histories involving “mild enough” inflationary outcomes.

3.3. The social trade-off

In economies that are in the threshold to hyperinflation, the main public policy trade-off is between the costs of increasing conventional tax collections and the costs associated with seigniorage. Almost every study about hyperinflation emphasizes the crucial role of seigniorage. What is less often emphasized in analytical studies of hyperinflation is that a modern tax system tends to be a missing institution in the economies living through hyperinflation. The taxes in place are either excise taxes expressed in nominal terms, as it was the case in, among other places, Greece in the early 1940s, as stressed by Makinen (1986, pp. 797-99), or taxes on international trade transactions or internationally traded commodities, as in the cases of Bolivia and
Argentina during the mid and late 1980s, respectively. Referring to the case of Greece, Makinen (1986, p. 796) says: “The Greek tax system depended on specific rather than ad-valorem taxes, a shortcoming characteristic of other countries with experience of hyperinflation. The system made it difficult for tax revenue to keep pace with inflation”. Referring to the case of Argentina, Heymann (1991, p.115, Table 4. 3.), reports that during 1989, the year the hyperinflation got started, collections from the income tax were equivalent to 1.2% of GDP, the revenues from the Value Added Tax amounted to 2.3% of GDP, and taxes on foreign trade were equivalent to 3.1% of GDP. See Morales (1988) for the case of Bolivia.

Establishing a well-functioning, modern tax system is socially costly, as shown by the evidence reported in Cukierman et al. (1992), and especially so for countries that live through a hyperinflation, since tax collections cannot increase in any easy way to cover a sudden increase in government expenditures, a point stressed by Makinen (1986), as we have just seen. For instance, Bomberger and Makinen (1983, pp. 804-806) show that for all but 3 months during the Hungarian hyperinflation of 1945-46, less than 10% of expenditures were covered by legislated tax revenues and that figure fell to 5% for the final 2 months of the hyperinflation. They also add (Bomberger and Makinen, 1983, footnote 7, p. 806): “In 1945, approximately 75% of tax revenues came from the turnover tax and from the state monopolies on alcohol and tobacco.”

Furthermore, it can be reasonably argued that the public understands that in the absence of a well functioning tax system, and having exhausted the possibilities to float new debt, federal authorities have to resort to the printing press if there is a sudden need to increase government spending. To overcome the costs of information gathering and processing associated with the direct tracking of the political processes that lead to decisions on the financing of the government’s budget, the public is assumed to take a short-cut by inferring the costs of increasing tax collections for the government from the
information embedded in the price level. In other words, the public observes a reduced-form of the political processes related to the financing of the government’s budget at zero cost: the price level; the higher it turns out to be, the higher the implied costs for the government of increasing tax collections, from the perspective of the representative agent.

The previous discussion motivates the following assumption: the (log of) the cost of increasing tax collections is proportional to the (log of) the price level. Formally:

\[ \hat{C}_t = \hat{\beta} \hat{P}_t; \beta > 0 \]

Therefore, plugging (16) back into (15), we get the following expression for the cost of increasing tax collections:

\[ \hat{C}_t = \hat{\beta} \hat{P}_t - \frac{\beta}{\alpha} \int_0^t \hat{M}(s) e^{-(1/\alpha)(s-t)} ds \]

Notice that according to (17), if the money supply has grown at a rate higher than the rate implied by the exponential factor (1/alpha), then, given the negative sign preceding the second term on the right hand side of (17), the cost of increasing tax collections falls with the intensity at which the money supply has expanded in the past, a crucial insight when trying to rationalize why countries that experienced hyperinflations display substantially lower rates of inflation than similar countries lacking the same experience: hyperinflations act by reducing the social costs of collecting more (conventional) taxes.

4. Discussion

The relevance of the trade-off between tax collections and seigniorage and the consequent need to raise tax collections to stabilize the price level is well-documented, if not always stressed in analytical studies. A few illustrative examples follow.

Referring to the Greek stabilization plan of 1946, Makinen (1986, p. 802) says:
“Concluded on January 24, 1946, it gave top priority to arresting inflation through budget reforms that adjusted the specific tax rates, improved tax collection methods, and increased revenue from the sale of aid goods”

With regard to the Hungarian hyperinflation of 1945-46, Bomberger and Makinen (1983, p. 817) show in their Table 5 how tax receipts were more than doubled between the fiscal years 1946-47 and 1947-48, and referring to the fiscal reforms on the revenue side they add (Bomberger and Makinen, 1983, p. 816):

“A comprehensive reform of the tax system was undertaken. Rates of taxation were raised considerably over those in force prior to the war. Income taxes were imposed at the rate of 2% on incomes exceeding F1,200 (about $100), rising to a maximum of 60% on income from work and 80% on income from property. The maximum rates applied to incomes exceeding F84,000. The gross rent on houses was subject to a tax ranging from 60 to 80 percent. The purchase tax was raised from the pre-war rate of 2-5 percent to 3-10 percent. The company tax had to be paid according to turnover, irrespective of profit. All taxes in arrears were subject to a monthly penalty of 10%”

Sargent (1982) shows a similar pattern for the cases of Austria, Poland, and Germany (See Sargent, 1982, Table 3.5., p. 83 for the case of Austria, Table 3.13, p. 93 for the case of Poland, and Table 3.22., p. 111, for the case of Germany).

For a more recent episode of hyperinflation, Bolivia 1984-85, Morales (1988, p. 326, Table 7. 5.) shows that total tax revenues increased from 1.6% of GDP during the third quarter of 1895, when hyperinflation reached its peak, to 11.3% of GDP during the fourth quarter of 1985, when inflation was stabilized. Morales (1988, p. 318) also describes the reforms on the revenue side of the fiscal package introduced by the government to stabilize inflation. In a similar vein, Artana (2001, p. 21, Table 7) shows that in the case of Argentina, legislated revenues at the national level increased by 25%
in real terms between the years 1991, when the currency board was introduced, and 1992 (the first year inflation fell to low levels). At the provincial level, the increase was even more important: 33% in real terms during the same period. Commenting these developments, Artana (2001, p. 19) adds: “the inflation tax was replaced by consumption taxes and legislated revenues increased by 77% --in constant pesos of the year 2000— between the year 2000 (the year before the collapse of the currency board) and the average for the period 1985-90 (the years of the runaway inflation).”

5. Concluding Remarks

This paper has shown that there is compelling cross-country evidence indicating that hyperinflationary experience is followed by substantially lower rates of inflation than the average long-term rate of inflation prevalent in countries that lack the same experience. The quantitative effect depends, of course, on the composition of the control group, but it is always economically and statistically significant.

A standard representative agent model that has become an essential building block in any graduate-level Monetary Economics class was used to provide a rationale for the empirical result documented in the early parts of this paper. By integrating the differential equation for the rate of inflation “the old-fashioned way” (i.e., by means of an initial condition for the price level, rather than imposing a transversality condition on it), and including the assumption that the cost of increasing conventional tax collections is proportional to the price level, this paper has shown that hyperinflations reduce the social costs of increasing the collection of conventional taxes relative to the collection of seigniorage, an insight that is corroborated by all available evidence stemming from country case studies on how hyperinflations were eventually terminated.

(*) The author wants to thank Francisco Rodriguez for all the useful discussions held on this issue when we were both at the University of Maryland, College Park. All errors and omissions are my own.
References


Table 1: Summary Statistics for Inflation

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<th>Observations</th>
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Robust t statistics in parentheses; ***significant at 1%, ** significant at 5%; * significant at 10%
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Robust t statistics in parentheses; ***significant at 1%, ** significant at 5%; * significant at 10%