Discussion of 'The Conquest of South American Inflation,' by T. Sargent, N. Williams, and T. Zha*

Martín Uribe†
Duke University and NBER

March 25, 2007

This is an excellent paper. It identifies factors explaining episodes of high inflation and inflation stabilization in 5 Latin American countries during the postwar period.

A central finding of the paper, on which I will focus most of my discussion, is that the majority of the observed episodes of hyperinflation were driven by escape dynamics in inflation expectations, or inflation expectations going out of control. Table 1 summarizes this result. The authors identify seven hyperinflations in the data, of which five are estimated to

Table 1: Identified Hyperinflations and Their Sources

Hyperinflation Episode	Escape Dynamics
Argentina 87-91	YES
Brazil 87-91	YES
Brazil 92-95	YES
Chile 71-78	YES
Peru 87-92	YES
Argentina 76-86	NO
Bolivia 82-86	NO

Source: Sargent et al. (2006), table 5.

be driven by escape dynamics in inflation expectations.

The structure of the theoretical model that the authors use in the econometric estimation is extremely simple. It has 3 building blocks: A demand for money that depends only on expected inflation; a budget constraint stipulating that fiscal deficits are fully monetized; and the assumption that inflation expectations are adaptive.

*This discussion was prepared for the IX Workshop in International Economics and Finance organized by the Banco Central de Chile, The World Bank, and Universidad T. Di Tella. Santiago, Chile, March 16-19, 2007. Newer versions of this document are maintained at www.econ.duke.edu/∼uribe.

†Telephone: 919 660 1888. E-mail: uribe@duke.edu.

Within this simple framework, movements in inflation can originate from two sources: innovations in the current fiscal deficit or revisions in expectations. There is no room for any other factor.

In postwar Latin American data, there are many inflationary episodes that are not associated with current changes in the fiscal deficit. Naturally, given the model used to fit the data, all of these episodes are ascribed to escape dynamics in inflation expectations.

The literature on inflation dynamics in Latin America is vast and has identified two major sources of movements in inflation that are unrelated to current innovations in the fiscal deficit. Namely, currency substitution and temporary inflation stabilization. In this discussion, I argue that a fair assessment of the role of escape dynamics must be conducted in the context of a richer model than the one used by Sargent et al. that allows for currency substitution and temporary stabilization. Specifically, I conclude that estimates based on models that do not allow for these elements are likely to deliver biased results that overemphasize the role of escape dynamics in driving hyperinflations in Latin America.

Currency Substitution

Currency substitution is a phenomenon whereby a local, high-inflation currency circulates together with a foreign low-inflation currency. A large empirical literature documents the importance of currency substitution in high-inflation Latin American economies (see, for instance, the survey by Calvo and Vegh, 1996). In the Sargent et al. paper, the demand for money depends only on inflation expectations. Formally,

$$\frac{M_t}{P_t} = L(\pi^e_{t+1}),$$

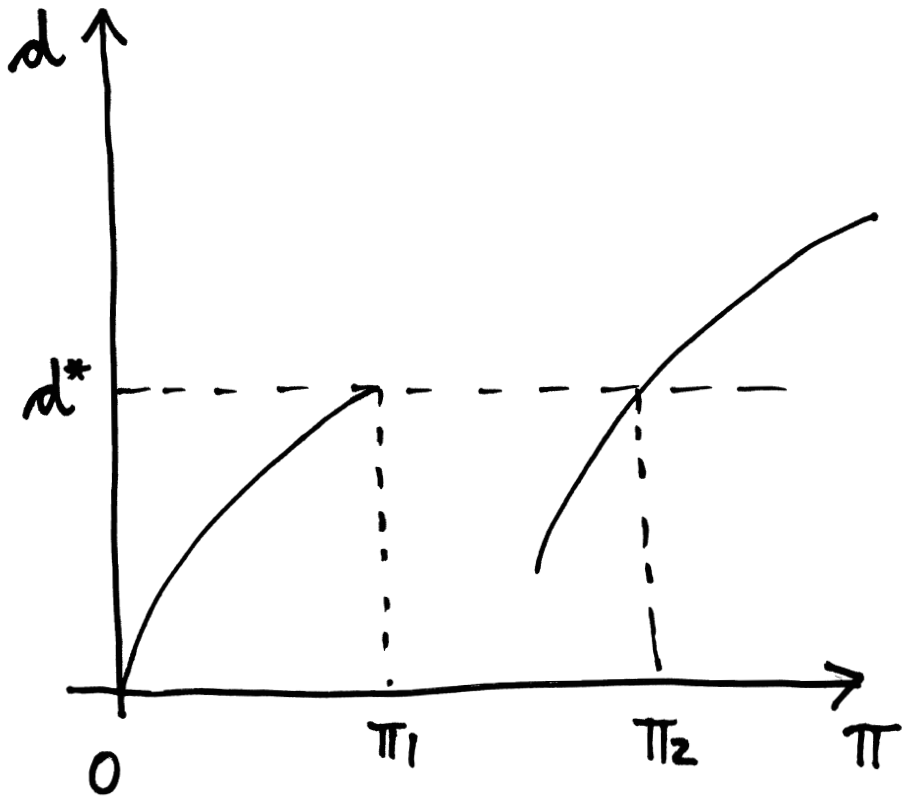
where M_t denotes nominal money holdings, P_t denotes the price level, $\pi_t \equiv P_t/P_{t-1}$ denotes the gross rate of inflation, and π^e_t denotes people's expectation of π_{t+1}, as of period t. Under currency substitution, the demand for money is of the form

$$\frac{M_t}{P_t} = L(\pi^e_{t+1}, k_t),$$

where the variable k_t is a stock of capital. It is not a stock of physical capital or a stock of human capital. It is a stock of network capital. It reflects the fact that there are network effects in the process of currency substitution. In economies where people are not used to transacting in a foreign currency, it is difficult for an individual to perform daily transactions in foreign currency. Think about paying with euros in a shopping mall in Pennsylvania. At the same time, in economies that are used to dealing with foreign currency it is easier for an individual to perform transactions in the foreign currency. It is quite easy, for instance to use dollars to pay for goods and services in Argentina or Peru.

The theoretical literature on currency substitution is concerned with constructing microfounded models of k_t. See, for instance, Uribe (1997) and the references therein. I will not spell out the structure of this class of models here. It suffices for the purpose of this discussion, to describe the relationship between inflation and seignorage revenue that emerges from this family of models. I do so with the help of figure 1. When the stock of network

Figure 1: Seignorage Revenue and Inflation Under Currency Substitution



capital is nil, there is a standard relation between inflation and the fiscal deficit, d_t, that can be financed by printing money. This normal relationship holds for fiscal deficits below d^* and inflation rates below π_1. In this range, the higher is the inflation rate, the higher is the amount of deficit that can be monetized. There is a threshold level of deficit, d^*, beyond which the economy begins to dollarize. That is, the network capital k_t begins to build up. At this point the function relating inflation and seignorage revenue shifts to the right. As the economy dollarizes, the inflation rate rises, from a low level π_1 to a high level π_2 (or, depending on parameter values, from a high level to a hyperinflationary) level, even if the fiscal deficit remains relatively stable around d^*. The transition from π_1 to π_2 takes time. During this transition, there is a clear disconnect between the fiscal deficit and the inflation rate.

Now suppose that an econometrician estimates a mispecified model that ignores currency substitution. How is the econometric technique going to handle situations like the one just described in which the inflation rate increases from π_1 to π_2 with the fiscal deficit relatively constant? Because the increase in inflation is not associated with a significant rise in current fiscal deficits, the inflationary episode will be ascribed to expectations going out of track. It

is in this sense that I claim that ignoring the presence of currency substitution is likely to create a bias toward overemphasizing the importance of escape dynamics.

Two hyperinflationary episodes that are in the Sargent et al. escape-dynamics list are poster cases for studying currency substitution: namely, Peru and Argentina in the early 1990's. In this episodes, dollarization was particularly acute, reducing the demand for local currency to unprecedented low levels. My conjecture is that if currency substitution was taken properly into account, the Peruvian and Argentine hyperinflations of the early 1990's would drop from the Sargent et al. escape-dynamics list.

Temporary Inflation Stabilization

In the Sargent et al. paper, the government budget constraint takes the form

$$\frac{M_t - M_{t-1}}{P_t} = d_t,$$

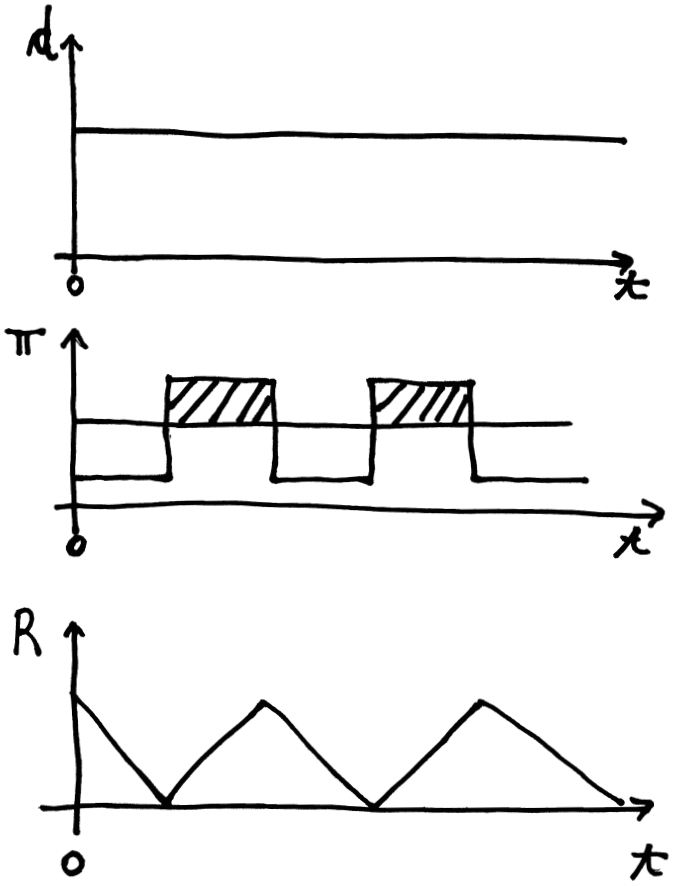
which asserts that fiscal deficits are fully monetized on a period-by-period basis. In reality, Latin American governments tend to use foreign reserves to control the fraction of the fiscal deficit that is monetized. This policy is often referred to as 'temporary inflation stabilization.' The seminal works of Krugman (1979) and Calvo (1986), mark the beginning of a large theoretical and empirical literature aimed at ascertaining the macroeconomic consequences of temporary stabilization programs . When foreign reserves are taken into account, the government budget constraint becomes

$$\frac{M_t - M_{t-1}}{P_t} = d_t + R_t - R_{t-1},$$

where R_t denotes the stock of foreign reserves held by the government at the end of period t. In the high-inflation decades of the 1970's and 1980's, the typical Latin American country can be described as being in one of two modes: the stabilization mode or the reserve buildup mode. In the stabilization mode, the government does not print money to finance the fiscal deficit, so the left-hand side of the budget constraint is zero. Instead, the deficit is financed with foreign reserves, which fall while the country is in stabilization mode. By contrast, in the reserve buildup mode, the government prints money not only to finance the deficit but also to rebuild its stock of foreign reserves. When the country is in this mode, therefore, the rate of inflation is above the level necessary to finance the fiscal deficit, as the government is generating extra seignorage revenue to rebuild the stock of foreign reserves. The appendix presents a model of repeated temporary stabilizations which nests the Sargent et al. (2006) model as a special case.

Figure 2 illustrates the dynamics of inflation under temporary stabilization. There is a constant deficit shown in the top panel. The middle panel shows two paths for inflation. A constant path, high enough to finance the fiscal deficit, and a nonconstant path followed by a government that engages in temporary stabilization. The government constantly switches from the stabilization mode to the reserve-buildup mode. In periods of inflation stabilization, the inflation rate is low and the government looses foreign reserves (bottom panel). In periods of reserve buildups, the inflation rate is above the level necessary to finance the deficit and

Figure 2: Temporary Inflation Stabilization



the stock of foreign reserves grows over time. During this periods, there is a disconnect between inflation and the level of fiscal deficits. This disconnect is graphically represented by the shaded boxes.

What are the implications of temporary stabilization for the results reported in the Sargent et al. paper? Suppose that an econometrician estimates a mispecified model that ignores the presence of temporary stabilization. How is the econometric technique going to handle the shaded boxes? Because these boxes represent inflationary episodes that are unrelated to the current level of deficits, they will be ascribed to escape dynamics in inflation expectations, that is, to inflation expectations going out of control. It is in this sense that I claim that not taking into account the presence of temporary stabilization introduces a bias toward overemphasizing the role of escape dynamics in inflation expectations.

One possible reaction to my comment on temporary inflation stabilization might be to point out that the Sargent et al. paper does take into account temporary stabilization. Namely, the policy that the authors call cosmetic stabilization. The temporary stabilizations illustrated in figure 2 are, however, fundamentally different from the cosmetic stabilizations of Sargent et al. For the temporary stabilization episodes shown in figure 2 are costly and

paid for by the government. The cost of temporary stabilization is given by the shaded boxes. These boxes represent the extra inflation tax necessary to rebuild the stock of foreign reserves, which, in turn, is used to finance the next temporary stabilization program. The cosmetic stabilizations of Sargent et al. are not paid for, and as a result do not give rise eventually to inflationary episodes that are disconnected from the current level of the fiscal deficit. My comment on temporary stabilization can be interpreted as suggesting a proper model of cosmetic stabilizations.

Adaptive Expectations

One building block of the Sargent et al. model is the assumption of adaptive expectations, as in Cagan's celebrated study of the eastern European hyperinflations of the first half of the twentieth century. A clear message that emerges from Cagan's work is that adaptive expectations is a good assumption for predicting money demand during hyperinflations, except at the final stage of these episodes. This assertion is clearly illustrated in figure 3, which reproduces figure 9 from Cagan's study. It plots expected inflation on the vertical axis and real money balances on the horizontal axis during the German hyperinflation. The solid line is the demand for money as estimated by Cagan using least squares. This line fits well the cloud of data points, with the exception of the four months prior to the end of the hyperinflation (August, September, October, and November 1923). Cagan leaves these points out of the regression. These four points, show that at the last stage of the German hyperinflation people were holding much more money than would be stipulated by the estimated money demand function.

Cagan advances an explanation of the unfitted four data points in the following terms:

> "In hyperinflation, rumors of currency reform encourage the belief that prices will not continue to rise rapidly for more than a certain number of months. This leads individuals to hold higher real cash balances than they would ordinarily desire..." Cagan (1956), p. 55.

In this quote, Cagan explains the outliers by arguing that money holdings in those four months were driven by rumors of future currency reform. This explanation clearly suggests that in Cagan's view, at the end game of hyperinflations the assumption of forward-looking expectations works better than the assumption of adaptive, or backward-looking expectations. This is reasonable, because the end of hyperinflations are necessarily associated with drastic changes in policy regime. So past inflation rates provide little information about future movements in prices.

Because the Sargent et al. model is essentially the Cagan model, one cannot help but wonder whether the former also does a poor job at explaining the end of hyperinflations.

Conclusion

The Sargent et al. paper is an important contribution because it calls attention to the empirical plausibility that hyperinflations may be driven by inflation expectations going

Figure 3: Cagan's Nightmare

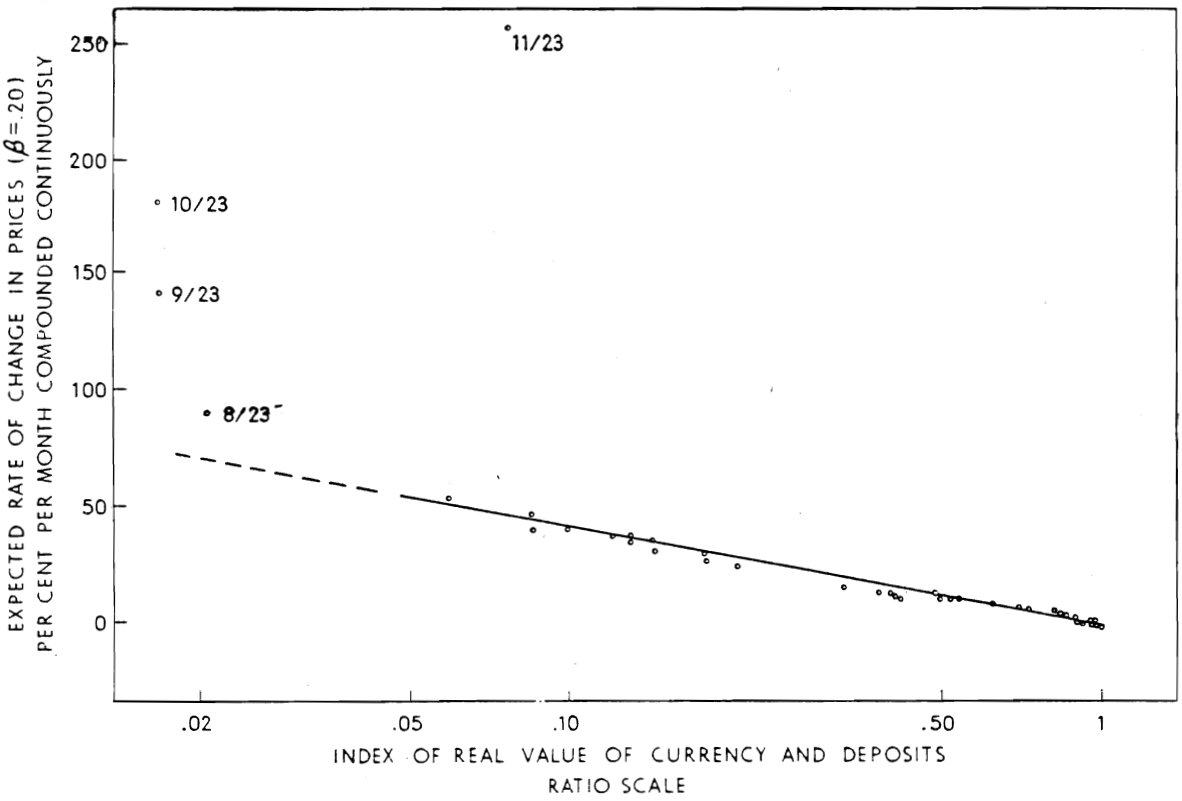


FIG. 9.—Germany—scatter diagram of mid-month expected rates of change in prices and indexes of real value of hand-to-hand currency and bank deposits, and regression line ($\alpha = 5.46$), September, 1920, to November, 1923. (Points excluded from calculation of regression line are dated.)

Note: Reproduced from Cagan (1956)

out of control (escape dynamics). However, a fair assessment of the empirical relevance of escape dynamics must be conducted in the context of a richer framework that includes other empirically relevant drivers of inflation, such as currency substitution and temporary stabilization programs.

Appendix: A Model of Repeated Temporary Stabilization

The money demand is of the form

$$\frac{M_t}{P_t} = L(\pi^e_{t+1}).$$

The government's budget constraint is given by

$$M_t - M_{t-1} = d_t P_t + (R_t - R_{t-1})P_t.$$

The monetary regime is defined by an endogenous state variable s_t, which takes the value 1 when the government is engaged in a stabilization program and 0 otherwise. Stabilization programs consist in pegging the price level (or, equivalently, in this simple model, the exchange rate). When the government is not engaged in a stabilization policy, it prints enough money to finance the fiscal deficit and to rebuild foreign reserves by μ_t units per period, where μ_t is an exogenous random variable. Formally,

$$\begin{array}{ll} \text{if } s_t = 1 \Rightarrow \frac{P_t}{P_{t-1}} = 1 & \text{(currency peg)} \\ \text{if } s_t = 0 \Rightarrow M_t - M_{t-1} = (d_t + \mu_t)P_t & \text{(money-growth rule)} \end{array}$$

The evolution of the stabilization state s_t is given by the following law of motion

$$R_{t-1} \leq R^L \quad \Rightarrow \quad s_t = 0$$

$$R_{t-1} \geq R^H \quad \Rightarrow \quad s_t = 1$$

$$R^L < R_{t-1} < R^H \quad \Rightarrow \quad s_t = s_{t-1},$$

where R^L and R^H are exogenous parameters (or possibly exogenous random variables). Finally, we close the model by assuming, as in Sargent et al. (2006), that inflation expectations are adaptive,

$$\pi^e_{t+1} - \pi^e_t = \epsilon(\pi_{t-1} - \pi^e_{t-1}).$$

Special Case: The Sargent et al. (2006) Model

This model nests the Sargent, Williams, Zha (2006) model. Formally, the Sargent et al. model obtains in the following special case:

$$R_{-1} < R^L$$

$$\mu_t = 0.$$

That is, the initial stock of reserves, R_{-1}, is too low for the government to launch a stabilization program. And because the government does not engage in rebuilding the stock of foreign reserves, $\mu_t = 0$, a stabilization program is never implemented.

References

Cagan, P., "The Monetary Dynamics of Hyperinflation," in M. Friedman editor, *Studies in the Quantity Theory of Money,* University of Chicago Press, Chicago, IL, 1956.

Calvo, G.A., "Temporary Stabilization: Predetermined Exchange Rates," *Journal of Political Economy,* 94, 1986/ 1319-1329.

Calvo, Guillermo A. and Carlos A. Végh, "From Currency Substitution to Dollarization and Beyond: Analytical and Policy Issues," in Guillermo Calvo, *Money, Exchange Rates, and Output,* The MIT Press, Cambridge, Massachusetts, 1996, 153-176.

Krugman, P.R., "A Model of Balance of Payments Crises," *Journal of Money, Credit and Banking,* 11, August 1979/ 311-325

Sargent, T., N. Williams, and T. Zha, "The Conquest of South American Inflation," NBER working paper No. 12606, October 2006.

Uribe, M., "Hysteresis in a Simple Model of Currency Substitution," *Journal of Monetary Economics,* September 1997, 40, 185-202.