

Federal Reserve Bank of Cleveland

# Money Demand and Inflation in Peru, 1979–91

by Jaime Pedro Ventura

**In this essay, Jaime Ventura explores the factors that affected Peruvians' money demand during a terrible period of hyperinflation and considers whether the government caused the hyperinflation by printing too much money to gain seigniorage revenue. Hyperinflations seem to be a problem most countries have learned to avoid. But many economies have emerged recently whose leaders face tough financial challenges. Generating revenue by overprinting currency to meet fiscal expenses is temptation that some find hard to resist. Now is a good time to recollect hyperinflation's devastating consequences and its causes.**

The demand for money during periods of extreme inflation is a monetary phenomenon that has drawn the attention of many economists during the twentieth century. This facet of monetary economics is of particular interest because of the consequences associated with holding money that can, literally, lose value by the minute.

Latin America has afforded several opportunities to investigate how hyperinflation affects money demand. While Latin America as a whole has suffered from the effects of high inflation since the 1970s, severe episodes of hyperinflation have transpired in Argentina, Bolivia, Brazil, and Peru.

This paper examines the particular circumstances surrounding the demand for money during the hyperinflationary experience in Peru between 1979 and 1991. During the 1980s, annual inflation rates in Peru seldom fell below 50 percent, and between 1988 and 1990, inflation rates skyrocketed uncontrollably, peaking in 1990 with annual inflation rates upwards

of 10,000 percent. Studying this episode helps us understand the causes of these very destructive phenomena.

## ■ Inflation and Money Demand

The relationship between inflation and the demand for money has been investigated extensively, and several studies have focused on money demand during periods of hyperinflation. Perhaps the most famous is Cagan's 1956 study of the inflationary circumstances in the countries of post–World War II Europe, including Germany, Austria, Hungary, Greece, Poland, and Russia.<sup>1</sup>

Economic theory maintains that an individual's demand for real money balances depends on variables such as wealth in real terms, real income, and the expected return on each asset that holds his wealth (on average, the nominal interest rate). Cagan finds that in times of hyperinflation, because the fluctuation in prices is so extreme, the rate of inflation becomes the most important determinant. In general, in the countries Cagan studied, the demand for real money balances tended to decline as inflation rates increased.

Asilis, Honohan, and McNelis (1993) provide a similar study of hyperinflation and money demand in another Latin American country, Bolivia.<sup>2</sup> Between 1980 and 1985, Bolivia experienced inflation comparable to that of Peru. These authors examine this five-year period of hyperinflation—in which Bolivian inflation rates reached nearly 20,000 percent—and the three-year stabilization period that followed. As in the Cagan study, money demand depended on the inflation rate during the Bolivian hyperinflation, but two other factors were also involved—the degree of uncertainty that people felt about future inflation, and the amount of money they had held in the previous period.

## Essays in Economics

The Federal Reserve Bank of Cleveland sponsored its first annual undergraduate economics essay competition in 2000. Jaime Ventura, a junior at Bowling Green State University in Ohio at the time he entered the competition, wrote the winning essay, which we reprint here.

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## ■ Money Demand during Peru's Hyperinflation

What determined the amount of money people held in Peru during the hyperinflation of 1979 to 1991? To answer this question, I designed an econometric model to estimate money demand for Peru during these years. The model tests the influence of three factors on the demand for real money balances: income, the inflation rate, and the quantity of real money balances held during the previous period. The inflation rate is used instead of the nominal interest rate suggested by the traditional theory because quarterly interest rates are unavailable for Peru during the period investigated.<sup>3</sup> Data used for this study were obtained from the International Monetary Fund's *International*

*Financial Statistics.* Measures of money (the reserve base and M1), the Consumer Price Index (CPI), and real GDP were all taken from this source.

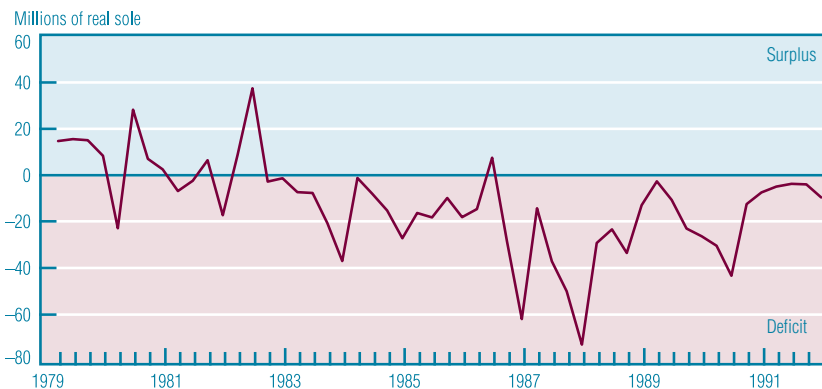
The model provides results that are consistent with earlier studies of the demand for money during times of extreme inflation. The inflation rate was related negatively to the demand for money. That is, as inflation rose, money demand fell. This is not surprising. As inflation increases, the cost of holding money increases. People respond by shedding themselves of currency, which drives up prices even further.

The model also shows that a change in the inflation rate caused only a small (although significant) decline in real money balances over the short term (that is, over a three-month period). The model suggests that a 10 percent change in the inflation rate (for example, from 10,000 percent to 11,000 percent) resulted in a decline in the demand for real money balances of 1.04 percent.<sup>4</sup> This makes sense because most Peruvians during this time did not have the luxury of easily exchanging their currency for some other interest-earning asset. Eventually, however, people have more flexibility with respect to the form in which they hold their money—or whether they hold their assets in terms of money at all. So over the long term, the relationship between inflation and the demand for real money balances, while remaining negative, should become more elastic, or responsive to change.

As for the relationship between the demand for money and income, the model shows that it was positive during this period, as economic theory predicts—as people’s income increased, they held more money. However, this relationship was not statistically significant. This result is consistent with Cagan’s claim that the inflation rate becomes the most important determinant of money balances in times of hyperinflation.

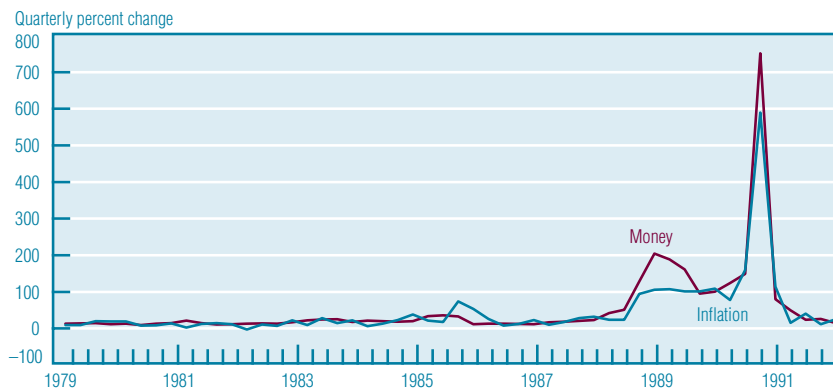
The final variable considered was real money balances held in the previous period. The model indicates a positive relationship between the demand for money and this variable, which is statistically significant. The reason may be that individuals require time to adjust their money holdings as the inflation rate changes. There is, therefore, some persistence in holding real money balances.<sup>5</sup>

**FIGURE 1: PERU’S FEDERAL BUDGET BALANCE, 1979–1991**



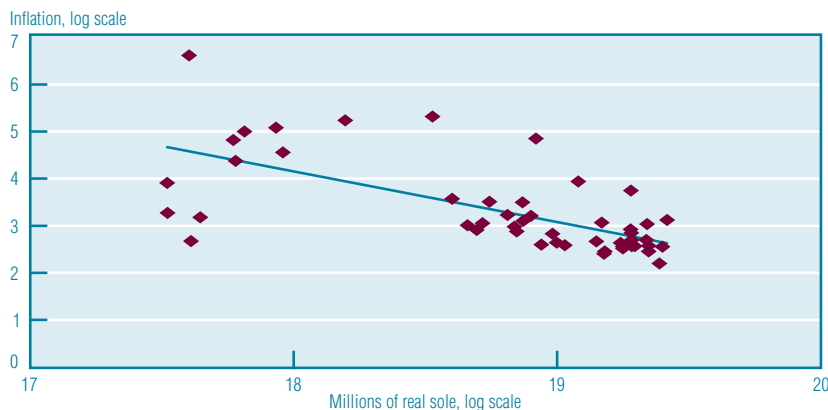
SOURCE: International Monetary Fund, *International Financial Statistics*.

**FIGURE 2: MONEY AND INFLATION RATE CHANGES IN PERU, 1979–91**



SOURCE: International Monetary Fund, *International Financial Statistics*.

**FIGURE 3: ESTIMATED MONEY DEMAND FOR PERU, 1979–91**



SOURCE: International Monetary Fund; and author’s calculations, *International Financial Statistics*.

■ **Seigniorage: The Cause of Peru’s Hyperinflation?**

When a country, particularly one without a high level of economic or political stability, needs to generate revenue to pay for programs or to finance a large debt, an

enticing option is to simply print currency. Printing currency earns a government revenue because once printed, the government can exchange it at its full face value for goods and services. The difference between the value of the

products and services that a government can buy with the money it prints and the cost of printing it is known as seigniorage. For example, it costs the United States about \$.04 to print a \$1 bill, but the bill can be used to purchase \$1 worth of goods. Those goods, then, actually cost the government only \$.04, and \$.96 has accrued to the government in the value of the goods it purchased.

Unfortunately, printing too much money causes inflation.<sup>6</sup> When inflation rises, the money people hold loses purchasing power. A dollar cannot buy as much as it used to buy. So seigniorage, in effect, imposes a tax on those who hold currency. While there is no formal tax paid to anyone, when the government prints too much money, people carrying cash pay a “tax” in the sense that their purchasing power decreases, while the government’s increases. The “tax rate” is the rate of inflation.

Inflation has a number of consequences for society. The repercussions seem particularly harsh for the poor, as the purchasing power of the little money they have diminishes even more. In Peru during its hyperinflationary period, the value of money sank so low in some instances that a loaf of bread cost a full week’s wages. Furthermore, when inflation gets too high, people try to find other means of conducting transactions, which are less efficient than using money, and market transactions become more difficult to conduct. For example, people may resort to bartering.

In the case of Peru, it appears likely that seigniorage may have been at the root of the nation’s inflationary problems. Quarterly budget data for Peru between 1979 and 1991 demonstrate that the country maintained a budget deficit for the majority of this period (see figure 1). During the same time, the money supply began to grow more rapidly (see figure 2). Around 1989, the money supply began to increase at an astronomical rate.

As figure 2 shows, just as money supply growth surged, inflation rates exploded, not coincidentally, around 1990. The inflation rate during this period of extreme inflation actually exceeded the money-supply growth rate. This reflects the fact that real money balances fell during the hyperinflation.

The model also provides some support for the claim that the government caused the hyperinflation by overprinting

currency to reap the seigniorage revenue. Recall that seigniorage can be viewed as imposing an inflation tax on money holders. The revenue that the inflation tax can generate is equal to the rate of inflation, multiplied by the real value of money balances (the “tax base”). But as inflation increases, the “tax base” shrinks. If real money balances decline more than inflation (the “tax rate”) rises, then printing more currency will actually reduce seigniorage. That is, a point will be reached after which printing more money to raise revenue is counterproductive.

Was such a point reached in Peru during its years of hyperinflation? The results achieved in this study indicate that it was not.<sup>7</sup> It is the coefficient, or the elasticity, of the inflation variable that suggests so. Because it was less than 1 (it was  $-0.104$ ), printing money was still generating seigniorage. Therefore, increasing money growth to pay for high budget deficits could have been a rational (although very costly) thing for the government to do. This supports the claim that the government was indeed printing currency because it was after the seigniorage revenue, and this caused the hyperinflation.

### ■ Conclusion

The economic atmosphere in Peru during the 1980s was one of great uncertainty and instability. The goal of this study was to observe the effects of hyperinflation on the demand for money. This is a preliminary study, and surely there are ways the model could be improved and some problems that currently exist could, in the future, be resolved.<sup>8</sup> Still, the overriding conclusion that can be taken from this study is that, in spite of all of the economic instability, a relatively stable demand curve, presented in figure 3, can be estimated for Peru during this 13-year period.<sup>9</sup> The case of Peru supports the traditional economic theory of hyperinflation and the demand for money.

### ■ Footnotes

1. Phillip Cagan, “The Monetary Dynamics of Hyperinflation,” *Studies in the Quantity Theory of Money*, Chicago: University of Chicago Press, 1956, pp. 25–117.
2. Carlos M. Asilis, Patrick Honohan, and Paul D. McNelis, “Money Demand during Hyperinflation and Stabilization: Bolivia, 1980–88,” *Economic Inquiry*, vol. 31, no. 2 (April 1993), pp. 262–73.

3. The model takes the form  $\ln(M/P)_t = \beta_0 + \beta_1 \ln(\pi_t) + \beta_2 \ln(Y_t) + \beta_3 \ln[(M/P)_{t-1}] + \mu_t$ , where  $M/P$  is real money balances for period  $t$ ,  $\pi$  is the inflation rate for period  $t$ ,  $Y$  is real gross domestic product (GDP) used as a measure of income for period  $t$ ,  $\ln(M/P)_{t-1}$  is real money balances held from the previous period, and  $\mu_t$  is the error term. By logging both the left and right sides of this equation, the coefficients take on the interpretation of elasticities, or percent changes. For example,  $\beta_2$  measures the percent change in real money demand resulting from a 1 percent increase in real income.

4. The coefficient for the inflation variable is  $-0.104$  and is statistically significant at the 0.05 level. Since the coefficient can be interpreted as an elasticity (see footnote 1), this value indicates that when the inflation rate increases by 1 percent, the demand for real money balances decreases 0.104 percent.

5. The coefficient for the lagged variable, real money balances held in the previous period, is estimated to be 0.891 and is statistically significant at a 0.05 level of significance. The coefficient for this variable is somewhat high and could indicate the absence of an additional variable that could have made this model better (such as the uncertainty variable used by Asilis et al.—see footnote 2).

6. This is an almost universally accepted claim of economic theory. Empirical studies also lend evidence to the claim. See, for example, Gregory N. Mankiw, *Macroeconomics*, New York: Worth Publishers, 1997. Mankiw writes that Milton Friedman and Anna J. Schwartz, in *A Monetary History of the United States, 1867–1960*, Princeton, N.J.: Princeton University Press, 1963, and in *Monetary Trends in the United States and the United Kingdom: Their Relation to Income, Prices, and Interest Rates, 1867–1975*, Chicago: University of Chicago Press, 1982, demonstrate clearly that countries with higher rates of money growth also have higher inflation rates.

7. This result is that the inflation elasticity of money demand (typically referred to as the interest rate elasticity of money demand) was negative. The point at which printing excess money begins to reduce seigniorage is when the inflation elasticity is greater than 1.

8. The adjusted  $R^2$  appears to be somewhat high and could indicate a problem with autocorrelation, especially since the model uses time-series data. Typically, a Durbin–Watson test could be utilized to test for autocorrelation; however, because there is a lagged independent variable in the model, this test is no longer applicable. Some conclusions may be drawn by observing a graph that plots the residuals over time. Upon viewing such a graph, it appears that the residuals are scattered randomly, indicating that the problem is unlikely autocorrelation. A further possibility is that the model could have a problem with cointegration, considering that the coefficient is close to 1, which

would indicate unit elasticity. One could test for cointegration by performing a Dickey–Fuller unit root test, but that is beyond the scope of this study. Furthermore, according to Peter Kennedy (*A Guide to Econometrics*, Cambridge: MIT Press, 1998), differencing the data can sometimes cause the loss of valuable economic information. Hence, the model was left in its original form, understanding that this is a preliminary study and that the possibility of errors does in fact exist.

9. The adjusted  $R^2$  for this regression model is 0.965, suggesting that the model provides an excellent fit to the data. The F-test also reflects that the regression model is a good fit to the data. At a 0.05 level of significance, the F-statistic of 476.588 falls within the rejection region. Hence, the result of the F-test is to reject the null hypothesis, which asserts  $R^2$  is equal to zero.

*Jaime Pedro Ventura is a senior at Bowling Green State University. He wishes to thank Mary Ellen Benedict and Timothy Fuerst, both assistant professors at Bowling Green State University, for their assistance to him in preparing this essay.*

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