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The Impact of Banking Crises on Money Demand and Price Stability

MARIA SOLEDAD MARTÍNEZ PERÍA*

This paper empirically investigates the monetary impact of banking crises in Chile, Colombia, Denmark, Japan, Kenya, Malaysia, and Uruguay during 1975–98. Cointegration analysis and error correction modeling are used to research two issues: (i) whether money demand stability is threatened by banking crises; and (ii) whether crises lead to structural breaks in the relation between monetary indicators and prices. Overall, no systematic evidence that banking crises cause money demand instability is found. However, the results on price stability are mixed; for three out of the seven countries, there appears to be evidence of instability. [JEL E41, E31, C22]

Recent studies reveal that over the last two decades more than 120 countries experienced some kind of systemic or nonsystemic banking crisis.[1] Systemic episodes typically refer to periods of pervasive bank unsoundness coupled with significant bank runs (or other substantial portfolio shifts), deposit freezes, bank holidays, collapses of financial firms, and/or massive government interventions. Nonsystemic crises refer to periods of extensive bank unsoundness that did not result in any of the events described above.

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[1]See Caprio and Klingebiel (1999), and Lindgren, Garcia, and Saal (1996).

Banking crises have the potential to complicate the conduct of monetary policy for a number of reasons. First, these episodes may destabilize money demand and money multipliers. Second, crises may diminish the effectiveness of monetary instruments. Third, crises may affect the relation between prices and monetary indicators—the variables that help monetary authorities monitor and explain the behavior of prices (e.g., monetary aggregates, interest rates, exchange rates, etc.). Finally, crises may ultimately reduce the government's ability to achieve its inflation objective.

A number of factors may cause money demand to become unstable during banking crises. Lack of confidence in the banking sector may cause individuals to withdraw their deposits from banks and to hold other financial assets instead (like government bonds) or even real assets. When banking crises are coupled with currency crises (and especially if dollar deposits are not accepted in local banks), individuals may prefer to hold foreign currency instead. Such portfolio shifts may give rise to money demand instability. It is also possible that banking crises may lead banks themselves to curtail the growth of their assets and their liabilities. For example, if banks are saddled with nonperforming loans, and consequently choose to limit the amount of loans they make, the growth of deposits may change drastically simply as a result of a slowdown in the growth of assets, even if banks do not experience runs on deposits. In this case too, the behavior of broad money (M2) may become unstable as a result of crises.

Banking crises may affect the relation between prices and monetary indicators in a number of ways. Money demand instability may cause monetary aggregates to become unreliable indicators of price behavior. Market segmentation between sound and unsound banks may make interest rate signals misleading, since they could reflect liquidity or solvency problems at particular banks, instead of the overall tightness in the banking system. Also, during crises, the growth of bank credit may become more dependent on bank capital levels than on the monetary policy stance. In general, the transmission of monetary policy through the money supply and interest rates may be distorted by illiquid or insolvent banks' inability to adjust their reserves or lending to monetary policy actions and by their diminished sensitivity to interest rate changes.

Despite the potential adverse impact of banking crises on monetary policy implementation, this issue has not received much attention in the recent banking crisis literature.[2] Lindgren, Garcia, and Saal (1996), Garcia-Herrero (1997), and Khamis and Leone (2001) are exceptions. The first two studies present anecdotal accounts of the monetary impact of banking crises in a sample of countries. However, they do not examine the consequences of crises in a systematic empirical manner.[3] On the other hand, Khamis and Leone (2001) present a thorough

[2]For studies that examine the determinants of banking crises see Caprio and Klingebiel (1996, 1999), Demirgüç-Kunt and Detragiache (1998), Eichengreen and Rose (1998), Goldstein and Turner (1996), Kaminsky and Reinhart (1998), and Lindgren, Garcia, and Saal (1996).

[3]Garcia-Herrero (1997) conducts a Johansen-type cointegration analysis to study long-run money demand stability in Argentina, Estonia, Latvia, Lithuania, Paraguay, Philippines, and Venezuela. However, she warns that her analysis is incomplete, and her sample is too short. Short-run money demand dynamics are also ignored. Lindgren, Garcia, and Saal (1996) cite evidence found by Sundararajan and Baliño (1991) that broad money demand intercepts and interest rate elasticities change during banking crises. However, their analysis does not contemplate issues like cointegration and error correction modeling, so it is unclear whether the equations they base their results on are well specified.

empirical analysis of the issue, but focus only on the question of money demand stability during the 1994 financial crisis in Mexico.

In the same way that the recent literature on banking crises has largely neglected to study the monetary consequences of these episodes, existing studies on money demand and price behavior have not examined the impact of these crises either. Baba, Hendry, and Starr (1992), Ericsson, Hendry, and Prestwich (1998), and Ericsson and Sharma (1998) are some of the most notable examples of money demand models. These studies: (*i*) address the potential nonstationarity of the variables that explain money demand; (*ii*) build error correction models that control for cointegrating relations among the variables included; and (*iii*) test for the constancy of the model parameters over periods of financial innovation and liberalization.

Regarding the behavior of prices, there is a vast empirical literature on the "information content" of monetary indicators.[4] This literature analyzes the marginal explanatory power of the variables included in the price equations, over different periods. For example, a number of studies for the U.S. have examined whether the information content of money (i.e., its ability to explain prices) has fallen over time as a result of financial liberalization and innovation, but not financial crises. Furthermore, these papers have largely ignored issues of stationarity, cointegration, and parameter stability.

Recently some empirical studies have identified stable price equations for a number of countries, using cointegration analysis and error correction modeling. For example, De Brouwer and Ericcson (1998), Durevall (1998), and Juselius (1992), obtain well specified, constant models for prices in Australia, Brazil, and Denmark, respectively, over the last three decades. Neither these papers nor the money demand studies, however, examine the impact of banking crises on the behavior of prices and the demand for money.

This paper conducts an empirical analysis of the monetary effects of banking crises. In particular, it concentrates on two issues. First, the paper evaluates the claim that money demand stability is threatened by the occurrence of banking crises. It focuses on M2, since the demand for narrow money is more likely to be affected by financial innovation and deregulation, events that can themselves lead to instability. Secondly, the paper analyzes the relation between monetary indicators and prices and tests whether crises lead to structural breaks.

Given that crises have become pervasive in recent decades, understanding their impact on money demand and prices is becoming increasingly important. Furthermore, the stability of money demand and price equations is relevant both from a statistical and economic standpoint. Constancy is required to ensure the validity of other statistical tests performed. More fundamentally, models that fail parameter constancy tests cannot be used for forecasting or for analyzing economic policy. Furthermore, a model can have a high R^2, signaling that the information content of a variable or group of variables is high, yet it may still be nonconstant and, therefore, unreliable. Thus, whether money demand models and

[4]See Baumgartner and Ramaswamy (1996), Baumgartner, Ramaswamy, Zettergren (1997), Davis and Henry (1994), Friedman and Kuttner (1992), Hostland, Poloz, and Storer (1987), Sims (1980), Stock and Watson (1989), among others.

price equations are stable over time is a more relevant question for policymakers than whether the information content of certain monetary indicators varies over different samples. As long as money demand and price equations remain stable over crisis periods, policymakers can continue to rely on the precrisis models to forecast the behavior of these variables and to analyze the impact of different policies adopted during or after crises.

Focusing on the experience of seven countries over the period from 1975 to 1998, this study analyzes the monetary consequences of banking crises in Chile (1981–87), Colombia (1982–88), Denmark (1987–92), Japan (1992–98), Kenya (1985–89 and 1992–95), Malaysia (1985–88), and Uruguay (1981–85). The dates in parentheses correspond to the periods identified by Caprio and Klingebiel (1996) and Lindgren, Garcia, and Saal (1996) as banking crisis episodes.

The sample in this paper is restricted to only seven countries due to data constraints and because the detailed empirical methodology pursued makes it difficult to implement this approach for a larger number of countries. Though limited, this sample is diverse in that it covers a number of geographical regions, focuses on countries with banking sectors of different sizes, and includes both developing and developed countries.[5] Developing countries tend to be more volatile than developed countries, and governments in the former set of countries usually have fewer policy tools at their disposal.[6] Thus, it is interesting to study whether there are systemic differences in the monetary impact of crises across these groups of countries.

For each country, cointegration analysis and error correction modeling are used to obtain appropriate dynamic specifications for money and prices. Parameter constancy tests are conducted on the estimated money demand equations to study whether money demand becomes unstable during crisis periods. Finally, parameter constancy tests are also performed to determine whether crises cause structural breaks in the relation between prices and monetary indicators.

With the exception of Uruguay, no systemic cross-country evidence is found that banking crises cause money demand instability in the sample.[7] Also, the paper finds that money, exchange rates, foreign prices, and domestic interest rates are significant indicators of price behavior, even during crisis periods. Finally, the results on price stability are mixed. While most of the coefficients in the price equations are not affected by banking crises, for three of the seven countries, evidence of instability (primarily variance nonconstancy) is found in these equations.

[5]As measured by the proportion of banking sector assets to GDP in the five years prior to the banking crises, the banking sectors in the seven countries ranked as follows in size: Japan (128 percent), Denmark (56 percent), Malaysia (51 percent), Uruguay (24 percent), Kenya (23 percent), Chile (18 percent), and Colombia (13 percent). These estimates come from Beck, Demirgüç-Kunt, and Levine (1999).

[6]In general, developing countries have a harder time borrowing in international markets, are constrained by large deficits, and are less capable of exercising monetary independence (see Calvo and Reinhart, 2000).

[7]Khamis and Leone (2001) find a similar result for the demand for currency money in Mexico.

I. An Anatomy of the Crises Under Study

This section presents a summary of the causes, scope, and monetary impact of the banking crises under study.[8] In particular, it focuses on the salient features of these crises, trying to draw similarities across countries where appropriate and to highlight differences when these are significant.

Causes

Most of the crises studied coincided with business cycle downturns brought about by external and/or internal factors. In all cases, the deterioration in economic conditions severely weakened the health of the financial institutions in these countries, precipitating the banking crises that followed.

In Chile, for example, following five years of rapid growth (averaging 8 percent annually), macroeconomic conditions shifted by the end of the 1970s. As the price of copper (Chile's main export at the time) collapsed, international interest rates rose, and foreign capital inflows shrank; the economy entered into a recession in 1982–83.

In Colombia, growth decelerated sharply between 1981–82. After reaching rates of 4 percent or higher every year since the mid-1970s, real GDP growth decelerated to 2 percent in 1981 and only 1 percent in 1982.

In Uruguay, both policy inconsistencies and external factors led to a rapid deterioration in Uruguay's economic and financial performance beginning in the late 1970s. In large measure as a result of the recession in the world economy and due to policy adjustments undertaken by Argentina and Brazil, demand for Uruguayan exports weakened. Adverse terms of trade shocks, together with rising world interest rates, negatively impacted the current account and output growth. Real GDP growth decelerated to about 2 percent in 1981, and in 1982, GDP declined by almost 10 percent.

Kenya faced a macroeconomic crisis in 1993. A number of factors contributed to this episode. First, Kenya suffered multiple exogenous shocks including irregular rainfalls, a large influx of refugees from neighboring countries, and substantial declines in export prices. Second, balance of payments assistance provided by bilateral donors was suspended in late 1991 due to donors' concern over political and economic reforms. Third, difficulties in government budgetary management and inefficiencies in the public enterprise sector escalated in the early 1990s. As a result of these factors, real GDP growth decelerated from 4.3 percent in 1990 to close to zero in 1992/93.

[8]Among other references cited, this section draws heavily on a number of IMF reports (entitled "Recent Economic Developments") for the seven countries included in the paper. Also, the following studies served as references for this section: Brownbridge (1998), Caprio and Klingebiel (1996), Dominioni and Licandro (1989), Geraghty (1987), Hausmann and Rojas-Suarez (1996), Koskenkyla (1994), Lindgren, Garcia, and Saal (1996), Machua (1986), Mbitiru (1986), Sheng, (1996), and Sundararajan and Baliño (1991).

In Denmark, Japan, and Malaysia, the collapse of stock and real estate price bubbles also contributed to the ensuing banking problems. In the first case, the rapid deregulation of credit and foreign exchange controls in the 1980s, combined with an economic boom, tax breaks on borrowing, and the fact that interest rates lagged collateral asset value growth, led banks to reckless lending on a grand scale in the mid-1980s. In the late 1980s, early 1990, as a result of recession, business failures, and the collapse of property and other asset markets, the Danish financial system sustained considerable losses. In Malaysia, fast monetary and credit growth, along with large fiscal deficits in the early 1980s, stimulated inflation and price bubbles in the stock and real estate markets. During this period, banks' exposure to the real estate sector also grew considerably. The countercyclical policies that followed led to a recession in 1985–86 and the subsequent bubble burst. By 1986, real estate prices had declined by 60–70 percent relative to 1983. The plunge in real estate prices had a devastating impact on banks' lending portfolios. Similarly, in Japan, a sustained strong economic expansion during 1987–90 raised resource utilization and resulted in an increase in inflationary pressures. The overheating of the economy prompted a tightening of monetary policy. As monetary policy was tightening, financial markets came under strong pressure. Interest rates rose steadily, stock market prices plummeted. Annualized GDP growth decelerated sharply from 5 1/2 percent in the first half of the year to less than 1 percent in the second half.

Microeconomic factors like risky lending practices, poor regulation, and weak supervision also played a role in most of the crises studied in this paper. According to Montes-Negret (1996), although a downturn in economic conditions might have precipitated bank failures in Colombia, the high concentration of bank loan portfolios was the most important reason for the insolvencies. Other contributing factors included weak supervision along with inadequate legal and institutional arrangements. Fraud, bad credit decisions, undercapitalization of banks and their corporate customers, the failure of overseas affiliates and subsidiaries, and increasing operational and financial cost also played a role. Similarly, Pérez-Campanero and Leone (1991) note that weak regulatory, accounting, and supervisory frameworks were also behind Uruguay's financial system problems. In the case of Chile, according to Velasco (1991), legislation curtailing excessive risk taking and unsound lending patterns was weak or nonexistent until 1980. Thus, related lending, rolling over of credits, and capitalization of interests were common practices. In Kenya, unorthodox financial practices of some nonbank financial institutions and commercial banks led to a serious crisis in the financial system in 1986. In the 1990s, aside from the adverse macroeconomic conditions, discretionary exemption of banking act provisions and unsound banking practices (including inside lending or directed lending to parastatals) left banks with large portfolios of nonperforming loans and illiquid or insolvent conditions.

Scope

While there are many similarities across countries in the causes behind crises, there is a lot more diversity concerning the scope and costs of these episodes.

Furthermore, there does not appear to be a clear link between the scope of crises and the size of the banking sector prior to these episodes.

Crises appear to have been more damaging and systemic in Chile, Kenya (in the 1990s), Japan, and Uruguay and significantly less so in the case of Denmark and Kenya (in the 1980s). Crises in Colombia and Malaysia rank somewhere in between.

In Chile the authorities intervened in four banks and four nonbank financial institutions (with 33 percent of outstanding loans) in 1981. Nine other banks and two more nonbanks (with 45 percent of outstanding loans) were subject to intervention in 1982–83. At the end of 1983, 21 percent of loans were nonperforming.

In Colombia, between 1982 and 1983, the monetary authorities had to take over temporarily the management of three banks and eight trade financing corporations, liquidate one bank and two specialized banks, and nationalize two commercial banks (one of them was the largest in the country). Approximately 15 percent of loans were nonperforming in 1984–85.

In Denmark, between 1990 and 1992, 9 percent of loans were nonperforming. Forty out of 60 problem banks (out of a total of 200) were merged.

In Kenya, in the mid-1980s, two commercial banks and three nonbank financial institutions were suspended. In the early 1990s, one third of the banks in Kenya (accounting for 63 percent of banking assets) were identified as distressed.

According to Kanaya and Woo (2001), between 1992 and 1997, Japan witnessed a slew of financial institution failures. Seven home mortgage-lending institutions (*jusens*) were dissolved during this period. In 1994, four credit cooperatives were suspended. Seven high profile financial institutions went into effective bankruptcy in 1997, and in 1998, two large banks were nationalized.

In the case of Malaysia, during 1985–86, there were sporadic bank runs, and a number of deposit-taking institutions failed. The authorities intervened in three banks, four finance houses, 24 deposit-taking cooperatives, and 14 insurance companies. Nonperforming loans in Malaysia were estimated at 32 percent of total loans in 1988.

Between 1984 and 1987, the central bank of Uruguay intervened in five domestic banks and de facto nationalized 75 percent of total deposits. In 1985, nonperforming loans reached 45 percent.

Aside from the percentage of loans impaired during crises, the fiscal and output costs of crises are two other measures of the depth of these episodes. The fiscal costs of crises refer to the resources (typically expressed as a percentage of GDP) spent by governments in "cleaning up" the financial system. Primarily, governments invest resources by injecting liquidity into the system, in purchasing nonperforming loans, and in recapitalizing problem banks. Honohan and Klingebiel (2000) estimate the fiscal cost of the crises in Chile, Colombia, Japan, Malaysia, and Uruguay to be 41, 5, 20, 5, and 31 percent of GDP, respectively.

An alternative measure of the cost of crises is the forgone output growth that occurs as a consequence of these episodes. Bordo and others (2001) obtain estimates of such costs for a sample of 54 countries for the period 1973–97.[9] These estimates are calculated by accumulating the difference between trend growth before crises and the growth observed during these episodes. Consistent with the other measures of the cost of crises, the output costs appear to have been larger in Chile, Japan, and Uruguay, reaching 25, 20, and 32 percentage points, respectively, relative to Colombia, Denmark, and Malaysia, where they approximated 10, 18, and 14 percentage points, respectively.

According to Beck, Demirgüç-Kunt, and Levine (1999), the ratio of bank assets to GDP in the years prior to the banking crises averaged 18 percent in Chile, 13 percent in Colombia, 56 percent in Denmark, 128 percent in Japan, 23 percent in Kenya, 51 percent in Malaysia, and 24 percent in Uruguay. Given the existing estimates of the cost of crises in these countries, there does not appear to be a clear pattern linking the latter to the size of the banking sector.

Monetary Impact: A Preliminary Analysis

A preliminary analysis of the impact of banking crises on money demand and price stability is conducted by analyzing the behavior of the growth of real broad money (M2) and the correlation between money and prices before, during, and after crises. Figures 1A through 1G illustrate the behavior of the 12-month growth in real M2, in each of the countries under study. Figures 2A through 2G show the 12-month rolling correlation between prices and M2.

In the case of Chile, Colombia, Denmark, Japan, and Uruguay, the growth of real M2 rises prior to the banking crises and falls during these periods. Furthermore, for most of these countries, crises are among the few episodes where this type of pattern is observed. However, the amplitude of the cycles varies significantly across these countries.

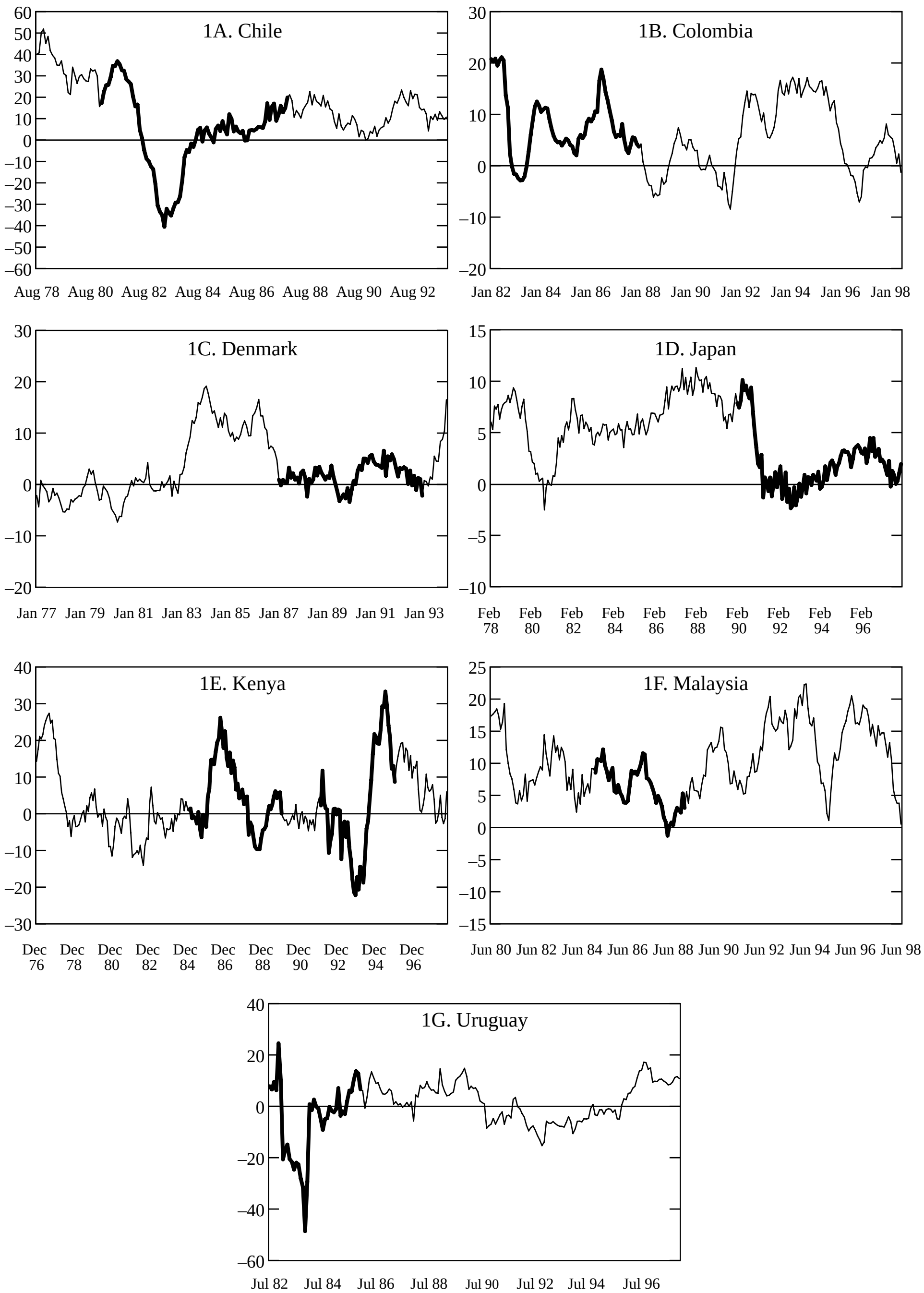
After growing at an annual average rate close to 50 percent, real M2 growth in Chile became negative at the height of the crisis, averaging –30 percent during 1983. The banking crisis is the only period during which the growth of real M2 in Chile became negative.

In the case of Colombia, the fall in real M2 growth was less sharp and also not exclusive to the banking crisis in the early 1980s. While real M2 was growing at a rate above 20 percent at the beginning of the 1980s, growth dropped to –3 percent towards the middle of 1983. Though the growth of real M2 in Colombia was never again as high as during the years right before the banking crisis, it did experience periods of negative growth other than the banking crisis of the early 1980s. In the early and late 1990s, real growth of M2 became negative for a brief period.

Large upswings in the growth of real M2 prior to the banking crisis are also evident in the case of Denmark. Between 1983 and 1986, real M2 growth in this

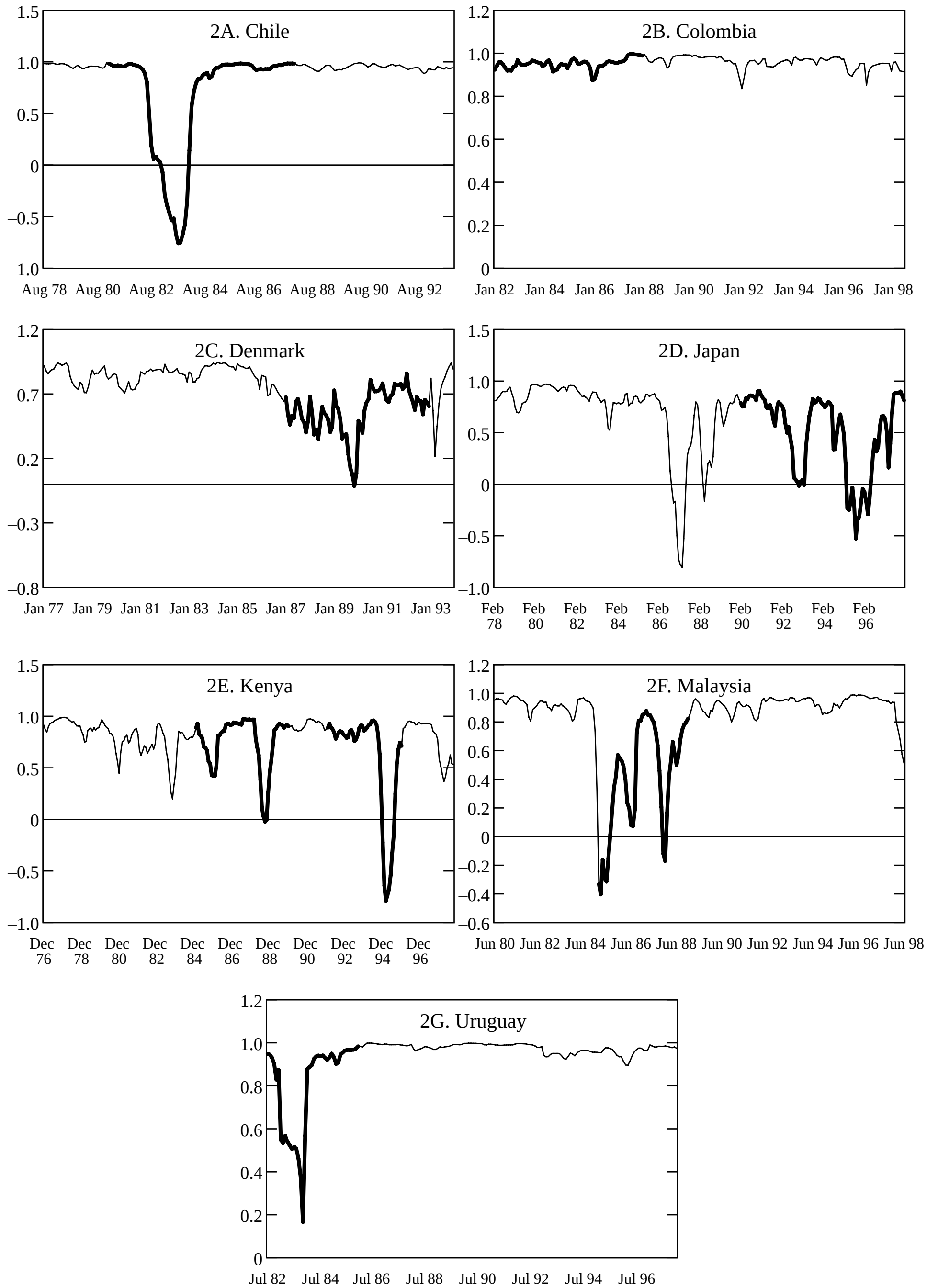
[9]They also provide estimates of the output cost of crises for a subset of 21 countries for the period 1880–1971.

Figure 1. Annualized Growth Rate of Real M2



Figures show the 12-month’s growth rate of real M2. Periods in bold correspond to banking crisis episodes.

Figure 2. Twelve-Month's Rolling Correlation Between Prices and M2



Periods in bold indicate banking crisis periods.

country soared to almost 20 percent. As banking problems surfaced in the late 1980s to early 1990s, real M2 growth plummeted, becoming negative at the start of the 1990s.

The growth of real M2 in Japan followed a similar pattern, rising significantly in the mid-1980s and falling sharply during the crisis period. In this case, growth prior to the crisis reached almost 12 percent in 1987, falling to approximately –2 percent in late 1992.

In Uruguay, the growth of real M2 went from almost 25 percent in 1982 to –50 percent in the mid-1980s.

In the case of the Kenyan 1990s crisis and in Malaysia during the mid-1980s, though real M2 growth did not increase as sharply prior to the banking crisis relative to other noncrisis periods, real money growth did fall during these episodes. In Kenya, real money growth reached –20 percent during 1994–95. On the other hand, no drop is observed in real M2 growth during the period of bank distress that took place in the mid-1980s.

While there is interest in the stability of the relation between prices and all types of monetary indicators (i.e., monetary aggregates, interest rates, exchange rates, etc.), this section focuses exclusively on the correlation between M2 and prices. The focus on broad money is explained by the fact that most of the countries in the sample, prior to the crises, either directly targeted M2 or monitored it closely as a key indicator of price behavior.[10] A formal test of the stability of the relation of prices and a host of monetary indicators is conducted in the sections that follow.

With the exception of Colombia—where the correlation between money and prices barely changed (and was close to 1) throughout the sample—this statistic dropped abruptly at times of crises (see Figures 2A–2G). In the case of Chile, Japan, Kenya, and Malaysia this correlation was above 0.8 for most noncrisis periods, but became negative during crises. In the case of Denmark and Uruguay, the correlations fell significantly during the crises, but much less sharply than in the previous cases.

To summarize, crises in the seven sample countries were the consequence of both adverse macroeconomic conditions and weak microeconomic environments. While there are many similarities among the countries in the factors that led to the crises, the scope and cost estimates vary significantly across countries. Crises appear to have been more severe in Chile, Kenya, Japan, and Uruguay. At first glance, episodes of banking distress appear to destabilize the behavior of monetary aggregates and the relation between them and prices. Causal observations suggests that there might be a link between the extent of these monetary consequences and the cost or severity of crises. However, no clear pattern is observed between the size of the banking sector on the one hand and the costs and monetary consequences of crises on the other.

[10]This statement is based on information gathered from a number of IMF reports for each of the countries under study.

II. Empirical Methodology and Data

While in the preceding section it was found that, for most countries in the sample, real M2 growth fell sharply during crises, the exercise is not a precise test of money demand stability. To the extent that these sharp movements in real money can be explained by factors typically associated with changes in money demand, then the money demand function may still prove to be stable. Similarly, a simple correlation between prices and money cannot fully detect whether the relation between these variables is statistically and formally unstable.

To empirically examine the monetary impact of banking crises, dynamic money demand and price (inflation) equations are estimated using monthly data for each country over the period 1975–98.[11, 12] The purpose of estimating these equations is twofold. First, to determine whether money demand stability is threatened by banking crises, and second, to test whether crises cause a structural break in the relation between monetary indicators and prices.

Following Juselius (1992), domestic prices in each country are modeled as a function of monetary, external, and cost-push (labor market driven) factors. In other words, consumer price inflation is assumed to be associated with wage (cost-push) inflation, monetary inflation, and imported inflation. Wage inflation refers to a situation where wages are above the underlying steady-state level. Monetary inflation is associated with excess money, while exchange rate depreciations and foreign price surges drive imported inflation. Since the determination of exchange rates can take place in both the goods and the capital markets, it is necessary to account for the interaction between them to capture the external effects on prices.

Empirical Approach

The empirical analysis pursued involves a number of steps. First, unit root tests are conducted to determine whether the variables included in the empirical analysis are stationary. Second, cointegration relations between prices and the monetary, cost-push, and external factors that determine prices are tested for. Third, single equation error correction models are obtained for money and prices. Finally,

[11]The sample for individual countries might be smaller than 1975–98, depending on data availability. See the data appendix.

[12]A number of studies have estimated money demand and inflation models for the seven countries considered in this paper (*Chile*: see Apt and Quiroz, 1992; Martner and Titelman, 1993; and Matte and Rojas, 1989. *Colombia*: see Fullerton, 1993; Herrera and Julio, 1993; and Wunder, 1990. *Denmark*: see Juselius, 1988, 1989, 1992, 1993, and 1998. *Japan*: see Arize, 1990; Arize, Avard, and Ukpolo, 1997; Corker, 1990; Frowen and Buscher, 1990; Hutchinson, 1998; Tamura, 1992; and Yoshida, 1990. *Kenya*: see Adam, 1992a and b; Chakrabarti and Ali, 1992; Darrat, 1985; Fielding, 1994; Karatzas, 1993; and Njuguna, 1993. *Malaysia*: Abdullah and Yusop, 1996; Dhakal, Kandil, Sharma, and Trescott, 1993; Habibulla, 1990; and Yusoff, 1988. *Uruguay*: Graziani, 1988; Perez-Campanero and Leone, 1991; and Wonsewer, 1986). However, most of these studies ignore issues like stationarity, cointegration, and parameter stability. More importantly, these existing studies do not analyze the impact of banking crises on money demand and price equations.

parameter constancy tests are conducted to examine whether banking crises affect the stability of the money demand and price (inflation) equations.

As in Juselius (1992) and Durevall (1998), the cointegration analysis is conducted for each sector (monetary, labor, and external) separately, for a number of reasons.[13] In the first place, the data sample is not large enough to examine systems with as many as ten variables. Secondly, as Juselius (1992) notes, it becomes increasingly difficult to interpret the cointegration space as the number of variables added in the VAR grows. Finally, even though the cointegration analysis is conducted for each sector separately, the analysis is still able to capture most of the economically meaningful long-run relations that might affect prices and money demand.

Testing for unit roots and cointegration are necessary steps to ensure that well specified models are obtained for money and prices, which take into account any nonstationarity in the regressors, as well as any long-run equilibrium conditions between the variables in the models. However, since the crux of this paper is the analysis of the stability of money demand and prices, the reader is referred to the working paper version of this study (Martínez Pería, 2000) for a detailed account of the unit root and cointegration tests.

The cointegration relations for the monetary sector reveal the factors that affect the long-term demand for money. However, in the short run, deviations from these relations could occur as a result of shocks to any of the relevant variables. Thus, after testing for cointegration in the monetary sector, an error correction model (ECM) for money is estimated for each country in the sample. This equation allows for the examination of the short-run and long-run dynamics of money demand. The conditional ECM for money is of the form:

$$\Delta m_t = c + \sum_{i=1}^{k-1} \gamma_{1i} \Delta m_{t-i} + \sum_{i=0}^{k-1} \gamma_{2i} \Delta p_{t-i} + \sum_{i=0}^{k-1} \gamma_{3i} \Delta y_{t-i} + \sum_{i=0}^{k-1} \gamma_{4i} \Delta I^O_{t-i} \qquad (1)$$

$$+ \sum_{i=0}^{k-1} \gamma_{5i} \Delta I^A_{t-i} + \sum_{i=0}^{k-1} \gamma_{6i} \Delta e_{t-i} + \lambda_1 * ECmoney_{t-1} + \omega_t,$$

where ω_t is a white noise error term. Δm, Δp, Δy, and Δe are the changes in the logarithm of nominal M2, prices, a measure of income (usually industrial production), and the dollar exchange rate, respectively. ΔI^o is the change in the rate of return on M2 (in most cases an average deposit rate), and ΔI^a is the change in the return on alternative assets to those included in M2, such as government bonds or bills. For those countries where there is evidence that money and prices are $I(2)$, the change in nominal money (Δm) is replaced by the change in real money ($\Delta(m–p)$), and the change in prices (Δp) is replaced by the change in the inflation rate ($\Delta^2 p$). Finally, adjustments in response to deviations of money demand from its long-run equilibrium are taken into account by including the cointegration vectors found for the monetary sector. *ECmoney* refers to these cointegrating vectors.

[13]The analysis of the labor sector is admittedly limited, given that it does not have monthly information on labor productivity. Instead, productivity is modeled by including a time trend.

Similarly, an ECM is developed to analyze the short-run and long-run determinants of prices (or inflation). This error correction model incorporates the cointegrating vectors found for the monetary (*ECmoney*), labor (*ECwages*), and external sectors (*ECexternal*). The ECM for prices is of the form:

$$\Delta p_t = c + \sum_{i=1}^{k-1} \pi_{1i} \Delta p_{t-i} + \sum_{i=1}^{k-1} \pi_{2i} \Delta m_{t-i} + \sum_{i=0}^{k-1} \pi_{3i} \Delta y_{t-i} + \sum_{i=0}^{k-1} \pi_{4i} \Delta I^O_{t-i} + \sum_{i=0}^{k-1} \pi_{5i} \Delta I^a_{t-i} \quad (2)$$

$$+ \sum_{i=0}^{k-1} \pi_{6i} \Delta w_{t-i} + \sum_{i=0}^{k-1} \pi_{7i} \Delta u_{t-i} + \sum_{i=0}^{k-1} \pi_{8i} \Delta e_{t-i} + \sum_{i=0}^{k-1} \pi_{9i} \Delta p^*_{t-i} + \sum_{i=0}^{k-1} \pi_{10i} \Delta I^*_{t-i}$$

$$+ \sum_{i=0}^{k-1} \pi_{11i} \Delta sp_{t-i} + \alpha_1 * ECmoney_{t-1} + \alpha_2 * ECwages_{t-1} + \alpha_3 * ECexternal_{t-1} + v_t,$$

where ν_t is a white noise error term. Δw, Δu, Δp^*, and Δsp refer to the change in the logarithm of wages, unemployment rates, foreign prices, and stock prices, respectively. ΔI^* refers to the change in the foreign interest rate. Foreign prices and interest rates refer to those for the U.S. in all cases except for Denmark, where the benchmark foreign country is Germany. The remaining variables are defined above. In those cases where money, prices, and wages are $I(2)$, the first differences of these variables (i.e., Δm_t, Δp_t, and Δw_t) are replaced by their second differences (i.e., $\Delta^2 m_t$, $\Delta^2 p_t$, and $\Delta^2 w_t$, respectively).

After estimating the ECM equations for money and prices, these models are reduced to obtain parsimonious representations for these variables. In other words, all insignificant variables and lags are excluded. Starting with the largest reasonable number of lags, at each stage, *F*-tests are conducted to compare the previous model with the latest reduced version of the model. Also, the latest version of the model is compared with the initial and all intermediate versions in order to verify that the restrictions implied by the reduced model are indeed accepted. For example, starting with a model including 13 lags, the model can be simplified to 10 lags if it is possible to accept going from 13 to 12 lags, from 13 and 12 to 11, and from 13, 12, and 11 to 10.[14]

Once the final reduced models are obtained, the stability of individual coefficients as well as the overall stability of the single equations for money and prices are investigated. To examine the stability of individual coefficients two tests are reported, namely, the Hansen (1992) test for coefficient stability and a *t*-test of the interaction of each variable with a dummy equal to one during the crisis period. The Hansen test "is approximately the Lagrange multiplier test of the null of constant parameter against the alternative that the parameter in question follows a martingale. This alternative incorporates simple structural breaks of unknown timing as well as random walk parameters" (p. 520). This test examines the null of constancy, but it is not designed to determine the timing of the structural breaks. Therefore, in order to analyze whether indeed coefficient instability arises from the banking crisis period, each coefficient is interacted with a

[14]These tests are available upon request.

dummy that equals one during the crisis period. A significant interaction term indicates that the coefficient in question is statistically different during crisis periods, relative to tranquil ones.

It is possible that even if it is found that some coefficients are unstable, the overall stability of the equation, which takes into account the joint hypotheses that all coefficients and the variance of the equation are stable, could still be accepted. The reverse situation, where individual parameters are stable but overall stability is rejected, is also possible. Thus, three kinds of tests are performed to study the overall stability of the money and price equations. First, Hansen's (1992) variance and joint-error variance and coefficient-stability tests are performed. These tests consider the null that either the variance or all coefficients (instead of individual ones) together with the equation variance are stable. Secondly, sequentially estimated one-period ahead and break-point Chow (1960) statistics are presented. Third, to test whether the instability arises explicitly from the crisis period, a Chow-type *F*-test is reported, which is labeled *F-CRISIS*. This test compares the equations estimated over the whole sample (i.e., the sample including crisis and tranquil periods) with the estimates for the period excluding banking crises.[15] Because the Hansen, one-period ahead and break-point Chow tests do not assume instability over a particular period, but rather the timing of structural breaks is unknown, they tend to be less powerful. Thus, whenever different results emerge from these tests, vis-à-vis the *F-CRISIS* test, the tendency is for the latter to be relied upon.

The Data

Monthly data on monetary aggregates and financial variables (like exchange rates and interest rates) come from national sources (e.g., Central Bank bulletins, Ministry of Finance reports, etc.) and international sources (IMF and OECD databases). Wherever possible, the analysis also controls for the role of wages, the unemployment rate, and external factors (like foreign prices and interest rates) in explaining prices. These variables come from the same sources mentioned above. For all countries, an attempt is made to cover the period closest to January 1975 through June 1998. A data appendix, at the end of the paper, describes the data used, the corresponding sources, and the relevant sample periods for each country in the study.

[15]See Greene (1993, p. 214) for a description of this type of test. The idea is that whenever we want to test whether the behavior of an equation over two subperiods is the same when one period is too short to be considered separately, this difference can be tested indirectly by comparing the overall period with the longer subperiod. Thus, the procedure is as follows: (1) estimate the regression using the full data set and obtain the restricted sum of squared residuals $e_r'e_r$; (2) estimate the regression over the longer subperiod and obtain the unrestricted sum of squared residuals $e_r'e_r$; (3) calculate the *F*-statistic as follows, $F[n1, n2-K] = [(e_r'e_r - e'e)/n1]/[\ e'e\ /(n2-K)]$, where $n1$ is the number of observations in the shortest subperiod and $n2$ corresponds to the number of observations in the longer subperiod.

III. Empirical Results

The paper's main objective is to examine money demand and price stability during banking crises. However, getting to that stage requires that the stationarity of the variables in the models is ensured, that cointegration among the different variables is tested for, and that cointegrating vectors are included (to control for long-run relations among the variables) in the single equation models for money and prices. Martínez Pería (2000) presents the unit root test results for all variables used, and shows and discusses the Johansen cointegration tests for the monetary, external, and labor sectors, for all countries. Tables A1 and A2 in the appendix summarize the order of integration of the variables included and detail the number of cointegration vectors found for each sector in each country, respectively. Table A3 displays the actual cointegrating vectors found for each sector in each country.

Most variables are integrated of order (1) and in some cases of order (2). Thus, stationary variables are obtained by first differencing $I(1)$ variables and by differencing twice those that are $I(2)$. In all cases, one vector is found with a long-run money demand interpretation. For most countries, the cointegration results for the external sector confirm that purchasing power parity (PPP) holds in the long run. In some cases, it is also found that uncovered interest parity (UIP) holds. Finally, for those countries where data on wages exist, real wages are found to be linked in the long run to the behavior of the unemployment rate and to a trend, which is interpreted as a proxy for productivity growth.

Is the Stability of Money Demand Affected by Banking Crises?

In this section, the results for the parsimonious, conditional, single-equation model for broad money demand are presented and discussed for each country in the sample. In all cases, the analysis began with a 13-lag model and dropped those lags that could be excluded according to a series of F-tests and the behavior of the Schwarz criterion.[16]

To verify that the final money demand equations for each country are well specified, panel A of Table 1 presents various diagnostic statistics. These statistics are tests against various alternative hypotheses such as residual autocorrelation (*AR*), skewness and excess kurtosis (*Normality*), autoregressive conditional heteroskedasticity (*ARCH*), and heteroscedasticity (*Hetero*). The null distribution of these statistics is either chi-squared (χ^2) or F depending on the test. The degrees of freedom are shown in parentheses. All equations, for all countries, are well specified except for the fact that there is some evidence of residual autocorrelation for Japan.

Having shown that all equations appear to be well specified, Table 2 summarizes the main results from the final money demand equations for each country. This table indicates the sign of each coefficient, whether they are statistically significant, and whether they are stable according to the Hansen test and the

[16]These results are not reported here, but are available upon request.

Table 1. Money Demand and Price Equation Misspecification Tests

	AR 1–13			*ARCH* 13			*Normality*			*Hetero*		
Country	Distribution	Statistic	*p*-value	Distribution	Statistic	*p*-value	Distribution	Statistic	*p*-value	Distribution	Statistic	*p*-value
A. Money Demand Misspecification Tests												
Chile	$F(13,144)$	0.29	0.99	$F(13,131)$	0.66	0.79	χ^2 (2)	1.07	0.58	F (32,124)	0.58	0.96
Colombia	$F(13,162)$	1.06	0.39	$F(13,149)$	0.83	0.62	χ^2 (2)	5.96	0.051	F (29,145)	1.42	0.09
Denmark	$F(13,155)$	0.95	0.50	$F(13,142)$	0.96	0.49	χ^2 (2)	3.5	0.17	F (46,121)	0.71	0.91
Japan	$F(13,196)$	2.21	0.01	$F(13,183)$	0.77	0.69	χ^2 (2)	1.35	0.51	F (39,169)	1.44	0.06
Kenya	$F(13,195)$	0.93	0.52	$F(13,182)$	1.56	0.10	χ^2 (2)	0.33	0.85	F (42,165)	0.70	0.91
Malaysia	$F(13,158)$	0.34	0.98	$F(13,145)$	1.52	0.12	χ^2 (2)	1.18	0.56	F (36,134)	0.97	0.53
Uruguay	$F(13,133)$	0.68	0.78	$F(13,120)$	0.77	0.69	χ^2 (2)	1.76	0.41	F (55,90)	1.27	0.16
B. Price Equation Misspecification Tests												
Chile	$F(13,136)$	1.79	0.05	$F(13,123)$	0.86	0.60	χ^2 (2)	2.46	0.29	$F(47,101)$	0.63	0.96
Colombia	$F(13,140)$	1.67	0.07	$F(13,127)$	1.67	0.07	χ^2 (2)	4.66	0.1	$F(63,89)$	1.38	0.08
Denmark	$F(13,143)$	0.94	0.52	$F(13,130)$	1.20	0.28	χ^2 (2)	0.38	0.07	$F(63,92)$	1.09	0.34
Japan	$F(13,183)$	1.06	0.39	$F(13,170)$	0.44	0.95	χ^2 (2)	1.12	0.57	$F(65,130)$	0.71	0.94
Kenya	$F(13,182)$	0.75	0.71	$F(13,169)$	0.70	0.76	χ^2 (2)	4.78	0.09	$F(62,132)$	1.21	0.18
Malaysia	$F(13,157)$	0.63	0.83	$F(13,144)$	0.93	0.52	χ^2 (2)	4.99	0.08	$F(40,129)$	1.41	0.08
Uruguay	$F(13,131)$	0.82	0.64	$F(13,118)$	0.82	0.64	χ^2 (2)	0.24	0.89	$F(70,73)$	1.15	0.27

Table 2. Summary of Single Equation Money Demand Results

Country (Regression R-squared)	Variables Included	Impact on Money Demand	Coefficient Significance (Percent)	Hansen (1992) Test for Coefficient Stability	Interaction with Crisis Dummy
Chile (0.594)	$\Delta(m-p)_{t-1}$	Negative	10	Accepts stability	Not significant
	$\Delta^2 p_t$	Negative	5 or less	Accepts stability	Not significant
	Δy_t	Positive	5 or less	Accepts stability	Not significant
	ΔI^O_t	Positive	5 or less	Accepts stability	Not significant
	Δe_t	Positive	Not significant	Accepts stability	Not significant
Colombia (0.585)	Δm_{t-1}	Positive	10	Rejects at 10 percent	Rejects at 5 percent
	Δp_{t-6}	Negative	10	Accepts stability	Not significant
	Δy_t	Positive	Not significant	Accepts stability	Not significant
	ΔI^O_{t-10}	Positive	Not significant	Accepts stability	Not significant
	Δe_{t-3}	Positive	10	Rejects at 10 percent	Not significant
	$\Delta e_{t-4,\,t-12}$	Negative	5 or less	Rejects at 10 percent	Δe_{t-4} significant at 10 percent
Denmark (0.886)	$\Delta(m-p)_{t-1,\,t-3,\,t-6,\,t-7}$	Indeterminate	5 or less	Accepts stability	Not significant
	$\Delta^2 p_{t,\,t-5}$	Negative	5 or less	Accepts stability	$\Delta^2 p_{t-5}$ significant at 10 percent
	Δy_{t-1}	Positive	Not significant	Accepts stability	Not significant
	ΔI^O_t	Negative	Not significant	Accepts stability	Not significant
	ΔI^A_t	Negative	5 or less	Accepts stability	Not significant
	Δe_t	Negative	5 or less	Accepts stability	Significant at 5 percent
Japan (0.681)	$\Delta(m-p)_{t-1,t-3,t-5,t-6,t-9,t-10}$	Indeterminate	5 or less	Accepts stability	$\Delta(m-p)_{t-1}$ significant at 5 percent
	$\Delta^2 p_{t,\,t-12}$	Negative	5 or less	Accepts stability	Not significant
	Δy_t	Negative	5 or less	Accepts stability	Significant at 5 percent
	ΔI^A_t	Negative	Not significant	Accepts stability	Not significant
	ΔI^O_t	Positive	Not significant	Accepts stability	Significant at 10 percent

Table 2. *(concluded)*

Country (Regression R-squared)	Variables Included	Impact on Money Demand	Coefficient Significance (Percent)	Hansen (1992) Test for Coefficient Stability	Interaction with Crisis Dummy
Kenya (0.473)	$\Delta m_{t-1,t-3}$	Indeterminate	5 or less	Accepts stability	Significant at 10 percent
	Δp_t	Positive	Not significant	Accepts stability	Not significant
	Δy_t	Negative	10	Accepts stability	Not significant
	$\Delta I^{A}_{t,t-2}$	Negative	5 or less	Accepts stability	Significant at 5 percent
	ΔI^{O}_{t-2}	Positive	5 or less	Accepts stability	Not significant
	$\Delta e_{t-2,\ t-3}$	Negative	5 or less	Accepts stability	Significant at 5 percent
Malaysia (0.447)	$\Delta(m-p)_{t-1}$	Negative	5 or less	Accepts stability	Not significant
	$\Delta^2 p_{t,t-12}$	Negative	5 or less	Accepts stability	Not significant
	Δy_t	Positive	5 or less	Accepts stability	Significant at 5 percent
	ΔI^{O}_{t}	Negative	Not significant	Accepts stability	Not significant
	ΔI^{A}_{t}	Negative	Not significant	Accepts stability	Not significant
	Δe_t	Negative	Not significant	Accepts stability	Not significant
Uruguay (0.897)	$\Delta(m-p)_{t-2,t-6,t-12}$	Positive	5 or less	Accepts stability	$\Delta(m-p)_{t-12}$ significant at 10 percent
	$\Delta^2 p_{t,t-5,t-8,t-9,t-10,t-11,t-12}$	Negative	5 or less	Accepts stability	Not significant
	Δy_t	Positive	Not significant	Accepts stability	Not significant
	ΔI^{O}_{t-7}	Positive	5 or less	Accepts stability	Not significant
	$\Delta e_{t,t-2}$	Positive	5 or less	Accepts stability	Significant at 10 percent
	$\Delta e_{t-1,t-4,t-8}$	Negative	5 or less	Rejects at 10 percent	Not significant

significance of the crisis dummy interaction terms. Detailed regression results can be found in Martínez Pería (2000).[17]

Except for Colombia and Kenya, in all countries, inflation (Δp), or the change in inflation ($\Delta^2 p$), is significant and has a negative effect on the demand for real money, as expected. In general, the coefficient on this variable appears to be stable according to the Hansen test. Also, the interaction term between inflation and a crisis dummy is insignificant for all countries (at 5 percent significance), indicating that there is no evidence of instability on this coefficient that can be attributed to the crisis period.

In general, changes in income (y) have a positive effect on the demand for money. However, income is only significant in the money demand equations for Chile and Malaysia. According to the interaction term between the change in income and the crisis dummy, the coefficient on income is unstable for the case of Japan and Malaysia. The rate of return on M2, I^o (typically the average deposit rate), has a positive and significant impact on the demand for broad money in Chile, Kenya, and Uruguay. A higher return on money raises the demand for it, as expected. This variable is insignificant for all other countries. At 5 percent significance, no evidence is found of coefficient instability for the rate of return on M2. Changes in the rate of return on assets outside from those included in M2 (indicated as I^a) have a significant negative impact on money demand in Denmark and Kenya. There is no evidence of coefficient instability for this variable either.

With the exception of Japan, the change in the exchange rate (Δe) is included as a regressor in the single equation for money for all countries. This variable is introduced to control for the possibility of flight to foreign currency in countries where there are not a lot of competing assets relative to bank deposits, and/or where the exchange rate has been traditionally pegged to a foreign currency.[18] Exchange rate changes are mostly significant and have a negative impact on the demand for broad money in Colombia, Denmark, and Kenya.[19] At 5 percent significance, there is some evidence that the coefficients on some lags of the exchange rate are unstable in the case of Denmark and Kenya.

As mentioned above, it is possible that the stability of some specific coefficients is rejected, while the overall stability of the money demand equation is still accepted. If the structural stability of money demand is unaffected by banking crises, then policymakers can continue to rely on these models for forecasting and for economic policy analysis. Thus, one-period ahead and break-point Chow tests, Hansen tests, and *F*-tests are conducted to examine the overall stability of the money demand equations.

[17]The error correction terms associated with long-run money demand are included as controls, but are not discussed in Table 2. In general, these terms are significant and negative in the dynamic money demand equations for all countries. In most cases, however, adjustment to the long-run equilibrium is slow.

[18]The change in the exchange rate was not included in the cointegration analysis, because this variable was found to be $I(0)$ for all countries according to the Dickey-Fuller (1981) tests.

[19]An increase in the exchange rate represents a depreciation.

Figures 3A through Figure 3H show sequentially estimated one-period ahead and break-point Chow statistics for each money demand function.[20] These results are summarized in panel A of Table 3. Also, this table reports the Hansen (1992) variance and joint (coefficient and variance) tests for parameter constancy. Finally, aside from testing for unknown break-points in the money demand equations, tests are conducted to determine whether the models estimated for the overall sample (i.e., including tranquil and crisis observations) are equivalent to those estimated over the period excluding banking crisis episodes. These episodes are identified according to the dates established in the banking crisis literature (see Caprio and Klingebiel (1996, 1999) and Lindgren, Garcia, and Saal (1996)). This test statistic, which is labeled *F-CRISIS*, has an *F* distribution.[21] If this *F*-test rejects, then it can be inferred that the instability in the money demand function arises from the period of the banking crisis, since the only difference between the overall sample and the sample excluding the crisis, is the crisis period itself.

According to the recursively estimated Chow, Hansen, and *F-CRISIS* tests, money demand functions in Chile, Denmark, and Malaysia appear to be stable.[22] So, from these results, it seems that banking crises in these countries have not threatened the stability of broad money demand.

The Hansen tests, as well as the one-period ahead and break-point Chow tests, provide evidence of parameter instability in the estimated money demand equation for Colombia. However, the instability in the equation seems to be coming from the period after the banking crisis. The Colombian banking crisis took place between 1982–87. When the model is estimated through 1989, rather than the overall sample 1981–98, no evidence of instability is found according to the Hansen and Chow tests (see panel A in Table 3 and Figure 1c). Furthermore, the *F-CRISIS* test also accepts the null of constancy over the crisis period.

Whether the money demand for Japan is stable or not is unclear. The Hansen tests definitely support stability. The one-period ahead and the break-point Chow tests point to some periods of instability, but they are definitely few and short lived. The *F-CRISIS* test rejects stability, but only at 10 percent significance. Overall, the evidence in favor of instability is not overwhelming.

The one-period ahead and, in particular, the break-point Chow tests provide some evidence of money demand instability in Kenya. However, the evidence is very marginal at 5 percent significance. Furthermore, the Hansen stability tests and the *F-CRISIS* statistic indicate that the equation is stable. So, overall, there is an inclination to interpret the results for Kenya as accepting the hypothesis of money demand stability.

[20]The recursively estimated Chow tests are only useful in those cases when they include the crisis periods. In some countries, however, because the data sample starts well into the crisis, the recursive estimates start after the crisis period or well into it. In these cases, the *F-CRISIS* and Hansen tests are relied upon.

[21]The degrees of freedom in the numerator correspond to the number of observations in the crisis period, and those in the denominator are equal to the degrees of freedom of the model estimated over the tranquil period.

[22]In the case of Chile, some one-period ahead Chow statistics reject at 5 percent, but they are too few to jeopardize the overall stability of the estimated equation.

Figure 3. Money Demand Structural Break Tests: One-Period Ahead Chow Tests and Break-Point Chow Tests

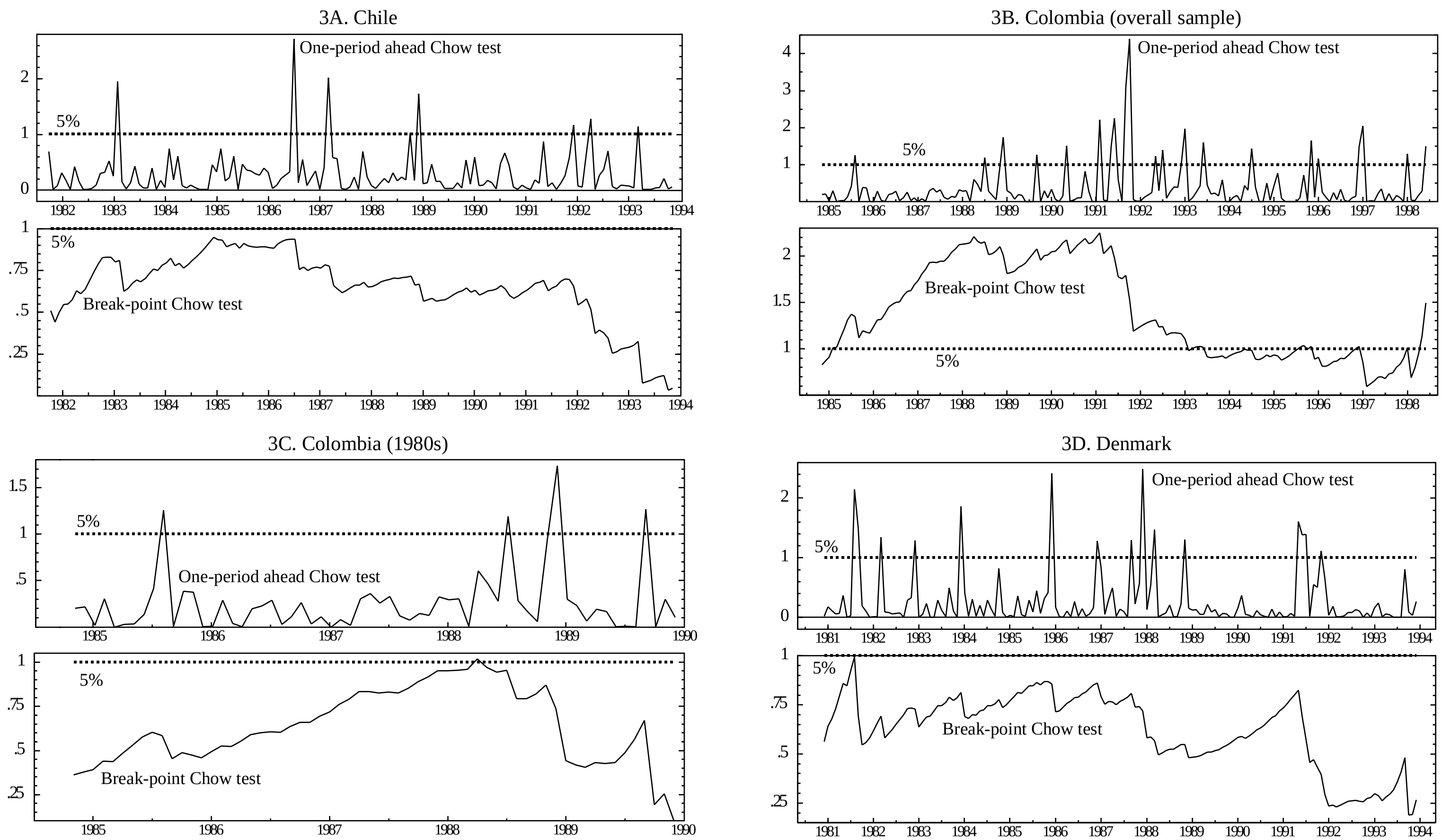


Figure 3. *(concluded)*

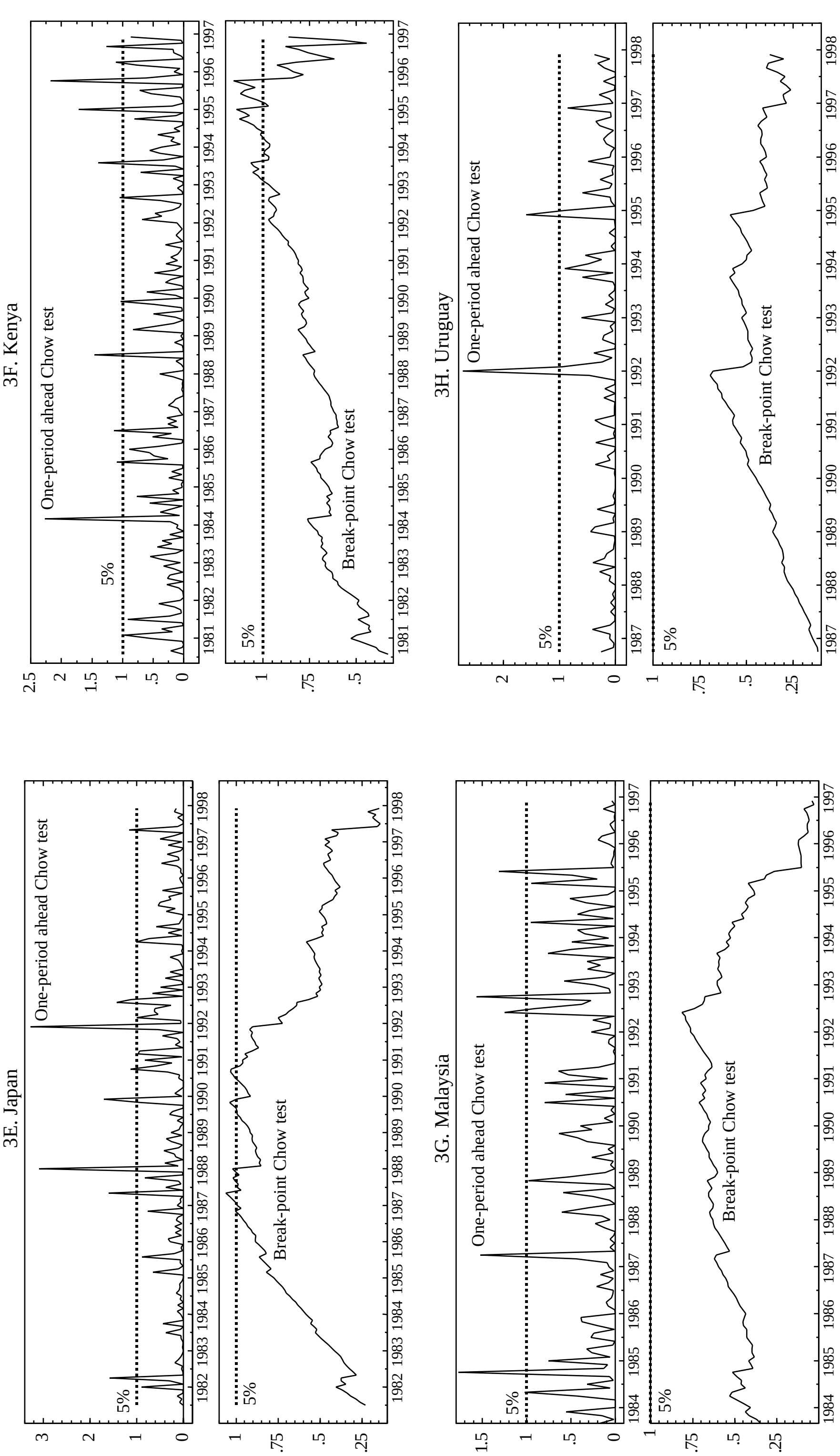


Table 3. Summary Table for Money Demand and Price Stability Tests

A. Money Demand Stability Tests

Country	Recursive Squares Chow Tests	Hansen Test Variance	Hansen Test Joint	*F-CRISIS*
Chile	Stable[1]	0.163	3.999	1.343
Colombia				
Entire Sample	Unstable	0.714*	4.758	0.572
1982:3–1989:12	Stable[2]	0.086	4.29	
Denmark	Stable	0.102	4.238	1.154
Japan	Stable	0.189	3.495	1.334
Kenya	Stable	0.096	3.705	1.063
Malaysia	Stable	0.222	4.655	0.66
Uruguay	Stable[1]	0.227	4.965	2.269**

B. Price Equations Stability Tests

Country	Recursive Squares Chow Tests	Hansen Test Variance	Hansen Test Joint	*F-CRISIS*
Chile	Stable	0.298	5.674	0.963
Colombia	Stable[1]	1.035*	6.754	2.545**
Denmark	Stable	0.259	4.813	0.754
Japan	Stable	0.523*	7.961	0.855
Kenya				
Entire Sample	Unstable	0.491*	4.327	1.439*
1980s				0.748
1990s				2.163**
Malaysia	Stable	0.355	5.315	0.736
Uruguay	Stable[1]	0.21	5.568	2.142**

Notes: *, ** denotes significance at 5 percent and 1 percent, respectively.
[1]The recursive estimation does not include the crisis period.
[2] The overall instability in the sample comes from the period after the crisis.

The stability test results for the Uruguayan money equation are mixed. On the one hand, the Hansen tests accept stability, but the *F-CRISIS* test rejects it. Given that the Hansen tests typically have low power, because the break-point is unknown, the *F-CRISIS* test results tend to be more heavily relied upon. The one-period ahead and break-point Chow tests are not particularly useful in this case, because the recursive estimations conducted to obtain these tests start after the crisis period. It is clear from these figures, however, in particular from the residual bands, that the estimation in the 1980s is less precise and stable than during the 1990s. This suggests that the banking crisis during the period 1981–85 may have affected money demand stability in Uruguay.

To summarize, the results in this section show that with the exception of Uruguay, no overwhelming evidence is found that banking crises jeopardize broad money demand stability.[23] The evidence presented here, together with the fact that

[23]In the case of Colombia, evidence of instability was found, but it seems to be arising in the 1990s, many years after the financial crisis in that country.

for all countries a cointegration vector is found with a long-run money demand interpretation, indicates that whatever changes may have occurred in the demand for money owing to banking crises can be explained by the same function used to model money demand at times of tranquility. Thus, at least for this sample of countries, banking crises do not systematically threaten the short-run or long-run broad money demand functions.

Does the Relation Between Prices and Monetary Indicators Break Down During Crises?

Starting from a model including 13 lags of each variable, the reduced and final equation for prices in each country are obtained by dropping insignificant lags according to a series of *F*-tests and the behavior of the Schwarz criterion. That the final equations are well specified is confirmed by conducting diagnostic tests for residual autocorrelation (*AR*), skewness and excess kurtosis (*Normality*), autoregressive conditional heteroskedasticity (*ARCH*), and heteroscedasticity (*Hetero*). The results from these tests are summarized in panel B of Table 1. None of the price equations reject any of these specification tests. Thus, all price equations seem to be free of specification problems.

Table 4 presents a summary of the results from the estimated price equations. In particular, this table indicates the sign of each variable included, whether the variable is significant or not, and whether the coefficient on each variable is stable or not according to the Hansen stability test and the crisis dummy interaction term. A detailed set of results for the price equations can be found in Martínez Pería (2000).[24]

In the parsimonious price equations, lagged changes in broad money (or the second difference, depending on the order of integration of the variables) are found to have a positive and significant impact on inflation (or its growth rate, depending on the country) in Chile, Denmark, Japan, Kenya, and Uruguay. The interaction terms between money and the crisis dummy provide some evidence of instability for Japan and Uruguay at 5 percent significance.

For Denmark, Japan, and Uruguay, positive changes in income exercise a significant upward pressure on prices. For all other countries, income is insignificant. For Uruguay, there is some evidence that the coefficient on this variable becomes unstable during crisis periods.

[24]In particular, Table 4 does not show the cointegration vectors that were found for each of the three sectors. However, these vectors were, in fact, included in the estimations, and results for them can be found in Martínez Pería (2000). The results for the error correction terms vary widely across countries. The PPP error correction terms are significant in the case of Chile and Denmark, while the error correction term that can be interpreted as a UIP relationship is significant in the price equations for Denmark, Japan, and Uruguay. The money error correction terms affect prices in the equations for Denmark and Japan. Finally, wage cointegrating vectors are significant only for Denmark and Japan. In general, the coefficients on the error correction terms are small, indicating that prices in these countries adjust slowly to their long-run equilibrium.

Table 4. Summary of Single Equation Price Results

Country (Regression R-squared)	Variables Included	Impact on Inflation	Coefficient Significance (Percent)	Hansen (1992) Test for Coefficient Stability	Interaction with Crisis Dummy
Chile (0.724)	$\Delta^2 p_{t-2}$	Negative	5 or less	Accepts stability	Not significant
	$\Delta^2 m_{t-2}$	Positive	5 or less	Accepts stability	Not significant
	Δy_t	Negative	Not significant	Accepts stability	Not significant
	$\Delta I^O_{t-5,t-6}$	Negative	5 or less	Accepts stability	Not significant
	Δe_t	Positive	5 or less	Accepts stability	Not significant
	Δp^*_t	Positive	5 or less	Accepts stability	Not significant
	$\Delta^2 w_t$	Negative	Not significant	Accepts stability	Not significant
	Δu_t	Negative	5 or less	Accepts stability	Not significant
	Δsp_t	Positive	Not significant	Accepts stability	Not significant
Colombia (0.762)	$\Delta p_{t-1,t-11,t-12}$	Indeterminate	5 or less	Accepts stability	Not significant
	Δm_{t-1}	Positive	Not significant	Accepts stability	Not significant
	Δy_t	Negative	Not significant	Accepts stability	Not significant
	ΔI^O_t	Positive	Not significant	Accepts stability	Not significant
	$\Delta I^*_{t,t-7}$	Indeterminate	5 or less	Accepts stability	Not significant
	Δp^*_{t-2}, Δp^*_{t-3}, Δp^*_{t-4}	Indeterminate	Not significant	Accepts stability	Not significant
	Δe_t	Positive	Not significant	Accepts stability	Not significant
	Δw_t	Positive	5 or less	Accepts stability	Not significant
	Δu_t	Negative	Not significant	Accepts stability	Not significant
	Δsp_t	Positive	Not significant	Accepts stability	Not significant
Denmark (0.856)	$\Delta^2 p_{t-1}$	Positive	5 or less	Accepts stability	Not significant
	$\Delta^2 m_{t-12}$	Positive	5 or less	Rejects at 10 percent	Not significant
	Δy_{t-5}	Positive	5 or less	Accepts stability	Not significant
	ΔI^O_{t-1}	Positive	5 or less	Accepts stability	Not significant
	ΔI^A_t	Negative	Not significant	Accepts stability	Not significant
	Δe_t	Positive	Not significant	Accepts stability	Not significant
	Δp^*_t	Positive	5 or less	Accepts stability	Not significant
	ΔI^*_t	Positive	Not significant	Accepts stability	Not significant
	$\Delta u_{t-5,t-6,t-12}$	Positive	5 or less	Accepts stability	Not significant
	$\Delta^2 w_t$	Positive	10	Accepts stability	Not significant

Table 4. *(continued)*

Country (Regression R-squared)	Variables Included	Impact on Inflation	Coefficient Significance (Percent)	Hansen (1992) Test for Coefficient Stability	Interaction with Crisis Dummy
Japan (0.861)	$\Delta^2 p_{t-10,t-11}$	Negative	Positive	Accepts stability	Significant 5 percent
	$\Delta^2 m_{t-1}$	Positive	5 or less	Accepts stability	Significant 5 percent
	Δy_t	Positive	5 or less	Accepts stability	Not significant
	$\Delta I^A_{t\text{-}6}$	Positive	5 or less	Accepts stability	Not significant
	$\Delta I^O_{t-2,t-11}$	Negative	10	Accepts stability	Not significant
	$\Delta I^b_{t-1,t-5}$	Negative	5 or less	Accepts stability	Significant 10 percent
	$\Delta e_{t-2,t-5,t-7}$	Positive	5 or less	Accepts stability	Not significant
	$\Delta p^*_{t-2,t-6,t-9}$	Indeterminate	5 or less	Accepts stability	Not significant
	ΔI^*_t	Negative	Not significant	Accepts stability	Not significant
	$\Delta^2 w_t$	Positive	Not significant	Accepts stability	Not significant
	Δu_t	Negative	Not significant	Accepts stability	Not significant
	Δsp_t	Negative	Not significant	Accepts stability	Not significant
Kenya (0.833)	$\Delta p_{t-3,t-4,t-8}$	Indeterminate	5 or less	Accepts stability	Not significant
	$\Delta m_{t-3,t-4}$	Positive	5 or less	Accepts stability	Not significant
	Δy_t	Negative	Not significant	Accepts stability	Significant at 5 percent
	$\Delta I^A_{t-4,t-5}$	Positive	5 or less	Accepts stability	Not significant
	$\Delta I^O_{t-1,t-2,t-6}$	Indeterminate	5 or less	Accepts stability	Not significant
	ΔI^*_t	Positive	Not significant	Accepts stability	Significant at 5 percent
	Δe_t	Positive	5 or less	Accepts stability	Not significant
	Δp^*_{t-2}	Positive	5 or less	Accepts stability	Not significant

Table 4. *(concluded)*

Country (Regression R-squared)	Variables Included	Impact on Inflation	Coefficient Significance (Percent)	Hansen (1992) Test for Coefficient Stability	Interaction with Crisis Dummy
Malaysia (0.704)	$\Delta^2 p_{t-1}$	Negative	5 or less	Accepts stability	Not significant
	$\Delta^2 m_{t-1}$	Positive	Not significant	Accepts stability	Not significant
	Δy_t	Negative	Not significant	Accepts stability	Not significant
	ΔI^O_t	Positive	Not significant	Accepts stability	Not significant
	ΔI^A_{t-2}	Negative	5 or less	Accepts stability	Not significant
	$\Delta e_{t,t-3,t-5}$	Indeterminate	5 or less	Accepts stability	Significant at 5 percent
	Δp^*_{t-1}	Positive	5 or less	Accepts stability	Not significant
Uruguay (0.876)	$\Delta^2 p_{t-1,t-2,t-3,t-4,t-5,t-7}$	Negative	5 or less	Accepts stability	Significant at 5 percent
	$\Delta^2 m_{t-5,t-6,t-7,t-8,t-9}$	Positive	5 or less	Accepts stability	Significant at 5 percent
	Δy_{t-4}	Positive	5 or less	Rejects stability	Not significant
	$\Delta I^O_{t,t-3,t-8}$	Indeterminate	5 or less	Accepts stability	Not significant
	$\Delta u_{t-1,t-2,t-3,t-6,t-2,t-7}$	Indeterminate	5 or less	Accepts stability	$\Delta u_{t-1,t-6}$ significant at 5 percent
	$\Delta^2 w_{t,t-1}$	Negative	5 or less	Rejects stability	Significant 5 percent
	Δe_t	Negative	5 or less	Accepts stability	Not significant
	Δe_{t-1}	Positive	5 or less	Accepts stability	Not significant
	Δp^*_t	Positive	5 or less	Accepts stability	Not significant
	$\Delta I^*_{t-1,t-9}$	Positive	5 or less	Accepts stability	Not significant

Changes in the exchange rate are largely significant and have a positive effect on inflation. Thus, periods of exchange rate depreciations in these countries are likely to be followed by a surge in inflation. With the exception of Malaysia, the hypothesis can be accepted that the coefficient on this variable is stable.

Foreign price changes are, in general, positive and significant.[25] On the other hand, foreign interest rates are significant only in the cases of Colombia and Uruguay. In general, the coefficients on foreign variables appear stable.

Domestic interest rates (typically, the rate of return on money and its outside rate) have a negative significant impact on inflation. This is particularly the case for Chile, Japan, Malaysia, and Uruguay. For Kenya and Denmark, the own rate of return on money has a positive and significant effect. At 5 percent significance, the coefficients on both kinds of interest rates are stable.

Wage changes are significant for Colombia and Uruguay at 5 percent significance and for Denmark at 10 percent. In general, wage increases result in higher inflation. On the other hand, increases in unemployment typically have a negative impact on inflation, but they are only significant for the case of Chile and Uruguay. The coefficients on some lags of the unemployment rate are unstable in the case of Uruguay. Finally, changes in stock prices have no significant impact on consumer price inflation across countries.[26]

The overall constancy of the estimated price equations is analyzed using the same methodology discussed for the money demand equations. Figures 4A through 4G show sequentially estimated one-period ahead and break-point Chow statistics. Also, the Hansen variance, joint-variance, and coefficients-tests for parameter constancy are reported in panel B of Table 3. In the Hansen tests, the break-point date is unknown, so a finding of instability cannot be immediately connected to a given period. Therefore, to examine whether the instability is a result of banking crises, a Chow-type *F*-test (labeled *F-CRISIS*) is conducted as before. This test compares the price equation results for the overall sample, with the results obtained for the sample excluding the crisis period.

Both the Hansen and the break-point Chow tests indicate that the Chilean price equation is stable. Also, *F-CRISIS* fails to find any evidence that the banking crisis period led to instability in the price equation. Similar results are obtained for the Danish and Malaysian price equations.

According to the sequentially estimated one-period ahead and break-point Chow tests, the Colombian price equation appears stable. However, the Hansen tests reject stability. In particular, these statistics point to variance instability. These seemingly contradictory results can be reconciled by the fact that the recursive estimations start well into the sample. In other words, the recursive Chow tests are not very useful in this case, because they practically do not cover the crisis period.[27] The *F-CRISIS* test rejects the hypothesis that both periods can be

[25]Foreign prices are measured by U.S. prices for all countries except for Denmark, where German prices are included.

[26]Stock prices were only available for Chile, Colombia, and Japan.

[27]The Colombian crisis took place between 1982–88. Recursive estimations for the price equation start around 1987.

Figure 4. Price Equation Structural Break Tests: One-Period Ahead Chow Tests and Break-Point Chow Tests

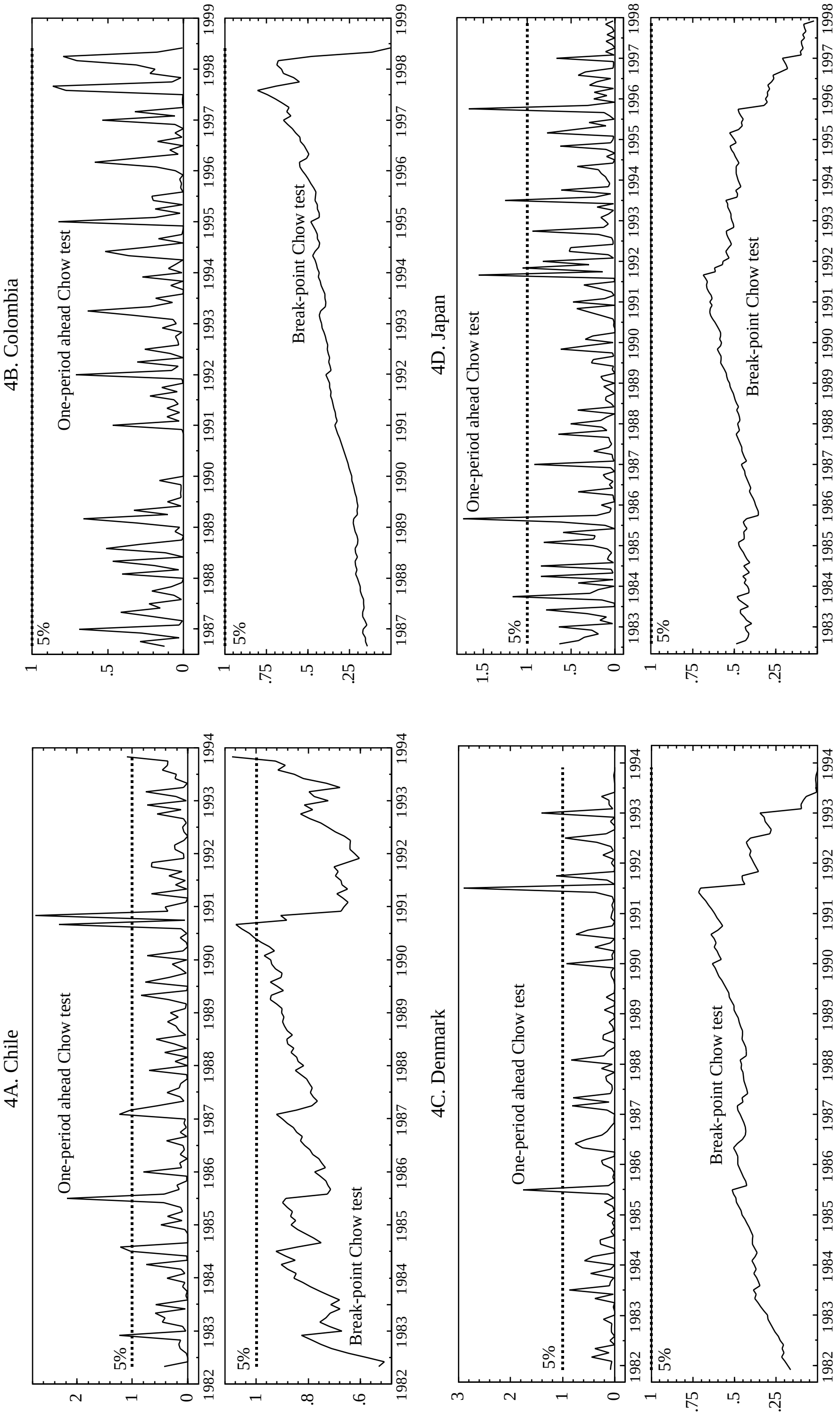
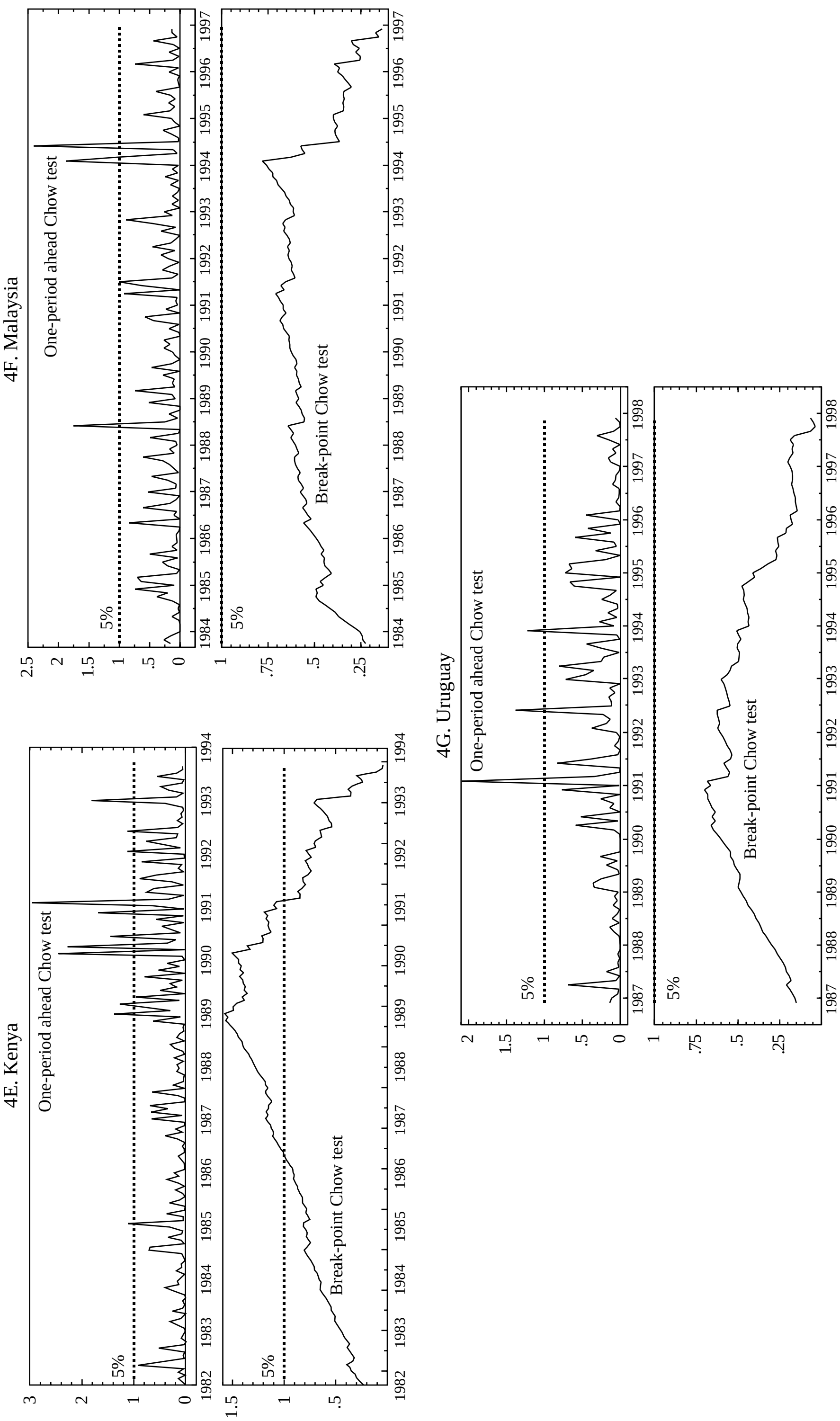


Figure 4. *(concluded)*



explained by the same equation. This seems to point to the fact that the price equation is particularly unstable during the banking crisis in Colombia.

Regarding the constancy of the Japanese price equation, the Hansen tests indicate the presence of instability. However, this applies only to variance instability and the evidence is marginal, since the critical value for the Hansen variance test at 5 percent significance is roughly 0.5, and the test statistic is 0.52 (Hansen, 1992). Furthermore, the break-point Chow and *F-CRISIS* tests indicate parameter constancy over the crisis period.

In the case of Kenya, the Hansen test for variance stability, the one-period ahead, and the break-point Chow tests indicate that the equation is not constant. In particular, it can be observed from the recursively estimated Chow tests that the instability seems to occur during the 1990s. Kenya experienced two banking crises, one over the period 1985–89 and another over the period 1992–95. The *F*-test comparing the crisis in the 1980s with the tranquil observations suggests that this period is not different from the overall sample. However, the 1990s crisis does appear to be different from the tranquil period.

The evidence on stability for the Uruguayan price equation is mixed. The Hansen test accepts stability, but *F-CRISIS* rejects it. Thus, there is a tendency to rely on the *F-CRISIS* result. The one-period ahead and break-point Chow tests are not useful in this case because the recursive estimations conducted to obtain these tests start after the crisis period. However, it can be seen from the residual bands that the estimation in the 1980s is less precise and stable than during the 1990s.

To summarize, the results from this section indicate that money, exchange rates, foreign prices, and domestic interest rates are significant in explaining prices in most countries. Stock prices, on the other hand, did not prove to be useful indicators of price behavior. In general, the relation between prices and individual monetary indicators is stable, despite the occurrence of crises. In three out of seven countries, however, evidence is found of (at least variance) instability in the price equations.

IV. Conclusions

In the recent literature on banking crises, not much attention has been devoted to the monetary impact of these episodes. Two exceptions, Garcia-Herrero (1997) and Lindgren, Garcia, and Saal (1996), warn about some of the potential adverse effects of banking crises for the conduct of monetary policy. In particular, using mostly a descriptive approach, the authors argue that banking crises may have significant implications for money demand stability and for the relation between prices and monetary indicators. Though both of these studies are very interesting and informative, they arrive at their conclusions without a systematic empirical investigation of the issues. A recent study by Khamis and Leone (2001) conducts a thorough empirical analysis of the impact of crises on currency demand stability. However, the study focuses exclusively on the case of Mexico.

For a sample of developed and developing countries, using cointegration analysis and error correction modeling, this paper analyses the claim that banking crises jeopardize money demand stability was examined. Secondly, the overall stability of the process for inflation and the impact of crises on the coefficients of individual monetary indicators were also analyzed.

The results suggest that the stability of money demand is not systematically threatened by banking crises. With the exception of Uruguay, it was found that money demand functions are stable. Regarding the indicators of price behavior, changes in money, exchange rates, foreign prices, and domestic interest rates seem to be useful in explaining prices. Finally, in three out of the seven countries, evidence was uncovered of (primarily variance) instability in these equations due to crises.

Though undoubtedly more research is needed in this area, the results indicate that the behavior of money demand during crises can be modeled by the same function as during periods of tranquility. On the other hand, even though in general individual coefficients in the price equations do not seem to be severely affected by crises, it appears that crises can give rise to variance instability in the price equations. Such instability may jeopardize the usefulness of these models to conduct forecasts and to examine the impact of economic policies on prices.

This study has not conducted a thorough investigation as to why instability is observed in some countries and not others. This important question is left for future research. However, casual observation of the scope and cost of crises suggests that there might be a link between the depth of crises and the countries for which evidence of instability is found. On the other hand, there does not appear to be a connection between the size of the banking sector and the subsequent cost and monetary impact of banking crises. Further investigation of these issues is clearly warranted.

APPENDIX

Chile

Data Sample

August 1977–November 1993

List of Variables

m = log of broad money (M2), p = log of CPI prices, y = log of industrial production, I^o = interest rate on deposits from 30 to 89 days, p^* = log of U.S. prices, i^* = U.S. 6-month CD rate, e = log of peso/dollar exchange rate, w = log of wage index, u = log of unemployment rate, and sp = log of the share price index.

Data Frequency and Data Sources

Monthly. Exchange rate (pesos/U.S. dollars), M2, Chilean consumer price index, U.S. consumer price index, U.S. 6-month CD rate, interest rate on deposits from 30 to 89 days, and share price index (source, *International Financial Statistics* (IMF)). Unemployment rate (source, *UN Monthly Bulletin*).

Quarterly. Industrial production and wage index (source, *Central Bank of Chile*).

Colombia

Data Sample

January 1981–June 1998

List of Variables

m = log of broad money (M2), *p* = log of CPI prices, *y* = log of industrial production, I^o = average interest rate for 90 day certificates of deposits, *p** = log of U.S. prices, *i** = U.S. 6-month CD rate, e = log of peso/dollar exchange rate, *w* = log of wage index, *u* = log of unemployment rate, *sp* = log of share price index.

Data Frequency and Data Sources

Monthly. Exchange rate (pesos/U.S. dollars), Colombian consumer price index, U.S. consumer prices index, U.S. 6-month CD rate, and share price index (source, *International Financial Statistics* (IMF)). M2 and interest rate for 90-day certificates of deposit. (source, *Central Bank Monthly Bulletin*). Industrial production and wage index (source, *Central Bank and DANE monthly bulletin*).

Quarterly. Unemployment rate (source, *Central Bank and DANE monthly bulletin*).

Denmark

Data Sample

January 1976–December 1993

List of Variables

m = log of broad money (M2), *p* = log of CPI prices, *y* = log of industrial production, I^o = average deposit rate, I^a = bond rate, *p** = log of German prices, *i** = German bond rate, *e* = log of krone/deutsche mark exchange rate, *w* = log of wage index, and *u* = log of unemployment rate.

Data Frequency and Data Sources

Monthly. Exchange rate (krone/deutsche mark), M2, industrial production, Danish consumer price index, German consumer prices index, Danish deposit interest rate, Danish government bond yield, and German government bond yield (source, *International Financial Statistics* (IMF)). Unemployment rate and wage index (source, *OECD Main Economic Indicators*).

Japan

Data Sample

February 1977–December 1997

List of Variables

m = log of broad money, *p* = log of CPI prices, *y* = log of industrial production, I^o = average CD rate, I^a = gensaki rate, *I* = 10-year bond rate, I^* = U.S. bond rate, p^* = log of U.S. prices, I^* = U.S. bond rate, *e* = log of yen/dollar exchange rate, *w* = log of wage index, *u* = log of unemployment rate, and *sp* = log of share price index.

Data Frequency and Data Sources

Monthly. Exchange rate (yen/U.S. dollar), Japanese consumer price index, U.S. consumer price index, industrial production, U.S. government bond yield, and share price index (source, *International Financial Statistics* (IMF)). M2 + CDs, Gensaki rate, CD rate, 10-year government bond, and nominal wage (source, *OECD Main Economic Indicators*).

Kenya

Data Sample

December 1975–December 1997

List of Variables

m = log of broad money, *p* = log of CPI prices, *y* = log of annually interpolated GDP, I^o = average rate on deposits from two to six months, I^a = 90 day t-bill rate, I^* = U.S. 6-month CD rate, p^* = log of U.S. prices, and *e* = log of shilling/dollar exchange rate.

Data Frequency and Data Sources

Monthly. Exchange rate (shillings/U.S. dollars), M2, Kenyan consumer price index, U.S. consumer price index, interest rate on deposits from two to six months, and 90-day treasury bill rate (source, *International Financial Statistics* (IMF)).

Annual. GDP (source, *International Financial Statistics* (IMF)).

Malaysia

Data Sample

June 1979–December 1996

List of Variables

m = log of broad money, p = log of CPI prices, y = log of industrial production, I^o = 3-month deposit interest rates for commercial banks, I^a = 3-month deposit interest rates for financial institutions, I^* = U.S. 6-month CD rate, p^* = log of U.S. prices, and e = log of ringgit/dollar exchange rate.

Data Frequency and Data Sources

Monthly. Exchange rate (ringgit/U.S. dollar), M2, Malaysian consumer price index, U.S. consumer price index, industrial production, and 3-month deposit interest rates for commercial banks (source, *International Financial Statistics* (IMF)). Three-month deposit interest rates for financial institutions (source, *Central Bank monthly bulletin*).

Uruguay

Data Sample

August 1981–December 1997

List of Variables

m = log of broad money, p = log of CPI prices, y = log of industrial production, I^o = interest rate on 1- to 6-month deposits, I^* = U.S. 6-month CD rate, p^* = log of U.S. prices, e = log of peso/dollar exchange rate, w = log of wages, and u = log of the unemployment rate.

Data Frequency and Data Sources

Monthly. Exchange rate (peso/U.S. dollar), M2, Uruguayan consumer price index, and interest rate on 1- to 6-month deposits (source, *International Financial Statistics* (IMF)). Wage index. (source, *Central Bank bulletin*).

Quarterly. Unemployment rate (source, CEPAL "Economic Survey"). Industrial production (source, *Central Bank bulletin*).

Table A1. Unit Root Tests Summary

Country	Variable	Order of Integration
Chile	Money (M2)	$I(2)$
	Prices	$I(2)$
	Income	$I(1)$
	Wages	$I(2)$
	Unemployment	$I(1)$
	Exchange rate	$I(1)$
	Interest rate on money	$I(1)$
Colombia	Money (M2)	$I(1)$
	Prices	$I(1)$
	Income	$I(1)$
	Exchange rate	$I(1)$
	Interest rate on money	$I(1)$
	Wages	$I(1)$
	Unemployment	$I(1)$
	Stock prices	$I(1)$
Denmark	Money (M2)	$I(2)$
	Prices	$I(2)$
	Income	$I(1)$
	Krone/Deutschemark exchange rate	$I(1)$
	German prices	$I(1)$
	Interest rate on money	$I(1)$
	Interest rate on other financial assets not in M2	$I(1)$
	German interest rate	$I(1)$
	Wages	$I(2)$
	Unemployment	$I(1)$
Japan	Money	$I(2)$
	Prices	$I(2)$
	Income	$I(1)$
	Exchange rate	$I(1)$
	Stock prices	$I(1)$
	Interest rates on money	$I(1)$
	Interest rate on other financial assets not in M2	$I(1)$
	Wages	$I(2)$
	Unemployment	$I(1)$

Table A1. *(concluded)*

Country	Variable	Order of Integration
Kenya	Money	$I(1)$
	Prices	$I(1)$
	Income	$I(1)$
	Dollar exchange rate	$I(1)$
	Interest rate on money	$I(1)$
	Interest rate on other financial assets not in M2	$I(1)$
	U.S. interest rate	$I(1)$
Malaysia	Money	$I(2)$
	Prices	$I(2)$
	Income	$I(1)$
	Dollar exchange rate	$I(1)$
	Interest rate on money	$I(1)$
	Interest rate on other domestic financial assets	$I(1)$
	U.S. 6-month CD interest rate	$I(1)$
Uruguay	Money	$I(2)$
	Prices	$I(2)$
	Income	$I(1)$
	Dollar exchange rate	$I(1)$
	Interest rate on money	$I(1)$
	U.S. CD rate	$I(1)$
	Wages	$I(2)$
	Unemployment	$I(1)$

This table reports the order of integration of each variable according to the results from augmented Dickey–Fuller (1981) unit root tests. Detailed results from these tests are reported in Martínez Pería (2000).

Table A2. Summary of Cointegration Tests: Number of Vectors

Country	Monetary Sector	Labor Sector	External Sector
Chile	3	1	1
Colombia	2	1	3
Denmark	2	2	1
Japan	1	1	2
Kenya	3	n.a.	1
Malaysia	4	n.a.	1
Uruguay	1	1	2

This table summarizes the number of cointegrating vectors found by performing Johansen's (1988) tests. For the monetary sector, cointegration tests are conducted for the variables in the vector $Z_t^{1\prime}=[m,p,y,I^o,I^a,\Delta p,t]$ where *m* is the logarithm of nominal or real M2, *p* is the logarithm of consumer prices, *y* is the logarithm of a measure of income, I^o is the rate of return on M2, and I^a is the return on alternative assets to those included in M2, such as government bonds or bills. Finally, *t* is a time trend. For the labor sector, if wages and prices are *I*(1), cointegration tests are conducted between the variables in the vector $Z_t^{2a\prime}=[w,u,p,t]$. *w* corresponds to the logarithm of nominal wages, *u* is the log of the unemployment rate, and *p* is the log of prices. For the countries where prices and wages are *I*(2), cointegration is tested among the variables in the vector $Z_t^{2b\prime}=[w\text{-}p,u,\Delta p,t]$ where *w-p* is the real wage (defined as the log of wages minus the log of prices). For the external sector, if domestic and foreign prices are *I*(1), cointegration tests are conducted for the vector of variables $Z_t^{3a\prime}=[p,e,p^*,I,I^*, t]$. In this case, *p* corresponds to the logarithm of domestic prices, *e* is the log of the exchange rate with respect to the U.S. dollar or deutsche mark depending on the country, *p** is the logarithm of the foreign price level (represented by the U.S. or German price level depending on the country), *I* is the domestic interest rate, and *I** is the corresponding foreign (U.S. or German) interest rate. When there is evidence that domestic prices could be *I*(2), cointegration among the variables in $Z_t^{3b\prime}=[p\text{-}e,p^*,\Delta p,I,I^*]$ is examined. The remaining variables are defined above. Detailed results for the Johansen tests can be found in Martínez Pería (2000). n.a. indicates that data on wages and unemployment was not available, therefore cointegration tests for the labor sector were not performed in these cases.

Table A3. Cointegration Vector Results–Monetary Sector

Country	Vector Name	Cointegration Vector
Chile	*ChiECrM2*	$m-p = -0.031{*}\Delta p + y + 0.0035{*}t$
		(0.003) (0.0005)
	ChiECytrend	$y = 0.0039{*}t$
		(0.0003)
	ChiECIown	I^{o}
Colombia	*ColECnM2*	$m = p + y + 0.0018{*}t$
		(0.0002)
	ColECIown	$I^{O} = -0.0308{*}t$
		(0.0089)
Denmark	*DenECrM2*	$m-p = -0.021{*}\Delta p + y + 0.06{*}I^{o} - 0.06{*}I^{A} - 0.19{*}capcon$
		(0.003) (0.007) (0.041)
	DenECinfl	$\Delta p = 0.007{*}y + 0.002{*}I^{O} - 0.001{*}I^{A} - 0.003{*}capcon - 0.00002t$
		(0.002) (0.0002) (0.0002) (0.0009) (0.0000)
Japan	*JapECrM2*	$m-p = -0.091{*}\Delta p + y + 0.239{*}I^{O} - 0.23{*}I^{A}$
		(0.0085) (0.049)
Kenya	*KenECnM2*	$m = p + y - 0.24{*}I^{A} + 0.017{*}t$
		(0.006) (0.003)
	KenECgdp	$y = 0.065{*}I^{O} + 0.001{*}t$
		(0.005) (0.001)
	KenECispr	$I^{o} = I^{A} - 0.04{*}t$
		(0.009)
Malaysia	*MysECrM2*	$m-p = -0.25{*}\Delta p + y$
	MysECytrend	$y = +0.008{*}t$
		(0.0001)
	MysECIown	$I^{o} = -0.037{*}t$
		(0.009)
	MysECIalt	$I^{A} = -0.038{*}t$
		(0.008)
Uruguay	*UruECrM2*	$m-p = -0.017{*}\Delta p + y + 0.018{*}I^{o} + 0.003{*}t$
		(0.003) (0.003) (0.001)

Table A3. Cointegration Vector Results–External Sector

Country	Vector Name	Cointegration Vector
Chile	*ChiECrPPP*	$p–e = –0.051*\Delta p+p*$
		(0.008)
Colombia	*ColECnPPP*	$p–e = p*$
	ColECIdom	I
	ColECIfor	$I*$
Denmark	*DenECrPPP*	$p–e = –0.01*\Delta p+p*$
		(0.002)
	DenECuip	$I = \Delta p+I*–0.015*t$
		(0.006)
Japan	*JapECrPPP*	$p–e = –0.164*\Delta p+p*+0.005*t$
		(0.018) (0.001)
	JapECuip	$I = \Delta p+I* + 0.024*t$
		(0.005)
Kenya	*KenECnPPP*	$p–e = +p* +4.016*I –4.016*I* –0.337*t$
		(0.013) (0.062)
	KenECidiff	$I = +1.05*I* + 0.084*t$
		(0.016)
Malaysia	*MysECrPPP*	$p–e = 0.269*\Delta p +p*$
		(0.0529)
Uruguay	*UruECrPPP*	$p–e = 0.007*\Delta p +p* +0.006*t$
		(0.0026) (3.129)
	UruECuip	$I = \Delta p +I* –0.049*t$
		(0.0181)

Table A3. Cointegration Vector Results–Labor Sector

Country	Vector Name	Cointegration Vector
Chile	*ChiECrwage*	$w–p = –0.01*\Delta p–0.228*u–0.002*t$ (0.002) (0.043) (0.0004)
Colombia	*ColECnwage*	$w–p = +0.001*t$ (0.0001)
Denmark	*DenECrwage*	$w–p = –0.042*\Delta p–1.26*u+0.027*t$ (0.024) (0.293) (0.001)
Japan	*JapECrwage*	$w–p = 0.029*\Delta p+0.001*t+0.007*DJuneT–0.007*DJuneT$ (0.008) (0.0002) (0.001)
Kenya	No data on wages and unemployment available.	
Malaysia	No data on wages and unemployment available.	
Uruguay	*UruECrwage*	$w–p = –0.0025*\Delta p – 0.348*u$ (0.0006) (0.0486)

This table reports the cointegrating vectors found by performing Johansen's (1988) cointegration tests for each sector where: *m* is the logarithm of nominal or real M2 (depending on the order of integration of M2), *y* is the logarithm of a measure of income (usually industrial production), I^o is the rate of return on M2 (in most cases an average deposit rate), and I^A is the return on alternative assets to those included in M2, such as government bonds or bills, *t* is a time trend, *w* corresponds to the logarithm of nominal wages, *u* is the log of the unemployment rate, *p* is the log of prices, $w-p$ is the real wage, Δp is the inflation rate, *e* is the log of the exchange rate with respect to the U.S. dollar or deutschemark depending on the country, *p** is the logarithm of the foreign price level (represented by the U.S. or German price level depending on the country), *I* is the domestic interest rate, and *I** is the corresponding foreign (U.S. or German) interest rate. Finally, *DJuneT* and *DJulyT* are dummies that equal 1 in June and July, respectively, interacted by a monthly time trend. These dummies are included in the wage equations for Japan to control for bonus payments that occur during these months. *Capcon* is a dummy that equals 1 for the period January 1983 through February 1998, the period after the removal of capital controls. Detailed results for the Johansen tests can be found in Martínez Pería, 2000.

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