UC Santa Cruz
UC Santa Cruz Previously Published Works

Title
How bad are twins? Output costs of currency and banking crises

Permalink
https://escholarship.org/uc/item/6bt7f4cw

Journal
Journal of Money Credit and Banking, 37(4)

ISSN
0022-2879

Authors
Hutchison, M M
Noy, I

Publication Date
2005-08-01

Peer reviewed

eScholarship.org Powered by the California Digital Library
University of California

Project MUSE®

MICHAEL M. HUTCHISON
ILAN NOY

How Bad Are Twins? Output Costs of Currency and Banking Crises

We investigate the output effects of banking and currency crises in emerging markets, focusing on whether "twin crises" entail especially large losses. Recent literature emphasizes the costs of financial crises, and suggests that twin crises are particularly damaging to the real economy. Using a panel data set for 1975–97, we find that currency (banking) crises are very costly, reducing output by about 5%–8% (8%–10%) over a 2–4 year period. The cumulative loss of both types of crises is therefore very large. We do not find, however, additional feedbacks or interactive effects associated with twin crises further damaging the economy.

JEL codes: F43, G15, G21, O40
Keywords: banking crisis, balance of payments, twin crisis, growth.

SEVERE FINANCIAL CRISES occur with some frequency in emerging market economies—more than 51 currency and 33 banking crises episodes over the past 25 years in our emerging markets sample and 20 occurrences of "twin crises"—currency and banking crises that occurred simultaneously. Moreover, this frequency of financial crises appears to be a reoccurring phenomenon, persistent over time and across regions of the world (Bordo et al., 2001, Glick and Hutchison, 2001). A large and growing empirical literature attempts to explain the factors that cause currency, banking, and twin crises, as well as their timing, on the basis of macroeconomic, institutional, and structural factors (see, for example, Arteta and Eichengreen, 2002,

We thank participants at the UCSC workshop series on currency crises for helpful suggestions on an earlier version of this paper, especially Joshua Aizenman, Menzie Chinn, two anonymous referees, and the editor of this journal.

MICHAEL M. HUTCHISON *is a Professor in the Department of Economics at University of California* (*E-mail*: hutch@ucsc.edu). ILAN NOY *is an Assistant Professor in the Department of Economics at University of Hawaii.* (*E-mail*: noy@hawaii.edu).

Received August 20, 2002; and accepted in revised form July 11, 2003.

Journal of Money, Credit, and Banking, Vol. 37, No. 4 (August 2005)
Copyright 2005 by The Ohio State University

Demirgüç-Kunt and Detragiache, 1998, Eichengreen, Rose, and Wyplosz, 1995, Frankel and Rose, 1996, Glick and Hutchison, 2001, Hutchison and McDill, 1999, Kaminsky and Reinhart, 1999, Sachs, Tornell, and Velasco, 1996).

There is also a growing literature on the effects of currency, banking, and twin crises on the economy. Theoretical work emphasizing channels of transmission through which output losses are associated with financial crises includes Aghion, Bacchetta, and Banerjee (2001a, 2001b), Céspedes et al. (2001), Chang and Velasco (2000b), Corsetti, Pesenti, and Roubini (1998), Dekle and Kletzer (2001), Dooley (2000), Goldfajn and Valdés (1997), McKinnon and Pill (1998), Paasche (2001), and Schneider and Tornell (2001). A sharp devaluation (*currency/balance of payments crisis*) may have a contractionary effect on output, working through such channels as a contraction in credit due to balance sheet deterioration of firms and financial institutions having extensive foreign currency liabilities or a sudden cessation in capital inflows. *Banking crises* may also have adverse effects on output by disrupting the process of credit intermediation. Any number of factors may induce a banking crisis (e.g., exogenous shock reducing the collateral value of assets, sunspot bank runs, and so on), and the transmission to the real economy may take the form of a financial accelerator, credit constraints, decrease in collateral values, disruption in the payments system, bankruptcies, and other channels (e.g., Bernanke and Gertler, 1989, Bernanke, Gertler, and Gilchrist, 1996, Kiyotaki and Moore, 1997).

The linkages between currency and bank crises—the twin crisis phenomenon—have also been addressed in the recent theoretical literature, including how these crises may adversely impact output. Most "third generation" currency crisis models with some combination of corporate credit flows, balance sheet currency mismatches (e.g., dollarization of liabilities), bank runs into foreign assets, international illiquidity, or international financial transaction costs raise the possibility of a "twin" crisis with adverse effects on the real economy (see, for example, Chang and Velasco, 2000a, 2000b, Dekle and Kletzer, 2001, Goldfajn and Valdés, 1997, Céspedes, Chang, and Velasco, 2001, Martin and Rey, 2002, Paasche, 2001, Schneider and Tornell, 2001). This joint occurrence may reflect a response to common factors or spillover effects running from currency crises to banking crises and vice versa. Chang and Velasco (2000a), for example, emphasize the role of international illiquidity as a common "fundamental." Another common fundamental factor frequently emphasized in this literature is financial liberalization combined with moral hazard incentives that induce banks to take on particularly risky portfolios, including unhedged foreign currency liabilities (e.g., Dooley, 2000, McKinnon and Pill, 1998). More generally, Kaminsky and Reinhart (1999, p. 474) argue that their analysis of the determinants of twin crisis "...point to common causes, and whether the currency or the banking crisis surface first is a matter of circumstance."

The cost on the real economy associated with a twin crisis may be measured separately as the additive effects of independent currency and banking crises. But there may also be other costs that arise from feedback and interaction effects associated with the simultaneous occurrence of the two events. That is, twin crises may be associated with disproportionately large output costs such that the "sum of

the parts" is indeed greater than either of the two types of crises acting alone. These disproportionately large effects associated with twin crises are often mentioned in attempts to explain the deep recessions experienced in East Asia in 1998 (e.g., Berg 1999). Kaminsky and Reinhart (1999), for example, suggest that twin crises can lead to vicious cycles that are especially damaging to the economy—though it is not clear whether a twin crisis would be larger than the combined effect of the two crises measured as if they were independent of each other.[1]

In light of recent theoretical developments and substantial policy interest, there is surprisingly little empirical literature systematically testing the extent to which financial crises impact output growth and no empirical article of which we are aware of that focuses on twin crises. The empirical evidence suggests that either a currency crisis or a banking crisis is, on average, associated with a reduction in output growth for one or more years. Recent empirical papers investigating the output costs of currency crises include Cavallo et al. (2002), Gupta, Mishra, and Sahay (2001), and Hutchison and Noy (2002b). Recent empirical studies investigating the output costs associated with banking crises include Arteta and Eichengreen (2002), McDill (2000), and Hutchison and McDill (1999). However, only a few articles, reviewed in Section 2, consider the impact of either a currency or a banking crisis—separately or jointly—on the real economy within the context of a single empirical model.

This article focuses on the output costs associated with twin crises in emerging market economies. Our objective is to examine separately the output costs of a currency crisis and a banking crisis, as well as their joint effect (twin crisis), using panel data that allow us to model growth dynamics with factors that vary both over time and across countries. In this context we are able to examine whether feedback effects, contagion, and linkages between domestic and international financial markets *make output losses of twin crises particularly severe.* In addressing this issue, we measure the direct effect of currency and banking crises (additive effect) as well as the *marginal* output growth effect of a simultaneous occurrence of a currency and banking crisis.[2] The maintained hypothesis is that the marginal effect is negative—there is something special about a twin crisis that makes output losses more severe than otherwise would be expected by simply considering the additive effect. However, we also consider the opposite possibility—a twin crisis may be greater than either a banking or currency crisis in isolation but the total effect may be less than the sum of the parts, i.e., the marginal effect is positive. This would occur, for example, if some of the same channels of transmission to the real economy were operative for both the currency and banking crisis and not reinforcing. We investigate these issues

1. Kaminsky and Reinhart (1999) write: "Financial-sector problems undermine the currency. Devaluations, in turn, aggravate the existing banking-sector problems and create new ones. These adverse feedback mechanisms...can be amplified, as we have seen in several of the recent Asian crises, by banks' inadequate hedging of foreign-exchange risk. The presence of vicious circles would imply that, a priori, the *twin crises are more severe than currency or banking crises that occur in isolation*." (p. 479) [Italics ours].

2. Indeed, only Bordo et al. (2001) address the potential effects of a twin crisis. They look at a cross-section of countries in recession and focus on whether the costs of rfinancial crises are the same today as over the century ending in 1971 (the collapse of Bretton Woods).

directly and apply our analysis to examine whether the East Asian output collapse in 1998 was likely associated with the fact that all of these nations experienced severe twin crises.

To this end, we investigate output growth developments for emerging market economies in a panel dataset over 1975–97. (Previous work has typically employed cross-sectional methodologies.[3]) We measure the impact of twin crises, carefully controlling for domestic and external factors, country time-invariant effects, and state of the business cycle. We employ the fixed-effects panel IV and GMM estimation procedures, respectively, of Hausman and Taylor (1981) and Arellano and Bond (1991). Several recent studies indicate that emerging markets may be different with respect to the factors that make them susceptible to a financial crisis (Glick and Hutchison 2001) and how they respond to them (IMF 1998). Specifically, emerging markets tend to be open to international capital inflows, and have experienced large private capital inflows that are typically short-term. This debt is also frequently denominated in foreign currency (generally the U.S. $). These large short-term foreign currency debt positions increase the vulnerability of these economies to swings in exchange rates and cessation of new capital to roll over existing debt (the "sudden stop" syndrome of Calvo, 1998). Furthermore, emerging markets tend to have more developed banking sector. Emerging markets therefore appear most vulnerable to twin crises and, potentially, their adverse consequences.[4] Accordingly, we focus our investigation on emerging markets. However, we also employ a much larger dataset that includes poorer developing countries to check the robustness of our results.

We find that currency (banking) crises are very costly, reducing output by about 5%–8% (8%–10%) over a 2–4 year period. The cumulative loss of both types of crises is therefore very large. We do not find, however, additional feedbacks or interactive effects associated with twin crises further damaging the economy. Our results are robust to the particular estimation procedure employed, to the inclusion of a broader sample of developing countries, and to alternative sets of control variables. Overall, we are able to explain close to 35%–50% of the variation in annual real GDP growth in emerging markets during 1975–97 using the three crisis indicators (currency, banking, and twins) and a host of control variables. Nonetheless, the model predicts (out-of-sample) much stronger East Asian real GDP growth in 1998 than what actually occurred.

Section 1 examines a few of the theoretical linkages between both types of crises and their effects on output costs. This selected literature review allows us to motivate the hypotheses tested in the empirical section. Section 2 reviews the empirical literature on the output growth effects of financial crises and highlights our contribution to the literature. Section 3 presents the basic empirical model. Section 4

3. Barro (2001) is the only exception we are aware of, and unlike our own annual panel, he uses a panel of 5-year averages.

4. A number of recent theoretical papers also suggest that emerging markets (middle income countries) will be more vulnerable and will respond differently to financial crises (e.g., Caballero and Krishnamurthy, 2002, Martin and Rey, 2002, Tornell and Westermann, 2002).

discusses the data employed in the study. Section 5 reports before/after (currency, banking, and twin crises) summary statistics on key macroeconomic variables and the primary empirical results of the study. This section presents estimation results of the output equations, model dynamics, and robustness checks. Section 6 presents predictions for output development in the East Asian crisis obtained by simulating our empirical results for the out-of-sample data for the five Asian 1998 crisis countries. Section 7 concludes the paper.

1. OUTPUT EFFECTS OF TWIN CRISES

There is a growing theoretical literature that models the joint occurrence and interaction between currency and banking crises. This work frequently falls within the group of third generation currency crisis models where financial crises typically have real effects on the economy. In this section we draw on this literature to motivate and formulate our hypothesis tests of the output effects of twin crises. We discuss the implications of several contributions, broadly representative of the recent literature, that develop direct linkages between currency and banking crises and their implications for the real economy.

Although much of the recent literature emphasizes the close and sometimes indistinguishable connection between currency and banking crises, Chang and Velasco (2000b) is of especial interest for our work since it analyzes cases where a currency (banking) crisis may occur without a banking (currency) crisis, as well their joint occurrence (twin crisis). They provide "...a detailed and formal account of the possible interactions between bank fragility and the exchange rate and monetary regimes"(p. 30) and show that different nominal regimes induce different real allocations and imply varying degrees of financial fragility. Their focus is how the form of the exchange rate regime influences the likelihood of each type of crisis, in turn brought on by self-fulfilling runs, and on the welfare implications. Expected utility in this framework is based upon consumption in a two-period model (and money balances necessary to purchase consumption goods), where the banking sector is modeled explicitly. In this model, banks accept short-term deposits and make decisions to invest either in short-term liquid assets or higher yielding illiquid assets. Bank runs may occur with or without a currency crisis and vice versa depending on a host of factors including the degree of dollarization, the extent of deposit insurance, the extent of international borrowing, the form of exchange rate regime, and other factors. Currency, banking, and twin crises are separately identifiable phenomena in their framework with different real allocations and welfare implications.

In related work, Chang and Velasco (2000a) emphasize the important interaction between banking crises and real exchange rate movements in a model with a banking sector and tradable and nontradable goods producers[5]. A banking crisis in its model increases the likelihood of a real depreciation because it leads to a credit crunch

5. Banerjee (2000) characterizes the Chang and Velasco (2000a) by its "...potentially nasty interaction between banking crises and real exchange rate movements."

(and the physical liquidation of bank assets), which in turn leads to a fall in the output of tradable goods. Real depreciation simultaneously leads to a loss of value in the nontradable goods sector, inducing bankruptcies among these firms, and increases the likelihood of a banking crisis. The latter results from the assumption that loans to the nontradable sector are part of the bank's more liquid assets. A banking crisis (currency crisis) may occur without a currency (banking) crisis, but raises the likelihood of a twin crisis occurring with an additional output cost to the economy. Self-fulfilling international bank runs are possible when short-term bank assets are large relative to central-bank reserves, but may also be induced by the refusal of domestic and foreign investors to roll over other (nonbank) short-term assets, as in a self-fulfilling public debt run.[6]

Aghion, Bacchetta, and Banerjee (2001a) also develop a model of currency crises in which the "crisis equilibrium" is accompanied by low output. In their model, currency depreciation leads to deterioration in firms' balance sheets, which, in a credit-constrained economy, reduces borrowing capacity and investment. This effect and channel of transmission is exacerbated if credit is further limited by a contemporaneous (and perhaps unrelated) banking crisis. Thus, not only does each type of crisis carry its own costs on the economy, but also the presence of a banking crisis might exacerbate the costs of a currency crisis. Other recent papers that emphasize imperfections in financial markets and their connections with currency crises are Paasche (2001), Schneider and Tornell (2001), Céspedes, Chang, and Velasco (2001), and Aghion, Bacchetta, and Banerjee (2001b).

Alternatively, a banking crisis may be exacerbated if a currency crisis occurs concurrently—a sharp devaluation at the time when many banks are teetering on the edge of insolvency may push many further into bankruptcy. This can happen directly if the banks' own exposure to currency risk is not hedged sufficiently, and indirectly if the currency crisis hurts borrowers and increases the banks' portfolios of nonperforming loans. Thus, the associated disruption to the payments system and credit markets can be made more severe than would have happened in the absence of a contemporaneous currency crisis. These interlinking channels lead to what Kaminsky and Reinhart (1999) call "vicious circles" in which one channel reinforces the other and leads to especially large output costs.

Cavallo et al. (2002) develop a model of currency crises characterized by dollarization of liabilities, and extend the models of Céspedes, Chang, and Velasco (2001) and Bernanke et al. (2000) by imposing margin constraints on the home country. Real devaluations reduce the value of domestic debt relative to international liabilities, deteriorating balance sheets, and may cause countries to hit the margin constraint. They model the financial constraints facing firms, but the balance sheet deterioration could be incorporated into a banking sector playing an intermediary function. Hitting the margin constraint in turn forces countries to sell domestic assets (for foreign assets), further depreciating the exchange rate and inducing overshooting. This "fire-sale" may induce a large negative wealth effect as in Krugman (2000). Cavallo

6. This point is emphasized by Roubini (2000) in a comment on Chang and Velasco (2000a).

et al. (2002) emphasize the linkages between balance sheet deterioration, high foreign debt levels, and the output costs associated with crises under fixed and flexible exchange rates.

These models illustrate that while the linkages between currency crises and banking fragility (corporate fragility) may be complex, they are at the core of many third generation currency crisis models. The three crisis forms are presented as distinct phenomena with potentially different consequences on the real economy. Our objective is to measure the real output costs of currency, banking, and twin crises. The literature reviewed suggests that all three crises should have a negative output effect, but is unclear precisely over the relative magnitudes. Based on our reading of the literature, however, it appears likely that the effect of a twin crisis is likely to be greater than either a currency or a banking crisis in isolation. This is our first maintained hypothesis. Secondly, much of the literature suggests especially damaging effects arising from a twin crisis. This may be interpreted in several ways, and we test the hypothesis that the adverse effect of a twin crisis is greater than the sum of its parts, i.e., that the interaction of a currency and banking crisis is significantly negative indicating that the twin crisis is especially damaging to the economy. Of course, it may be the case that the total negative effect on output from a twin crisis is less than the sum of negative effects attributed to a currency crisis and banking crisis. This could occur, for example, if there are overlapping channels of transmission associated with the two types of crises, thereby limiting the overall drop in output. In this case, the interaction effect would be significantly positive.

2. EMPIRICAL LITERATURE ON THE OUTPUT COSTS OF FINANCIAL CRISES

Several studies in the literature investigate the output costs of currency crises, but very few systematically analyze the costs of banking crises or both forms of crises taken together. Most important for our purposes, none of the studies of which we are aware measure the feedback and interactive effect on output arising from a twin crisis. Additionally, by employing a panel setup and implementing unbiased estimation procedures with instrumental variables, we obtain more detailed, nuanced and robust results than previous research in the area.

Most of the limited empirical literature on the output costs of currency and balance of payment crises focuses on single crisis episodes (e.g., Calvo and Mendoza, 1996, Lane and Phillips, 1999) or on episodes that are known to have been contractionary (e.g., Calvo and Reinhart 1999). Exceptions that analyze output developments around the time of a currency crisis in a broad sample of countries are Ahmed et al. (2002), Aziz, Caramazza, and Salgado (2000), Barro (2001), Bordo et al. (2001), Gupta, Mishra, and Sahay (2000), and Milesi-Ferretti and Razin (2000).

McDill (2000) and Demirgüç-Kunt et al. (2001) focus on the output cost of a banking crisis. McDill (2000) investigates the effect of banking crises on a panel

data set comprising industrial, emerging, and developing economies. She regresses output growth on contemporaneous banking crises and several control variables (lagged exchange rate depreciation, the real interest rate, lagged money growth, and lagged change in stock price). She finds that banking crises are associated with 1.2%–1.8% decline in output growth during each year of the banking crisis. Demirgüç-Kunt et al. (2001) consider a cross-section of 36 banking crises, investigating macroeconomic developments before, during, and after crisis episodes. They test differences in the developments of each variable (e.g., output growth) during these different periods (before, during, and after) using a regression that accounts for heterogeneity across countries. They find that a banking crisis is associated (contemporaneously) with a 4% decline in output growth and that growth remains depressed in the year following the crisis.

2.1 Output Costs of Twin Crises

Barro (2001) and Bordo et al. (2001) are the only papers, we are aware of, that attempt to measure the output cost of a currency crisis and a banking crisis in the same model. Barro (2001), however, measures the effects of these crises separately—the twin crisis phenomenon is not investigated. Bordo et al. (2001) consider the output costs of twin crises, but measure this phenomenon independently of currency and banking crises.

Specifically, Barro (2001) considers the pattern of 5-year average output growth in a broad panel covering industrial, emerging, and developing economies. He regresses 5-year output growth averages on conventional control variables (e.g., per capita GDP, schooling, life expectancy) and contemporaneous and lagged currency and banking crises. The crisis variable measures a (1, 0) dummy for a crisis occurrence anytime during the focal 5-year period. He finds that a currency (banking) crisis is associated with a 1.3% decline (0.6% decline) in average output growth over the 5-year period. He concludes that the combination of a currency and a banking crisis reduces growth contemporaneously by about 2% per year.[7]

Bordo et al. (2001), in their work most closely related to our own article, conduct a cross-sectional investigation of the effect of both kinds of financial crises and their twin effect on recessions. For their modern (1973–97) sample, they find that the cumulative output loss for a twin crisis over and above the average recession is 16% of GDP. This effect is measured separately from the 13% cumulative output loss that is found to be the combined effect of a banking and currency crisis (4.4% and 8.7%, respectively).[8] Overall, their result is ambiguous about the exact difference in outcomes between a twin and a combined currency and banking crisis phenomenon and their cross-sectional methodology does not allow them to differentiate between

7. It is noteworthy, however, that Barro (2001) also finds that the currency (banking) crisis is followed by a 0.6% (0.9%) and statistically significant *rise* in average output growth during the subsequent 5-year period. The net effect is an average 0.2% decline in output growth per year over the decade when a currency crisis coincides with a banking crisis.

8. The equivalent results for their 1880–1997 sample are 14.8%, 3.2%, and 7.8%, respectively.

these different hypotheses nor to trace the dynamics of the output developments in detail.

3. ESTIMATING THE EFFECTS OF CURRENCY, BANKING, AND TWIN CRISES ON REAL OUTPUT GROWTH

Our contribution is to measure output costs of currency and banking crises, as well as their joint occurrence, in a panel framework for emerging markets. We pay particular attention to the additional output cost of a twin crisis, over and above that that may be associated with currency and banking crises viewed as separate phenomena**.** Unlike other literature in this area, we estimate a panel model with annual data and control for bias associated with estimation of fixed-effects dynamic panel models. By estimating this model for emerging market economies, we are also able to address whether twins are especially problematic in general terms and whether the deep recessions in East Asia were typical of the "bad" outcome of a twin crisis.

Our methodological approach begins by explaining output growth in emerging markets by a standard set of variables as well as currency, banking, and twin crises. The determinants of output in this model are a set of domestic policy, structural, and external factors, as well as country-specific effects and lagged output growth. Domestic policy factors are changes in government budget surpluses and credit growth. External factors are growth in foreign output and real exchange rate overvaluation. The structural factor we consider is the openness of the economy to international trade. Country-specific effects are introduced in order to account for the widely varying average growth experiences in our set of emerging market economies over the past 25 years. All of the variables, with the exception of foreign output growth, are introduced with a 1-year lag in order to capture the delayed response of output to macroeconomic developments. Our main concern in this context is to introduce relevant control variables into the regression equation so that the identified impact of a crisis on output growth is not simply due to omitted-variables bias. Plausible additional variables that appear in the empirical literature on growth are numerous (see, for example, Sala-i-Martin 1997). We preserve our parsimonious specification so that our sample, already limited to emerging markets, is not narrowed further.

In the context of our "benchmark" model, we test for the additional effect on output growth arising from a currency, banking, and twin crises. We consider both lagged and contemporaneous effects of crises on output growth, and also estimate several variants of the model, including changes in the lag structure and definition of crises, to check the robustness of the basic results. Since we are controlling for a host of factors that influence the evolution of output growth, the coefficient estimates on our financial crisis indicators (currency, banking, and twin) may be interpreted as the marginal effects of crises.

The formal specification of the empirical model is as follows. The growth of real GDP for the ith country at time t (y_{it}) is explained by policy variables ($x_{i(t-1)}$),

external and structural factors ($w_{i(\cdot)}$), the recent occurrence of a currency or a banking crisis ($D^{CC}_{i(\cdot)}, D^{BK}_{i(\cdot)}$), a twin crisis ($D^{CC}_{i(\cdot)} * D^{BK}_{i(\cdot)}$), and an unobservable random disturbance (ε_{it})

$$y_{it} = \mu_0 + \beta_k x_{i(t-1)} + \alpha_h w_{i(\cdot)} + \beta^{CC} D^{CC}_{i(\cdot)} + \beta^{BK} D^{BK}_{i(\cdot)} + \beta^{TW}(D^{CC}_{i(\cdot)} * D^{BK}_{i(\cdot)}) + \varepsilon_{it}\,, \tag{1}$$

where x is a k-element vector of policy variables for country i at time t, w is an h-element vector of external variables for country i at times (t or $t-1$), $D^{CC}_{i(t)}$ is a dummy variable equal to unity if the country has recently experienced a currency crisis or balance of payments crisis (and zero otherwise) and likewise for a banking and twin crises. The ε_{it} is a zero mean, fixed variance, disturbance term and μ_0 is a vector of country effects (allowing average growth rates to vary across countries in the sample), β_k is a k-element vector measuring the impact of policy changes on output, α_h is an h-element vector measuring the impact of exogenous factors on output, and β^{CC}, β^{BK}, and β^{TW} measure the output growth effects of currency, banking, and the marginal effect of a twin crises, respectively.

In our main estimates we follow a procedure first suggested by Hausman and Taylor (1981) that takes into account the bias in estimation of a dynamic panel with predetermined and endogenous variables. For a rigorous formulation of this bias, see Nickell (1981). This three-step estimation methodology is an instrumental variable estimator that takes into account the possible correlation between the disturbance term and the individual country-specific effects.

In the first step, least squares estimates (with fixed effects) are employed to obtain consistent but inefficient estimates for the variance components for the coefficients of the time-varying variables. In the second step, an FGLS procedure is employed to obtain variances for the time-invariant variables. The third step is a weighted IV estimation using deviation from means of lagged values of the time-varying variables as instruments.[9] We do not assume the exclusionary restrictions on the lag structure that would be necessary to solve the problem of simultaneous equations, and therefore interpret our results as correlations/associations between financial crises and output growth rather than causality.[10]

While the Hausman–Taylor (HT) procedure provides asymptotically unbiased estimates, a recent literature suggests that it is not the most efficient estimator possible. More efficient General Methods of Moments (GMM) procedures rely on utilizing

9. For exact details on the motivation and estimation procedure, see Greene (2002) and Hausman and Taylor (1981).

10. Consider, for example, a simple two-equation simultaneous model (real output growth and currency crisis are the endogenous variables) with lagged dependent variables and country-specific effects (dynamic fixed-effects model). The HT estimation procedure would address the simultaneity problem (as well as the dynamic fixed-effects bias) and provide consistent estimates of all the coefficients if we were to impose particular exclusionary restrictions. In this example we could consistently estimate the system by excluding the effect of lagged output growth on the contemporaneous likelihood of a financial crisis and excluding the effect of lagged currency crisis on contemporaneous output growth. However, given the literature on the determinants of financial crises—and our own results on the dynamic output effects of crises—we do not find these assumptions plausible.

more available moment conditions to obtain a more efficient estimation (e.g., Ahn and Schmidt, 1995, Arellano and Bond, 1991, 1998).[11] This procedure, however, is usually employed in estimation of panels with a large number of individuals and short time-series such as in the literature on long-run growth (Bond, Hoeffler, and Temple 2001). In our case, the data make this procedure difficult to implement for most specifications of the model. We provide results using the Arellano and Bond (1998) GMM framework and show that our coefficients do not change noticeably when compared to the benchmark Hausman and Taylor (1981) estimates.[12]

4. DATA DESCRIPTION

The basic panel data set for the analysis consists of 24 emerging market economies over 1975–97.[13] We define emerging markets as developing economies with real income of at least $2000 (PPP adjusted) in 1992. The other requirements are that each emerging market economy in the sample has at least 10 years of continuous annual GDP data and a population of at least one million.

4.1 Defining Currency and Balance of Payments Crises

Our indicator of currency and balance of payments crises is constructed by identifying "large" values in an index of currency pressure, defined as a weighted average of monthly real exchange rate changes and monthly (percent) international reserve losses.[14] Following convention (e.g., Kaminsky and Reinhart 1999) the weights are inversely related to the variance of changes of each component over the sample for each country. This excludes some large depreciations that occur during high inflation episodes, but it avoids screening out sizeable depreciation events in more moderate inflation periods for countries that have occasionally experienced periods of hyperinflation and extreme devaluation. Our measure presumes that any nominal currency changes or reserve changes associated with exchange rate pressure should affect the purchasing power of the domestic currency, i.e., result in a change in the real exchange rate (at least in the short run). An episode of serious exchange rate pressure, a standard crisis episode, is defined as a value in the index that exceeds the mean plus two times the country-specific standard deviation, provided that it also exceeds 5%. The first condition ensures that, relative to its own history, unusually

11. For a detailed survey of asymptotic consistency results and GMM estimation methods casting doubts on some of the results in this literature, see Arellano and Honoré (2001) and Bond, Hoeffler, and Temple (2001).

12. We use the LIMDEP software suite in all our estimations. We thank William Greene for providing us with an update of the LIMDEP package.

13. The countries we include are Argentina, Brazil, Chile, Columbia, Costa Rica, Cyprus, Hong Kong, Indonesia, Jordan, Korea, Malaysia, Malta, Mauritius, Mexico, Panama, Philippines, Singapore, South Africa, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uruguay, and Venezuela. Details on the crisis dates are available in the working paper version Hutchison and Noy (2002a).

14. Our currency pressure measure of crises does not include episodes of defense involving sharp rises in interest rates. Data for market-determined interest rates are not available for much of the sample period in many of the countries in our dataset.

large values of the index of currency pressure are counted as a crisis while the second condition attempts to screen out values that are insufficiently large in an economic (real) sense. Major currency crises are identified using a 3-standard deviations threshold point.

For each country-year in our sample, we construct binary measures of currency crises, as defined above (1 = crisis, 0 = no crisis). A currency crisis is deemed to have occurred for a given year if the currency pressure index for any month of that year satisfies our criteria. To reduce the chances of capturing the continuation of the same currency crisis episode, we impose windows on our data. In particular, after identifying each large indication of currency pressure, we treat any similar threshold point reached in the following 24-month window as a part of the same currency episode and skip the years of that change before continuing the identification of new crises. With this methodology, we identify 51 currency crises, 68 crisis years, and 42 major currency crises for our emerging markets dataset over the 1975–97 period (see Table 1).

In order to test the robustness of the results obtained by using our binary currency crisis identification algorithm, we also use the underlying currency pressure index (as well as an index taking into account exchange rate fluctuations alone) in our empirical analysis.

4.2 Defining Banking Crises

Banking problems are usually difficult to identify empirically because of data limitations. The potential for a bank run is not directly observable and, once either a bank run or large-scale government intervention has occurred, the situation most likely will have been preceded by a protracted deterioration in the quality of assets held by banks. Identifying banking-sector distress by the deterioration of bank asset quality is also difficult since direct market indicators of asset value are usually lacking. This is an important limitation since most banking problems in recent years are not associated with bank runs but with deterioration in asset quality

TABLE 1

Frequency of Banking and Currency Crises in Emerging Markets

	Threshold	Number of events
Currency crisis episodes	Standard	51 (9%)
	Major	42 (8%)
Currency crisis years	Standard	68 (12%)
Banking crisis episodes	Standard	33 (7%)
	Major	21 (4%)
Banking crisis years	Standard	105 (21%)
Twin crisis episodes	Standard	20 (3%)

Notes: The sample consists of annual observations for 24 emerging markets for the years 1975–97. For our selection procedure and details on definitions, see Section 4. For a list of crisis episodes, see the working paper version (Hutchison and Noy 2002a, p. 33). The number in parentheses is the percent of total annual observations in the sample associated with each type of crisis. A standard crisis is defined as a deviation of the currency pressure index of more than 2 standard deviations from the country-specific mean (3 standard deviations for major crises). See Section 4 for details on the definitions of standard and major banking crises. Twin crisis is defined as instances of a standard currency crisis at (t) with a banking crisis occurring during a 2-year band before or after the currency crisis.

and subsequent government intervention. Moreover, it is often laxity or failure of government analysis in identifying banking fragility, and slow follow-up action once a problem is recognized, that allows the situation to deteriorate to the point of a systemic crisis involving large-scale government intervention.

Our measure identifies and dates episodes of banking-sector distress following the criteria of Caprio and Klingebiel (1996, and updated in 1999) and Demirgüç-Kunt and Detragiache (1998). If an episode of banking distress is identified in either study, it is included in our sample. If there is ambiguity over the timing of the episode, we use the dating scheme of Demirgüç-Kunt and Detragiache (1998) since it tends to be more specific about the precise start and end of each episode.[15] Major bank crises are taken from Caprio and Klingebiel (1999) and defined as posing a substantial threat to the entire financial system.

Our emerging markets' dataset over the 1975–97 period includes 33 banking crises, 105 crisis years, and 21 major banking crises. Thus, the average duration of a banking crisis is 3.2 years while the average duration of a currency crisis is only 1.3 years.

4.3 Defining Twin Crises

Our definition of twin crises, taken from Glick and Hutchison (2001), marks a crisis if the onset of a banking crisis occurred 2 years before, during, or after the onset of a currency crisis. We use this definition to allow for the imprecise identification of the timing of banking crises previously discussed. Using a narrower 1-year band does not qualitatively alter our results. We identify 20 instances of a twin crisis in our dataset.

4.4 Control Variables in the Output Growth Equation

The domestic policy factors included in our estimation are lagged changes in government budgets and lagged credit growth; external factors are (trade-weighted) external growth rates of the G-3 and lagged index of real exchange rate overvaluation; and the structural factor we consider is the openness of the economy to international trade.[16] All of the macroeconomic data series are taken from the International

15. Demirgüç-Kunt and Detragiache (1998) identify banking-sector distress as a situation where one of the following conditions hold: ratio of nonperforming assets to total assets is greater than 2% of GDP; cost of the rescue operation was at least 2% of GDP; banking-sector problems resulted in a large-scale nationalization of banks; and extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were enacted by the government in response to the crisis. Caprio and Klingebiel (1996) do not offer a systematic identification scheme but rely on expert opinions solicited from varied sources. They identify a systemic crisis as one in which "much or all of bank capital [was] being exhausted". Arteta and Eichengreen (2002) compare these sources and others and conclude that their empirical results do not depend on the banking identification scheme used.

16. The "openness" variable is defined as the sum of imports and exports relative to GDP. Real exchange rate overvaluation is defined as deviations from a fitted trend in the real trade-weighted exchange rate. The real trade-weighted exchange rate is the trade-weighted sum of the bilateral real exchange rates (defined in terms of CPI indices) against the U.S. dollar, the German mark, and the Japanese yen. The trade-weights are based on the average bilateral trade with the U.S., the European Union, and Japan in 1980 and 1990.

Monetary Fund's IFS CD-ROM. As stated above, a limited number of control variables were used so as not to restrict the sample further. The control variables represent a standard set of variables used in short-run growth literature, avoiding obvious omitted-variables bias in the results.

The minimum data requirements to be included in our study are that GDP figures are available for a minimum of 10 consecutive years over the period 1975–97. We use annual observations. We employ monthly data for our (real) exchange rate and international reserves pressure index to identify currency crises and date each by the year in which it occurs. Banking crises are identifiable only in annual data.

5. EMPIRICAL RESULTS

5.1 Conditional Probabilities for Crises Onsets

Table 2 presents hypothesis tests on the likelihood that currency and banking crises (twins) are statistically independent. The hypothesis that banking and currency crises are not correlated can be rejected with probability of more than 99%. For our sample, the onsets of 31% of banking crises were accompanied by currency turmoil. Furthermore, there is a statistically significant correlation between lagged banking crises and contemporaneous currency crises but not vice versa. This result is similar to that found in Glick and Hutchison (2001) for a broader dataset including developing countries as well as emerging markets.[17]

5.2 Macro Developments: Before/After Crises Statistics

Table 3 presents summary statistics on key macroeconomic developments around currency (Panel A) and banking (Panel B) crises. It presents before/after statistics

TABLE 2

BANKING AND CURRENCY CRISES: CONDITIONAL PROBABILITIES

	Standard banking crises	Major banking crises
Percentage of banking crisis onsets associated with a contemporaneous onset of currency crisis	31 (0.00)	38 (0.00)
Percentage of currency crisis onsets associated with a contemporaneous banking crisis	20 (0.00)	16 (0.00)
Percentage of banking crisis onsets associated with a previous ($t - 1$) currency crisis	6 (0.52)	5 (0.45)
Percentage of currency crisis onsets associated with a following ($t + 1$) banking crisis	4 (0.52)	2 (0.45)
Percentage of banking crisis onsets associated with a following ($t + 1$) currency crisis	21 (0.03)	24 (0.06)
Percentage of currency crisis onsets associated with a previous ($t - 1$) banking crisis	13 (0.03)	9 (0.06)

NOTES: Sample is the same as in Table 1. In parenthesis we include the probability that the two series defined on the left are independent. The probability is based on a chi-squared statistic once both binary series are assumed to be i.i.d over all observations (across both time and countries). For the definitions of standard and major banking crises, see Section 4 and references therein.

17. This result is consistent with the find, reported in Glick and Hutchison (2000), that causality is more likely to run from banking to currency crises and not, as is sometimes portrayed for the turmoil in East Asia, from a currency crisis to a systemic banking failure.

TABLE 3

DESCRIPTIVE STATISTICS

	Type of crisis	$t-2$	$t-1$	T	$t+1$	$t+2$
A. Currency Crises[a]						
Real GDP growth rate (%)	Currency	4.0	2.7	1.4	1.7	3.6
	Currency (but no banking)	3.6	2.4	1.9	1.7	3.6
	Twin (currency and banking)	4.3	4.9	0.7**	1.0	2.1
Change in budget surplus (%)	Currency	−1.2	−1.4	−1.1	−1.0	−1.1
	Currency (but no banking)	−0.9	−1.1	−1.2	−1.2	−1.2
	Twin (currency and banking)	−1.4	−2.1	−1.1	−1.9	−0.5
Inflation rate (%)	Currency	30.5	31.6	36.3	43.4	42.0
	Currency (but no banking)	28.1	25.9	23.8	33.0	35.0
	Twin (currency and banking)	43.2	53.2	67.9	57.6	50.1
RER overvaluation measure	Currency	8.0	14.7*	1.6**	−6.8*	−4.3
	Currency (but no banking)	12.1	18.1	4.1**	−6.7**	−4.8
	Twin (currency and banking)	−0.4	7.4	3.0	4.0	−2.8
B. Banking Crises[b]						
Real GDP growth rate (%)	5.1	5.1	1.0**	5.9**	6.5	
Change in budget surplus (%)	−0.5	−1.3	−0.8	−0.4	−0.2	
Inflation rate (%)	29.7	32.5	33.6	29.0	26.5	
RER overvaluation measure	1.5	8.3*	4.1	−6.5**	−3.7	

NOTES: Sample as in Table 1. * and ** denote rejection of same mean as the number to the left with 5% and 1% confidence levels. [a]We identify the onset of each standard currency crisis and describe averages of the macroeconomic variables for the two years before the crisis ($t-2$, $t-1$), the crisis years (t), and the 2 years following the end of the crisis episode ($t+1$, $t+2$). We differentiate between those currency crisis episodes that were not accompanied by a contemporaneous banking crisis and those that were (for exact definition of twin crises, see Section 4). [b]We employ our measure of standard banking crises (see Section 4).

for the standard definitions of "normal" currency, banking, and twin crises mentioned above. Four-year windows are imposed on the data to clearly delineate the macroeconomic developments around the time of crisis.

Our focus variable, real GDP growth, shows an average decline of about 1.3% in the year a currency crisis takes place, and it recovers only minimally the following year (by 0.3%). Average output growth goes back to its previous level 2 years after the crisis, and this upturn is statistically significant. This pattern is almost identical for standard and major crises (not reported for brevity). Average losses appear to be even smaller for our subsample of currency crises without banking crises (reducing output growth by only 0.5%).

By contrast, output developments around banking crises are striking by the very large costs involved (4.1% for each year of the crisis). Output growth dynamics surrounding twin crises are similar and appear to entail a reduction of 4.2% in the year of the crisis, followed by sustained depressed output for the following 2 years. Hence, at first pass, the summary statistics indicate significant and—in some cases—prolonged effects of financial crises and twin crises in particular. We focus on more formal tests of this proposition in the subsections below.

Interestingly, there are no evident statistical trends in the evolution of the budget surplus.[18] Inflation rates trend upward starting from before the onset of either a currency or twin crisis, but not a banking one. More pertinent is the fact that twin crises occur more frequently in countries with higher inflation rates before, during, and after the crisis episode when compared to other crisis episodes. Our index for real exchange rate overvaluation shows dynamics that can be expected given the fact that it is a key element used to identify currency crises.

5.3 Benchmark Model Estimates

Table 4 presents results from our benchmark model. The statistically significant control variables are external output growth, real exchange rate overvaluation, and lagged output growth. A 1% rise in the growth rate of the G-3 economies (Row 4) raises output growth in emerging market economies by about, on average, 0.3%–0.4%. A rise in real exchange rate overvaluation (Row 5) significantly reduces output growth. This is noteworthy in its own right, indicating that emerging market economies should avoid currency overvaluation. However, budget changes, credit growth, and the openness measure are not statistically significant. The coefficient estimates for the control variables are consistent across alternative specifications of the model reported in Table 4 and in the other tables.

Turning to the key variables of interest, the coefficient estimates reported in Column (2) Rows (9) and (10) of Table 4 indicate that a currency crisis is associated with a contemporaneous (lagged) fall in GDP growth of about 2.9% (2.5%). Very similar results are obtained, but not reported for brevity, when including only the

18. While not presented here, the same is true for credit growth rates. Foreign interest rates typically rise about 100 basis points on average and foreign growth rates decline modestly surrounding currency crises.

TABLE 4

Output Growth and Currency Crises—Benchmark Dependent Variable: Real GDP Growth Rate (Hausman–Taylor Estimation)

		(1)	(2)[a]	(3)	(4)	(5)
1	Real GDP growth ($t-1$)	0.327** (6.75)	0.213** (4.33)	0.266** (5.47)	0.249** (4.87)	0.240** (4.72)
2	Change in budget surplus to real GDP ratio ($t-1$)	−1.601 (−0.21)	−1.369 (−0.19)	−0.385 (−0.05)	−0.678 (−0.09)	−2.460 (−0.32)
3	Credit growth ($t-1$)	−0.009 (−1.38)	−0.008 (−1.21)	−0.007 (−1.05)	−0.007 (−1.04)	−0.006 (−0.88)
4	External growth rates—weighted average (t)	0.360** (3.42)	0.394** (3.96)	0.381** (3.75)	0.386** (3.77)	0.390** (3.81)
5	Real exchange rate overvaluation ($t-1$)	−0.024* (−1.88)	−0.033** (−2.73)	−0.028* (−2.28)	−0.029* (−2.28)	−0.019 (−1.39)
6	Openness (t)	0.011 (1.05)	0.010 (0.92)	0.010 (0.97)	0.010 (0.95)	0.010 (0.89)
7	Currency crises onset dummy—lead ($t+2$)					−0.457 (−0.66)
8	Currency crises onset dummy—lead ($t+1$)					−1.558* (−2.21)
9	Currency crises onset dummy (t)		−2.930** (−5.02)	−2.453** (−3.78)	−2.622** (−3.93)	−2.793** (−4.16)
10	Currency crises onset dummy—lag ($t-1$)		−2.547** (−4.12)	−2.634** (−3.77)	−2.671** (−3.64)	−2.838** (−3.87)
11	Currency crises onset dummy—lag ($t-2$)				−1.008 (−1.31)	−1.034 (−1.35)
12	Currency crises onset dummy—lag ($t-3$)				0.545 (0.71)	0.470 (0.61)
13	Currency crises onset dummy—lag ($t-4$)				−0.066 (−0.08)	0.010 (0.01)
	Adjusted R^{2}[b]	0.27	0.37	0.32	0.32	0.33
	Number of observations	374	374	373	370	370
	Correlation of error terms	0.09	0.11	0.09	0.11	0.12

Notes: The sample consists of annual observations for 24 emerging markets for the years 1975–97. Missing observations are skipped during estimation. For our selection procedure and details on definitions of all variables, see Section 4. For a list of crisis episodes, see the working paper version (Hutchison and Noy 2002a, p. 33). We use the Hausman and Taylor (1981) estimation procedure (for details, see Section 3 and references therein). * and ** denote significance at the 5% and 1% confidence levels, respectively. [a]The regression in Column (2) uses all identified crisis years instead of the "onset" variable used in Columns (3)–(5). [b]The adjusted R^2 reported is for the fixed-effects least squares stage in the Hausman–Taylor procedure.

contemporaneous or the lagged currency crisis binary variable. After a 2-year period, a currency crisis is associated with an output growth decline of about 5.5%.

Table 4 also presents more information on the dynamics of output adjustment at the time of currency crises. To allow for additional lagged values, we focus attention on the currency crisis "onset"—the initial year of the currency crisis. Column (3) reports the analogous regression to Column (2) using the onset version of the variable. Not surprisingly, since most currency crises have duration of only about 1 year, the results of Column (3) are very similar to those reported in Column (2) with a cumulative output effect of 5.1%. Adding further lags (second, third, and fourth year lags) to the model, reported in Column (4) Rows (11–13), indicate that the contemporaneous and 1-year ahead effects of a currency crisis remain negative and highly significant and with roughly the same magnitudes as reported previously. This is followed by a substantially negative, but statistically insignificant, effect on the second year following a crisis and eventually a (insignificant) positive output effect in the third and fourth years. Thus, output growth in emerging markets declines for about 1–2 years following a currency crisis. This result remains when the insignificant lags are dropped. Our results therefore do not indicate a persistent link—beyond a 2-year horizon—between crises and output growth.

We also include lead values of currency crises in the equations, shown in Column (5) Rows (7) and (8), to further investigate the dynamic responses. Only one of the lead value coefficients, the 1-year lead value of currency crises, is statistically significant. This result indicates that a currency crisis tends to follow, by about a year, a decline in real output growth. On the other hand, a currency crisis also is associated with a further decline in output growth contemporaneously and over a period of 2 years. These model estimates suggest that, within 2–3 years, output declines cumulatively by almost 8% for an average currency crisis in an emerging market economy.

An important question is whether a particularly severe crisis—substantially larger than the normal crisis—is related to an especially severe decline in growth. To investigate this issue, we introduce a "major" currency crisis variable that is identified by a threshold point in our pressure index that exceeds 3 standard deviations from the mean. For brevity, we do not report these results. Somewhat surprisingly, the output effects of a major crisis are not larger than the typical crisis situation. Coefficients for a version of Column (3) using the major crisis measure yield coefficients of –2.3 and –2.8 for the contemporaneous and lagged major currency crisis variables, respectively. Major currency crises do not appear to have a substantially different association with output growth than the standard crisis (identified using a 2-standard deviation threshold).

5.4 Banking and Twin Crises

The full results for our model are reported in Table 5. Columns (1) and (2) Row (11) report the cost of a banking crisis with and without the inclusion of lagged and contemporaneous currency crises variables. In both cases, banking crises are costly: 3%–3.5% of GDP growth is lost for each year of the crisis. As an

TABLE 5

Output Growth, Banking Crises, and Twin Crises Dependent Variable: Real GDP Growth Rate (Hausman–Taylor Estimation)

		(1)	(2)	(3)	(4)	(5)
1	Real GDP growth ($t-1$)	0.234** (4.60)	0.139** (2.84)	0.146** (2.88)	0.193** (3.73)	0.146** (2.87)
2	Change in budget surplus to real GDP ratio ($t-1$)	−2.497 (−0.34)	6.030 (0.85)	6.172 (0.87)	6.453 (0.88)	6.363 (0.89)
3	Credit growth ($t-1$)	−0.008 (−1.20)	0.002 (0.35)	0.003 (0.45)	0.002 (0.36)	0.003 (0.45)
4	External growth rates—weighted average	0.397** (3.85)	0.335** (3.42)	0.337** (3.43)	0.330** (3.27)	0.342** (3.44)
5	Real exchange rate overvaluation ($t-1$)	−0.004 (−0.30)	−0.016 (−1.41)	−0.016 (−1.36)	−0.013 (−1.07)	−0.015 (−1.23)
6	Openness	0.019 (1.36)	0.016 (1.23)	0.017 (1.26)	0.023* (1.92)	0.017 (1.26)
7	Currency crises dummy (t)		−2.427** (−4.28)	−2.363** (−4.09)		−2.412** (−4.02)
8	Currency crises dummy ($t-1$)		−1.853** (−3.15)	−1.852** (−3.14)	−1.885** (−3.12)	−1.856** (−3.14)
9	Magnitude of currency crisis (t)					0.184 (0.30)
10	Leading banking crises dummy ($t+1$)				0.467 (0.58)	
11	Banking crises dummy (t)	−3.541** (−6.36)	−3.074** (−5.84)	−2.958** (−5.21)	−3.108** (−5.23)	−2.957** (−5.20)
12	Banking crises dummy ($t-1$)				0.809 (0.87)	
13	Twin crises dummy (t)			−0.559 (−0.57)	−1.344 (−1.37)	−0.616 (−0.62)
	Adjusted R^{2a}	0.34	0.47	0.45	0.41	0.44
	Number of observations	342	333	333	333	333
	Correlation of error terms	0.22	0.24	0.25	0.22	0.25

Notes: The sample consists of annual observations for 24 emerging markets for the years 1975–97. Missing observations are skipped during estimation. For our selection procedure and details on definitions of all variables, see Section 4. For a list of crisis episodes, see the working paper version (Hutchison and Noy 2002a, p. 33). We use the Hausman and Taylor (1981) estimation procedure (for details, see Section 3 and references therein). * and ** denote significance at the 5% and 1% confidence levels, respectively. [a]The adjusted R^2 reported is for the fixed-effects least squares stage in the Hausman–Taylor procedure.

average banking crisis lasts 3.3 years, the cumulative output loss amounts to around 10% of GDP.

A central result is presented in Column (3) Row (13) of Table 5; the coefficient on the twin crisis interactive variable is negative but not statistically different from zero. Furthermore, the coefficients on the currency and banking crises variables stay almost exactly the same (−4.2 and −3.0, respectively). Neither does the inclusion of leads and lags for the banking crisis dummy, reported in Column (4) Rows (10) and (12), substantially changes the magnitude of these coefficients.[19]

The joint occurrence of crises is associated with a very large average decline in output growth—depressing GDP by about 15–18% over a 3–4 year period.[20] Moreover, it appears that contagion between crises is a serious problem in emerging markets so that the threat (probability) of a twin crisis is significant given that either a banking or a currency crisis occurs. However, twin crises are not associated with any additional marginal effect on output above and beyond the effect of the contemporaneous occurrence of a banking and currency crisis. Twin crises are bad in that they entail output losses associated with both a currency and banking crisis, but there do not appear to be additional feedback effects further damaging the economy.

In Column (5) we examine whether the magnitude of the balance of payments crisis, proxied by the deviation of the currency pressure index (measured in standard deviations) from its country-specific mean. The inclusion of this variable does not appear to contribute to the explanatory power of the model nor does it substantially change the estimated coefficients on all our crisis variables. In results not reported here (available upon request), we also employ the same specifications as the one in Column (5) but with a currency pressure index constructed only from the changes in the real exchange rate (i.e., excluding international reserve losses). These results are almost identical.

5.5 Robustness Tests

To check the robustness of our results we first examine whether our estimation technique, based on the Hausman and Taylor (1981) IV estimator, gives similar coefficient estimates from those obtained by the standard least squares fixed effect estimator (LSDV) or the more efficient first-differenced GMM estimator suggested by Arellano and Bond (1991, 1998). These results are reported in Table 6 (Columns 1–3) where we also include the HT estimation for exactly the same sample.[21] There is very little difference between the coefficients obtained on our focus variables—currency and banking crises—in all three estimation techniques. As can be expected, the GMM estimator yields much higher *t*-statistics.

19. Interestingly, both the coefficients on the lead and lag of banking crises are insignificantly different from zero as well.

20. This figure is derived from the average duration of both types of crises.

21. The sample here is somewhat smaller than the one used in the results reported in Tables 4 and 5. The GMM estimator poses both data restrictions and restrictions on the models that could be estimated with our data (because of insufficient variation of the twin variable within individual countries).

TABLE 6

OUTPUT GROWTH—ROBUSTNESS TESTS DEPENDENT VARIABLE: REAL GDP GROWTH RATE

		(1) LSDV	(2) HT	(3) GMM1	(4) HT	(5) HT	(6) HT[a]
1	Real GDP growth ($t-1$)	0.151** (2.55)	0.177** (3.04)	0.248** (10.36)	0.315** (8.39)	0.316** (8.39)	0.244** (4.87)
2	Change in budget surplus to real GDP ratio ($t-1$)	−14.038 (−1.50)	−10.564 (−1.17)	6.167* (2.09)	5.340 (1.25)	5.450 (1.27)	4.871 (0.64)
3	Credit growth ($t-1$)	0.001 (0.06)	−0.001 (−0.14)	0.009** (4.83)	−0.004 (−0.97)	−0.003 (−0.91)	0.001 (0.12)
4	External growth rates—weighted average (t)	0.432** (3.65)	0.418** (3.55)	0.359** (8.74)	0.311** (3.97)	0.311** (3.97)	0.318** (3.03)
5	Real exchange rate overvaluation ($t-1$)	−0.035* (−2.10)	−0.040* (−2.52)	−0.025** (−4.88)	−0.021** (−2.58)	−0.020** (−2.56)	−0.024* (−1.98)
6	Openness	0.069* (2.16)	0.027 (1.90)	0.014** (8.19)	0.019* (2.50)	0.019* (2.48)	0.019 (1.65)
7	Currency crises dummy ($t-1$)	−3.343** (−4.39)	−3.260** (−4.33)	−3.396** (−14.09)	−1.952** (−4.31)	−1.931** (−4.24)	−2.086** (−3.26)
8	Onset of banking crises dummy (t)	−3.187** (−3.69)	−3.109** (−3.64)	−3.139** (−10.90)	−2.553** (−4.20)	−2.169* (−2.50)	−2.284** (−3.21)
9	Twin crises dummy (t)					−0.673 (−0.62)	−1.073 (−1.01)
	Sample	280	280	280	574	574	333

NOTES: The sample consists of annual observations for 24 emerging markets for the years 1975–97. Missing observations are skipped during estimation. For the subsample used for Columns (1)–(3) see Note 21. For our selection procedure and details on definitions of all variables, see Section 4. For a list of crisis episodes, see the working paper version (Hutchison and Noy 2002a, p. 33). * and ** denote significance at the 5% and 1% confidence levels, respectively. We use least squares fixed effects for Column (1), the Hausman and Taylor (1981) estimation procedure for Columns (2), (4–6), and the Arellano and Bond (1998) one-step procedure for Column (3). See Section 5 and references therein for details. [a]Column (6) reports the results for a major banking crises variable (and its corresponding twin definition).

As an additional robustness check, we run the same model for a larger sample of developing economies, adding 42 developing countries (with a real per capital income of less than $2000 in 1992) to our emerging markets sample. Data availability—at least 10 years of continuous annual real GDP data—again guided our selection of additional countries. Comparisons of Column (4) with Column (2) in Table 6 leads us to conclude that both currency and banking crises have a weaker impact on output growth in our larger sample of developing countries (–2.0 instead of –3.3 for lagged currency crises and –2.6 instead of –3.1 for banking crises). In Column (5) Row (9), the insignificance of the marginal effect of a twin crisis is also evident in our larger sample of developing countries as was found for our emerging markets sample. That is, the association of both currency and banking crises with output losses is somewhat weaker and the coefficient on the twin crisis variable is still insignificantly different from zero.

In Table 6 Column (6) Rows (8) and (9), we investigate whether the main results are robust when the variables of interest are severe or major banking and currency crises. As was reported previously for currency crises, the severity of a banking crisis does not appear to influence its economic cost in terms of foregone output growth. Our central finding is indeed robust to the "major crises" specification—major twin crises do not seem to have any statistically discernible association with output growth beyond the separate effects of major currency and banking crises.

It is possible that the results reported to this point are subject to sample selection bias. Countries that experience a currency or banking crises may be different in important respects from other countries or episodes. That is, it may not be the currency or banking crisis per se but several other factors contributing to them that are causing the decline in output growth. This is a variant of the sample selection bias problem.

We employ Heckman's (1979) Inverse Mills Ratio (IMR) to control for sample selection bias of this form. This statistic is constructed from the results of probit regressions explaining both currency and banking crises and added as additional explanatory variables in the output growth regressions.[22] Including the IMR in the regression of interest prevents possible bias in our coefficient estimates and is a standard approach to account for sample selection bias.[23] For brevity, these results are not reported. In no case are the IMR coefficients statistically significant and, assuming that the probit equations were correctly specified, sample selection bias may be rejected. More importantly, the coefficient estimates on the other explanatory factors, both control and crises variables are very similar to those reported in Table 5.

6. OUT-OF-SAMPLE GROWTH FORECASTS FOR THE 1998 EAST ASIAN CRISIS

How much of the collapse in East Asian output following the financial crisis does the model explain? Table 7 presents the predicted values for output growth for the five

22. The exact specifications of the probit regressions are taken from Glick and Hutchison (2001). Details are available from the authors upon request.

23. For a survey of sample selection correction methodologies, see Blundell and Costa Días (2000).

TABLE 7

OUT-OF-SAMPLE GROWTH FORECASTS FOR EAST ASIAN CRISIS COUNTRIES—1998

	1 Domestic variables	2 External variables	3 Currency crisis	4 Banking crisis	5 Twin crisis	6 Predicted growth	7 Actual growth
Indonesia	5.26	0.50	−4.22	−2.78	−1.57	−2.81	−14.16
Korea	5.51	0.85	−1.86	−2.78	−1.57	0.14	−6.92
Malaysia	5.99	0.53	−1.86	−2.78	−1.57	0.30	−7.65
Philippines	6.17	0.48	−1.86	−2.78	−1.57	0.44	−0.54
Thailand	4.42	0.65	−1.86	−2.78	−1.57	−1.15	−10.73

NOTES: Columns (6) and (7) present predicted and actual 1998 output growth rates. Predicted values are based on 1997 values of the explanatory variables, and the coefficient estimates using the basic model presented in Column (4) of Table 5, but estimated over a data sample ending in 1996. Predicted values are decomposed into: Column (1) domestic factors (lagged output growth, change in budget surplus, credit growth, and country-specific effects), Column (2) external–structural factors (external growth, real exchange rate overvaluation, and openness), and Columns (3)–(5) the currency, banking, and twin crises effects.

East Asian countries that experienced a severe financial crisis in 1997 and large output contractions in 1998—Indonesia, Korea, Malaysia, the Philippines, and Thailand. These predictions are for 1998 output growth rates and are based on 1997 values of the explanatory variables, and the coefficient estimates using the basic model presented in Column (4) of Table 5, but estimated over a data sample ending in 1996. Predicted values are decomposed into: (1) domestic factors (lagged output growth, change in budget surplus, credit growth, and country-specific effects), (2) external–structural factors (external growth, real exchange rate overvaluation and openness), and (3) the currency, banking, and twin crisis effects.

Predicted average output growth for the five countries is close to zero in 1998—negative predictions for Indonesia and Thailand and small positive predictions for Korea, Malaysia, and the Philippines. The forecast errors (unexpected declines in output) are therefore quite large. The significant negative effect exerted by the crisis variables is dominated by a strong positive domestic effect—mainly a history of very strong growth in the region and the consequently large country-specific effects—and a modestly supportive external–structural growth environment.

It appears that the depth of the East Asian output collapse in 1998 is much greater than could have been expected based on the average association of financial crises with output growth in emerging markets in the post-Bretton Woods period. Our model explains a large fraction of the decline in output from its historical norm in the region—accounting for a 6.3%–8.6% decline in GDP—mainly reflecting the combined effect of a currency and banking crisis. (Strong feedback effects between currency and banking crises were less evident, and contributed only 1.6% to the predicted growth decline). The actual deviation in output from the historical norm was even greater, however. There appears to have been a common shock or common vulnerability in these countries—unobserved in this model—causing the unexpectedly large collapse in output.

A number of explanations have been offered in this respect based on both fundamental problems and speculative capital flight. Corsetti, Pesenti, and Roubini (1998), for example, emphasize the structural and institutional weaknesses that contributed

to the depth of the crisis in Asia. They point to financial fragility associated with corrupt financial practices, politically directed loans, weak regulatory and supervisory practices, and implicit government guarantees contributing to moral hazard. They argue that these financial sector weaknesses led to lending booms, overinvestment, and a misallocation of resources to risky and low profitability projects and sectors of the economy. When a crisis did occur, it was especially costly—greater than would be predicted by our model—since real adjustment in the economy was overwhelmed by the cumulative misallocation of resources and overinvestment. To be consistent with our model, however, this explanation must assume that the investment distortions in East Asia were larger than in other country/regions affected by twin crises.

McKinnon and Pill (1998) point out that the Asian economies that came under stress in 1997 were high savers, showed little evidence of overconsumption and had little or no domestic inflation indicating real exchange rate overvaluation. Rather, in explaining why East Asia was so hard hit (and different from other emerging markets facing crises), they emphasize "massive overinvestment of poor quality" as the fundamental problem. Another possible explanation for the large output losses is that the size of foreign debt or degree of liability dollarization was more extensive in East Asia than in other emerging markets. If this were the case, a twin crisis would lead to especially large balance sheet effects, bankruptcies, and eventually output losses. The empirical work of Cavallo (2002) and Hausmann and Panizza (2003), however, does not suggest that foreign debt or dollarization was especially large in East Asia compared with other emerging markets. Several authors have also suggested a sudden stop in capital inflows as a major factor underlying the severity of the financial crises in East Asia (Calvo, 1998, Calvo and Reinhart, 1999).

7. CONCLUSIONS

We find that both currency and banking crises are very damaging to emerging market economies, associated with output growth declines of about 5%–8% and 8%–10%, respectively, over a 2–4 year period. The combined effect of the two crises occurring simultaneously is therefore about 13%–18% of output. However, twin crises do *not* appear to contribute additional (marginal) negative impact on output growth above and beyond the combined effect of the two crises.

These are very large estimates of output losses, and should alarm policymakers, particularly in light of the robustness of the empirical results to model specification and estimation technique. Our results are robust to the particular estimation procedure employed—standard LSDV, Hausman and Taylor (1981) IV estimator, or the more efficient first-differenced GMM estimator suggested by Arellano and Bond (1991, 1998). The results also hold when the emerging market economies sample is extended to include an additional 42 low-income developing economies, when alternative measures of currency crises are investigated, and when a distinction is

made between "severe" banking and currency crises as opposed to more moderate ones.

Overall, we are able to explain close to 35%–50% of the variation in annual real GDP growth in emerging markets during 1975–97 using the three crisis indicators (currency, banking, and twins) and a host of control variables. Nonetheless, the model predicts (out-of-sample) much stronger East Asian real GDP growth in 1998 than what actually occurred. The model explains a large fraction of the decline in output from its historical norm in the region—with currency and banking crises associated with large output losses in these economies—but the actual deviation in output from the historical norm was even greater. Twin crises took a large toll on East Asia economies, but future work is warranted to help better quantify the relative importance of other contributing factors such as regional contagion, the misallocation of credit, or the sudden stop in capital flows.

LITERATURE CITED

Aghion, Philippe, Philippe Bacchetta, and Abhijit Banerjee (2001a). "Currency Crises and Monetary Policy in an Economy with Credit Constraints." *European Economic Review* 45, 1121–1150.

Aghion, Philippe, Philippe Bacchetta, and Abhijit Banerjee (2001b). "A Corporate Balance-Sheet Approach to Currency Crises." Manuscript, MIT.

Ahmed, Shaghil, Christopher J. Gust, Steven B. Kamin, and Jonathan Huntley (2002). "Are Depreciations as Contractionary as Devaluations? A Comparison of Selected Emerging and Industrial Economies." Board of Governors of the Federal Reserve System, International Finance Division Working Paper No. 737.

Ahn, Seung C., and Peter Schmidt (1995). "Efficient Estimation of Models for Dynamic Panel Data." *Journal of Econometrics* 68, 5–27.

Arellano, Manuel, and Stephen Bond (1991). "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies* 58, 277–297.

Arellano, Manuel, and Stephen Bond (1998). "Dynamic Panel Data Estimation Using DPD98 for Gauss." Manuscript, http://www.cemfi.es/∼arellano/#dpd.

Arellano, Manuel, and Bo Honoré (2001). "Panel Data Models: Some Recent Developments." In *Handbook of Econometrics*, edited by J. Heckman and E. Leamer. Amsterdam, New York, and Oxford: Elsevier Science.

Arteta, Carlos, and Barry Eichengreen (2002). "Banking Crises in Emerging Markets: Presumptions and Evidence." In *Exchange Rate and Financial Vulnerability in Emerging Markets*, edited by M. Blejer and M. Skreb. Cambridge, MA: MIT Press.

Aziz, Jahangir, Francesco Caramazza, and Ranil Salgado (2000). "Currency Crises: In Search of Common Elements." IMF Working Paper WP/00/67.

Banerjee, Abhijit (2000). "Comment on Chang and Velasco." In *NBER Macroeconomics Annual 1999*, edited by B.S. Bernanke and J. Rotemberg. Cambridge, MA: MIT Press.

Barro, Robert (2001). "Economic Growth in East Asia Before and After the Financial Crisis." NBER Working Paper No. 8330.

Berg, Andrew (1999). "The Asian Crisis: Causes, Policy Responses, and Outcomes." IMF Working Paper WP/99/138.

Bernanke, Ben, and Mark Gertler (1989). "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review* 79, 14–31.

Bernanke, Ben, Mark Gertler, and Simon Gilchrist (1996). "The Financial Accelerator and the Flight to Quality." *Review of Economics and Statistics* 78, 1–15.

Blundell, Richard, and Monica Costa Días (2000). "Evaluation Methods for Non Experimental Data." *Fiscal Studies* 21, 427–468.

Bond, Stephen, Anke Hoeffler, and Jonathan Temple (2001). "GMM Estimation of Empirical Growth Models." Manuscript.

Bordo, Michael, Barry Eichengreen, Daniela Klingebiel, and Maria Soledad Martinez-Peria (2001). "Is the Crisis Problem Growing More Severe?" *Economic Policy* 16, 53–82.

Caballero, Ricardo, and Arvind Krishnamurthy (2002). "A Dual Liquidity Model for Emerging Markets." *American Economic Review* 92, 33–37.

Calvo, Guillermo (1998). "Capital Flows and Capital-Market Crises: The Simple Economics of Sudden Stops." *Journal of Applied Economics* 1, 35–54.

Calvo, Guillermo, and Enrique Mendoza (1996). "Mexico's Balance of Payments Crises. A Chronicle of a Death Foretold." *Journal of International Economics* 41, 235–264.

Calvo, Guillermo, and Carmen Reinhart (1999). "When Capital Inflows Come to a Sudden Stop: Consequences and Policy Options." Manuscript, University of Maryland.

Caprio, Gerald, and Daniela Klingebiel (1996). "Bank Insolvencies: Cross-Country Experiences." World Bank Policy Research Paper No. 1620.

Caprio Gerard, and Daniela Klingebiel (1999). "Episodes of Systemic and Borderline Financial Crises." Manuscript, World Bank.

Cavallo Michele, Kate Kisselev, Fabrizio Perri, and Nouriel Roubini (2002). "Exchange Rate Overshooting and the Costs of Floating." Manuscript, New York University.

Céspedes, Luis P., Roberto Chang, and Andrés Velasco (2001). "Balance Sheets and Exchange Rate Policy." Manuscript, New York University.

Chang, Roberto, and Andres Velasco (2000a). "Liquidity Crises in Emerging Markets: Theory and Policy." In *NBER Macroeconomics Annual 1999*, edited by B.S. Bernanke and J. Rotemberg, pp. 11–78. Cambridge, MA: MIT Press.

Chang, Roberto, and Andres Velasco (2000b). "Financial Fragility and the Exchange Rate Regime." *Journal of Economic Theory* 92, 1–34.

Corsetti, Giancarlo, Paolo Pesenti, and Nouriel Roubini (1998). "What Caused the Asian Currency and Financial Crisis? Part I: A Macroeconomic Overview." NBER Working Paper No. 6833.

Dekle, Robert, and Kenneth Kletzer (2001). "Domestic Bank Regulation and Financial Crises—Theory and Empirical Evidence from East Asia." In *Preventing Currency Crises in Emerging Markets,* edited by S. Edwards and J.A. Frankel. Chicago, IL: University of Chicago Press.

Demirgüç-Kunt, Asli, and Enrica Detragiache (1998). "The Determinants of Banking Crises in Developing and Developed Countries." *IMF Staff Papers* 45, 81–109.

Demirgüç-Kunt, Asli, Enrica Detragiache, and Poonam Gupta (2001). "Inside the Crisis: An Empirical Analysis of Banking Systems in Distress." World Bank Policy Research Paper No. 2431.

Dooley, Michael (2000). "A Model of Crises in Emerging Markets." *Economic Journal* 110, 256–272.

Eichengreen, Barry, Andrew Rose, and Charles Wyplosz (1995). "Exchange Market Mayhem. The Antecedents and Aftermath of Speculative Attacks." *Economic Policy* 21, 249–312.

Frankel, Jeffrey, and Andrew Rose (1996). "Currency Crashes in Emerging Markets. An Empirical Treatment." *Journal of International Economics* 41, 351–366.

Glick, Reuven, and Michael Hutchison (2000). "Capital Controls and Exchange Rate Instability in Developing Economies." Federal Reserve Bank of San Francisco Center for Pacific Basin Studies Working Paper No. PB00-05.

Glick, Reuven, and Michael Hutchison (2001). "Banking and Currency Crises: How Common Are Twins?" In *Financial Crises in Emerging Markets,* edited by R. Glick, R. Moreno, and M. Spiegel. Cambridge, UK: Cambridge University Press.

Goldfajn, Ilan, and Rodrigo Valdés (1997). "Capital Flows and the Twin Crises: The Role of Liquidity." IMF Working Paper WP/97/87.

Greene, William (2002). "Linear Models for Panel Data." In *LIMDEP Econometric Modelling Guide*, Vol. 1. Plainview, NY: Econometric Software, Inc.

Gupta, Poonam, Deepak Mishra, and Ratna Sahay (2000). "Output Response during Currency Crises." Manuscript, IMF.

Hausmann, Ricardo, and Ugo Panizza (2003). "The Mystery of Original Sin." Paper presented at the Latin America Santa Cruz Center for International Economics Conference.

Hausman, Jerry, and William Taylor (1981). "Panel Data and Unobservable Individual Effects." *Econometrica* 49, 1377–1398.

Heckman, James (1979). "Sample Selection Bias as a Specification Error." *Econometrica* 47, 153–161.

Hutchison, Michael, and Kathleen McDill (1999). "Are All Banking Crises Alike? The Japanese Experience in International Comparison." *Journal of the Japanese and International Economies* 13, 155–180.

Hutchison, Michael, and Ilan Noy (2002a). "How Bad Are Twins?" Economic Policy Research Unit (EPRU) Working Paper No. 2002-09.

Hutchison, Michael, and Ilan Noy (2002b). "Output Costs of Currency and Balance of Payments Crises in Emerging Markets." *Comparative Economic Studies XLIV*, 27–44.

International Monetary Fund (1998). "Financial Crises: Characteristics and Indicators of Vulnerability." In *World Economic Outlook*. Washington, D.C.: IMF Press.

Kaminsky, Graciela, and Carmen Reinhart (1999). "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems." *American Economic Review* 89, 473–500.

Kiyotaki, Nobuhiro, and John Moore (1997). "Credit Cycles." *Journal of Political Economy* 105, 211–248.

Krugman, Paul (2000). "Fire-sale FDI." In *Capital Flows and the Emerging Economies: Theory, Evidence and Controversies,* edited by S. Edwards. Chicago, IL: The University of Chicago Press.

Lane, Timothy, and Steven Phillips (1999). "Macroeconomic Environment." In *IMF-Supported Programs in Indonesia, Korea, and Thailand: A Preliminary Assessment,* edited by Timothy Lane, Atish Ghosh, Javier Hamann, Steven Phillips, Marianne Schultze-Ghaltas, and Tsidi Tsikata. Washington, D.C.: IMF Press.

Martin, Philippe, and Hélène Rey (2002). "Financial Globalization and Emerging Markets: With or Without Crash?" NBER Working Paper No. 9288.

McDill, Kathleen (2000). "On the Causes, Costs and Persistence of banking crisis." Unpublished Ph.D. Dissertation, University of California, Santa Cruz.

McKinnon, Ronald, and Huw Pill (1998). "The Overborrowing Syndrome: Are East Asian Economies Different?" In *Managing Capital Flows and Exchange Rates: Perspectives from the Pacific Basin*, edited by R. Glick. Cambridge, UK: Cambridge University Press.

Milesi-Ferretti, Gian Maria, and Assaf Razin (2000). "Current Account Reversals and Currency Crises: Empirical Regularities." In *Currency Crises,* edited by P. Krugman. Chicago, IL: The University of Chicago Press.

Nickell, Stephen (1981). "Biases in Dynamic Models with Fixed Effects." *Econometrica* 49, 1417–1426.

Paasche, Bernhard (2001). "Credit Constraints and International Financial Crises." *Journal of Monetary Economics* 48, 623–650.

Roubini, Nouriel (2000). "Comment on Chang and Velasco." In *NBER Macroeconomics Annual 1999*, edited by B.S. Bernanke and J. Rotemberg. Cambridge, MA: MIT Press.

Sachs, Jeffrey, Aaron Tornell, and Andres Velasco (1996). "Financial Crises in Emerging Markets: The Lessons from 1995." *Brookings Papers on Economic Activity* 1, 147–215.

Sala-i-Martin,-Xavier (1997). "I Just Ran Two Million Regressions." *American Economic Review* 87, 178–183.

Schneider, Martin, and Aaron Tornell (2001). "Boom-Bust Cycles and the Balance Sheet Effect." Manuscript, UCLA.

Tornell, Aaron, and Frank Westermann (2002). "The Credit Channel in Middle Income Countries." NBER Working Paper No. 9355.