Learning from Financial Crises

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Abstract

This paper considers the question of whether international banks learn from their previous crisis experiences and reduce their lending to developing countries in the event of a financial crisis. The analysis combines a bank-level dataset of bank activity and ownership with country-level data on the stock of historical crisis events between 1800 and 2005. To circumvent selection and endogeneity concerns, the paper exploits temporal variations in the relative recency of crises as instruments for crisis experience. The results

indicate that foreign banks with greater crisis experience reduced their lending significantly more relative to other foreign banks, which can be interpreted as evidence in favor of a learning effect. The findings survive robustness checks that include alternative measures of crisis experience, additional controls, and decompositions into different types of crises. The question of learning is also examined from the perspective of other measures of bank performance.

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1 Introduction

The history of modern economies is a history of financial crises. While the global crisis of 2007/08 distinguished itself in part due to its origin in the advanced economies, financial crises in the high-income countries of today were in fact fairly commonplace throughout the 19th and 20th centuries: Reinhart & Rogoff (2009) document no less than 2,678 separate domestic financial crises on a yearly basis in the 47 countries for which data are available between 1800 and 2005. From the Panic of 1857 to Black Tuesday in 1929 that marked the onset of the Great Depression, these crises undoubtedly shaped the economic fortunes of the economies in which they occurred. But how does a history of crises shape the post-crisis behavior of international banks today?

Although the recent crisis was certainly unique in some ways, one key feature of the recent crisis—the run on financial assets whose values had become uncertain, leading to a collapse in valuations and widespread contagion—was in fact distressingly pedestrian (Bernanke 2013; Brunnermeier 2009; Gorton & Metrick 2012). To the extent that this meant that banks undergoing the crisis could draw on their stock of experience with previous crises, such “experienced” banks may engage in distinctly different post-crisis behavior, as compared to banks that do not possess such histories. The accumulated experience is particularly important for the recent crisis, which was marked by exceptional uncertainty over conditions in the real economy.

In this paper, we apply the lens of learning to the question of banking responses to a financial crisis, such as the recent 2007/08 crisis. Specifically, we draw on data from foreign subsidiaries of international banks and ask whether banks based in home economies with richer crisis histories display lending patterns over the 2007/08 crisis that differed from other foreign banks. Due to increases in informational asymmetries following crises, banks tend to ration credit (Stiglitz & Weiss 1981). Such hoarding of lending could well be optimal from the point of view of shoring up liquidity and strengthening balance sheets (Bernanke 1983; Bernanke & Blinder 1992; Uchida 2003), or navigating heightened uncertainty surrounding borrowers’ credit quality (Bernanke & Gertler 1989; Bernanke, Gertler & Gilchrist 1996). Banks that learn from their previous crisis experiences would therefore be more circumspect about expanding their loan portfolios, especially in the aftermath of a financial crisis.¹

Naturally, our investigation is complicated by the fact that banks owned by crisis-prone home countries may well be systematically different from those owned by countries without such histories. If such differences were both observable and measurable, it would be a straightforward exercise to address the problem by the inclusion of the relevant intervening variable(s). In the absence of such controls, however, it becomes impossible to disentangle the crisis learning effect from other sources of unobserved heterogeneity. We address this fundamental endogeneity problem by exploiting the fact that the stock of financial crisis experiences not only varied between home countries, but the *recency* of crises also differed. Inspired by the behavioral economics literature (in particular

¹It is also theoretically possible that banks with more crisis experience choose to *expand* lending following a crisis, perhaps because they have learned how to better cope with crises and hence seek to capture market share. The question of whether experienced banks lend more or less in a post-crisis environment is ultimately an empirical one, although the theoretical literature leans toward reductions in lending as optimal responses.

primacy-recency biases and the availability heuristic), we exploit this time variation in crisis recency as instruments to help us isolate the effect of learning from crisis experiences, as opposed to other systematic selection effects.

Our findings rely on a novel dataset of foreign subsidiaries of international banks operating in developing countries, which includes the identity of the home country of the parent bank. We merge this information on ownership with country-level data on the history of financial crises (Reinhart & Rogoff 2009), and construct a variable that captures the stock of a bank’s financial crisis experiences, along with the time elapsed since the last banking, currency, debt, or stock market crisis (which we use as instruments). We then use this measure to examine the extent to which past experience with crises affects a foreign bank’s lending patterns in the recent 2007/08 crisis. Our focus on only foreign banks in developing countries enables us to simultaneously exclude the role of these banks in precipitating the crisis (which was imported from high-income countries), while at the same time maintaining an appropriate counterfactual (since domestic banks typically differ from foreign ones).

We find that banks with greater crisis experience reduced their lending to a greater degree relative to other banks. In our baseline instrumental variables (IV) estimates, the shrinkage in lending by a bank that had experienced 10 more crisis episodes is to the order of 0.8 to 1.1 of a percentage point. The main qualitative message from our results survives a host of robustness checks, including variations in measurement, specification, and estimation methodology. We then proceed to examine whether certain *types* of crises may be responsible for the results. We find that, consistent with intuition, crises that affect the balance sheet of banks appear to drive the learning effect.

There is a raft of studies that consider the general issue of post-crisis lending behavior of foreign banks. In general, this literature has found that foreign banks tend to contract credit by less than domestic banks following a crisis (de Haas & van Lelyveld 2006; Detragiache & Gupta 2006; Levy-Yeyati & Micco 2007). But it is unclear whether this is simply because foreign banks tend to exercise greater prudence in their pre-crisis lending behavior—and so require less post-crisis reassessment of their loan portfolios—or if they are less constrained by the post-crisis liquidity crunch, perhaps because they are better able to access to credit lines from their parent banks. Just as important, foreign banks may experience solvency constraints that are quite distinct from those of domestic banks, given the likelihood that their balance sheets likely comprise different assets. Our decision to constrain our analysis to only foreign banks, therefore, is guided by the fact that failure to distinguish between the two classes of banks renders it impossible to infer the extent to which learning, rather than other factors, conditions banks’ lending activity.²

Of course, even among foreign banks, there is evidence of differential post-crisis lending behavior, depending on the characteristics of the bank and the primary markets they serve (de Haas & van Horen 2012a,b; de Haas & van Lelyveld 2010, 2014). Foreign banks that possess greater

²The focus of much of this rich literature is also on credit provision, rather than other elements of bank performance. A major reason for this is that bank performance metrics tend to exhibit far less stability after a crisis (for reasons we document in Subsection 4.1). Detragiache & Gupta (2006) and Micco, Panizza & Yañez (2007) are two notable exceptions that consider alternative metrics in a post-crisis setting.

familiarity with their host markets, for instance, may exploit their deeper knowledge of local credit conditions, and hence choose to retrench less in terms of lending. The question is then whether there are important key characteristics among foreign banks—especially associated with their home countries—that distinguish them in a post-crisis setting. Our approach in this paper is to isolate one element that we consider to be especially crucial in navigating the difficult economic conditions following a financial crisis: that of experience with past crises.

Several papers, all closely aligned with our spirit of inquiry, peer more deeply into such specifics. The seminal paper by Peek & Rosengren (1997) delves into how binding risk-based capital requirements were in instigating a decrease in lending by Japanese banks in the United States, following the Japanese stock market crash of 1989–92. Other more recent papers explore other aspects: de Haas & van Horen (2012b), for instance, examine the importance of geographical distance, while Wu, Luca & Jeon (2011) consider the role that host-country monetary shocks play. Our paper, in contrast, emphasizes crisis histories, and we are especially interested in the potential of learning from this stock of experience.

Although the literature on learning in both financial markets (Pástor & Veronesi 2009) and macroeconomics (Evans & Honkapohja 2001) is now well-established, there is still a relative dearth of systematic empirical analysis of learning in the area of financial crises.³ There have been some papers in economic history that have advanced conjectures about learning from specific crisis episodes. For example, Bernanke (1995, p. 1) analyzes empirically the consequences of the Great Depression on macroeconomic policy stance and economic behavior, and argues that “[t]he experience of the 1930s continues to influence macroeconomists’ beliefs [and] policy recommendations.” In a more recent study, Aizenman & Noy (2013) examine the history of crises on *macroeconomic* performance. They find that countries appear not to have learned from their history of past crises, although in one key macroeconomic variable—saving—past crisis experience appears to condition current saving, which offers some limited evidence in favor of a crisis learning effect. We see our present work as an important supplement to theirs, from the perspective of a key private-sector actor in financial crises: banks.

The rest of the paper is organized as follows. In the following section, we review the relevant theory on the manner by which financial crises affect bank lending, focusing on various channels by which a crisis may impact optimal bank lending. In Section 3, we explore some of the key features of financial crises as they have played out in history, as well as the behavior of our key crisis experience variable in our study. Section 4 details our empirical methodology, and Section 5 documents our main results, including the robustness of our benchmark. A penultimate section dives deeper into the question of learning and bank lending behavior, before a final section concludes with some brief reflections on policy.

³Analogous to typical applications in these areas, where actors gradually update their priors regarding an identifiable (but uncertain) fundamental through Bayesian learning, in our case banks that have learned more from their crisis experiences would tend to lend less, as we argue in Subsection 2.1.

2 Learning from Crisis Experiences

Financial crises are watershed events, affecting banks not just in terms of the macroeconomic environment in which they operate, but also affecting the day-to-day operation of banks as well. Crises alter the valuation of bank balance sheets as well as the quality of borrowers seeking loans, both of which influence the extent to which banks are willing to extend credit. Consequently, banks may respond to the external crisis through changes in their lending activity and loans supply. Such crisis-induced changes to the optimal lending behavior of banks are typically transmitted along several distinct channels.

2.1 Bank lending responses to financial crises

One key channel is related to banks' liquidity considerations. Crises lead to reductions in bank deposits, so that their lending is subject to a more stringent liquidity constraint. Monetary policy—or more precisely, the stance of monetary policy—can alter the extent to which this constraint is binding. In the aftermath of a financial crisis, monetary authorities may react to the shock by modifying the monetary policy stance. A contractionary stance (which is not an uncommon response to currency crises) can, *ceteris paribus*, further reduce reserves held by banks, which in turn affects their ability to extend loans (Bernanke & Blinder 1988). Crises can also affect banks' ability to access wholesale funding: the shock erodes banks' abilities to post deposit collateral (Hart & Moore 1994; Uchida 2003). At the extreme, banks may even engage in precautionary hoarding (Brunnermeier 2009), where they choose to retain funds for their own internal projects and proprietary trades, rather than increasing outstanding loan volumes, in case they are exposed to additional shocks. The predilection toward maximizing liquidity following a crisis may be recognized more readily by banks that have learned from previous crisis experiences, so that they are more likely to limit their lending vis-à-vis inexperienced banks.

A second channel revolves around the effect of a crisis on banks' balance sheets. Crises raise the cost of credit intermediation because weaker bank balance sheets recommend greater prudence in the issuance of new loans (Bernanke 1983). Moreover, following the initial shock from the crisis—which is typically accompanied by a short-run selloff of securities held on bank balance sheets—banks often rebalance their portfolios with contractions in loans (Bernanke & Blinder 1992), especially in cases where banks are highly leveraged and/or equity injections are not forthcoming (Gertler & Kiyotaki 2010). Under any of these circumstances, the reduction in lending is optimal for banks managing their balances sheets in response to a crisis, and banks that possess more experience with navigating such crises would thus be better positioned to contract their lending more than the average bank.

Taken together, the liquidity and solvency channels discussed here are often referred to as the “bank lending channel” in the monetary policy transmission literature. However, this literature also establishes an additional channel—the “balance sheet channel”—through which a financial crisis can influence banking activity.

This third channel arises from informational asymmetry among borrowers. The process of fi-

nancial intermediation requires information regarding potential creditors' solvency, but a financial crisis can alter the net worth of firms, which raises the costs of monitoring and screening (Bernanke & Gertler 1989). Moreover, uncertainty over asset values following a crisis could trigger an adverse feedback loop where the financial disruption dampens economic activity, which in turn amplifies uncertainty and further perpetuates the downturn (the so-called financial accelerator mechanism) (Bernanke *et al.* 1996). Building on this notion, Ruckes (2004) argues that the bank credit policies fluctuate over the business cycle. During recessions, the average default probabilities of creditors increase and banks' screening of borrowers is then intensified. As a consequence, the price competition between banks decreases and credit standards tighten significantly. Indeed, heightened uncertainty alone can potentially interfere with investment and production, if firms seek to retain the option value of waiting in an uncertain post-crisis environment (Bloom 2009). The upshot is that banks may rationally choose to scale back on lending until the crisis is resolved, and banks that have learned from previous crisis experiences may do so in a more expedient fashion.

Given the importance of learning in conditioning banks' post-crisis lending behavior, it is natural to ask how such learning can transfer over time in an organization. Literature on the theory of the firm offers some insight in this regard. After all, one of the central functions of firms, *qua* organizations, is to facilitate the low-cost process of productive knowledge transfer (Coase 1937), and to serve as repositories of such knowledge (Winter 1988); such transfers may even serve as one of the sources of competitive advantage accruing to firms (Argote & Ingram 2000). There is clear empirical evidence that knowledge transfer occurs within firms (Doheny-Farina 1992; Kogut & Zander 1993). To the extent that such transfers are effected not just spatially but also temporally, the firm—or more generally, any organization—can be said to exhibit a capacity for “learning” (Mantzavinos, North & Shariq 2004); it is in this sense that we consider learning about crises as possible within banking institutions. Indeed, such learning may well characterize relationship lending practices by banks in the aftermath of a crisis, as shown both theoretically and empirically by Bolton, Freixas, Gambacorta & Mistrulli (2013).

Might learning result from the direct transfer of institutions at the country level? There is some evidence that the country-level transfer of institutional knowledge can occur; this is most evident in the phenomenon of democratic cascades (Huntington 1991; Leeson & Dean 2009), but could also be present in other institutional mechanisms as well (Franzese & Hays 2008). Learning of this form typically results from some type of demonstration effect. Alternatively, knowledge from home-country institutional reform may also be transmitted directly across borders, although it is likely that transfers of this nature would occur within the auspices of banks themselves. For example, bank subsidiaries may choose to adopt more stringent capital requirements following post-crisis financial reform in the home country of their parent bank, even if this is not required by host-country regulators.

2.2 Evidence of lending responses to financial crises

There is abundant empirical evidence that all these channels are operative in curtailing bank lending during financial crises, and that lending tends to fall immediately following crises. While this fact alone does not imply that scaling back lending is an unambiguously optimal response for banks, it would appear that such reductions are, at the least, a constrained optimal choice. This choice is also strongly supported by the empirical evidence.

For example, Eichengreen, Hale & Mody (2001) examine emerging market crises in the 1990s and find that credit contractions reflect, *inter alia*, balance sheet considerations that impact the volume of lending. For the more recent crisis, Cetorelli & Goldberg (2011a) find the balance sheet effect operative for global banks. The recent crisis has also demonstrated that liquidity considerations came into play. Many U.S. banks experienced difficulties in rolling over their short-term obligations (Gorton 2009), which—coupled with unexpectedly large drawdowns on their revolving credit lines (Ivashina & Scharfstein 2010)—meant that banks’ liquidity needs rose sharply, which limited their ability to expand their lending activity, and in fact led to a curtailment of lending by these banks. Puri, Rocholl & Steffen (2011) examine U.S. bank lending during the 2007/08 financial crisis and find that liquidity-constrained banks did scale back more on lending to retail customers, relative to unconstrained banks; Cetorelli & Goldberg (2011b) also consider this channel in greater detail with regard to banks’ internal capital markets. In a slightly different context, Khwaja & Mian (2008) also demonstrate the importance of liquidity access for sustained bank lending following a (political) crisis.

From a practical perspective, surveys designed to measure changes in credit standards and terms on bank loans, along with perceived changes in the demand for bank credit, have been conducted in the U.S., Europe and emerging countries, notably during the recent financial crisis.⁴ There is evidence that banks started to tighten a number of terms on loans to both businesses and households in the aftermath of the 2007/08 crisis. Participating banks reported that balance sheet constraints and expectations about future economic activity were the main reason for this behavior. The results of these surveys also show the practical restrictions on credit that firms and households are confronted with, and how they are implemented by the banks. To tighten access to finance, banks tend to reinforce the conditions to obtain credit, but they also exhibited higher rejection rates with respect to the potential borrowers. In particular, younger firms and households without significant collateral suffered from these restrictions. Information asymmetry also influences responding banks’ behavior, as they become more pessimistic about potential creditors’ prospects and decide that a larger share of them would not be able to meet loan requirements. The surveys show that both mechanisms were relevant in the recent 2007/08 crisis.

⁴For the U.S., this is the Federal Reserve’s Senior Loan Officer Opinion Survey on Bank Lending Practices (<http://www.federalreserve.gov/boarddocs/snloansurvey/>). The equivalent surveys for Western Europe and the emerging economies are, respectively, the European Central Bank’s Euro Area Bank Lending Survey (<http://www.federalreserve.gov/boarddocs/snloansurvey/>) and the Institute of International Finance’s Emerging Markets Bank Lending Conditions Survey (<http://www.iif.com/emr/global/emls/>).

3 Experience with Financial Crises

3.1 Cross-country experiences with financial crises

Despite a tendency to associate financial crises with emerging economies, financial crises have historically occurred remarkably frequently in the relatively richer countries of today. For the period between 1800 and 2005, Reinhart & Rogoff (2009) list 47 countries that have undergone financial crises, and the predominant part is comprised of developed economies: 23 countries are high-income, and of the remaining 24, 16 are upper-middle income countries (with 8 lower-middle and low-income economies rounding off the list). Part of the reason for the overrepresentation of developed economies is, undeniably, due to data availability. However, the selection issue is not a significant concern for our application, because we are primarily interested in capturing the crisis experience of foreign subsidiaries of international banks in developing countries, most of which are based in high-income home countries in any case.

For the period 1800–2005, the 47 countries experienced a total of 2,678 crisis episodes, measured on an annual basis. Of these episodes, 919 are currency crises, 155 are domestic debt crises, 532 are banking crises, and 1,072 are stock market crashes. The high count is attributable to the somewhat liberal, but consistent and quantifiable, definition of crisis deployed by Reinhart & Rogoff (2009). Importantly, the definition used is rooted in the existing empirical literature on financial crises (a description of each crisis type is provided in the appendix).

The international distribution of crisis experiences illustrates well the tendency for crisis experience to be greater in relatively richer countries: economies that experienced the largest number of crises reside on the American continent, along with Western Europe (Figure 1).

While hardly a flattering accomplishment (and perhaps surprisingly), the United States tops the list as the country with the deepest experience with financial crises, having undergone 132 crisis episodes between 1800 and 2005. A substantial share of these is the legacy of the the Long Depression—29 crisis episodes between 1873 and 1894—as well as the Great Depression, which accounts for 14 crisis episodes between 1929 and 1933. Following the United States, the next six most experienced economies are in Latin America. Chile, Mexico, Argentina, Brazil, Uruguay and Peru each underwent between 90 and 110 crisis episodes each during the time period considered, although their crisis experience was garnered relatively recently: more than half of all episodes occurred after the onset of World War II. By way of contrast, countries with less experience are not concentrated in any particular region of the world; examples include Singapore (20), Zambia (22), Belgium (47), and Venezuela (52).

Another way to capture the dispersion of crisis experiences is to consider the differences in continental averages of crisis episodes. American countries experienced, on average, 83 financial crises, while European countries averaged 59, Asian countries 46, Oceanic countries 37, and African countries 31. Clearly, the financial experience embedded in the history of past crises exhibits large discrepancies between countries around the world, and does not necessarily conform with one’s priors, which are often biased toward recent episodes. This is important, because some countries

Figure 1: Geographical distribution of crisis experience. Crisis experiences appear to be greater in North and South America and Western Europe. The full list of countries and their crisis experiences is documented in the annex.

that may be regarded as more resilient to financial crises were actually significantly more crisis-prone in the past (Germany and Greece, for instance, experienced the same number of crises between 1800 and 2005). In seeking to establish whether such accumulated experience matters, it is important to turn to a more systematic analysis, which is the goal of this paper.

3.2 The distribution of crisis experience across foreign banks

Among banks, the distribution of crisis experiences suggests that the country-level distribution of crisis experiences roughly conforms with the distribution of crises at the bank level.⁵ Kernel density estimates indicate that the distribution is broadly normal,⁶ with the average bank owned by a prototypical country that experienced 72 financial crises (Figure 2). A slight majority of the banks—more than 60 percent—are domiciled in countries that experienced between 52 and 87 financial crises.

Two local maxima exist at the lower and upper ends of the distribution. These correspond, respectively, to banks from a mix of high income and developing economies that experienced a

⁵The discussion here is based on the effective sample of 365 foreign-owned banks across 77 developing (host) countries, and owned by entities established in 39 (home) countries.

⁶The kurtosis in the distribution is not significantly different from a normal, although it exhibits a mild right skew.

Figure 2: Epanechnikov kernel density estimate of crisis experiences for 365 foreign-owned banks, computed with a bandwidth of 5.9. The distribution is broadly normal, although minor local maxima exist at experience levels in the lower and upper terciles of the distribution.

modest but nontrivial number of crises, and banks based in the United States.

4 Empirical Methodology

4.1 Data sources and description

The data used for this paper are drawn from two main sources: the *Bankscope* database, where information on a standard set of bank-level covariates—size (total assets),⁷ solvency (equity to assets ratio), profitability (return on equity, or RoE), and interest margin (net interest margin ratio)—were obtained, and the World Bank’s *World Development Indicators*, which include (lagged) real GDP growth, real GDP per capita, consumer price inflation, and the current account balance. To minimize endogeneity with our main independent variable of interest (country-level crisis experience), these are included at their 2006 levels.⁸

We supplement this core set of bank and country-level controls with additional host-country covariates in our robustness checks. At the bank level, these include measures of cost (overhead costs) and riskiness (loan loss provisions over interest revenue); at the country level, we add measures of economic openness (trade openness and share of financial exports in total exports), and the overall status of the financial sector (aggregate capital to assets ratio, and the ratio of banks’ nonperforming loans to total gross loans). In addition, to better proxy for *bilateral* influences, our robustness section also employs bilateral trade flows data between home and host countries drawn from the United Nations’ COMTRADE database.⁹

⁷Considering total assets relative to the host country’s size does not alter the main estimates and conclusions.

⁸We relax this constraint in robustness checks by taking (along with bank-level covariates) the difference in levels between 2006 and 2009.

⁹This variable is constructed by taking total bilateral trade, dividing by the sum of home and host countries’

The key dependent variable we use is the difference in a given bank’s loan-to-asset ratio between 2006 and 2009.¹⁰ The dependent variable thus directly captures, in percentage points, the increase (or decrease) in the loan-to-asset ratio just prior to and immediately following the crisis. A bank that initially possesses a high loan-to-asset ratio runs a higher risk of default by borrowers; an increase in this variable therefore indicates that the bank has also increased proportionately its lending relative to its assets (and thus its exposure to default risk).

Our primary variable of interest, the stock of *crisis experience*, is constructed in three steps. We begin with data on bank ownership, which is an update of the one built by Claessens, van Horen, Gurcanlar & Mercado (2008) (and independently updated by Claessens & van Horen (2014)). The dataset includes annual observations for 4,496 domestic and foreign-owned¹¹ commercial, saving, and cooperative banks, as well as bank holding companies, for the period 1995 to 2010, spanning 131 developing countries. The ownership variable is coded from *Bankscope*, and supplemented with additional sources in order to definitively establish majority ownership.¹²

Next, we use data on past financial crises by Reinhart & Rogoff (2009) to construct measures of the stock of financial crises. The dataset documents financial crises that occurred across 70 countries between 1800 to 2010. Six different categories are defined: currency, inflation, banking, domestic debt, external debt, and stock market crises; each of which corresponds to an objective threshold—or to the occurrence of specific events—that would constitute a crisis episode. If crisis conditions are fulfilled for a given episode, we assign to the specific type of crisis an indicator of unity, and zero otherwise. We then aggregate crisis histories for the period between 1800 and 2005,¹³ by type, to obtain a country’s cumulative stock of each class of crisis, resulting in six distinct crisis history indicators.

For the baseline results, we further refine this measure by aggregating four of the six types of crisis histories: currency, banking, domestic debt, and stock market crises.¹⁴ Our decision to exclude external debt and inflation crises are for two separate reasons. We exclude inflation crises because of its very high correlation with currency crises; the simple Pearson ρ is 0.70, and highly statistically significant.¹⁵ This fact is recognized as much by Reinhart & Rogoff (2009, p. 1678), who point out that “currency crashes and inflation crises go hand in hand.” To avoid overweighting

GDP, and then separating the the sample into three equally-sized groups of countries, with an indicator variable corresponding to each group.

¹⁰In contrast to some of the literature, we prefer the use of differences as opposed to the growth rate, because our view is that the latter unnecessarily overweights changes in banks starting from a low initial base. Many of our results are robust to this alternative metric, however, and are available on request.

¹¹Our definition of foreign ownership is direct ownership of a bank (or bank holding company) by a country of at least 50 percent of its shares. If the shares of a bank are majority held by foreigners from different countries, the nationality is that of the country with the highest share. Further details on the construction of this variable are provided in the appendix.

¹²These supplementary sources include websites and annual reports, banking regulators’ publications and announcements, parent companies’ reports, and news articles.

¹³Excluding post-2005 episodes is natural and avoids the problems associated with simultaneity and reverse causality that would result otherwise.

¹⁴We do so with an unweighted sum. An alternative aggregation methodology would involve constructing an aggregate from the principal components of the four relevant variables; results for this alternative are considered in our robustness checks.

¹⁵A correlation matrix of the instrumental variables is provided in the appendix.

this class of crisis (and crises of a nominal nature), we accordingly drop inflation crises (which is more highly correlated with the other indicators than currency crises) from the set of crisis history indicators that we consider.

Our exclusion of external debt crises is motivated by a different rationale. External debt refers to debt that falls under foreign jurisdiction, and so a crisis of this sort—typically involving default, restructuring, or repudiation—does not directly concern domestic markets, and is less likely to lend itself to the learning experience of banks within the country. Just as important, the impact of external debt crises on banks’ balance sheets is unclear. Unlike the default of domestic debt obligations—which unambiguously imposes a burden on banks holding such instruments as assets—external debt default may (paradoxically) *strengthen* bank balance sheets: if banks mainly hold domestic debt, the selective default of foreign obligations can result in an enhanced ability to repay domestic creditors, which in turn improves bank balance sheets.¹⁶ The upshot is that domestic banks can largely avoid the consequences of external debt crises, with little change to the crisis experience of their home country. In contrast, domestic debt crises are directly related to the domestic banking sector, may include—*inter alia*—deposit freezes or the forcible conversion of foreign currency deposits into local currency, and hence are far more likely to directly affect bank balance sheets. For these reasons, we do not feature external debt crises in our set of crisis history measures.

Finally, we merge the aggregated crisis histories with the bank ownership data to obtain our crisis experience variable. Although matched to banks, this measure is at the country level: thus, a bank established in Mexico but owned by a U.S. institution will be endowed with the crisis experience of the United States. Since organizational learning experiences are typically embedded in operational procedures disseminated from a bank’s home base, this attribution strikes us as perfectly reasonable.

Additional details regarding variable construction, along with definitions and sources, are provided in the appendix (Subsection A.1 and Table A.1), along with summary statistics for the main variables of interest (Table A.2).

4.2 Empirical model

Our baseline model is the following cross-sectional specification:

$$\Delta l_{ijk} = \alpha + \delta crisisXP_k + \beta' \Delta \mathbf{B}_i + \chi' \mathbf{C}_k + \eta_j + \epsilon_{ijk}, \quad (1)$$

where l_{ijk} is the loan-to-asset ratio of bank i in (host) country j and owned by an entity established in (home) country k , $crisisXP_k$ is the stock of crisis experience corresponding to the bank’s home

¹⁶Of course, banks are just as likely to hold external sovereign debt. However, in this case an external debt crisis does not present an opportunity for learning attributable to the home country of the bank. For example, consider a case where Deutsche Bank holds Greek paper. An external debt crisis resulting from a Greek default does not add to the stock of learning by Greece (although it might for Germany).

country.¹⁷ The operator Δ indicates the change between 2006 and 2009. The remaining variables are controls: $\mathbf{B}_i$ is a vector of covariates specific to bank i , and $\mathbf{C}_k$ a vector of additional controls specific to home country k . η_j represents a host country fixed effect, which can be interpreted as capturing (time-invariant) demand-side conditions in country j . δ is our key coefficient of interest: the extent to which the crisis experience of the bank's home country conditions its lending activity. Finally, ϵ_{ijk} is an idiosyncratic error term, which we cluster at the host country level. Our robustness checks reproduce this basic regression in (1), while modifying the selection of control variables populating $\mathbf{B}$ and $\mathbf{C}$, in order to investigate the sensitivity of δ .

A major concern of estimating (1) is the possibility of endogeneity. In the construction of *crisisXP*, we consider only crises anterior to 2006, to limit simultaneity bias. Nevertheless, endogeneity problems may also result from omitted variables and, more crucially, selection. For instance, countries historically endowed with high-quality institutions may tend to be more resilient to crises in general, but institutional quality can concurrently influence the development of the finance and banking sector of a country; yet observable measures of institutional quality may fail to fully capture this heterogeneity. Banks in countries with a rich history of crises may also systematically differ from those that are not based in such economies, in a way that is not encompassed by the learning effect.

It is therefore necessary to rely on instrumental variable estimates that correct for such endogeneity concerns. We exploit the time variation that exists between the current and the last year in which a currency, stock market, domestic debt, and banking crisis occurred, and use this vector of elapsed time as instruments for the crisis experience variable. Our first stage IV thus estimates:

$$\widehat{crisisXP}_k = \lambda + \boldsymbol{\tau}' \mathbf{crisisET}_k + \phi I_k + \theta_k, \quad (2)$$

where λ is a constant, $\mathbf{crisisET}_k$ is the vector of excluded instruments (elapsed time since the last currency, domestic debt, stock market, and banking crisis in country k), and I_k the vector of included instruments (controls from the second-stage baseline). μ_k is an idiosyncratic error term clustered at the host country level. The predicted $\widehat{crisisXP}_k$ then substitutes the actual *crisisXP* _{k} in the second stage, analogous to (1), and this new estimate of δ now measures the (local average) learning effect.¹⁸ As in the baseline, we modify the selection of controls in order to analyze the sensitivity of the IV estimates to alternative instrument sets.

¹⁷Data constraints imply that our key explanatory variable (crisis experience) is in a distinct ontological unit from our dependent variable (bank lending). We believe, however, that such concerns fall short of an outright ecological fallacy. First, it is useful to recall that the country-level crisis variable was constructed by observing the performance of the banks in any given country. Second, while we are indeed drawing inferences about bank experience on the basis of more aggregate data, our claims regarding the relevance of the learning effect are actually tested, rather than simply asserted. Finally, while we regard the main transmission mechanism for learning as occurring within the institution of the bank, the possibility that changes in lending result from country-level institutional transfer does not negate our hypothesis that learning occurs from greater experience with crises.

¹⁸Strictly speaking, our crisis experience measure is continuous rather than binary, and so referring to δ as capturing a local average treatment effect (LATE) is somewhat of a misnomer. Nevertheless, we wish to stress the fact that the estimate applies only to economies that have nonzero crisis experience (the local effect), and that we are ultimately capturing only the influence of learning on average (the average effect).

We estimate the coefficient vector $[\alpha \ \delta \ \beta \ \chi]$ with ordinary least squares (OLS) and IV (2SLS). Since banks established in the same country form a group within which errors may be potentially correlated, we impose heteroskedasticity-robust standard errors clustered at the country level.

4.3 Identification strategy and estimation approach

The intuition behind our choice of instruments is the notion that countries that possess a richer history of crises are more likely to demonstrate beneficial learning effects from the recent incidence of a crisis. At one level, this relationship is because of probabilities: for a country with a greater stock of crisis experience, there is a greater probability that a crisis will have occurred recently. However, there is also a behavioral explanation underlying this statistical result. Events that are encountered first, as well as most recently, are more likely to be remembered and lessons from said event learned; this phenomenon is known as the *primacy-recency effect* (Deese & Kaufman 1957; Murdock Jr. 1962). There is evidence that such biases condition agents' response to probabilistic events (such as financial crises; this mental shortcut is known as the *availability heuristic*) (Curt & Zechmeister 1984).

The combination of a long history of crises—consistent with the primacy effect—and a more recent incidence of one—as implied by the recency effect—suggests that lower values of $crisisET_k$ are likely to render a large stock of crisis experience more salient, insofar as its impact on lending activity is concerned. As discussed earlier, banks can “learn” from previous crisis experiences through embedding lessons into lending guidelines, information systems, and practices; to the extent that home-country institutional practices become embedded in , there is learning from this channel, too. Primacy-recency effects then predict the type of banks that learn the most: those that have both historically encountered crises, and also those that experienced them recently.

We see this effect in cross-correlations for the instrument set (reported in Table A.3): the elapsed times (in years) since each type of crisis are uniformly negatively correlated with the crisis experience variable,¹⁹ suggesting that those with more experience do indeed possess relatively briefer periods of calm since the last crisis. The strong correlations also allude to the relevance of the instruments (in the regression we also report formal F -tests for first-stage goodness-of-fit).

The more critical issue is whether the instruments satisfy the exclusion restriction. For starters, there is little reason to believe why elapsed time since the most recent crisis would be related to any other standard socioeconomic variable that might give rise to reverse causality or omitted variable bias. We further verify this by comparing the correlation between our instruments and the dependent variable; overall, the correlation is very weak (all falling below 0.072 in absolute terms).

But what if banks in crisis-experienced countries were simply systematically different from those in less experienced ones? Perhaps countries with a long history of crises are simply more crisis-prone, and consequently, banks in such countries behave differently. If so, this selection effect is entirely consistent with our story that such banks learn from their crisis experiences. It is difficult, however, to conceive of an alternative channel affecting the lending behavior of *subsidiaries*

¹⁹Correlations with crisis experience range from -0.14 for stock market crises to -0.42 for domestic debt crises.

operating in distinct host economies, which is simultaneously consistent with a short elapsed time since the prior crisis.

One possible concern regarding the quality of the instruments is that the elapsed time from the previous crisis may simply reflect the fact that banks from those countries may have had less time to recover from the crisis-related shock, and so the instruments are capturing not so much a learning effect, but a sluggish mean reversion process for macroeconomic or institutional factors (which would violate the exclusion restriction). While this *may* be possible, there are reasons why we are skeptical that this is the case.

First, if we were using only one instrument corresponding to the elapsed time from the most recent crisis, such a possibility could in fact be true. However, given our instrument set that includes recency of an entire *suite* of crises, this outcome is far more unlikely. Indeed, in some cases any given instrument includes a span of as many as 10 years—hardly reason to believe that the economy is still licking its wounds, or that the effects from the previous crisis would not have been fully incorporated into agents’ decisionmaking.

Second, it is helpful to recall that our sample comprises subsidiaries of banks located in host countries distinct from their parents’ home economies. There is both theoretical reason to believe,²⁰ and empirical evidence to support, the fact that subsidiaries operate primarily in response to economic conditions in their local markets (Brealey & Kaplanis 1996; Focarelli & Pozzolo 2000), rather than those of their parent banks. Consequently, the history of crises on the home country would likely have a minor impact, if any, on the *contemporary* balance sheet of these subsidiaries (indeed, they may have not even been established at the time of the previous crisis), and it is even less likely that *home* crisis effects could have transmitted via the other home-country actions (such as expansionary monetary policy or banking sector reform, which would likely have fairly limited effects on lending conditions in the host country).

Third, and perhaps most importantly, slow mean reversion would imply that the correlation between our instruments and observable measures of macroeconomic and bank performance, such as GDP growth or returns on assets, will be positive. However, cross-correlations between the instruments and such performance variables indicate that no such systematic relationship exists, with correlations entering with low values and mixed signs (available on request).

We also attempt to limit the possibility that the crisis event may not be exogenous by considering only foreign subsidiaries of international banks operating in developing countries. Since the epicenter of the 2007/08 financial crisis was the banking sector of high-income economies, the crisis was—from the perspective of developing countries—effectively an exogenous event “imported” from high-income ones, and unlikely to have been caused by the foreign banks in question. Restricting our working dataset to *only* foreign-owned banks further ensures that the analysis is performed against the appropriate counterfactual conditional, since an extensive literature has established that domestic and foreign banks differ in systematic ways (see, for example, the review by Clarke, Cull, Martínez Pería & Sánchez (2003)).

²⁰Since most lending activity of subsidiaries would occur in a bank’s host economy, profit-maximizing banks are unlikely to be able to sustain prolonged repatriation of liquidity, irrespective of local financing demands.

Finally, one concern that may arise regarding our working sample is the possibility of survivorship bias. Although there is undoubtedly attrition in our sample between 2006 and 2009, we view this issue as mainly a red herring. So long as we accept the plausible exogeneity of our instrument, the IV estimate will be unbiased by even in the presence of attrition (any attrition bias would show up in the error term, but this is unlikely to be correlated with our instrument). Nevertheless, as an additional credibility check, we compute a number of (observable) means and standard deviations for the subsample of banks that had observations in 2006 but not 2009, and compare these means against those of our working sample, for the main dependent and independent variables. Standard t-tests for comparison of means indicate that there is no significant difference between these means.²¹

5 Baseline Results

The baseline results are reported in Table 1. The first three columns (A1)–(A3) estimate (1) using OLS with a host country fixed effect, and clustering of the error term by host country.²² The first specification leaves $\mathbf{B}_i$ and $\mathbf{C}_k$ empty, and contains only the key independent variable $crisisXP_k$ as a regressor. We successively introduce bank and home country-level covariates in the second and third regressions, respectively.

In the first three columns, the coefficients on crisis experience are statistically significant at conventional levels, and negative. These results mean that greater experience is associated with a smaller change in the loan-to-asset ratio during the recent financial crisis: for every additional ten years of experience, the ratio decreases by around 0.8 percentage points.

To illustrate these results, we compute the predicted value of loan-to-asset ratio difference for each country between 2006 and 2009 (Figure 3). We base this prediction on specification (A3), with bank- and country-level covariates taken at their mean values. The figure shows a clear negative relationship between the prediction of the dependent variable and the key independent variable. One of the most striking features is that no country simultaneously possesses a large increase in the loan-to-asset ratio *and* high levels of crisis experience; this means that experienced countries tend to avoid increasing loans more than assets in financial crisis.

Two notable outliers, Switzerland and Singapore, experienced fewer crises in the past and also obtain low values of the predicted change in the loan-to-asset ratio. A possible explanation is that these economies are global financial centers that have been particularly adroit at acquiring crisis

²¹For example, the means for total loans as a share of assets for the working and excluded subsamples are 48.1 and 40.7, respectively, with the t statistic for difference in means given by 0.83 ($p = 0.40$). Similarly, the means for, say, equity as a share of total assets are 16.3 and 18.4 ($t = -0.34, p = 0.73$). Indeed, there are only six banks for which observations exist in 2006 but not in 2009 (and the absence of 2009 data for these banks are not so much because of survivorship bias—the banks remain active in 2011—but that they did not report lending data for 2009). Full results for these additional tests are available on request.

²²Coefficients with random effects are very similar, and Hausman tests indicate that differences between fixed and random effect estimates are not systematic in this baseline. However, for comparability with later specifications (where the random effects may not apply), we retain the fixed effects model for all our specifications estimated via OLS. The random effects results are available on request.

Table 1: Baseline regressions for the difference in bank loan-to-asset ratio between 2006 and 2009[†]

	A1	A2	A3	A4	A5	A6
Crisis experience	-0.079 (0.02)***	-0.073 (0.02)***	-0.082 (0.04)**	-0.080 (0.04)**	-0.077 (0.04)**	-0.110 (0.05)**
	<i>Bank covariates</i>					
Size		0.000 (0.00)	-0.000 (0.00)		0.000 (0.00)	-0.000 (0.00)
Solvency		-0.179 (0.09)**	-0.170 (0.08)**		-0.178 (0.09)**	-0.164 (0.09)*
Profitability		-0.018 (0.02)	-0.015 (0.02)		-0.018 (0.02)	-0.015 (0.02)
Interest margin		0.613 (0.20)***	0.605 (0.21)***		0.614 (0.19)***	0.611 (0.20)***
	<i>Host country covariates</i>					
GDP per cap.			-0.000 (0.00)			-0.000 (0.00)
Lagged GDP growth			-0.100 (0.73)			-0.055 (0.72)
Current account balance			-0.189 (0.17)			-0.235 (0.16)
Inflation			0.236 (0.41)			0.279 (0.40)
Host fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
1st-stage F				0.00	0.00	0.00
Underid. test				0.00	0.00	0.00
Weak id. test (rel. bias)				< 5%	< 5%	< 5%
Overid. test				0.61	0.59	0.44
R^2	0.02	0.06	0.08			
2nd-stage F	0.00	0.01	0.00	0.03	0.02	0.01
Estimation	OLS	OLS	OLS	IV	IV	IV
Obs. (Host countries)	365 (77)	362 (76)	361 (76)	350 (62)	347 (61)	346 (61)

[†] The dependent variable is the difference in bank loan-to-asset ratios between 2006 and 2009. Heteroskedasticity and host country correlation-robust standard errors are reported in parentheses. A constant term was included in the regressions, but not reported. The underidentification test is the Kleibergen-Paap rk LM , the weak identification test is the Kleibergen-Paap rk Wald F , and the overidentification test is the Hansen J . * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

management experience from their rich financial and banking sectors, which compensates for their lack of direct crisis experience. A related possibility is that stricter prudential regulation due to their status as global financial centers may forestall the incidence of crises. In order to take these possibilities into account, Section 6 considers introducing additional banking and financial-sector variables, along with an alternative measure of financial experience.

To gauge the economic significance of our results, we examine in greater detail the average foreign-owned bank of our sample, which carries a loan-to-asset ratio of 48.09 in 2006, and initially

Figure 3: Predicted difference in loan-to-asset ratio between 2006 and 2009

experiences no change in lending between 2006 and 2009. If this bank was owned by an entity established in a country with ten additional years of crisis experience, then the ratio would decrease by 0.8 percentage points, reaching 47.29 in 2009. This decrease constitutes a contraction of the loan-to-asset ratio of 1.7 percent. But since the standard deviation of the crisis experience variable amounts to 29 years, a more typical change of one standard deviation would translate to a change of 4.8 percent in the ratio, which is of substantial economic significance.

As countries are relatively heterogeneous with respect to their crisis experiences, it would be informative to consider this change in a country's experience relative to that of others in the sample. If the Republic of Mauritius—the country with the narrowest crisis experience in our sample—were to increase its number of crises experienced by one standard deviation, Mauritian crisis experience would increase from 10 to 39 years, reaching a level comparable to that of Australia or New Zealand. *Ceteris paribus*, the predicted difference in the loan-to-asset ratio would then see a reduction of 11.31 to 9.09 percentage points.²³

An alternative perspective is to directly relate the result with the host country and its decision to accept the establishment of a foreign bank from another country. Our results suggest that this choice has nontrivial economic consequences with respect to loan provision. For instance, Canada experienced 109 crises less than the United States between 1800 and 2005; over the course of the recent crisis, a bank owned by Canadian entities tended to *increase* their loan-to-asset ratio by 3.25 percentage points, whereas a bank owned by American entities would tend to *decrease* this ratio by 3.69 percentage points.

²³ As a second example in the opposite direction, a one-standard deviation decrease in the crisis experience of the United States would see its loan-to-asset ratio would pass from -3.69 to -1.47 percentage points.

Finally, it is worth noting that two bank-level covariates appear to be significantly related to bank lending behavior. The bank solvency ratio is negatively associated with the loan-to-asset ratio—an increase in the ratio of a bank’s equities to total assets would see a concomitant decrease in its loan-to-asset ratio during the crisis—while a bank’s interest margin has the opposite (positive) relationship. The former could be due to the need for banks to improve their solvency in the crisis, especially in terms of cherry-picking customers in a “flight to quality” à la Bernanke *et al.* (1996), while the latter suggests that more profitable banks tend to be more willing to extend credit.

As explained in the Subsection 4.2, the OLS regressions suffer from potential endogeneity problems. To address the endogeneity issue, we report analogous specifications for instrumental variables estimates in columns (A4)–(A6). For each of the IV specifications, we report the usual accompanying tests for instrument relevance (underidentification), coherence (overidentification),²⁴ and weakness.

The results for the underidentification and overidentification tests are consistent with the instruments being relevant (a rejection of the null that the excluded instruments are uncorrelated with the endogenous regressor) and coherent (a failure to reject the null that the error term is uncorrelated with the instruments), while the weak identification tests indicate that the instruments are reasonably strong (the IV estimator introduces bias that is less than 5 percent that of the bias of the OLS estimator). The three tests confirm that the vector of years elapsed since the last crisis is a suitable instrument for our specifications.

The IV estimates are roughly comparable to the OLS results (significant and conventional levels and negative), and in the case of the fullest specification (B6), the point estimate is actually marginally larger. We conclude that the main result—that more experienced countries tend to lend less over the course of the most recent crisis—is robust to baseline endogeneity considerations.

6 Robustness of the Baseline

To test the robustness of our baseline finding, we consider several variations along the following lines: (1) we introduce additional variables to control for additional banks or host-country characteristics; (2) we consider alternative measures for the dependent and key independent and control variables; (3) we perform a decomposition of the crisis experience variable into different crisis types; and (4) we consider whether the results are sensitive to our temporal frame by performing a placebo test using the pre-crisis period.

6.1 Additional controls

In our baseline, the core set of controls include bank-level covariates (size, solvency, profitability, and interest margin) and home country-level covariates (GDP, GDP growth, inflation, and the current

²⁴Standard tests for overidentifying restrictions are often interpreted as tests of the validity of the moment conditions, although such tests are neither necessary nor sufficient Parente & Santos Silva (2012). We report them here for completeness, but interpret the results as indicative of whether the instrument set is coherent, rather than whether it is valid.

account balance). In Table 2, we expand this core set of control variables for both categories. Since we take the endogeneity issue seriously, we report only IV results, following the methodology outlined in the previous section (results are generally very similar with OLS, and are available on request).

Table 2: Robustness regressions for the difference in bank loan-to-asset ratio between 2006 and 2009, with additional controls[†]

	B1	B2	B3	B4	B5	B6
Crisis experience	-0.098 (0.04)**	-0.139 (0.05)***	-0.163 (0.07)**	-0.098 (0.04)**	-0.133 (0.05)***	-0.140 (0.05)**
<i>Additional covariates</i>						
Overhead costs	0.638 (0.25)**					0.598 (0.29)**
Weakness	-0.938 (1.32)					2.224 (0.89)**
Trade openness		-0.053 (0.01)***				-0.048 (0.02)**
Financial export		-0.057 (0.11)				-0.131 (0.16)
Bank capital			0.803 (0.63)			0.989 (0.54)*
Non perf. loans			0.321 (0.77)			0.121 (0.98)
Low bil. trade				-3.721 (2.66)		-5.752 (3.16)*
Medium bil. trade				-6.036 (2.73)**		-6.526 (3.88)*
Colony dummy				-0.907 (1.72)		-0.495 (2.21)
G-SIFIs parent dummy					4.906 (2.61)*	2.089 (2.66)
Host FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank covariates	Yes	Yes	Yes	Yes	Yes	Yes
Home country covariates	Yes	Yes	Yes	Yes	Yes	Yes
1st-stage F	0.00	0.00	0.00	0.00	0.00	0.00
Underid. test	0.00	0.00	0.00	0.00	0.00	0.01
Weak id. test (rel. bias)	< 5%	< 5%	< 5%	< 5%	< 5%	< 10 %
Overid. test	0.51	0.52	0.51	0.53	0.58	0.50
2st-stage F	0.00	0.00	0.02	0.00	0.00	0.00
Estimation	IV	IV	IV	IV	IV	IV
Obs. (host countries)	301 (57)	339 (59)	314 (60)	329 (59)	343 (60)	256 (53)

[†] The dependent variable is the difference in bank loan-to-asset ratios between 2006 and 2009. Heteroskedasticity and host country correlation-robust standard errors are reported in parentheses. A constant term was included in the regressions, but not reported. The underidentification test is the Kleibergen-Paap rk LM , the weak identification test is the Kleibergen-Paap rk Wald F , and the overidentification test is the Hansen J . * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

In our baseline, we retained only a key set of bank covariates that capture distinct features of

banks that may be related their lending activity. Here, we expand the core set of covariates to include several controls that may come into play, especially during crisis episodes. Overhead costs, for example, may experience substantial shocks due to bank restructuring in response to a crisis; such costs, in turn, may impact bank lending, as intermediation or agency costs have been shown to be a potential influence on the impact of the financial accelerator mechanism (Bernanke 1983; Bernanke *et al.* 1996). Another characteristic that may have a role in lending is a bank’s willingness to take on risk: relatively greater exposure to credit risk was, after all, one of the key preconditions of the recent crisis (Gorton 2009), and post-crisis adaptations by banks may involve changing their prior risk exposure (either involuntarily due to new regulation, or voluntarily due to revised risk management practices). In column (B1), we introduce these two factors, respectively, by adding banks’ overhead costs as a share of total assets and the ratio of loan loss provisions to net interest revenue (bank “weakness”) to our set of bank-level controls.²⁵

It is also possible to account for further home-country heterogeneity beyond the standard macroeconomic controls we include in the baseline. In columns (B2) and (B3), we consider two separate families of home-country covariates. Economic openness may influence the banks’ strategies with respect to credits and loans; Baltagi, Demetriades & Law (2009) have shown that both financial and trade openness are statistically significant determinants of banking sector development and, in particular, of private credit extension. Economic openness can also enhance competitive pressures and erode incumbent banks’ rents, which could in turn affect their lending patterns. Our proxies for this openness effect are trade openness (the total trade share of GDP), and financial-sector openness (the share of insurance and financial services in total services exports). Another family of variables that may affect bank lending at the home country level is the level of development of its banking sector (Clarke *et al.* 2003). For this family, we include two home banking system variables: bank capital as a share of output, and the share of nonperforming loans in banks.

Foreign entities presence and activity are often determined by how interconnected home and host countries are. Such links can be geographical, historical or cultural, and cross-border lending can be strongly conditioned by such bilateral relationships (de Haas & van Horen 2012b). We use a measure of bilateral trade to proxy for the strength of this interconnectedness effect. We construct these controls by first computing the total bilateral trade share of total pair output, then classifying these into three equally-sized bins: low, medium, and high. We then add the first two of these categories (high bilateal trade being the excluded group) to the baseline. Consistent with this theme, there may also be an historical link between host and home countries that involves a deeper knowledge and less retrenchment for the foreign-owned banks. We proxy this link by adding a dummy encompassing colonial relationships for each country over the past two centuries. In column (B4), we report the estimated model with these two additional elements.

Finally, one might be concerned by whether the importance and reputation of parent banks may play a role in the behavior of their subsidiaries. In particular, major international banks are often believed to be more willing to engage in riskier behavior, since they may regard themselves

²⁵As is evident, our sample size falls significantly when we include these additional controls, which justifies their somewhat selective exclusion in the simple baseline.

as “too big to fail.” Subsidiaries of such banks may consequently be more willing to engage in riskier lending—resulting in higher loan-to-asset ratios—and hence may differ systematically from those that are not. We identify such subsidiaries by matching bank ownership information with the classification of global systemically important financial institutions (G-SIFIs) from the Basel Committee on Banking Supervision (Financial Stability Board 2011). This indicator variable is included as an additional covariate in column (B5).

As evident from Table 2, our results survive this array of robustness checks. For completeness, we also report in column (B6) the entire set of control variables considered in this subsection; again, the main result—that crisis experience conditions lending in a negative fashion—remains, and if anything the magnitude of the coefficient is slightly larger as a consequence of including these additional controls.

6.2 Alternative measures

As additional tests, we consider replacing several key variables in the baseline with alternative measures. These are reported in Table 3, where each specification is run successively excluding, then including, home country-level covariates.

The first test pertains to replacing the key independent variable, that of crisis experience. As alluded to in Section 5, a country does not necessarily need to experience a financial crisis to attain expertise in the management of banking activities through a crisis (as was the case of Switzerland and Singapore). We introduce here an alternative measure of financial experience as developed by Abiad, Detragiache & Tressel (2010), which measures financial reforms in 91 economies over the 1973–2005 period. Although the period coverage is not identical with our baseline experience measure, this variable covers multiple aspects of financial sector policy, and is, in some ways, qualitatively richer in terms of the strength of experience measured. However, since this is not directly related to the occurrence of crises, the instruments employed for our IV in the baseline are not appropriate. We therefore report OLS estimates in columns (C1) and (C2).²⁶ The coefficient for this alternative measure of experience is statistically significant and, as is the case for our baseline crisis experience variable, negative.

One concern over our narrative of learning that we have conveyed thus far is the possibility that knowledge may be transmitted not so much within each banking institution, but rather between countries via some other indirect form of institutional transfer. Our second test, reported in columns (C3) and (C4), seeks to address this concern by including *both* the main crisis experience variable as well as financial reforms measure. Since financial reforms are a more direct measure of the effect of learning via cross-country institutional transfer—for example, new macroprudential regulations promulgated in a crisis-struck home country may provide a demonstration effect for the host country—a finding where crisis experience is rendered insignificant by the inclusion of this

²⁶If, instead, we were to include simultaneously *both* our baseline crisis experience alongside this financial experience variable as regressors, there is no change in the significance and sign of our coefficients; we report this set of results in Table A.5 of the appendix. The bottom line is that both measures appear to capture somewhat distinct, but reinforcing, elements of experience; while positive, the correlation between the two variables is only 0.14.

Table 3: Robustness regressions for the difference in bank lending between 2006 and 2009, with alternative measures[†]

	C1 <i>LtA^a</i>	C2 <i>LtA^a</i>	C3 <i>LtA^a</i>	C4 <i>LtA^a</i>	C5 <i>Loans^b</i>	C6 <i>Loans^b</i>	C7 <i>LtA^a</i>	C8 <i>LtA^a</i>
Financial reforms	-0.727 (0.22)***	-0.758 (0.30)**	-0.611 (0.23)***	-1.081 (0.36)***				
Crises experience			-0.087 (0.04)**	-0.136 (0.05)***	-6.485 (2.53)**	-6.111 (2.86)**	-0.092 (0.05)**	-0.085 (0.04)**
<i>Bank covariates</i>								
Size	-0.000 (0.00)	-0.000 (0.00)	0.000 (0.00)	0.000 (0.00)	0.185 (0.05)***	0.186 (0.05)***		0.000 (0.00)
Solvency	-0.166 (0.09)*	-0.165 (0.09)*	-0.156 (0.09)*	-0.133 (0.09)	-3.126 (2.32)	-3.833 (2.59)		-0.167 (0.08)**
Profitability	-0.007 (0.01)	-0.007 (0.02)	-0.016 (0.02)	-0.020 (0.02)	0.406 (1.55)	0.178 (1.56)		-0.018 (0.02)
Interest margin	0.447 (0.18)**	0.488 (0.19)**	0.646 (0.19)***	0.707 (0.19)***	50.148 (15.15)***	53.677 (15.70)***		0.628 (0.20)***
<i>Host country covariates</i>								
GDP per cap.		0.000 (0.00)		0.000 (0.00)		0.005 (0.01)		
Lagged GDP growth		-0.110 (0.33)		-0.611 (0.54)		-58.864 (35.84)		
Current account balance		-0.011 (0.11)		-0.194 (0.14)		4.487 (8.52)		
Inflation		-0.119 (0.53)		0.692 (0.34)**		25.517 (39.43)		
Δ GDP							-0.001 (0.00)	-0.001 (0.00)
Δ GDP							0.056 (0.32)	0.032 (0.32)
Δ Current							0.175 (0.31)	0.078 (0.32)
Δ Inflation							0.530 (0.48)	0.428 (0.47)
Host FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1st-stage F			0.00	0.00	0.00	0.00	0.00	0.00
Underid. test			0.00	0.00	0.00	0.00	0.00	0.00
Weak id. test (rel. bias)			< 5%	< 5%	< 5%	< 5%	< 5 %	< 5%
Overid. test			0.66	0.68	0.64	0.66	0.82	0.80
R^2	0.06	0.06						
2nd-stage F	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.01
Estimation	OLS	OLS	IV	IV	IV	IV	IV	IV
Obs. (host countries)	397 (80)	391 (80)	340(59)	340(59)	347 (61)	346 (61)	349 (62)	346 (61)

[†] All changes in home-country variables are for 2006 and 2009, with the exception of GDP growth, which is growth rate between 2005 and 2010. Heteroskedasticity and host country correlation-robust standard errors are reported in parentheses. A constant term was included in the regressions, but not reported. The underidentification test is the Kleibergen-Paap rk LM , the weak identification test is the Kleibergen-Paap rk Wald F , and the overidentification test is the Hansen J . * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

* The dependent variable is the difference in bank loan-to-asset (LtA) ratio between 2006 and 2009.

[‡] The dependent variable is the difference in bank gross loans between 2006 and 2009.

additional measure would indicate that learning was occurring more via country-level institutional transfer, rather than bank-level mechanisms. We find that although the financial reform variable *is* significant (suggesting that some institutional learning may be at play), the coefficient on crisis experience remains significant. Perhaps more importantly, the magnitude of the coefficients are comparable to the baseline, which suggests that including a proxy for country-level knowledge transfer does not diminish the likelihood that learning is also occurring at the level of the bank.

The third test changes the dependent variable itself: instead of changes in the loan-to-asset ratio, we utilize the difference in gross loans directly. The total amount of loans is used as often as the loan-to-asset ratio in empirical studies studying banks lending behavior (see, *inter alia*, Ivashina & Scharfstein (2010) and Puri *et al.* (2011)). Since we are no longer normalizing our loan measure by size, we are careful to always include our measure of size (total bank assets in 2006) as a control. These results are reported in columns (C5)–(C6). While the point estimate of the coefficients for crisis experience are no longer comparable, we note that its sign is consistent (negative), and that it is statistically significant. As might be expected given the close relationship between loans and total assets, the model’s goodness-of-fit (measured by the second-stage F statistic) rises substantially, although this is more a statistical artifact than an actual increase in explanatory power.

In our final test, we replace the home-country covariates, which are taken at their 2006 values to minimize endogeneity, by their difference between 2006 and 2009. Intuitively, the evolution of home countries’ macroeconomic environments may well feature in explaining banks’ lending activity. For instance, entities established in a faster-growing country may have a greater propensity to expand their activities and influence across borders. A similar argument can be made for countries that have become richer over the time period, as captured by changes in GDP per capita. While we are more cautious about including the change in these variables in baseline due to endogeneity concerns, we nevertheless report this alternative as a robustness check in columns (C7) and (C8). Again, the baseline results remain largely unchanged; however, given the weaker performance of the home-country variables in these specifications, we regard our choice of variables taken at their initial 2006 as appropriate.

6.3 Unpacking the crisis experience

Our third set of robustness checks considers decomposing the crisis experience variable into its constituent parts. Doing so achieves two objectives. First, it helps clarify the robustness of our results to an alternative construction methodology for our key variable. Second—and more importantly in our view—we can use this decomposition to peer into exactly what sorts of crises appear to be driving our results, and consequently whether we can make reasonable economic inferences regarding the types of crises that banks appear to learn from.

These decompositions are reported in Table 4. Columns (D1)–(D4) include, separately, the stock of experience corresponding to each of the four classes of crises in the Reinhart & Rogoff (2009) dataset that are represented in our aggregate crisis experience variable (as described in Subsection 4.1). The most striking result is that every single crisis type has a negative coefficient—

in line with our aggregate—but only experiences in currency and domestic debt crises enter with a significant coefficient. We also note that experience in banking crises enters with a relatively high coefficient, and is statistically insignificant mainly because it is accompanied by correspondingly large standard errors. This latter result may be understood by recognizing the fact that banking crises are generally rather heterogeneous in terms of both context and causes. As a result, banks may acquire mixed experiences as a result of past banking crises, and accordingly respond to them in ways that go beyond contractions in their loan portfolio. These decompositions are reported in Table 4. Columns (D1)–(D4) include, separately, the stock of experience corresponding to each of the four classes of crises in the Reinhart & Rogoff (2009) dataset that are represented in our aggregate crisis experience variable (as described in Subsection 4.1). The most striking result is that every single crisis type has a negative coefficient—in line with our aggregate—but only experiences in currency and domestic debt crises enter with a significant coefficient. We also note that experience in banking crises enters with a relatively high coefficient, and is statistically insignificant mainly because it is accompanied by correspondingly large standard errors. This latter result may be understood by recognizing the fact that banking crises are generally rather heterogeneous in terms of both context and causes. As a result, banks may acquire mixed experiences as a result of past banking crises, and accordingly respond to them in ways that go beyond contractions in their loan portfolio. These decompositions are reported in Table 4. Columns (D1)–(D4) include, separately, the stock of experience corresponding to each of the four classes of crises in the Reinhart & Rogoff (2009) dataset that are represented in our aggregate crisis experience variable (as described in Subsection 4.1). The most striking result is that every single crisis type has a negative coefficient—in line with our aggregate—but only experiences in currency and domestic debt crises enter with a significant coefficient. We also note that experience in banking crises enters with a relatively high coefficient, and is statistically insignificant mainly because it is accompanied by correspondingly large standard errors. This latter result may be understood by recognizing the fact that banking crises are generally rather heterogeneous in terms of both context and causes. As a result, banks may acquire mixed experiences as a result of past banking crises, and accordingly respond to them in ways that go beyond contractions in their loan portfolio.

The relative importance of currency crises and domestic debt crises in terms of crisis experience suggests that these sorts of crises offer important learning opportunities, insofar as lending activity is concerned. Currency and domestic debt crises often impose real costs (Caballero & Krishnamurthy 2001), which may or may not always occur with stock market and banking crises. However, there is also the possibility that these crises are especially important because they directly impact bank balance sheets (as opposed to stock market crashes or external debt crises, which would have either a small or indirect impact on bank balance sheets, or banking crises, which affect bank operations across their entire spectrum of operations, not just their lending).

Another approach to decomposing the crisis experience variable is to capture the independent components embedded in the crisis experience measure after stripping out correlated elements within each separate type of crisis experience. We perform this decomposition with principal components analysis (PCA). More specifically, we calculate the proportion-weighted average of the

Table 4: Robustness regressions for the difference in bank lending between 2006 and 2009, decomposed crisis experience[†]

	D1	D2	D3	D4	D5	D6
Currency crises	-0.180 (0.09)**					
Stock market crises		-0.120 (0.10)				
Domestic debt crises			-0.615 (0.24)**			
Banking crises				-0.302 (0.26)		
Princ. comp. 1 & 2 (4 crises)					-3.209 (1.35)**	
Princ. comp. 1 & 2 (6 crises)						-2.213 (1.18)*
Host FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank covariates	Yes	Yes	Yes	Yes	Yes	Yes
Home country covariates	Yes	Yes	Yes	Yes	Yes	Yes
1st-stage F	0.00	0.00	0.00	0.00	0.00	0.00
Underid. test	0.00	0.00	0.00	0.00	0.00	0.00
Weak id. test (rel. bias)	< 5%	< 5%	< 10%	< 5%	< 5%	< 5%
Overid. test	0.44	0.11	0.65	0.14	0.74	0.71
2nd-stage F	0.00	0.02	0.00	0.06	0.00	0.01
Estimation	IV	IV	IV	IV	IV	IV
Obs. (host countries)	346 (61)	346 (61)	346 (61)	346 (61)	346 (61)	346 (61)

[†] The dependent variable is the difference in bank loan-to-asset ratios between 2006 and 2009. Heteroskedasticity and host country correlation-robust standard errors are reported in parentheses. A constant term was included in the regressions, but not reported. The underidentification test is the Kleibergen-Paap rk LM , the weak identification test is the Kleibergen-Paap rk Wald F , and the overidentification test is the Hansen J . * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

principal components with eigenvalue greater than unity,²⁷ and use this as an alternative measure of crisis experience.

The results using the measure constructed from our four included classes of crises are reported in column (D5). Moreover, since PCA decompositions effectively resolve the problem of excess correlation between different crisis categories, we can now add the final two (initially dropped) categories of crises into the construction of a PCA measure; the results from this expanded measure are reported in column (D6). Overall, the PCA decompositions validate the results obtained in the baseline: greater crisis experience tends to reduce the change in the loan-to-asset ratio resulting from the crisis.²⁸

²⁷In our data, the first two principal components explain more than 75 percent of the data, and are the only two whose eigenvalues exceed the value of one. In our composite PCA measures, we use their variance proportion as the weight for each respective component.

²⁸Additional specifications with additional decompositions are provided in appendix, and the results therein confirm the main conclusions discussed here.

6.4 Falsification test for pre-crisis period

Might our results be a quirk of the 2006–09 period that we consider? In this subsection we introduce a placebo test designed to investigate the possibility that banks with extensive crisis experience were more risk-taking and may thus have lent significantly more during the pre-crisis period. The implication of this assertion is that excess pre-crisis lending might force such banks to cut their post-crisis loan volumes more drastically. If this assertion is indeed true, we would expect a positive and significant sign of the coefficient on crisis experience in the period preceding the crisis.

Table 5: Falsification test regressions for the difference in bank lending between 2003 and 2006, decomposed crisis experience[†]

	E1	E2	E3	E4	E5	E6
Crisis experience	-0.052 (0.03)*	-0.058 (0.03)*	-0.068 (0.05)	-0.031 (0.05)	-0.047 (0.06)	-0.004 (0.09)
Size		0.000 (0.00)	0.000 (0.00)		0.000 (0.00)	0.000 (0.00)
Solvency		-0.214 (0.11)**	-0.232 (0.11)**		-0.212 (0.11)*	-0.226 (0.10)**
Profitability		0.015 (0.02)	0.014 (0.01)		0.015 (0.02)	0.013 (0.01)
Interest margin		0.264 (0.31)	0.231 (0.33)		0.256 (0.31)	0.221 (0.32)
GDP per cap.			-0.000 (0.00)			-0.000 (0.00)
Lagged GDP growth			-0.937 (1.03)			-0.813 (1.05)
Current account balance			-0.222 (0.25)			-0.038 (0.30)
Inflation			-0.188 (0.56)			-0.252 (0.57)
Host FE	Yes	Yes	Yes	Yes	Yes	Yes
1st-stage F				0.00	0.00	0.00
Underid. test				0.00	0.00	0.00
Weak id. test (rel. bias)				< 5 %	< 5 %	< 10 %
Overid. test				0.12	0.05	0.05
R^2	0.01	0.03	0.03			
2nd-stage F	0.09	0.04	0.00	0.54	0.09	0.00
Estimation	OLS	OLS	OLS	IV	IV	IV
Obs. (host countries)	288 (75)	287 (74)	286 (74)	262 (52)	262 (52)	261 (52)

[†] The dependent variable is the change in bank loan-to-asset ratio between 2003 and 2006. Heteroskedasticity and host country correlation-robust standard errors are reported in parentheses. A constant term were included in the regressions, but not reported. Underid. test: Kleibergen-Paap rk LM statistic, weak id. test: Kleibergen-Paap rk Wald F. statistic and overid. test: Hansen J. statistic. * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Our test involves altering the pre- and post-crisis dates to an earlier period; we choose 2003 and 2006 as our alternative years. In addition to being a test of whether experienced banks lent more in the pre-crisis period, this test can also determine whether bank lending behavior in response to

crisis experience is an idiosyncrasy associated with a crisis environment, or whether such behavior is more general in nature (and in this sense the exercise can be regarded as a placebo test).

The results from this change are reported in Table 5, and in only two specifications—columns (E1) and (E2)—does the coefficient on crisis experience enter with a (negative and) significant coefficient, and even so, only marginally at the 10 percent level. Otherwise, the estimates all point to statistically indistinguishable differences between the differentially-experienced banks for the pre-crisis period between 2003 and 2006. In general, there is little evidence to support the idea that crisis experience matters in a non-crisis environment, or that more experienced banks behaved differently *ex ante*. This fact can also be corroborated graphically by the absence of any distinct pre-crisis trends for experienced bank lending in the earlier period (as shown in Figure A.1 of the appendix).

7 Do Banks That Learn from Crises Perform Better?

The empirical approach outlined in Subsection 4.2 relies on changes in loan-to-asset ratios as our main measure of evaluating foreign banks’ post-crisis activity. A natural question to ask, when attempting to evaluate post-crisis bank performance, is why we do not instead attempt to capture a more direct measure of bank performance, instead of using an indirect one. The main reason for this is that bank performance measures are likely to be especially noisy following a crisis, and so offer a much weaker signal with which to determine banks’ learning from crises.

Unlike changes in loan-to-asset ratios, which definitively capture a size-adjusted variation in loan activity (since loans are a component of the asset side of the bank’s balance sheet), standard measures of bank performance may be misleading after a crisis. Take, for example, changes in the bank’s return on assets (RoA, or the ratio of net income to total assets). A bank that makes inferior lending decisions will likely experience a reduction in net income. However, should the same bank see its overall asset base decline even faster—an entirely possible scenario after a crisis—this would give rise to an *increase* in the RoA, which is contrary to what one would expect from changes in income alone, and misleading when interpreted as a measure of performance. An analogous problem plagues other standard performance measures, such as RoE. Hence, using such measures of performance in our data may yield misleading conclusions.²⁹

There is an additional, substantive, reason why we focus on loans. Although bank performance metrics legitimately capture learning effects insofar as *banks* are concerned, we are ultimately interested in how banks react to crises in terms of the main outcome that matters for the *economy* at large; this outcome is bank credit.

Nevertheless, one may be interested in whether banks that learn from their crisis experiences do end up with better performance outcomes. Our approach to (partially) circumvent this issue is an indirect one. Rather than simply replacing lending with performance measures as a dependent

²⁹This problem does not arise with our lending measure, however; since both lending and total assets fall on the same side of the bank’s balance sheet, changes in lending will always result in net assets changing proportionately in the same direction.

variable—which would potentially be subject to the indeterminacy problem outlined above—we examine the relationship between performance measures (such as the RoA) and *lending* (as captured by our loan-to-asset ratio). Since these measures are scaled by a common denominator (total assets), we are assured that the relationship that we capture is unaffected by potentially contradictory changes in the numerator and denominator (while the normalization by total assets also ensures that we take important size differences into account).

A regression of bank performance measures on loans introduces problems of its own, however. Since lending and performance are codetermined, we run into an endogeneity problem between the two. Our resolution involves instrumenting the loan-to-asset ratio with *predicted* loan to assets. More specifically, we estimate:³⁰

$$\Delta\pi_{ijk} = \phi + \kappa\Delta l_{ijk} + \gamma'\Delta\mathbf{B}_i + \psi_j + \varepsilon_{ijk}, \quad (3)$$

where π_{ijk} is a bank performance measure (income, profits, or efficiency) for bank i in host country j and owned by home country k . As before, l_{ijk} is the bank's loan-to-asset ratio, $\mathbf{B}_i$ is a vector of bank covariates, and the operator Δ indicates the change between 2006 and 2009. ψ_j is a host country fixed effect, and ε_{ijk} is an idiosyncratic error term, which we cluster at the host country level. κ , our coefficient of interest in this section, captures the relationship between bank performance and lending.

We consider three main alternative measures for bank performance. The first two were used as bank-level covariates in the estimation of (1): *return on assets*, a standard measure of the profitability of firms and commonly used to capture performance of banks, and *bank profitability*, which is the ratio of profit before taxes over total assets.³¹ Our final performance measure is the *cost-to-income* ratio, which relates a bank's costs to its income, and serves as a proxy for how efficiently the bank is being run.³² For the first two variables, higher ratios indicate greater performance, while the opposite is the case for the third. Thus, if *a priori*, we expect κ to enter with a negative coefficient when the dependent variable is either of the first two, and *vice versa* for the last.

Our first stage is the predicted change in the loan-to-asset ratio:

$$\widehat{\Delta l}_{ijk} = \zeta + \boldsymbol{\xi}'\mathbf{crisisXP}_k + \vartheta_k, \quad (4)$$

where ζ is a constant, $\mathbf{crisisXP}_k$ is the vector of crisis experience instruments, and ϑ_k is an

³⁰Of course, this strategy requires that our excluded instruments, in particular the two crisis experience measures we employ, influence bank performance *only* through the medium of bank lending. While we believe that this is plausible—banks' loan portfolios do, after all, dominate other potential determinants of bank performance (Bourke 1989)—we are less prepared to strongly defend this claim, and so the findings in this section are meant to be illustrative, and should be interpreted cautiously because of the complex linkages that exist between loans and performance in banking sector.

³¹Since cross-country tax differentials may give rise to important discrepancies between countries unrelated to bank performance, we consider profit before taxes as a means to tackle this issue.

³²Note that this measure does *not* use total assets in the denominator, but since both operating costs and income constitute flows in the income statement, there is no ambiguity in the interpretation of changes in the ratio.

idiosyncratic error term clustered at the host country level. $\hat{\Delta}_{ijk}$ serves as our instrument that substitutes the actual change in the loan-to-asset ratio. In order to maximize the information content of our experience variables, we use both our main crisis experience stock measure as well as the alternative financial reform measure introduced in Subsection 6.2 as exogenous instruments for **crisisXP_k**.

We report the results of this exercise in Table 6. The first three columns (F1)–(F3) correspond, respectively, to specifications of (3) using return on assets, profitability, and cost-to-income as the dependent variable. The next three columns (F4)–(F6) populate $\mathbf{B}_i$ with the core set of bank-level controls (excluding the corresponding dependent variable).

Table 6: Regressions for changes in bank performance measures on changes in loan-to-asset ratios

	F1 <i>RoA</i> [*]	F2 <i>Profit</i> [†]	F3 <i>CIR</i> [§]	F4 <i>RoA</i> ^a	F5 <i>Profit</i> ^b	F6 <i>CIR</i> ^c
Loans to assets ratio	-0.109 (0.07) [*]	-0.147 (0.08) [*]	77.991 (41.74) [*]	-0.100 (0.07)	-0.135 (0.08) [*]	68.348 (41.27) [*]
Bank covariates	No	No	No	Yes	Yes	Yes
Host FE	Yes	Yes	Yes	Yes	Yes	Yes
1st stage <i>F</i> (pval.)	0.00	0.00	0.00	0.01	0.00	0.01
Underid. test (pval.)	0.02	0.02	0.01	0.02	0.02	0.01
Weak id. test (rel. bias)	< 20%	< 20%	< 20%	< 20%	< 20 %	< 20 %
Overid. test (pval.)	0.70	0.71	0.76	0.71	0.76	0.73
2nd stage <i>F</i> (pval.)	0.07	0.08	0.07	0.07	0.01	0.08
Estimation	IV	IV	IV	IV	IV	IV
Obs. (Host countries)	342 (60)	342 (60)	334 (58)	342 (60)	342 (60)	333 (58)

[†] Heteroskedasticity and host country correlation-robust standard errors are reported in parentheses. A constant term was included in the regressions, but not reported. The underidentification test is the Kleibergen-Paap rk *LM*, the weak identification test is the Kleibergen-Paap rk Wald *F*, and the overidentification test is the Hansen *J*. ^{*} indicates significance at 10 percent level, ^{**} indicates significance at 5 percent level, and ^{***} indicates significance at 1 percent level.

^{*} The dependent variable is the difference in bank net income over total assets (RoA) between 2006 and 2009.

[†] The dependent variable is the difference in bank profit before taxes over total assets (profitability) between 2006 and 2009.

[§] The dependent variable is the difference in bank cost-to-income ratio (CIR) between 2006 and 2009.

The results are consistent with our argument that reduced lending is associated with greater learning from experience and hence superior bank performance. Both return on assets and profitability measures enter with a negative and significant coefficient, while the coefficient for the cost-to-income ratio is significant and positive. Taken together, the estimated coefficients for κ in Table 6 imply that lower lending has a positive influence on the overall performance of banks in our sample (a result consistent with our theoretical discussion in Section 2). Furthermore, there are no immediate concerns that arise regarding the relevance and coherence of the instrument set (although we note that the Kleibergen-Paap *F* statistic does suggest, as we suspected, that the

instruments are not particularly strong).

8 Conclusion

In this paper, we have sought to demonstrate that past experience with financial crises can condition the manner by which banks respond to a crisis environment, in terms of their lending activity. We interpret this as evidence that such experienced banks learn from their past crisis history, and rationally scale back on their post-crisis lending; this reduction in credit extension subsequently results in superior post-crisis bank performance, across a range of metrics. Our basic finding takes into account the possibility that such experienced banks may fundamentally differ from inexperienced ones, by deploying an instrumental variables approach that controls for endogeneity arising from such selection effects, as well as possible reverse causality. Policymakers tasked with managing crises may therefore wish to exercise caution before sanctioning foreign banks that sharply curtail their lending; such banks may, after all, possess superior knowledge of the post-crisis risk environment.

We also show that this result is remarkably robust to alternative measures of crisis experience and a host of additional (observable) controls. This robustness appears to arise from learning effects attributable to experience gained from currency and domestic debt crises. These crises likely engender learning as they tend to strike at banks' balance sheets; in this sense certain crises may serve an important learning function. Governments that recognize this distinction may thus wish to avoid engaging in bailout choices that may short-circuit such learning.

In this spirit, future research along the lines pursued here can consider the important mediating role that policy—both monetary and fiscal—can play in helping banks internalize the learning effects associated with crises, especially with an eye toward future crisis prevention. Such research can also delve more deeply into distinct learning mechanisms that not only help banks to *respond* optimally to crises, but also show how they can better *avoid* them in the first place.

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Technical Appendix

A.1 Data Description

A.1.1 Rules for ownership determination in the ownership database

Data on ownership was constructed from the Bankscope database. Ultimate ownership was used if:

1. The main country of foreign ownership is a tax haven, the owner(s) in the tax haven is a holding company which seems to function purely as a holding company and not as an operational firm, and total foreign ownership is 50% or more;
 - If the main foreign owner(s) is a holding company located in a country classified by the OECD as a tax haven or classified by the OECD as an OECD member country with a potentially harmful preferential tax regime; whenever the direct owner is a holding company resident in one of these countries, we assume that the arrangement exists for tax purposes and uses direct ownership, except in cases when there is evidence that the owner is not merely a holding company but an operational firm in its own right;
2. Majority ownership by a holding company, which functions purely as a holding company, and which is fully owned by a third firm;
 - When a Bank is majority owned by a holding company, and that holding company is not itself an operational bank and seems to exist purely for the purpose of ownership (according to the best judgment of the authors); and that holding company is fully owned by a parent firm; then the nationality of the holding company's parent is used.³³
3. Transfer of a bank from its parent to another of the parent's subsidiaries for the purpose of being absorbed by that other subsidiary;
 - Ownership was transferred from a parent company to another subsidiary for the purpose of absorption by that other subsidiary. The nationality of the parent is applied to that year (the final year of the bank's existence), since the bank is in effect still directly owned by that parent at the time when it becomes part of another bank which is owned by that parent, and effectively loses its autonomy more or less at the time of transfer to the domestic sibling.
 - For example, Banca Italo Albanese (Albania) is owned by Intesa (Italy) for several years, until March 2008, when the bank is acquired by ABA, another Albanian subsidiary of Intesa, from the parent company, for the purpose of absorbing it. Banco Italo Albanese is immediately absorbed by ABA, and ceases to exist as a bank. Despite that the last owner of the bank in 2008 was Albanian, 2008 ownership is recorded as Italian.

A.1.2 Definition of crisis experience

The crisis experience measures are extracted from Reinhart & Rogoff (2009). Financial crises are sorted into several categories: currency, inflation, banking, domestic debt and external debt. In addition to these crisis categories, a measure of stock market crashes is introduced to have a measure based on financial markets. Each of these yearly indicators is a dummy taking the value of one if the country exceed a certain threshold or if some conditions are met and zero if not.

With respect to currency and inflation crises, the emphasis is not placed on the beginning year but on the duration of the crisis episodes. A *currency crisis* occurs when the following condition is met:

- The local currency undergoes an annual depreciation versus the US dollar (or the relevant anchor currency historically the UK pound, the French franc, or the German DM and presently the euro) of 15 percent or more (currency crashes).

The *inflation crisis* is characterized by a high and out of control inflation rate. As described by Reinhart and Rogoff, inflation crises and currency crisis episodes are highly correlated to each other and one should be careful in using simultaneously these two indicators. An episode is listed as an inflation crisis when the following condition is met:

- The annual inflation rate is equal to 20 percent or higher.

³³In most cases when this rule is applied, the ultimate owner is a large global bank with a familiar name (HSBC, Citibank/Citigroup, etc.)

Concerning banking crises, Reinhart and Rogoff emphasize events introduced in existing studies and in the financial press mainly due to data availability. A *banking crisis* is characterized by two types of events:

- Bank runs causing closure, merging, or takeover by the public authorities of one or more financial institutions; or
- In case of no runs, the closure, merging, takeover, or large-scale public authorities assistance of an important financial institution, that spills over into other financial institutions' activity.

A *debt crisis* is defined as a sovereign default and occurs when one of the following conditions is met:

- The national authorities fail to meet a principal or interest payment on the due date; or
- The rescheduled sovereign debt is extinguished in terms less favorable than mentioned in the original commitment.

Reinhart and Rogoff distinguish the external debt crisis from the domestic debt crisis. The external debt concerns loans issued by a government under another country's jurisdiction and mostly involves foreign banks and creditors. The domestic debt concerns loans issued under a country's own legal jurisdiction. This means that domestic debt crisis involves freezing of bank deposits and/or forcible conversions of such deposits from dollars to local currency. It is, however, not excluded to face both domestic and external debt crises at the same time. The purpose of this paper is directly related to the experience gained by the local banks through a crisis hitting the domestic markets. Because of this, the analysis is essentially performed using the domestic debt crisis indicator.

Stock market crashes data are collected by extending Barro and Ursua (2009) dataset. They, first, compute annual, arithmetic real rates of return (from the end of the previous year to the end of the current year). Stock-market crash episodes are then defined as cumulative multi-year returns of -0.250 or less. Data are extended from Reinhart & Rogoff (2009).

Table A.1: Sources and definitions for main variables of interest

Variable	Definition	Source
<i>Key variables of interest</i>		
Loan-to-asset ratio	Total loans to total assets (%) difference between 2009 and 2006	Bankscope
Crisis experience	Sum of currency, domestic debt, banking and stock market crises the home country has experienced since 1800 [†]	Reinhart & Rogoff (2009)
<i>Core bank covariates</i>		
Size	Total assets in 2006	Bankscope
Solvency	Equity to assets ratio (%) difference between 2006 and 2009	Bankscope
Profitability	Return on average equity (%) difference between 2006 and 2009	Bankscope
Interest margin	Net Interest Margin difference between 2006 and 2009	Bankscope
<i>Core home country level covariates</i>		
GDP per cap.	GDP per capita (constant 2000 US\$) in 2006	WDI [‡]
Lagged GDP Growth	Annual percentage growth rate of GDP at market prices (constant 2000 US\$) in 2005	WDI [‡]
Current account balance	Current account balance (% of GDP) in 2006	WDI [‡]
Inflation	Inflation rate, consumer prices (annual %) 2006	WDI [‡]
<i>Additional bank and country covariates</i>		
Overhead costs	(% of total assets) difference between 2009 and 2006	Bankscope
Loan loss prov.	Ratio of loan loss provisions to net interest revenue (%) difference between 2009 and 2006	Bankscope
Trade openness	Imports plus exports (% of GDP) in home country in 2006	WDI [‡]
Financial exports	Insurance and financial services (% of service exports, BoP) in home country in 2006	WDI [‡]
Bank capital	Bank capital to assets ratio (%) in home country in 2006	WDI [‡]
Nonperforming loans	Ratio of banks' nonperforming loans to total gross loans (%) in home country in 2006	WDI [‡]
Bilateral trade categories	Three equally sized categories based on bilateral total trade between home and host countries (% of the sum of their GDP) in 2006	UN COMTRADE [‡]
G-SIFI	Indicator for subsidiary of a globally systemically important parent bank	
Financial Stability Board (2011)		
RoA	Net income (% of total assets) difference between 2009 and 2006	Bankscope
Profit bef. taxes	Profit before taxes (% of total assets) difference between 2009 and 2006	Bankscope
CIR	Overhead costs over net income difference between 2009 and 2006	Bankscope

[†] Further details about variable construction are described in Annex A.1.

[‡] WDI = World Development Indicators, UN COMTRADE = United Nations Commodity Trade Statistics Database.

A.2 Additional tables

This subsection reports additional supplementary results to those in the main paper. Table A.2 reports summary statistics for the main variables, while Table A.3 computes the correlation matrix for the main instrumental variables used in the IV regressions. Table A.4 documents the crisis experiences among all countries in our sample. Table A.5 elaborates on the results in columns (C1) and (C2) of Table 3 in the main text, by including both financial reforms and crisis experience as covariates. Table A.6 elaborates on the results in Table 4 of the main text with additional decompositions of the key crisis experience variable.

Table A.2: Summary statistics for main variables of interest[†]

Variable	N	Mean	Std. Dev.	Min	Max
Loan-to-asset ratio	365	0.58	14.59	-63.48	50.77
Crisis experience	365	72.38	29.25	10.00	132.00
Size	365	2,943.96	8,863.65	0.99	71,034.72
Solvency	365	-0.89	11.65	-75.07	73.77
Profitability	364	-2.74	43.56	-268.62	560.27
Interest margin	362	-0.28	3.35	-21.77	12.22
GDP per cap.	365	21,282.87	12,182.57	442.02	39,965.86
Lagged GDP growth	365	3.45	2.09	0.68	11.30
Inflation	364	3.32	2.61	0.24	14.45
Current account balance	365	-0.27	7.55	-11.30	25.95
Currency crisis (elapsed)	365	6.85	13.32	0	75
Stock market crash (elapsed)	365	4.47	2.99	0	16
Domestic debt crisis (elapsed)	365	113.71	74.16	0	205
Banking crisis (elapsed)	365	22.31	29.66	2	205

[†] Notes: Descriptive statistics correspond to the baseline specification, namely column (A1) of Table 1. Bank-level covariates report the difference between 2009 and 2006 values. Country-level covariates report their 2006 value.

Table A.3: Correlation matrix for main instrumental variables[†]

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Loan-to-asset ratio	1					
(2) Currency crisis (elapsed)	0.030	1				
(3) Stock market crash (elapsed)	0.072	0.148***	1			
(4) Domestic debt crisis (elapsed)	-0.001	0.117**	-0.010	1		
(5) Banking crisis (elapsed)	-0.029	0.111**	-0.270***	-0.213***	1	
(6) Crisis experience	-0.129**	-0.394***	-0.141***	-0.423***	-0.301***	1

[†] Notes: Pearson correlation coefficients reported. * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table A.4: Crisis experiences, by country

<i>Low experience countries</i>			
Mauritius	10	Indonesia	46
Ireland	17	Philippines	46
Singapore	20	Poland	46
Malaysia	22	Belgium	47
Zambia	22	Denmark	48
Canada	23	Zimbabwe	48
Nigeria	24	Finland	51
Kenya	28	Norway	51
Switzerland	31	Venezuela	52
Hungary	34	South Africa	52
Paraguay	34	Netherlands	58
New Zealand	36	Romania	59
Thailand	36	India	60
Australia	38	Turkey	60
Korea	42		
<i>Medium experience countries</i>			
Japan	62	Colombia	72
China	63	Austria	75
United Kingdom	67	Germany	81
Russia	68	Greece	81
Italia	69		
<i>High experience countries</i>			
Spain	85	Argentina	100
France	87	Mexico	104
Peru	90	Chile	110
Uruguay	95	United States	132
Brazil	96		

Table A.5: Supplementary regressions for the difference in bank lending between 2006 and 2009, with both financial reform and crisis experiences[†]

	H1	H2	H3	H4	H5	H6
Crisis experience	-0.066 (0.03)***	-0.063 (0.02)**	-0.117 (0.04)***	-0.089 (0.04)**	-0.087 (0.04)**	-0.136 (0.05)***
Financial reforms	-0.645 (0.24)***	-0.633 (0.23)***	-1.042 (0.38)***	-0.620 (0.24)**	-0.611 (0.23)***	-1.081 (0.36)***
Size		0.000 (0.00)	0.000 (0.00)		0.000 (0.00)	0.000 (0.00)
Solvency		-0.162 (0.09)*	-0.138 (0.09)		-0.156 (0.09)*	-0.133 (0.09)
Profitability		-0.016 (0.02)	-0.020 (0.02)		-0.016 (0.02)	-0.020 (0.02)
Interest margin		0.639 (0.20)***	0.699 (0.20)***		0.646 (0.19)***	0.707 (0.19)***
GDP per cap.			0.000 (0.00)			0.000 (0.00)
Lagged GDP growth			-0.600 (0.55)			-0.611 (0.54)
Current account balance			-0.165 (0.15)			-0.194 (0.14)
Inflation			0.632 (0.34)*			0.692 (0.34)**
1st-stage F				0.00	0.00	0.00
Underid. test				0.00	0.00	0.00
Weak id. test				< 5%	< 5%	< 5%
Overid. test				0.69	0.66	0.68
R^2	0.06	0.08	0.11			
2nd-stage F	0.00	0.00	0.00	0.00	0.00	0.00
Estimation	OLS	OLS	OLS	IV	IV	IV
Obs. (host countries)	361 (77)	358 (76)	357 (76)	344 (60)	341 (59)	340 (59)

[†] The dependent variable is the change in bank loan-to-asset ratio between 2006 and 2009. Heteroskedasticity and host country correlation-robust standard errors are reported in parentheses. A constant term were included in the regressions, but not reported. Underid. test: Kleibergen Paap rk LM statistic, weak id. test: Kleibergen Paap rk Wald F. statistic and overid. test: Hansen J. statistic. * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

Table A.6: Supplementary regressions for the difference in bank lending between 2006 and 2009, additional decompositions of crisis experience[†]

	G1	G2	G3	G4	G5	G6
Inflation crisis	-0.155 (0.13)					
External debt crisis		-0.096 (0.05)*				
Princ. comp. 1 (4 crises)			-2.279 (1.00)**			
Princ. comp. 2 (4 crises)				-2.752 (1.51)*		
Princ. comp. 1 (6 crises)					-0.432 (1.00)	
Princ. comp. 2 (6 crises)						-2.240 (0.91)**
Host FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank covariates	Yes	Yes	Yes	Yes	Yes	Yes
Home country covariates	Yes	Yes	Yes	Yes	Yes	Yes
1st-stage F	0.00	0.00	0.00	0.00	0.00	0.00
Underid. test	0.00	0.00	0.00	0.00	0.00	0.00
Weak id. test (rel. bias)	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %
Overid. test	0.24	0.41	0.55	0.67	0.38	0.80
2nd-stage F	0.02	0.01	0.00	0.00	0.04	0.00
Estimation	IV	IV	IV	IV	IV	IV
Obs. (host countries)	346 (61)	346 (61)	346 (61)	346 (61)	346 (61)	346 (61)

[†] The dependent variable is the change in bank loan-to-asset ratio between 2006 and 2009. Heteroskedasticity and host country correlation-robust standard errors are reported in parentheses. A constant term were included in the regressions, but not reported. Underid. test: Kleibergen Paap rk LM statistic, weak id. test: Kleibergen Paap rk Wald F. statistic and overid. test: Hansen J. statistic. * indicates significance at 10 percent level, ** indicates significance at 5 percent level, and *** indicates significance at 1 percent level.

A.3 Additional figures

Figure A.1: Evolution of the loan-to-asset ratio between 2003 and 2009, by crisis experience. Countries were categorized according to whether their crisis experience fell within the lower, middle, or upper equally-sized terciles of the banks' distribution of crisis experience, with 2003 loan-to-asset for each group normalized to 100. In the 2003–06 pre-crisis period, it is clear that the three groups evolved in a similar fashion (and if anything, low crisis experience countries expanded lending at a slightly faster rate than the other two groups), but following the crisis, the lending pattern of high crisis-experience countries diverges sharply from the other two.