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Monetary Policy and Bank Lending Rates in Low-Income Countries: Heterogeneous Panel Estimates[1]

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Abstract

This paper studies the transmission of monetary shocks to lending rates in a large sample of advanced, emerging, and low-income countries. Transmission is measured by the impulse response of bank lending rates to monetary policy shocks. Long-run restrictions are used to identify such shocks. Using a heterogeneous structural panel VAR approach, we find that there is wide variation in the response of bank lending rates to a monetary policy innovation across countries. Monetary policy shocks are more likely to affect bank lending rates in the theoretically expected direction in countries that have better institutional frameworks, more developed financial structures, and less concentrated banking systems. Low-income countries score poorly along all of these dimensions, and we find that such countries indeed exhibit much weaker transmission of monetary policy shocks to bank lending rates than do advanced and emerging economies.

Keywords: monetary policy, bank lending, structural panel VAR

JEL Codes: E5, O11, O16

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1. Introduction

The Great Recession of 2007-10 has witnessed a resurgence of discretionary countercyclical fiscal policy. Until these dramatic recent events, however, doubts about the efficacy of fiscal policy, as well as recognition of the substantial "inside" and "outside" lags involved in its implementation, have placed primary responsibility for short-run stabilization policy in the hands of monetary policy in almost every country. Despite the central role that monetary policy plays as a short-run stabilization instrument around the world, there continues to be considerable doubt about its efficacy as well as about the channels through which it exerts its effects on the real economy. Even in the United States, where these issues have received substantial attention, evidence about the effects of monetary policy on the real economy remains controversial.

It has long been recognized that both the efficacy of monetary policy and the channels for its transmission are strongly influenced by a country's financial structure (see, for example, Monti, 1971 and Modigliani and Papademos, 1982), and that financial structures differ substantially among economies, even industrial ones. These differences are even more pronounced when comparing low-income countries (LICs) to advanced and emerging ones. The financial structures of low-income countries share many features that differentiate them systematically from both high-income as well as emerging economies. As documented by Mishra, Montiel, and Spilimbergo (MMS, 2013), low-income countries tend to be poorly integrated with international financial markets, their central banks generally intervene heavily in foreign exchange markets, and their domestic macroeconomic environments are often unstable. MMS argue that these characteristics suggest that the bank lending channel should dominate monetary transmission in low-income countries.

However, they also argue that other characteristics of the financial structures of LICs tend to undermine the effectiveness of the bank lending channel. For example, such countries suffer from a weaker domestic institutional environment (e.g., poorly defined property rights, inefficient legal systems, poor legal protection for creditors, weak accounting and disclosure standards), they have small and illiquid securities markets, and their banking systems are small, highly concentrated, poorly capitalized, and many banks are publicly owned. Mishra, Montiel, and Spilimbergo indeed find impressionistic evidence that this channel tends to be weak and unreliable in such countries – specifically, that in regressions of commercial bank lending rates on central bank policy rates, the latter have both smaller short-run as well as long-run coefficients, and policy rates tend to explain a substantially smaller share of the variance in lending rates than they do in high-income and emerging economies. There is now a substantial body of country-specific empirical work on the transmission of monetary policy beyond bank lending behavior to aggregate demand in a large number of low-income countries, much of which is based on individual country VAR evidence. , A review of this work by Mishra and Montiel (2013) is consistent with the MMS findings, in the sense that their review failed to turn up much systematic evidence of strong and reliable monetary transmission in such countries.

Given the key role of monetary policy as a short-run stabilization instrument in low-income countries, this state of affairs, if true, is alarming, because it suggests very little scope for the conduct of stabilization policy by central banks. However, the cross-country evidence provided by MMS was only impressionistic, and the country-specific VAR evidence surveyed by Mishra and Montiel suffers from a number of flaws, generally failing to give careful attention to the identification issues that have been the overriding concern in research on monetary policy effectiveness in advanced countries.

This paper attempts to investigate the effectiveness of monetary policy in low-income countries more systematically. Specifically, we are interested in exploring the effectiveness in such countries of the first step of monetary policy transmission through the bank lending channel – from monetary policy innovations to bank lending rates – leaving aside the question of whether changes in bank lending rates subsequently affect aggregate demand. We seek to do so subject to the double challenge of employing credible identifying restrictions while deriving results for a large group of possibly quite heterogeneous countries. Our objective is to investigate whether the effects of monetary policy shocks on bank lending rates are systematically different in low-income countries from what they tend to be in advanced and emerging economies and, if so, whether these differences are consistent with conventional theory.

The first step in doing so is to obtain estimates of the effects of monetary policy innovations on bank lending rates for a large group of countries. Since the data from many countries are available for too short a time span or are too noisy to reliably investigate using structural VARs at the individual country level (thus raising questions about the reliability of the country-specific VAR evidence), we employ a panel methodology that allows individual country responses to structural shocks to be heterogeneous. Conventional dynamic panel methods are not appropriate in light of the fact that they require the dynamics of individual country responses to be identical among all countries. Furthermore, it is important to take into consideration the fact that individual countries are likely to be linked cross-sectionally via common global and regional shocks. To address these issues in the context of structural identification, we use the panel SVAR methodology developed in Pedroni (2013).

Our paper has two main findings. First, there is substantial and statistically significant heterogeneity among countries in the dynamic response of the lending rate to domestic monetary

policy shocks. Second, countries with better institutional environments, more developed financial structures, and more competitive banking systems are those where monetary policy is the most effective in influencing commercial bank lending behavior. Given that LICs score poorly on all of these dimensions, we find the predicted transmission to be significantly weaker in these countries than in advanced and emerging ones.

The structure of the paper is as follows: the next section provides a simple conceptual framework for examining the roles that a weak institutional framework for financial intermediation and limited competition in the banking sector may play in determining the effectiveness of transmission of monetary policy to bank lending rates. Section 3 describes our empirical methodology and strategy for identifying monetary shocks in our structural panel VAR context. The paper's empirical results are presented and discussed in Section 4, while Section 5 summarizes and concludes. A technical appendix includes a brief description of the implementation of panel SVAR methodology.

2. Financial frictions, monopoly power, and monetary transmission

This section develops a simple model of bank lending behavior that explores the possible roles of financial frictions and bank monopoly power on the strength of monetary transmission. The purpose is expositional, so we analyze the behavior of a monopolistically competitive bank in the simplest possible setting.

Consider a representative LIC commercial bank that manages a portfolio consisting of loans to the private sector (L_j), government securities (B_j), and reserves (R_j), and finances it by issuing deposits (D_j), where the subscript j denotes the jth bank. The bank's demand for government securities is therefore given by:

$$B_j = D_j - L_j - R_j \tag{1}$$

We assume that the representative bank is a monopolistic competitor, so it faces a demand for loans given by:

$$L_j = L(i_{Lj} - i_L, i_L) = L_0 \exp [- \theta_1(i_{Lj} - i_L) - \theta_2 i_L) \tag{2}$$

Similarly, the bank faced a supply of deposits:

$$D_j = D(i_{Dj} - i_D, i_D) = D_0 \exp [\eta_1(i_{Dj} - i_D) + \eta_2 i_D], \tag{3}$$

where L_0 and D_0 are positive constants, i_L and i_D are respectively the average loan and deposit rates prevailing in the banking system, and i_{Lj} and i_{Dj} are the loan and deposit rates chosen by the jth bank. θ_1 and η_1 are positive constants denoting the own-rate semi-elasticities of the demand for loans and supply of deposits facing the bank, while θ_2 and η_2 are similarly positive constants denoting the semi-elasticities of the demand for loans and supply of deposits with respect to average loan and deposit rates in the banking sector. We assume that all banks are identical, so - L_0 and D_0 as well as the lending and deposit semi-elasticities are identical across banks. While banks are monopolistically competitive in the markets for loans and deposits, they have no market power in the market for government securities, where they each face the market interest rate i_B. That interest rate is determined in periodic auctions of government securities conducted by the central bank. Those auctions are the means by which the central bank determines the size of the monetary base.

Credit market frictions (asymmetric information and costly contract enforcement) make lending a costly activity and justify the existence of banks. These frictions are affected by the dual nature of production in many LICs: the additional intermediation costs, over and above the

costs of funds to the bank, for lending to well-capitalized, long-lived enterprises with established reputations are both small and constant, while intermediation costs for lending to small and medium -sized enterprises, most of which are relatively opaque and many of which may be new, are an increasing and convex function of the volume of loans intermediated. The convexity of these costs arise from the assumption that as banks seek to expand the volume of loans beyond well-capitalized, long-lived enterprises with established reputations, the marginal borrower, typically a small private enterprise, is progressively in a weaker position to offer collateral and is progressively more opaque. This results in a lending cost function of the form:

$$C_j = \gamma_0 L_j \text{ for } L_j \leq L^*$$

$$= \gamma_0 L_j + (\gamma_1 /2)(L_j - L^*)^2 \text{ for } L_j > L^*, \quad (4)$$

where γ_0, $\gamma_1 > 0$ are indicators of the costs of intermediation, and L^* denotes the volume of loans that the bank can extend to large and transparent firms that can offer good collateral. We assume that L^* and the parameters γ_0 and γ_1 are uniform across banks.

The parameters L^* and γ_1 play key roles in our model. The more unfavorable the domestic institutional environment for financial intermediation tends to be, the smaller we would expect the pool of bank customers with low lending costs to be, and the more rapidly we would expect intermediation costs to increase with the volume of funds being intermediated once the bank extends lending beyond its favored customers.[2] In other words, when the institutional environment is very unfavorable, as in the case of many LICs, we should expect L^* to be

[2] Note that what is essential to capture in the cost function is not a higher cost of lending in LICs – i.e., a higher γ_0 – but rather the increasing marginal cost of lending that emerges from a dualistic production structure in which borrowers are heterogeneous and in which expanding lending to increasingly more opaque borrowers who can offer less collateral requires banks to incur increasingly larger costs per unit of lending. This implies a convex marginal cost function which we capture most simply with a quadratic specification.

relatively small and γ_1 to be large. The idea is that lending becomes more costly as banks expand beyond their traditional customers that they know well. This effect is stronger in countries with weak institutional settings.[3]

Finally, we assume that banks are subject to a fixed required reserve ratio, i.e.:

$$R_j = \rho D_j \, . \tag{5}$$

Under these conditions, the individual bank's problem is to set its lending and deposit rates so as to maximize profits, subject to its balance sheet constraint (1) and the required reserve ratio (5), while taking the industry-wide lending and deposit rates as given. In other words, its problem is to:

$$Max\ \pi\ (i_{Lj},\ i_{Dj},) = i_{Lj}L(i_{Lj},..) + i_B B_j - c[L(i_{Lj},..)] - i_{Dj}D(i_{Dj},..)$$

$$= i_{Lj}L(i_{Lj},..) + i_B[(1-\rho)D(i_{Dj},..)) - L(i_{Lj},..)] - c[L(i_{Lj},..)] - i_{Dj}D(i_{Dj},..)$$

subject to (2)-(4) and nonnegativity constraints on each of its balance sheet variables, which we will assume not to be binding. The first-order conditions for this problem are given by:

$$L_j + (i_{Lj} - i_B)\, L' - C'L' = 0 \tag{6a}$$

$$- D_j + [i_B(1 - \rho) - i_{Dj}]D' = 0 \tag{6b}$$

[3] Djankov, McLiesh and Shleifer (2007) note the adverse implications of such environments for the provision of private credit by financial intermediaries, while Kumhof and Tanner (2005) provide evidence on the effects of such environments on commercial bank balance sheets, and specifically on banks' tendency to hold government debt rather than extend credit to the private sector.

Using the specific functional forms in (2)-(4) in (6a), and focusing on the case in which $L > L^*$, so that the bank finds it profitable to extend lending beyond the most creditworthy borrowers, we can express the optimal lending rate as:

$$i_{Lj} = (1/\theta) + (i_B + \omega + \gamma_1 L_j), \tag{7}$$

where $\omega = \gamma_0 - \gamma_1 L^*$ is a constant. That is, the optimal lending rate is set as a fixed mark-up, which is decreasing in the semi-elasticity of loan demand, over the marginal cost of funds to the bank. The latter, in turn is given by the sum of the Treasury bill rate i_B (the monetary policy variable, which represents the opportunity cost of loans) and the marginal cost of intermediation $\omega + \gamma_1 L_j$, which is increasing in the volume of loans extended by the bank, reflecting the increased costs of lending to increasingly more opaque borrowers who can offer progressively less collateral.

We are interested in the responsiveness of the bank lending rate to monetary policy, as measured by the effects of changes in i_B on i_{Lj} . Note that this effect is not simply one-for-one, because L_j in equation (7) is a function of the lending rate through equation (2). Differentiating (7), the effect of changes in i_B on i_{Lj} are instead given by:

$$0 < \partial i_{Lj} / \partial i_B = 1/(1 + \gamma_1 \theta_1 L_j < 1. \tag{8}$$

It is immediately evident from (8) that financial frictions, in the form of an increasing marginal cost of lending ($\gamma_1 > 0$) reduce the extent of pass-through from the policy rate to the bank lending rate. To verify the roles of financial frictions and imperfect competition in reducing the effects of monetary policy on the bank lending rate, we can differentiate the pass-through expression given by (8) with respect to γ and θ_1. The results are:

$$\partial^2 i_{Lj} / \partial i_B \, \partial \gamma_1 = - \theta_1 L_j / (1 + \gamma_1 \theta_1 L_j)^2 < 0 \quad (9a)$$

$$\partial^2 i_{Lj} / \partial i_B \, \partial \theta_1 = - (1 - \theta_1 i_L) \gamma_1 L_j / (1 + \gamma_1 \theta_1 L_j)^2 > 0 \quad (9b)$$

where the sign of (9b) follows from the fact that with positive lending, monopolistically competitive banks must operate on the elastic portion of their loan demand curves, which implies $(1 - \theta_1 i_{Lj}) < 0$. The upshot is that larger costs of financial intermediation (i.e., larger γ_1) and increased monopoly power (smaller θ_1) both tend to reduce the degree of pass-through from policy rates to the lending rates set by individual banks. Since all banks are identical, in general equilibrium we must have $i_{Lj} = i_L$, so the results derived in (9a) and (9b) apply to the lending rate i_L set by the banking sector.

3. Estimation and identification strategy

A central challenge in estimating monetary policy effects is to identify policy innovations. This essentially requires imposing *a priori* theoretical restrictions on the vector moving average (VMA) representation of the economy. The literature on estimating monetary policy effects has pursued several alternative techniques to generate these restrictions that are not suitable for our purposes. Sims' original "a-theoretic" approach involved implementing a Choleski decomposition, which essentially involves assuming that the relationship between the reduced form innovations and the initial period responses is recursive. However, these restrictions are understood to be *ad hoc*, and there is no reason to suppose that they would appropriately identify monetary policy innovations. Much of the subsequent literature on the estimation of monetary policy effects has been devoted to finding identification assumptions based on sound economic theory. Key contributions include Bernanke (1986), Blanchard (1989), Sims (1986), Bernanke and Blinder (1992), and Christiano, Eichenbaum, and Evans (1996).

All of these, however, are short-run approaches to identification, since they are based on restrictions on the contemporaneous response of the variables to the structural shocks. Unfortunately, none of them serves our purposes well because they all require specific assumptions about the timing of information flows and of macroeconomic responses that would be hard to justify across a large group of very diverse economies. For example, the contemporaneous information on the state of the economy available to the monetary authorities, as well as the speed with which monetary policy shocks affect macroeconomic variables, are likely to differ from country to country. We therefore require an approach that places less reliance on country-specific information.

Our approach is to achieve identification by relying on long-run restrictions instead, as developed originally in Blanchard and Quah (1989). While long-run identifying restrictions have been subject to criticisms, they serve our particular objectives well in that they are more likely to be applicable across a broad group of heterogeneous countries than are assumptions based on contemporaneous relationships among the variables in a VAR. Our strategy is based on the following underlying intuition: we are interested in detecting the effect of an innovation in monetary policy on commercial bank lending rates. Regardless of what intermediate variable it is targeting, the central bank implements monetary policy by altering the size of its outstanding liabilities – the monetary base. But a one-time change in the monetary base represents a level change in a nominal variable, and a monetary policy innovation engineered by the central bank is therefore a nominal shock. Long-run monetary neutrality suggests that level changes in nominal variables should leave the inflation rate unchanged in the long run, and should therefore leave both the real and nominal lending rates unaffected in the long run. We can use this property to distinguish between the types of monetary shocks that we are interested in, namely level shocks to

the monetary base, and other shocks that may affect the lending rate, which we will want to control for in our analysis.

To make use of monetary neutrality for identification, a minimal system for our purposes would therefore have to include the lending rate as the observable variable whose behavior we are trying to explain as well as some other nominal variable which is affected by a monetary policy shock in the long run. Among possible nominal variables, the monetary base is ideal as it will allow us to measure the size of the monetary policy shock in terms of its effect on the money base over any desired time frame, and to see the consequences of this on the nominal lending rate. The long-run structural form of the system can therefore be expressed as:

$$[nLR^*, nM0^*]' = A(1)\,[\varepsilon_R\,,\ \varepsilon_N]'$$

where *nLR** and *nM0** are respectively the steady state values of the nominal lending rate and nominal monetary base, *A(1)* is the *2x 2* matrix of long-run impulse responses, with $A(1)_{12} = 0$. We refer to the second shock, $\varepsilon_{N,}$ as a nominal shock to reflect the notion that it is a shock which is neutral in the long run on real variables. By contrast, the first shock, ε_R captures all remaining shocks to the economy that have a long run impact on real variables, including inflation. Notice that this implies that shocks to the demand for real money balances will be captured by our ε_R shock. Only shocks to the supply of the nominal money base are captured by $\varepsilon_{N.}$ Finally, to identify the sign of the shocks, we define a positive nominal shock as one that leads to a long run *increase* in the nominal monetary base, *nM0** so that $A(1)_{22} > 0$, and likewise a positive real shock is defined as one which increases the nominal lending rate, *nLR** in the long run, so that $A(1)_{11} > 0$. The short run dynamics of all of the responses to all of the shocks, including the

response of the lending rate to the nominal shock, are left entirely unrestricted, as these are the objects of our interest.

Specifically, we are interested in how the dynamic responses of the nominal lending rate to the nominal shocks vary across countries, and in particular whether they tend to be systematically weaker in countries with specific characteristics. However, implementing such a structurally identified VAR in order to estimate these coefficients for a large group of countries poses two further empirical challenges. The first of these is that many of the countries in our sample have relatively short spans of data available. For such countries a standard time series-based structural VAR analysis would not be reliable. The second is that the data from many of the countries are fairly noisy, so that even when more data are present, a conventional time series-based analysis for any one country may not be reliable. For these reasons, we wish to exploit the panel dimension of the data to increase the reliabilityof the inferences relative to simply basing our analysis on a large number of relatively unreliable individual country structural VAR results. This poses its own challenges, however, stemming from the fact that countries are interdependent and often respond to common external shocks that are not directly observed by the econometrician. In order to exploit the panel dimension we must take into account this form of cross sectional dependence in order for inference regarding the distribution of individual country responses to be valid. Furthermore, if the dynamics are potentially heterogeneous among countries, we must explicitly account for this in the panel estimation. Not addressing the heterogeneity by blindly treating the individual country dynamics as if they were homogenous as members of a pooled panel risks inconsistent estimation and inference.[4]

[4] See for example Pesaran and Smith (1995) for a discussion of this point.

For these reasons, we use the heterogeneous panel SVAR methodology as developed in Pedroni (2013). The approach is well suited for our context in that exploits orthoganalities associated with structural VAR identification schemes to obtain reliable country specific responses to both idiosyncratic domestic and global common shocks even when the time series dimension of the panel is too short for convential time series based structural VAR analsysis. Specifically, the orthoganality conditions allow one to obtain the country specific loadings for the decomposition of the structural shocks into common and idiosyncratic components in a relatively efficient and transparent manner that does not require much data. The result is a sample distribution of heterogenous individual country responses to the structural shocks that acccounts for both the dynamic heterogeneity as well as the cross sectional dependency. It is this distribution which we then use to study the nature and pattern of responses among different countries. Furthermore, the technique can be used in unbalanced panels, which becomes particularly important for low income countries with varying degrees of data availability. A brief outline of the estimation method is described in our technical appendix, and for further details we refer readers to Pedroni (2013).

4. Data sources

The data used in this paper are drawn from the International Financial Statistics of the IMF. The two key variables used in the panel VAR analysis are (i) nominal base money or M0, and (ii) the commercial bank lending rate. The nominal base is drawn from line 14. It typically includes currency in circulation and banks' reserves at the central bank. The bank lending rate is taken from line 60. This is the "rate that usually meets the short- and medium-term financing needs of the private sector" (IMF, 2008).

We first compile the dataset at a quarterly frequency. Our estimation sample covers a total of 132 countries over the period 1978-2013, which includes 16 advanced, 25 emerging, and 91 LICs.[5] The sample is unbalanced and is constructed based on the availability of data In order to implement our empirical methodology in an unbalanced panel, some additional restrictions are imposed on the sample. For example, we require a certain minimum number of observations over time in order to search over a suitable range of possible lag truncations for each country and still retain enough degrees of freedom for estimation. To ensure this, we use a span of 5 years of continuous data as our cutoff for the minimum sample length for any one country. If a country has fewer than 5 years of continuous data for our variables of interest, we drop the country from our sample. Similarly, to ensure that the average variable values and corresponding common structural shocks are estimated reasonably well in an unbalanced panel, we must ensure that we have a sufficient cross-sectional dimension present for each time period of our sample. Accordingly, we use 15 as our cutoff, meaning that if for any given period we do not have data available for at least 15 countries, we drop that period from our sample.

Finally, we need to ensure that we have both cross sectional and temporal variation in our data. For example, if a country has fixed its nominal lending rate over some portion of the sample period (as was often the case under financial repression, which prevailed for some countries during the early part of our sample period), then there is no possibility for the bank lending rate to respond to monetary policy. Similarly, for some countries, certain variables are only available at the annual frequency, but are nonetheless reported at the quarterly frequency with no variation from quarter to quarter. Such data should also not be used in our analysis,

[5] For the purposes of this paper, the classification of countries into advanced, emerging and LICs follows Rogoff et. al. (2004). Emerging market economies are those that are included in the Morgan Stanley Capital International (MSCI) index. With the exception of Israel, which is in the MSCI index, advanced economies are those that are classified as upper income economies by the World Bank. All other economies constitute low-income countries (LICs).

since there will be no quarterly shocks present in the data. Consequently, to guard against the absence of temporal variation due to either of these possibilities, we drop any country period from our sample for which the data values are identical for four or more consecutive quarters. The list of countries and time periods used in the study is provided in appendix table A1.

In order to study the variation in impulse responses across countries, we use data on a number of correlates which are drawn from the dataset compiled by Mishra, Montiel and Spilimbergo (2013), and are averaged over 1976-2008. These variables include measures of institutional quality, the ratio of deposit bank assets to GDP, the ratio of stock market capitalization to GDP, a measure of bank concentration, and an index of *de facto* international financial integration. A detailed description of all these variables is provided in table A2.

5. Results

The structural VAR methodology outlined above is used to generate impulse response functions that capture the dynamic effects of a monetary policy innovation on bank lending rates in each country of our sample. In this section we use these estimated effects to answer three questions: 1) what is the median response of the lending rate to a country-specific monetary shock? 2) how much cross-country variation is there in this response? 3) what factors determine the response of the lending rate to monetary policy shocks?[6]

Impulse responses and variance decomposition

Our most important finding is that there is wide variation in the impulse responses of the (log) lending rate to a positive domestic monetary policy shock (i.e., one that increases the long-

[6] In what follows, we will interpret the "nominal shock" as a monetary policy shock, given that we consider innovations to the monetary base.

run value of the monetary base) across countries. We find the expected negative response for a large group of countries, but by no means for all. As an illustration, consider the estimated responses over a four-quarter horizon for the United States and Uganda, shown in Figure 1. For the United States, the response of the lending rate to the monetary policy shock is negative, but small, in the first quarter, but it becomes progressively larger over the next two quarters, before beginning to taper off in the fourth quarter. For Uganda the initial effect, while negative, is very close to zero, and it turns *positive* (while remaining small) in the next two quarters, before becoming approximately zero in the fourth quarter.

Figure 2 reports the median as well as the 25th and 75th percent quantile responses among the 132 countries in our sample along with the associated 99% bootstrapped confidence bands for the quantiles.[7] The median of the country responses is small and not statistically different than zero as reflected by the confidence intervals. However, this does not imply that a zero effect of monetary policy on the lending rate is pervasive in our sample. To the contrary, 25th percent quartile results show that that there is likely a subset of countries for which monetary policy is effective in temporary lowering the lending rate and that this is statistically significant at the 99% confidence level. Specifically, the point estimates reveal that for the 25th percent quantile, a one-unit monetary policy shock (or equivalently a shock which results in a 3% long-run increase in money balances) reduces the lending rate by about 0.6% in the following quarter, and slowly converges to zero after 6 quarters. Conversely, the 75th percent quantile shows that there is likely a subset of countries for which monetary policy is not only not effective in temporarily lowering the lending rate, but is actually counterproductive. The fact that the 25th and 75th percent quantile confidence bands do not cross attests to the fact that the

[7] Note that the country that has the median response at response period S is not necessarily the same as the country with the median response in other response periods; the 25th and 75th percentile responses are constructed in the same way. Hence the curves shown in Figure 2 do not trace the responses for any particular country.

substantial heterogeneity of the lending rate responses to monetary policy is statistically very significant, and points to the hazard of treating heterogenous countries as if they were similar. It is the pattern in these robustly heterogeneous responses that we study next.

Figure 3 reports the median as well as the 25th and 75th percent country quantiles as fractions of the total forecast variance in the lending rate that is explained by the country specific monetary innovation.[8] On average, country-specific monetary innovations explain about 0.3-1.3% of the variation in the bank lending rate over all response periods. Once again, the interesting finding is that there is significant variation across countries. While the short-run (1 quarter response period) variation ranges from close to 0.3 to 5 percent, in the long run (6 quarters response period) it ranges from 0.1 to 1%.[9] The key question is, of course, what accounts for this cross-country heterogeneity in the effectiveness of monetary policy. Next we examine the role of specific country characteristics in explaining the cross-country pattern in the responses of lending rates to monetary policy.

Variation across countries in impulse responses

Our results so far suggest that the strength of the link between central bank monetary policy actions and commercial bank lending behavior, as reflected in lending rates, varies widely across countries. Is there a systematic pattern to this variation in the impulse responses across countries, or it purely random? As indicated above, MMS argued that in low-income countries with rudimentary financial structures monetary transmission is likely to operate primarily through the bank lending channel, but they also argued that when the domestic institutional

[8] Also in this case, the country with median fraction of variance in lending rate is not necessarily the same as the country with median fraction of variance in other periods.
[9] The impulse responses and variance decompositions for all the other variables in the system are provided in the appendix (Figures A1 and A2).

structure is weak, the domestic financial system is poorly developed, and the domestic banking sector is not competitive, even this channel may prove to be weak.

Figure 4 compares mean responses for the 16 high-income countries in our sample to those for the 91 low-income countries. As is evident from the figure, the two groups exhibit quite different IRFs. As was the case for the United States in Figure 1, the mean response for the high-income group is consistently negative, with the peak response occurring in the third quarter after the shock. By contrast, the mean response for the low-income group is perversely signed, with bank lending rates actually *increasing* after a positive monetary shock. More importantly, the difference between the mean responses for the high- and low-income groups is statistically significant over the first three quarters after the shock. We conclude that there is significant country heterogeneity in the response of bank lending rates to monetary policy shocks, and that this response differs between high- and low-income countries in the expected direction.

In order to further explore the determinants of the variation in impulse responses, we next examine the cross-section association between certain country characteristics, including those mentioned above, and the strength of the impulse responses. In particular, we test the MMS hypotheses by considering three factors that may influence the strength of monetary transmission: (i) the strength of the domestic institutional environment, (ii) the development of the domestic financial system, and (iii) the degree of competition in the domestic banking system. Our regressions will also include the degree of integration of the domestic economy with international financial markets as a control variable. The need to control for the degree of financial integration arises from the fact that higher integration may tend to dampen the impact of monetary policy shocks on domestic interest rates. Under fixed exchange rates, this is a direct consequence of the loss of monetary autonomy as implied by the "impossible trinity." Under

floating rates it reflects the fact that as financial integration increases, relatively more of the burden of monetary transmission falls on the exchange rate, rather than on the domestic interest rate, implying that monetary policy actions have smaller effects on domestic interest rates.

We measure the degree of institutional development using the index of the quality of regulation developed by Kaufman, Kraay and Mastruzzi (2009). We rely on two familiar complementary indicators of financial development from Beck, Demirguc-Kunt and Levine (2009): the ratio of the assets of deposit money banks to GDP and the ratio of stock market capitalization to GDP. In order to measure competition in the banking system, we use the concentration ratio in the domestic banking industry. Finally, we measure financial integration in *de facto* terms as the ratio of the sum of external assets and liabilities to GDP, after removing foreign exchange reserves from the asset side and concessionary loans from the liability side, following Dhungana (2008).

Measuring the effectiveness of the bank lending channel using impulse responses to a positive nominal shock is complicated by the fact that the response typically varies quarter by quarter, implying that no single number provides an unambiguous measure of the size of the response. Accordingly, we examine the magnitude of each of the responses over 1-4 quarter horizons, as well as by the magnitude of the average response coefficient over a four-quarter horizon. We also examine the effects of our covariates on the size of the peak response of the lending rate over the four-quarter horizon as a summary measure. Because a larger response (a more effective bank lending channel) would be recorded as a more *negative* impulse response coefficient, this involves explaining the *minimum* value of the impulse response over the four-quarter horizon. We expect the effects of an improved institutional environment and our two financial development indicators on each of these coefficients to be negative, indicating a more

powerful effect of the monetary shock on the lending rate in the theoretically-expected direction, and that of increased bank concentration to be positive, after controlling for the effect of financial integration, which should itself be expected to have a positive coefficient, consistent with a weakening of the interest rate response.

Before proceeding to the regression analysis, we examine the bivariate relationship between the impulse responses and each of the potential correlates. The scatter plots are shown in Figures 5a-5e. Each figure has six plots showing the bivariate relationship between the six impulse responses (four quarters, average and the minimum), and one covariate. The signs of almost all the bivariate correlations (29 out of 30) are consistent with the hypotheses outlined above. Better institutional quality and a higher degree of financial development are associated with a larger reduction in lending rates in response to a monetary shock; whereas more concentrated domestic banking sectors are associated with a smaller decrease in the lending rates. The estimated correlation coefficients on institutional quality are always statistically significant.

Our full regression results are presented in Table 2, where each column reports the regression of the impulse response coefficient at each horizon, listed along the top row of the table, on each of the five variables mentioned above. Because of the noisiness of both the regressands as well as the regressors, we focus initially on the signs of the estimated coefficients, rather than their precision.

The multivariate regression results are consistent with the bivariate correlations in Figure 5. First, the partial effect of higher institutional quality on the impulse responses in each of the four quarters, as well as the average and the minimum response over the four quarters, is

consistently negative. The effect is also statistically significant for the third and fourth quarters. This is consistent with the hypothesis that monetary expansion is more effective in reducing bank lending rates in countries with better institutional environments. Second, monetary transmission tends to be more effective in countries with more developed financial systems. The partial effects of the ratio of banking sector assets to GDP as well as stock market capitalization to GDP on the impulse response is negative over almost all horizons (except the fourth quarter and minimum for banking sector assets), and is also negative for the average four-quarter response. The effect of stock market capitalization in particular is not only negative over all four quarters, but it is statistically significant in all quarters, again consistent with the interpretation that in a strong institutional environment for the financial sector, the lending rate responds more quickly to monetary policy shocks. Third, the more concentrated the banking sector, the *less* negative is the response of lending rates. Again, this result holds over all horizons, with the effect being statistically significant for the third and the fourth quarter, as well as for the average and minimum responses. Fourth, the higher the degree of *de facto* financial integration; the weaker (or more positive) is the response of bank lending rates to monetary policy shocks. As indicated above, this result is consistent with increased financial integration resulting in a loss of monetary autonomy under fixed exchange rates, as well as a reallocation of the transmission burden from interest rates to exchange rates under floating rates.

While not all of our coefficients are statistically significant, this is to be expected with only 66 observations and in a regression that is designed to explain the cross-section values of very noisy estimated parameters. We note that the F-test for all of these equations is significant at the 5 percent level or better for all quarter responses except the first (where the F-stat is significant at close to 10 percent level), and place special weight on the remarkable consistency

in the signs of estimated parameters. Of the twenty estimated coefficients over the four quarters, eighteen carry the expected sign. As an illustration, if the true values of these coefficients were zero, and if coefficient were drawn independently from a symmetrical distribution, the probability of drawing 18 of 20 coefficients with the expected sign would be 1.81×10^{-4}.

The natural interpretation of these findings is that countries with better institutional environments, more developed financial structures, and more competitive banking systems, are those where monetary policy is most effective in influencing commercial bank lending behavior. On the other hand, countries with weaker institutional environments, less developed financial structures, and less competitive banking systems are those where monetary policy shocks do not tend to get transmitted to bank lending rates.[10]

We can see the implications of these differences in characteristics for the dynamic responses of bank lending rates to monetary policy shocks in each of these groups of countries by computing the predicted quarter-by-quarter impulse responses for each group based on these group-specific characteristics.[11] The results are shown in Figure 6. Both advanced and emerging economies display the expected negative response, larger on impact and more muted over time, with advanced economies displaying significantly larger responses than emerging economies. By contrast, low-income countries fail to display a negative response in any of the four quarters.

Figure 6 summarizes our central result: in contrast to advanced and emerging economies, the transmission of monetary policy shocks to bank lending rates in low-income countries

[10] The quality of the institutional environment may have multidimensional effects on the effectiveness of monetary policy. In addition to increasing the strength of monetary transmission from central bank actions to commercial bank lending rates, improved institutional quality could allow the central bank to pursue more countercyclical monetary policy by reducing its "fear of free falling" (Vegh and Vuletin 2012).

[11] Since we use financial integration only as a control variable, the predicted responses are computed for each group using the average value of the financial integration measure over the whole sample.

appears to be problematic. The poor institutional environment in which the financial sector operates in these economies, as well as the limited degree of competition in their banking systems, appear to significantly weaken the impact that central bank monetary policy actions exert on commercial bank lending rates in these economies. The implication is that these characteristics of LIC financial structures are likely to significantly undermine the strength of the bank lending channel.

Robustness

Since our estimation is based on an unbalanced panel, the number of observations used to estimate the impulse responses differs from country to country. Not surprisingly, more quarterly observations were available for high-income and emerging economies (112 and 88 on average), than for low-income economies (80 on average). Though these differences are not great, it is possible that the smaller number of observations available for LICs on average resulted in noisier estimates of the IR coefficients, introducing heteroskedasticity into the cross-section estimates of Table 2, and possibly invalidating our hypothesis tests.

To address this possibility, we have used bootstrap methods to generate standard errors for the impulse response coefficients and then weighted the impulse response coefficients used for estimating the regressions in Table 2 by the inverse of those standard errors (i.e., we re-estimated by weighted least squares). As can be confirmed in Table 3, the relationship between the institutional characteristics and the estimated IRs proves to be quite robust to this alternative estimation method. Importantly, the predicted quarter-by-quarter impulse responses for each country-group based on group-specific characteristics remain qualitatively similar (Figure A3).

A second possibility is that our indicators of institutional quality and financial development may be serving as proxies for another factor that influences the degree of transmission from monetary policy to bank lending rates. A likely candidate is the degree to which the banking system can interpret the central bank's policy intentions – i.e., banks are more likely to alter their lending rates in response to a monetary policy shock if they interpret that shock as a change in the authorities' policy stance. If central banks in countries with more favorable institutional environments for financial intermediation are more transparent, then our regression may simply be picking up the effects of central bank transparency.

To check this conjecture, we re-estimated the cross-section regressions in Table 2 after including a measure of central bank transparency from Dincer and Eichengreen (2009). The results are presented in Table 4. They indeed suggest that central bank transparency matters, as the Dincer-Eichengreen transparency indicator carries the theoretically-predicted negative sign and is statistically significant in all but the first quarter, but our other results are essentially unchanged.[12]

6. Conclusions

The links between central bank actions and ultimate effects on the real economy remain poorly understood. In the case of low-income countries, a strong *a priori* case can be made (see Mishra, Montiel, and Spilimbergo, 2012) that those links should operate primarily through the bank lending channel. Yet there are independent reasons, related to poor domestic institutions and weak competition in the banking sector, to suspect that the bank lending channel may itself

[12] The results are robust to using an alternative measure of central bank transparency from Crowe and Meade (2008). While we believe that central bank transparency is the appropriate variable to include, we also tried several measures of central bank independence in the regressions reported in Table 2 (e.g. Arnone et. al., 2006; Crowe and Meade, 2008). We did not find these to be significant influences on the impulse responses.

be weak and unreliable in such countries. If so, the classic analysis of Brainard (1967) suggests caution in the application of monetary policy, and in particular restraint in the use of monetary policy for stabilization purposes.

This paper is a first attempt at systematically documenting and providing tentative explanations for the variation in the effectiveness of the bank lending channel across countries. Using a sample of 132 countries and a heterogeneous panel VAR approach with relatively agnostic economically-motivated identification restrictions, we have found that there is evidence of substantial cross-country variation in the strength of the first stage of the bank lending channel, as measured by the impulse responses at various horizons of commercial bank lending rates to monetary policy shocks. Partial correlations of the magnitudes of these responses with various country characteristics suggested by theory as potentially affecting the strength of the bank lending channel are consistent with theoretical predictions. The implication is that monetary policy may be a highly unreliable instrument with which to pursue macroeconomic stabilization in countries that are characterized by a poor institutional environment and an uncompetitive banking sector, both of which are common characteristics in low-income countries. If this conclusion is correct, it raises the natural follow-up questions of how the central bank should behave in such an environment. In particular, it raises the prospect that aggressive pursuit of an activist monetary policy in this environment may tend to aggravate rather than reduce macroeconomic instability, with adverse consequences for investment-like activities that promote growth and development.

References

Angeloni, I., Kashyap, A. K., Mojon, B. and Terlizzese, D., 2003, "Monetary policy transmission in the euro area: where do we stand?" in *Monetary Policy Transmission in the Euro Area* (Eds) I. Angeloni, A. Kashyap and B. Mojon, Cambridge University Press, Cambridge, pp. 5–41.

Arnone, Marco, Bernard J. Laurens, and Jean-Francois Segalotto, "Measures of Central Bank Autonomy: Empirical Evidence for OECD, Developing, and Emerging Market Economies", *IMF Working Paper* No.06/228.

Beck, Thorsten, Asli Demigurc-Kunt and Ross Levine, 2010, "Financial Institutions and Markets across Countries and Over Time: The Updated Financial Development and Structure Database," *World Bank Economic Review,* Vol. 24(1), pp. 77-92.

Bernanke, Ben S. (1986), "Alternative Explanations of the Money-Income Correlation," NBER WP # 1842, *Carnegie-Rochester Conference Series on Public Policy* 25, pp. 49-100.

Bernanke, Ben S. and Alan S. Blinder (1992), "The Federal Funds Rate and the Channels of Monetary Transmission," *American Economic Review* 82(4) (September), pp. 901-921.

Bernanke, Ben S. and Ilian Mihov (1998), "Measuring Monetary Policy," *The Quarterly Journal of Economics*, Vol. 113, No. 3 (Aug., 1998), pp. 869-902.

Blanchard, Olivier (1989), "A Traditional Interpretation of Macroeconomic Fluctuations," *American Economic Review* Vol. 79, No. 5, pp. 1146-1174.

Blanchard, O. and D. Quah, 1989 "The Dynamic Effects of Aggregate Demand and Aggregate Supply Shocks." *American Economic Review*, 79-4, September, 655-673.

Brainard, William, 1967, "UncertainTy and the Effectiveness of Policy," *American Economic Review Papers and Proceedings* Vol. 57, No. 2 (May), pp. 411-425.

Cecchetti, Stephen G.,1999, "Legal Structure, Financial Structure, and the Monetary Transmission Mechanism," FRBNY *Economic Policy Review* (July), pp. 9-28.

Christiano, Lawrence J. , Martin Eichenbaum, and Charles l. Evans (1996), "Identification and the Effects of Monetary Policy Shocks," in M. Blejer, Z. Eckstein, Z. Hercowitz, and L. Leiderman, eds., *Financial Factors in Economic Stabilization and Growth* (Cambridge: Cambridge University Press), pp. 36-74.

Crowe, Christopher, and Ellen E. Meade, 2008, "Central Bank Independence and Transparency: Evolution and Effectiveness", IMF Working Paper No. 08/119.

Clarida, Richard, Jordi Gali, and Mark Gertler (1999), "The Science of Monetary Policy: A New Keynesian Perspective," *Journal of Economic Literature* 37(4), pp. 1661-1707.

Dhungana, Sandesh, 2008, "Capital Account Liberalization and Growth Volatility," Williams College, unpublished.

Djankov, Simeon, Caralee McLiesh, and Andrei Shleifer (2007), "Private Credit in 129 Countries," *Journal of Financial* Economics 84, pp. 299-329.

Friedman, Milton and Anna Schwartz (1963, *A Monetary History of the United States, 1867-1960* (Princeton: Princeton University Press).

Gerlach, Stefan, and Frank Smets, 1995, "The Monetary Transmission Mechanism: Evidence from the G-7 Countries," CEPR Discussion Paper No. 1219 (July).

IMF, 2008, *International Financial Statistics*.

Kamin, S., P. Turner and J. Van't dack, 1998, "The Transmission Mechanism of Monetary Policy in Emerging Market Economies: An Overview," in *The Transmission of Monetary Policy in Emerging Market Economies*, BIS Policy Papers No. 3.

Kaufmann, Daniel, Aart Kraay and Massimo Mastruzzi (2009), "Governance Matters VIII: Aggregate and Individual Governance Indicators, 1996-2008". World Bank Policy Research Working Paper No. 4978. Available at SSRN: http://ssrn.com/abstract=1424591.

Kumhof, Michael and Evan Tanner (2005), "Government Debt: A Key Role in Financial Intermediation," International Monetary Fund Working Paper WP/05/57 (March).

Levy Yeyati, Eduardo and A. Micco (2003), "Concentration and Foreign Penetration in Latin American Banking Sectors: Impact on Competition and Risk," Inter-American Development Bank. Research Department, Working Paper 499.

Mishra, Prachi, and Peter J. Montiel (2013), How Effective Is Monetary Transmission in Low-Income Countries? A Survey of the Empirical Evidence," International Monetary Fund, draft.

Mishra, Prachi, Peter J. Montiel, and Antonio Spilimbergo (2013), "Monetary Transmission in Low-Income Countries: Effectiveness and Policy Implications," *IMF Economic Review*.

Modigliani Franco and Lucas Papademos, 1982,"The Structure of Financial Markets and the Monetary Mechanism," (mimeo).

Monti, M., 1971, A theoretical model of bank behavior and its implications for monetary policy, L'Industria, 2, 165-191.

Morsink, James and Tamim Bayouimi, 2001, "A Peek Inside the Black Box: The Monetary Transmission Mechanism in Japan," *IMF Staff Papers*, Vol. 48, No. 1, pp. 22-56.

Pedroni, Peter, 2013, "Structural Panel VARs," *Econometrics*, 2, 180-206.

Pesaran, M. Hashem and Ronald Smith (1995) "Estimating Long-Run Relationships from Dynamic Heterogeneous Panels, *Journal of Econometrics*, 68, 79-113.

Sims, Christopher (1980), "Macroeconomics and Reality," *Econometrica* 48 (January), pp. 1-48.

Vegh, Carlos and Guillermo Vuletin, (2012). "Overcoming the Fear of Free Falling: Monetary Policy Graduation in Emerging Markets." NBER Working Paper No 18175 (June).

A Technical Appendix. Summary of Panel SVAR methodology from Pedroni (2013)

We summarize here briefly the panel SVAR methodology from Pedroni (2013) as it applies to our analysis of the relationship between monetary policy and bank lending rates. Toward this end, let $z_{it} = (nLR_{it}, nM0_{it})'$, with dimensions $i = 1, ..., N$, $t = 1, ..., T_i$, denote our unbalanced panel of log nominal lending rates and log nominal money base values, which have been demeaned to eliminate country specific fixed effects.

The first step is to compute the cross sectional averages of the differenced data, namely $\Delta\bar{z}_t = N_t^{-1} \sum_{i=1}^{N_t} \Delta z_{it}$. Pedroni (2013) shows that when the structural shocks are taken to be orthogonal to one another, as is typical in SVAR analysis, then these cross sectional averages contain identifiable information regarding the common shocks. Specifically, we consider the orthogonal structural shocks to be decomposed into orthogonal common and idiosyncratic components such that $\epsilon_{it} = \Lambda_i \bar{\epsilon}_t + \tilde{\epsilon}_{it}$, where ϵ_{it} are the composite shocks, $\bar{\epsilon}_t$ are the common shocks, $\tilde{\epsilon}_{it}$ are the idiosyncratic, country specific shocks, and Λ_i is a diagonal matrix of the country specific loadings, which reflect the relative importance of the common shock for a particular country. Under these conditions, Pedroni (2013) shows that the role of the idiosyncratic shocks in driving movements in the cross sectional averages is negligible and vanishes to zero as the cross sectional dimension becomes large, so that the common structural shocks can be recovered from the cross sectional averages. Toward this end, we estimate the VAR on the differenced data as $\bar{R}(L)\Delta\bar{z}_t = \bar{\mu}_t$, where $\bar{R}(L) = I - \sum_{j=1}^{\bar{P}} \bar{R}_j L^j$, using a suitable information criteria to choose the lag truncation $\bar{P}$. The moving average form $\Delta\bar{z}_t = \bar{F}(L)\bar{\mu}_t$, where $\bar{F}(L) = \bar{R}(L)^{-1}$, can then be related to the structural form subject to the identifying restrictions.

In particular, our identifying assumption that the steady state values for the nominal lending rate are invariant to nominal shocks that permanently move the money base imply that for the structural form, $\Delta\bar{z}_t = \bar{A}(L)\bar{\epsilon}_t$, we have $\bar{A}(1)_{1,2} = 0$. Evaluating the equivalency $\bar{F}(L)\bar{\mu}_t = \bar{A}(L)\bar{\epsilon}_t$ at $L = 0$ gives us the standard mappings, $\bar{\epsilon}_t = \bar{A}(0)^{-1}\bar{\mu}_t$ and $\bar{A}(L) = \bar{F}(L)\bar{A}(0)$, of the reduced form to the structural form via the impact matrix, $\bar{A}(0)$. Furthermore, evaluating at $L = 1$ allows us to map from the steady state response matrix, $\bar{A}(1)$, to the impact matrix, as $\bar{A}(0) = \bar{F}(1)^{-1}\bar{A}(1)$. Finally, orthogonality of the common shocks tells us that the reduced form long run covariance matrix can be related to the steady

state responses as $\bar{\Omega}(1) = \bar{A}(1)\bar{A}(1)'$, so that when $\bar{A}(1)_{1,2} = 0$, the steady state response $\bar{A}(1)$ can be obtained as the unique lower triangular decomposition of the long run covariance matrix, thereby completing the standard long run identification scheme and allowing us to back out estimates of the common structural shocks $\bar{\epsilon}_t$.

Next, a similar long run identification scheme can be exploited to obtain the composite structural shocks, ϵ_{it}, similarly the composite structural responses, $A_i(L)$, on the basis of a reduced form VAR estimation $R_i(L)\Delta z_{it} = \mu_{it}$, $R_i(L) = I - \sum_{j=1}^{P_i} R_{ij}L^j$ applied to the individual country data on a country-by-country basis, such that the lag truncation P_i is also chosen separately for each country. Once the structural composite shocks have been identified, these can be decomposed into their respective common and idiosyncratic components $\epsilon_{it} = \Lambda_i\bar{\epsilon}_t + \tilde{\epsilon}_{it}$. The fact that we are working with structurally identified *i.i.d.* white noise shocks at this stage is a key feature that allows us to obtain good quality estimates for the loadings Λ_i on the basis of simple OLS regressions, or indeed even simple correlation computations, with relatively few data points and without the need for principle components estimation of common factors.

Once the loadings are obtained, Pedroni (2013) shows that the composite structural vector moving average form can be decomposed as $A_i(L)\epsilon_{it} = A_i(L)\Lambda_i\bar{\epsilon}_t + A_i(L)(I - \Lambda_i\Lambda_i')^{1/2}\tilde{\epsilon}^*_{it}$, where $\bar{A}_i(L) = A_i(L)\Lambda_i$ represent the country specific responses to unit common global structural shocks. Similarly $\tilde{A}_i(L) = A_i(L)(I - \Lambda_i\Lambda_i')^{1/2}$ represent the country specific responses to unit idiosyncratic country specific structural shocks such that the idiosyncratic shocks $\tilde{\epsilon}^*_{it} = (I - \Lambda_i\Lambda_i')^{-1/2}\tilde{\epsilon}_{it}$ have been re-standardized to ensure that the impulse responses to the common and idiosyncratic shocks are to similarly sized shocks.

Finally, to generate bootstrapped sample distributions, we re-sample from the estimated series for the idiosyncratic shocks, $\tilde{\epsilon}_{it}$, and common shocks, $\bar{\epsilon}_t$, in order to preserve the dependence structure of the panel, and use these along with the estimated vector moving average representations to simulate the data. These are used to generate confidence bands around the spatial individual country quantiles as reflected in figure 2, and similarly are used to generate individual country standard error estimates, which are used in the weighted regressions for Table 1. We refer readers to Pedroni (2013) for further details on the panel SVAR methodology.

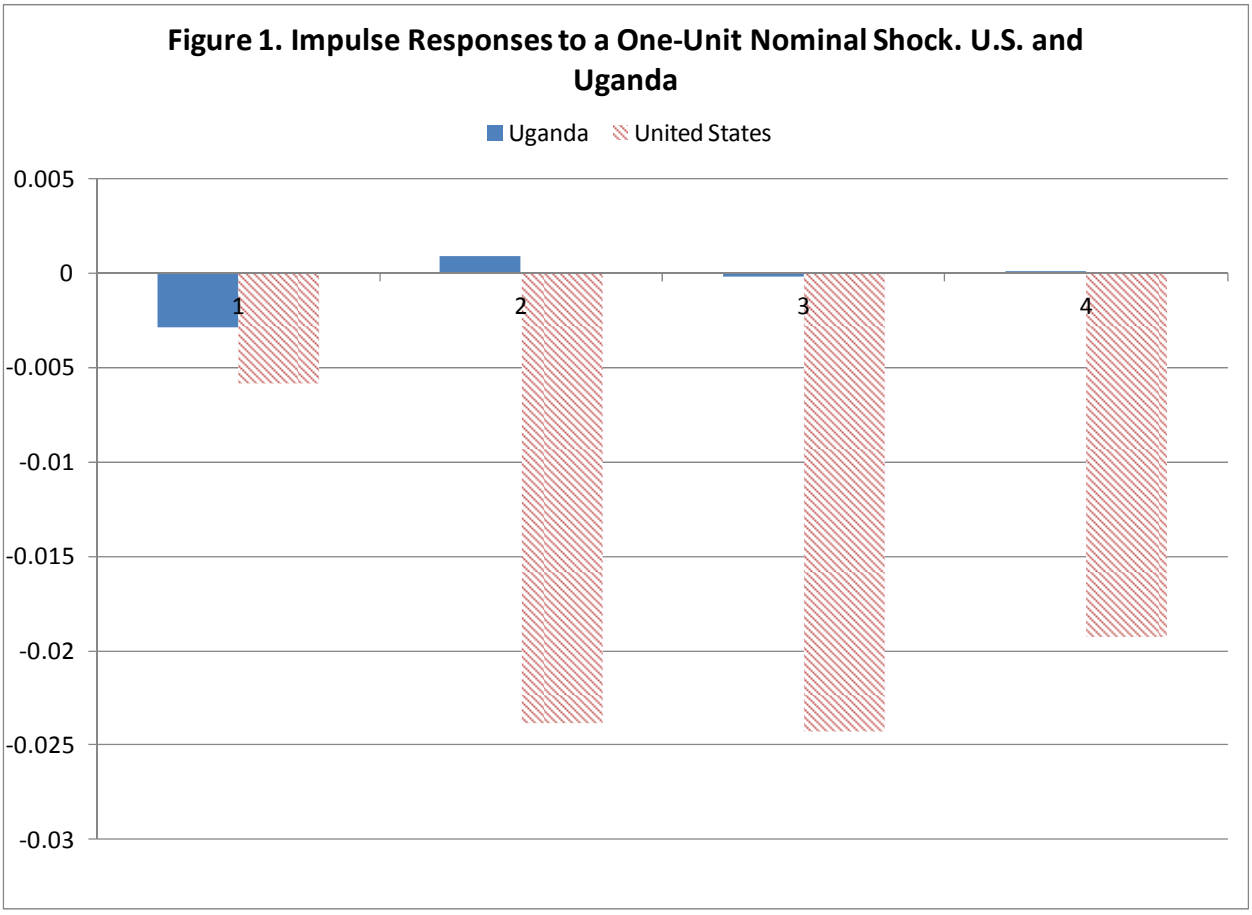
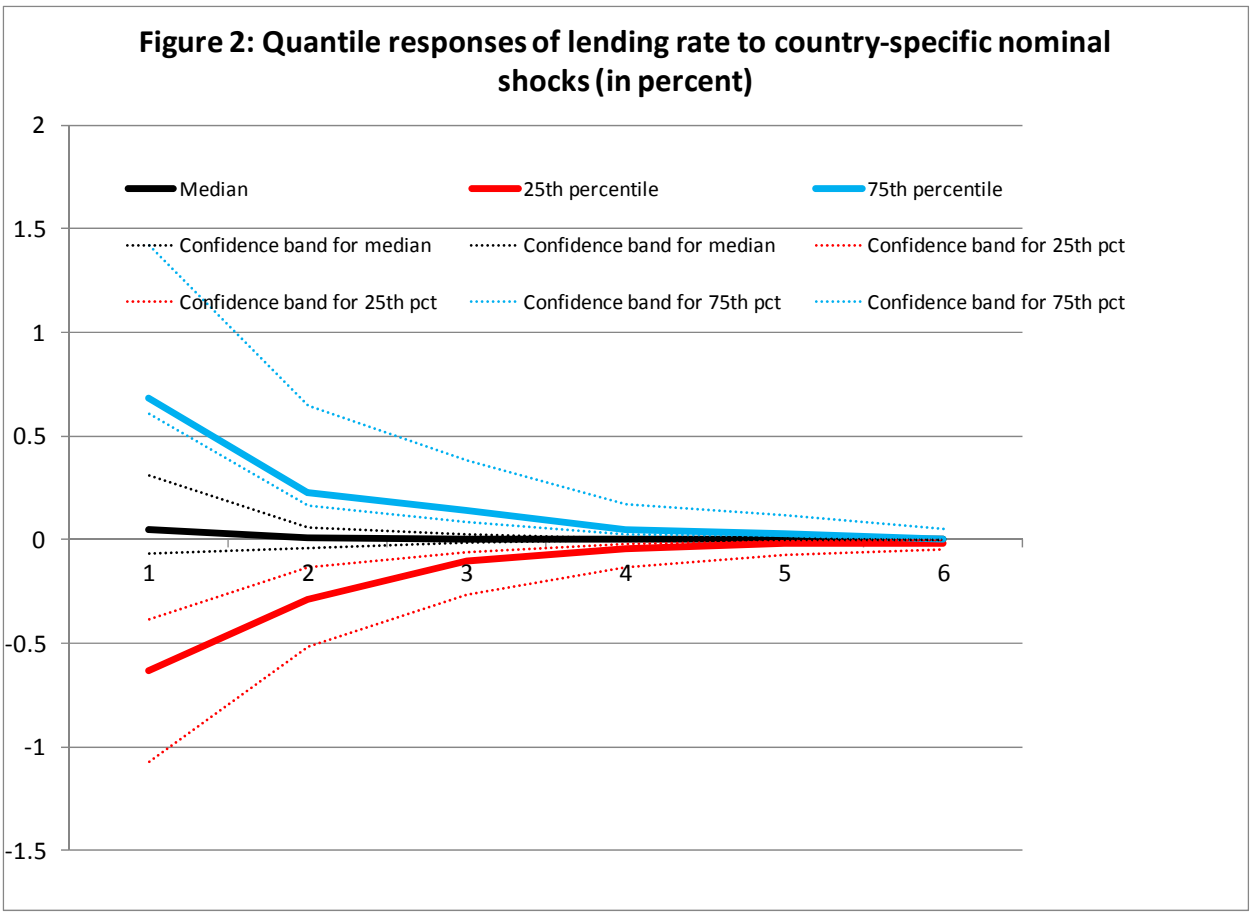
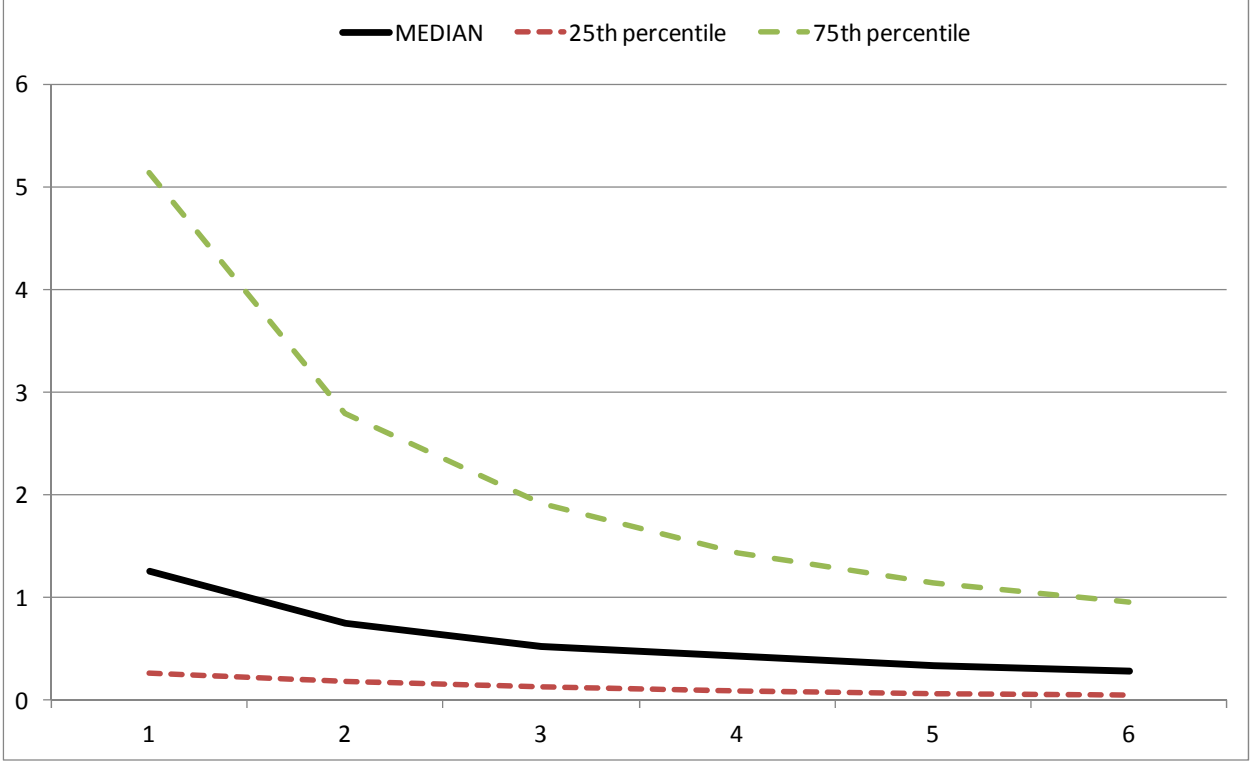


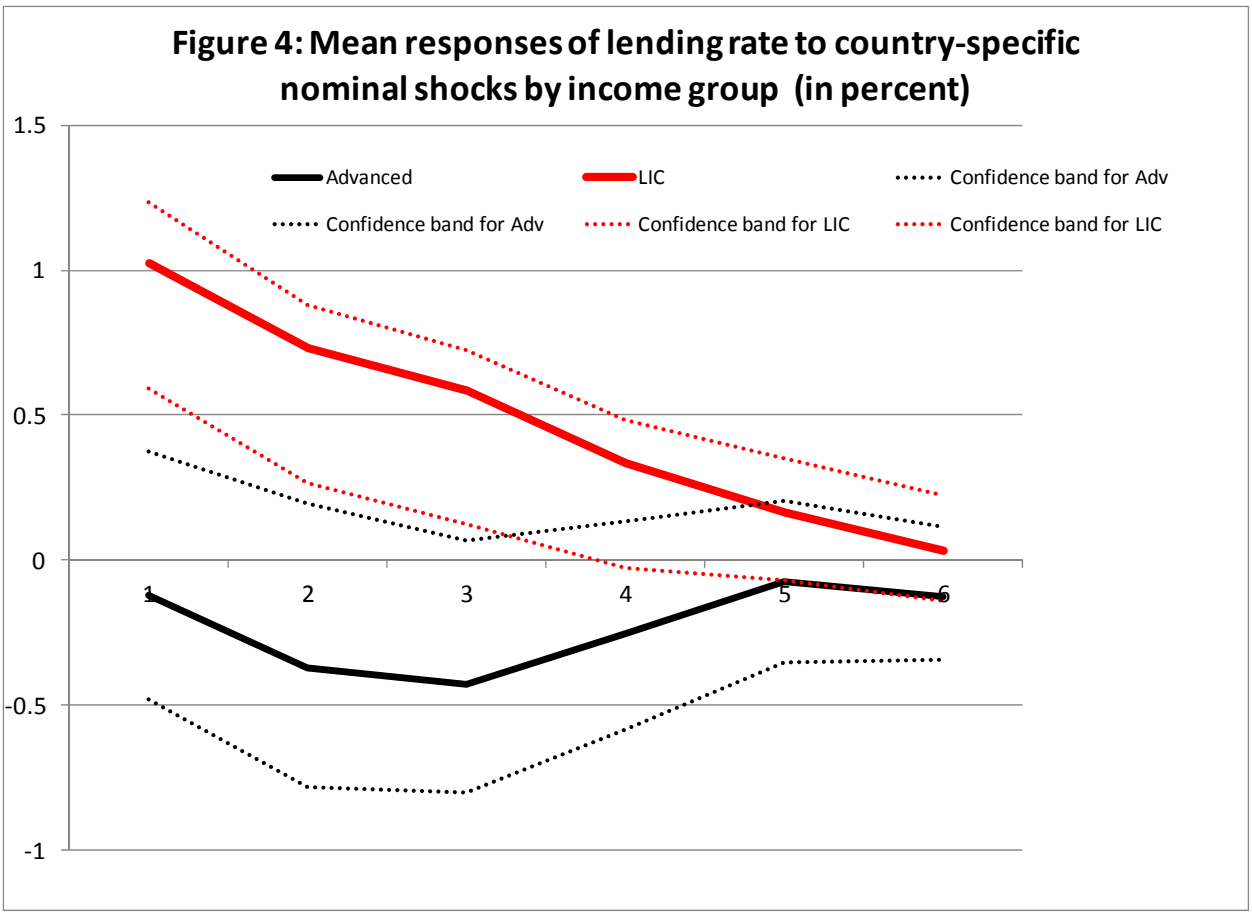
Figure 1. Impulse Responses to a One-Unit Nominal Shock. U.S. and Uganda
Uganda
United States
0.005
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
1
2
3
4



Notes. The dotted lines show the bootstrapped 99 percent confidence bands.

Figure 3: Share of the variance of lending rate due to country-specific nominal shocks (in percent)





Notes. The dotted lines show the bootstrapped 90 percent confidence bands.

Fig 5a: Impulse Responses and Regulatory Quality

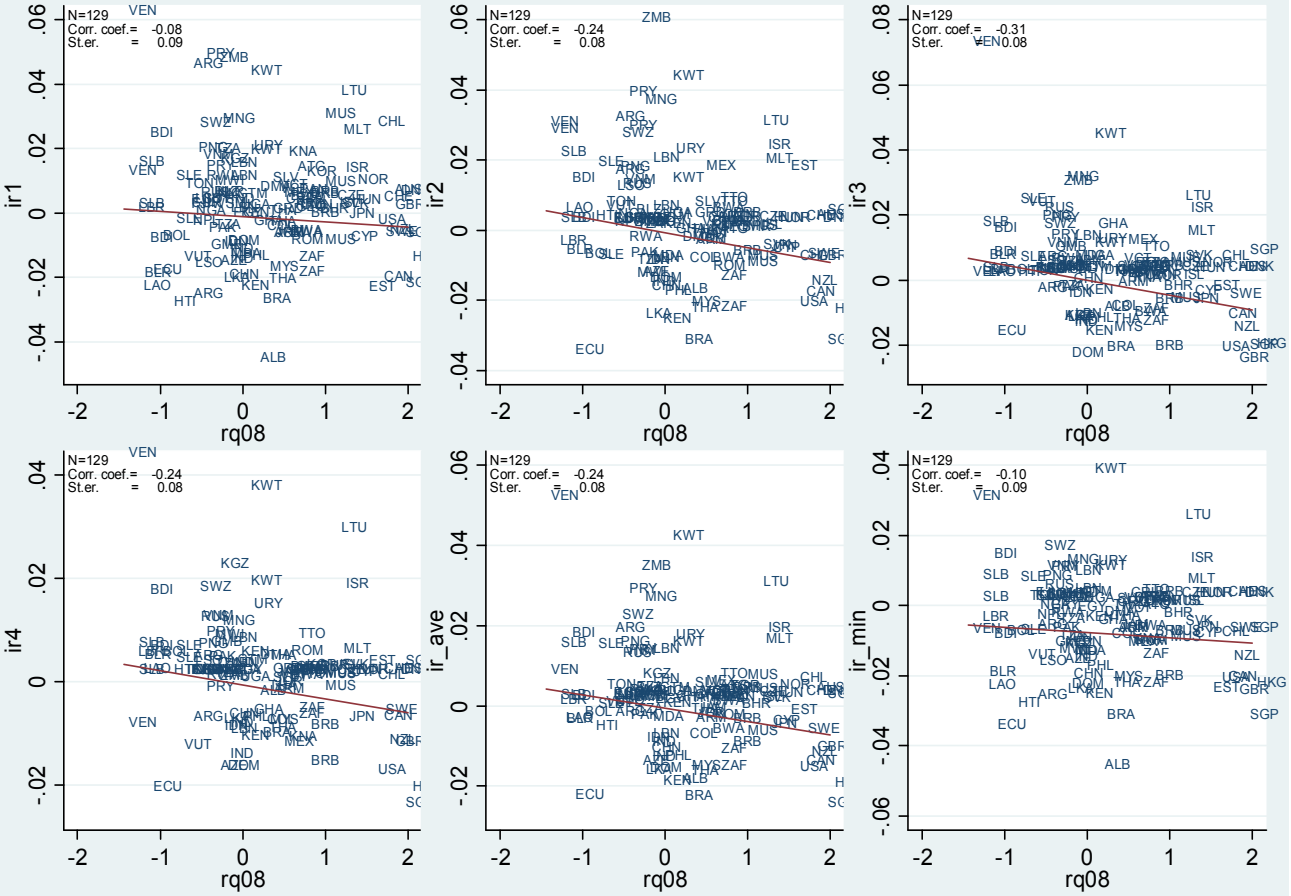


Fig 5b: Impulse Responses and Size of Banking Sector

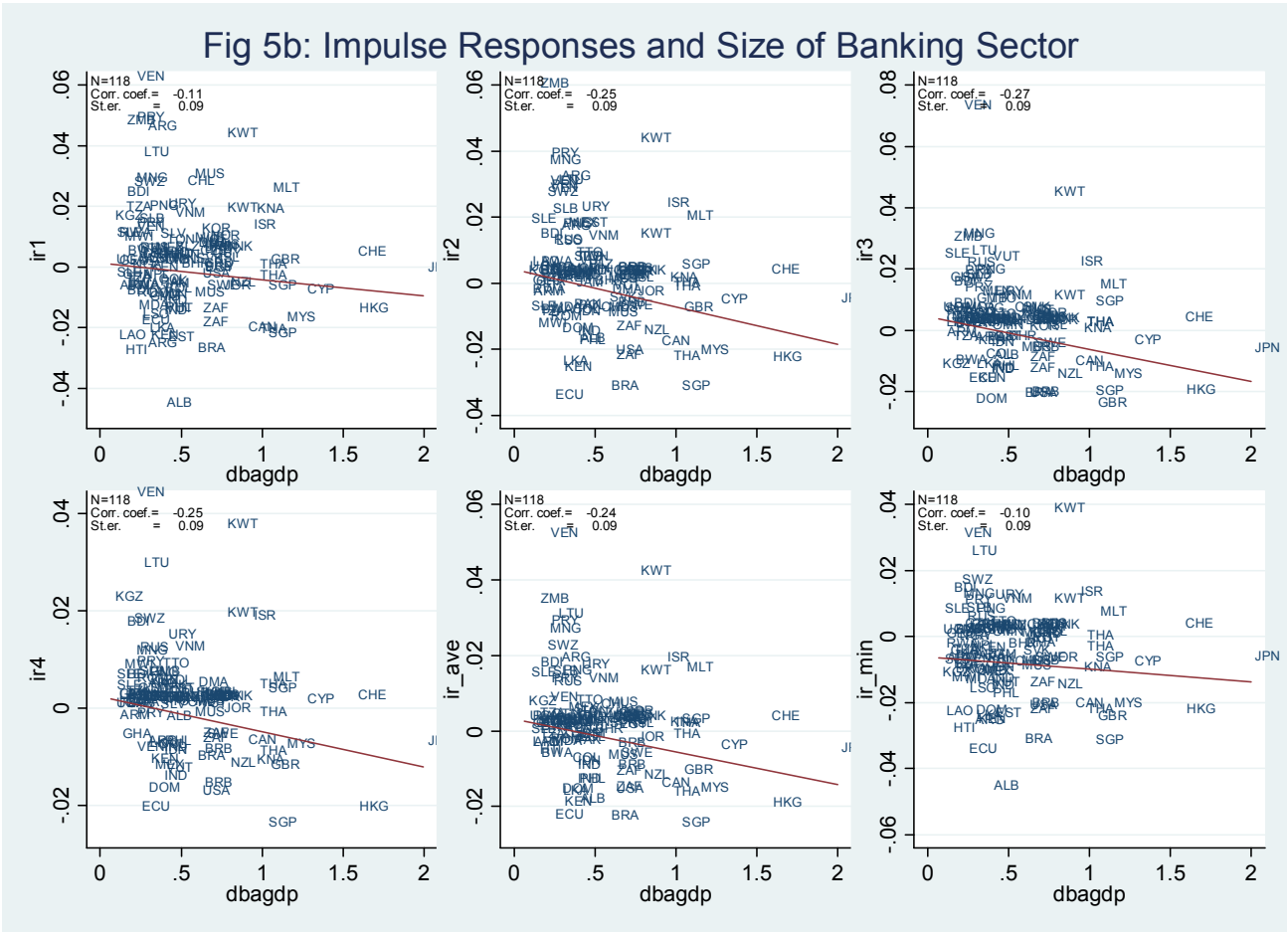


Fig 5c: Impulse Responses and Stock Market

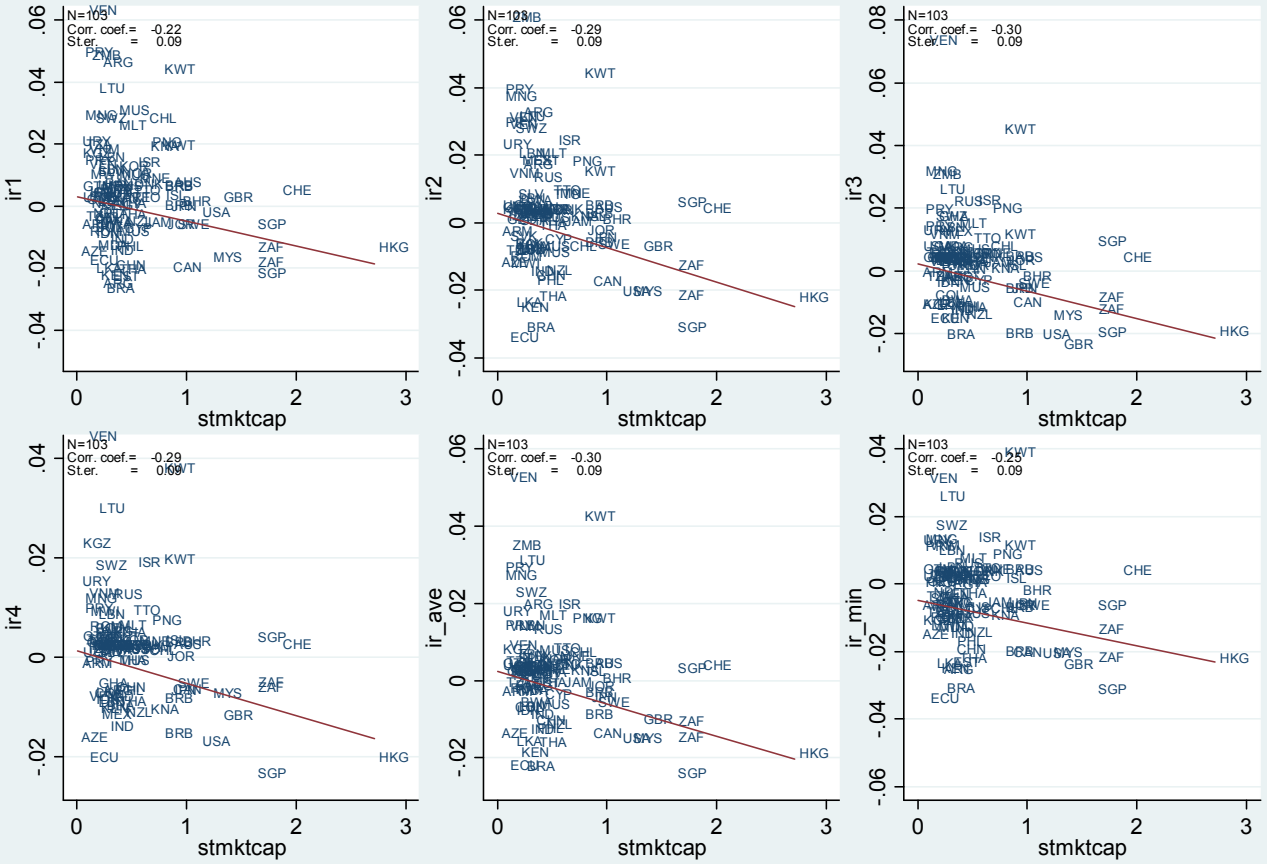


Fig 5d: Impulse Responses and Bank Concentration

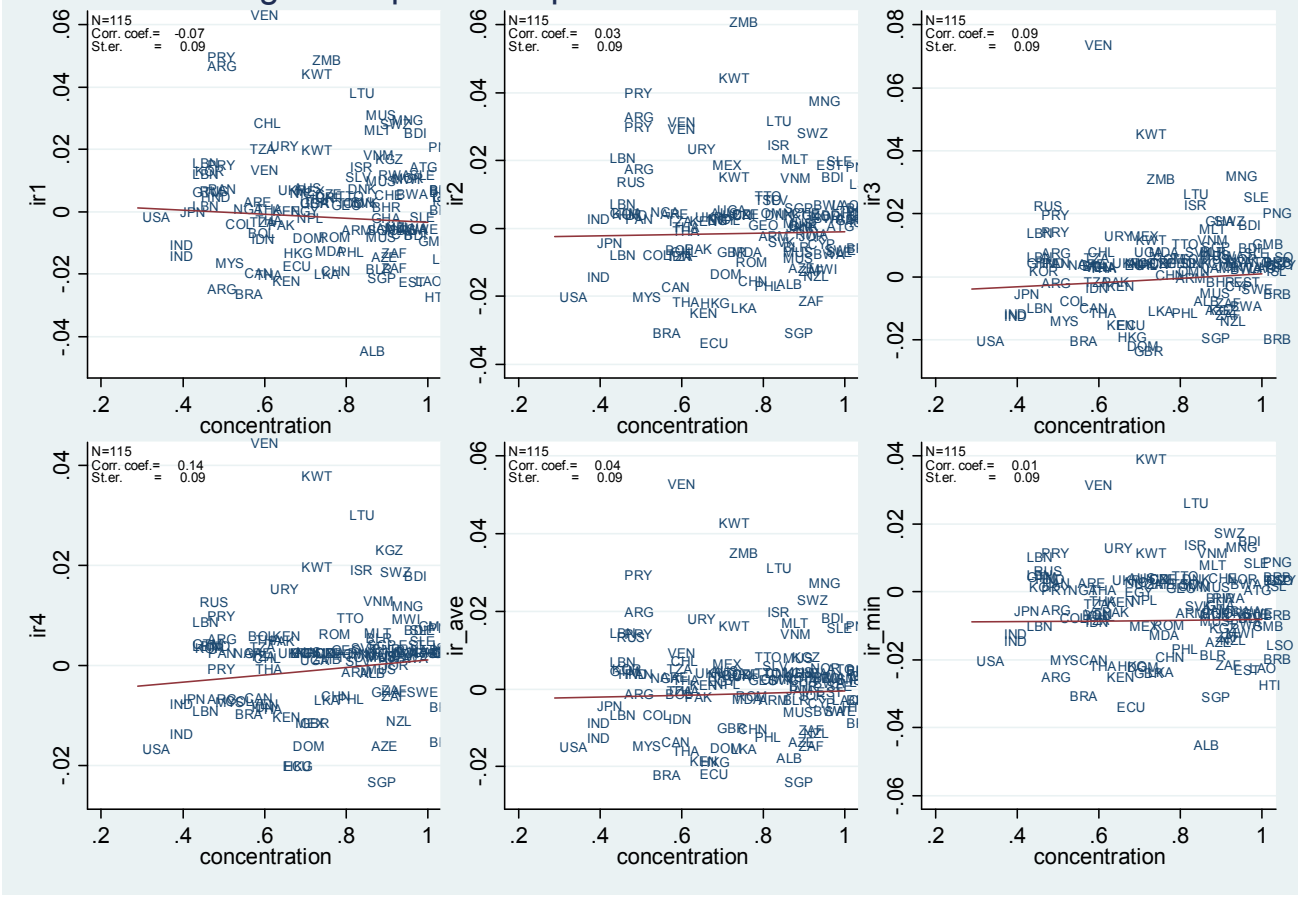


Fig 5e: Impulse Responses and International Financial Integration

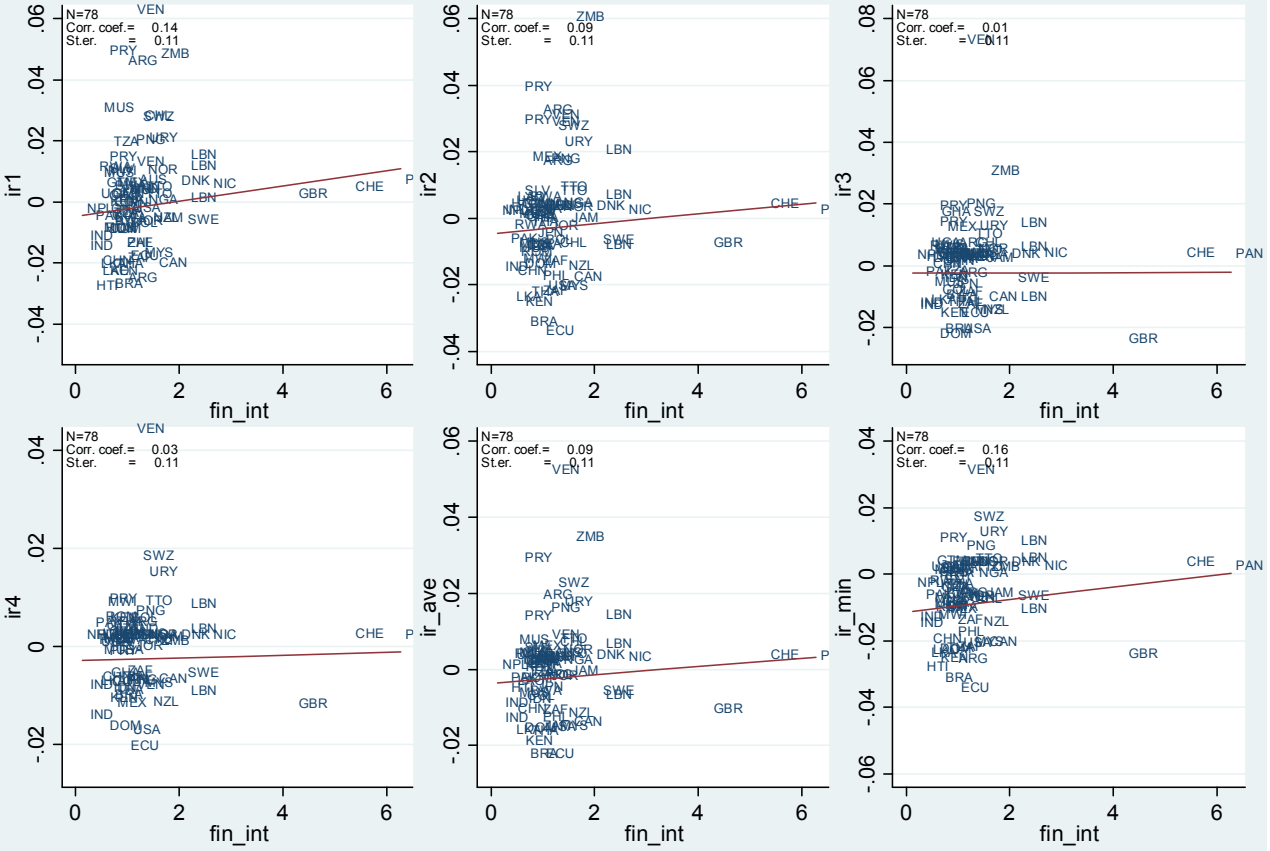
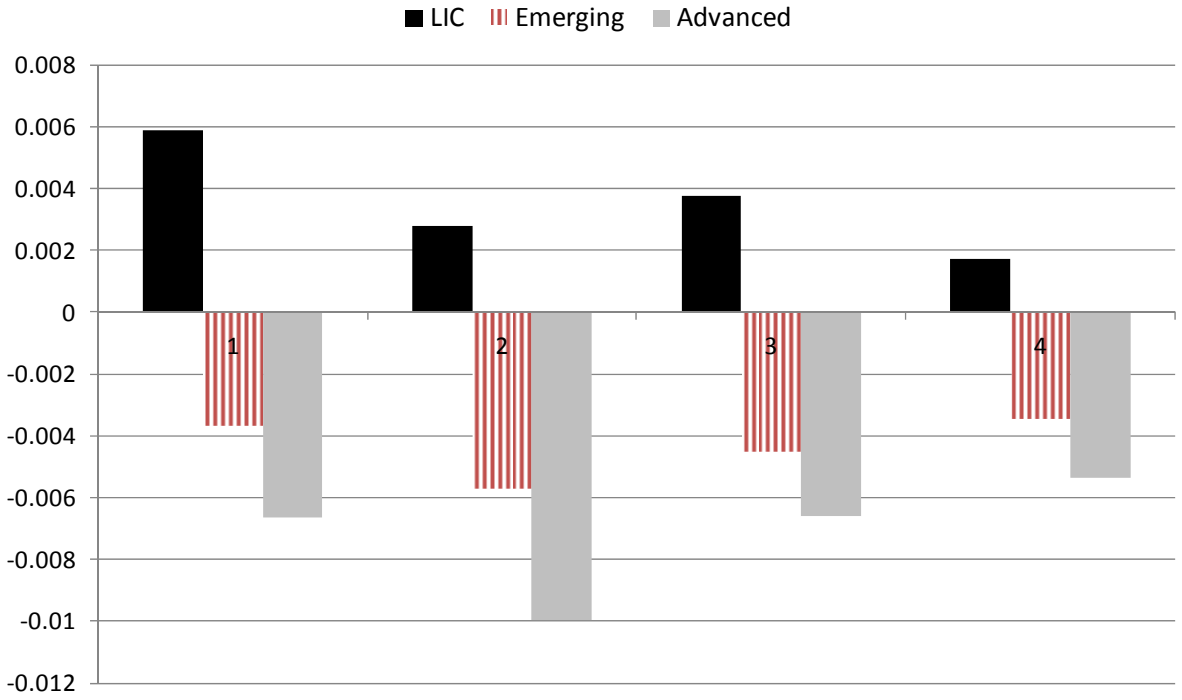


Figure 6. Predicted Four-Quarter Impulse Responses Conditional on Country Specific Characteristics



Notes. The predicted responses are based on the coefficient estimates in Table 2 (including the constant) and country-group means shown in Table 1.

Table 1. Country-Group Characteristics

	Advanced	Emerging	Low-income
Institutional quality	1.24	0.39	-0.25
Deposit money banks/GDP	0.91	0.64	0.29
Stock market capitalization/GDP	0.77	0.62	0.22
Bank concentration	0.73	0.63	0.80

Notes. Institutional quality is for 2008, and is taken from Kaufman, Kraay and Mastruzzi (2009). All other explanatory variables are long-term averages. Deposit money bank assets, stock market capitalization, and bank concentration are from Beck, Demirguc-Kunt and Levine (2009). The first two are averages over 1980-2007, the third is averaged over 1987-2007. The financial integration measure is from Dhungana (2008), and is averaged over 1980, 85, 90, 95, and 2000.

Table 2. Impulse response of log(lending rate) to nominal shocks: Correlates

	1st quarter	2nd quarter	3rd quarter	4th quarter	Average	Minimum
Regulatory quality	-0.001	-0.003	-0.002^	-0.003*	-0.002	-0.001
	[0.004]	[0.003]	[0.002]	[0.001]	[0.002]	[0.002]
Deposit money bank assets/ GDP	-0.008	-0.003	-0.001	0.000	-0.003	0.004
	[0.009]	[0.007]	[0.005]	[0.003]	[0.005]	[0.005]
Stock market capitalization / GDP	-0.011^^	-0.010*	-0.009**	-0.005*	-0.009**	-0.012**
	[0.008]	[0.006]	[0.004]	[0.003]	[0.004]	[0.004]
Bank concentration	0.011	0.008	0.015**	0.010*	0.011^^	0.013*
	[0.014]	[0.011]	[0.007]	[0.005]	[0.007]	[0.008]
International Financial Integration	0.004^^	0.003*	0.001^	0.001^	0.002*	0.002^^
	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]
Number of observations	66	66	66	66	66	66
R-squared	0.14	0.18	0.28	0.23	0.26	0.16
p-value for the F-stat	0.11	0.04	0.00	0.01	0.00	0.05

Notes. Regulatory quality is for 2008, and is taken from Kaufman, Kraay and Mastruzzi (2009). All other explanatory variables are long-term averages. Deposit money bank assets, stock market capitalization, and bank concentration are from Beck, Demirguc-Kunt and Levine (2009). The first two are averages over 1980-2007, the third is averaged over 1987-2007. The financial integration measure is from Dhungana (2008), and is averaged over 1980, 85, 90, 95, and 2000. **, *, ^^ and ^ denote significance at 5, 1, 15, and 20 percent respectively.

Table 3. Impulse response of log(lending rate) to nominal shocks: Correlates: Weighted Regressions

	1st quarter	2nd quarter	3rd quarter	4th quarter	Average	Minimum
Regulatory quality	0.006	-0.013**	-0.002	-0.005***	-0.003	-0.006*
	[0.006]	[0.005]	[0.002]	[0.002]	[0.003]	[0.003]
Deposit money bank assets/ GDP	-0.040**	-0.013	-0.014**	-0.002	-0.016**	0.008
	[0.018]	[0.014]	[0.006]	[0.004]	[0.007]	[0.008]
Stock market capitalization / GDP	-0.021*	-0.011^	-0.015***	-0.004^	-0.013***	-0.006
	[0.012]	[0.009]	[0.004]	[0.003]	[0.005]	[0.005]
Bank concentration	0.024	-0.013	0.025***	0.005	0.0090	-0.004
	[0.021]	[0.018]	[0.008]	[0.006]	[0.009]	[0.010]
International Financial Integration	0.008^^	0.016***	0.001	0.002^^	0.006***	0.002
	[0.005]	[0.004]	[0.002]	[0.001]	[0.002]	[0.002]
Number of observations	66	66	66	66	66	66
R-squared	0.27	0.35	0.57	0.34	0.47	0.15
p-value for the F-stat	0.00	0.00	0.00	0.00	0.00	0.08

Notes. Regressions are weighted by the inverse of the standard errors of the impulse response coefficients. For the average response, the regressions are weighted by inverse of average of standard errors. Regulatory quality is for 2008, and is taken from Kaufman, Kraay and Mastruzzi (2009). All other explanatory variables are long-term averages. Deposit money bank assets, stock market capitalization, and bank concentration are from Beck, Demirguc-Kunt and Levine (2009). The first two are averages over 1980-2007, the third is averaged over 1987-2007. The financial integration measure is from Dhungana (2008), and is averaged over 1980, 85, 90, 95, and 2000. **, *, ^^ and ^ denote significance at 5, 1, 15, and 20 percent respectively.

Table 4. Impulse response of log(lending rate) to nominal shocks: Correlates: (Including Central Bank Transparency)

	1st quarter	2nd quarter	3rd quarter	4th quarter	Average	Minimum
Deposit money bank assets/ GDP	-0.003	-0.003	0.001	0	-0.001	0.005
	[0.009]	[0.006]	[0.005]	[0.003]	[0.005]	[0.005]
Stock market capitalization / GDP	-0.012	-0.013**	-0.008*	-0.004	-0.009**	-0.011**
	[0.008]	[0.006]	[0.004]	[0.003]	[0.004]	[0.005]
Bank concentration	0.008	0.007	0.014*	0.010*	0.0100	0.019**
	[0.014]	[0.010]	[0.008]	[0.006]	[0.008]	[0.008]
International Financial Integration	0.007**	0.008***	0.003	0.002	0.005**	0.003
	[0.003]	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]
Central bank transparency	**-0.001**	**-0.002****	**-0.001****	**-0.001****	**-0.001****	**-0.001****
	[0.001]	**[0.001]**	**[0.001]**	**[0.000]**	**[0.001]**	**[0.001]**
Number of observations	51	51	51	51	51	51
R-squared	0.18	0.38	0.35	0.29	0.35	0.30
p-value for the F-stat	0.10	0.00	0.00	0.01	0.00	0.01

Notes. All explanatory variables are long-term averages. Central bank transparency is taken from Dincer and Eichengreen (2009), and is an average over the available years from 1998-2006. Deposit money bank assets, stock market capitalization, and bank concentration are from Beck, Demirguc-Kunt and Levine (2009). The first two are averages over 1980-2007, the third is averaged over 1987-2007. The financial integration measure is from Dhungana (2008), and is averaged over 1980, 85, 90, 95, and 2000. **, *, ^^ and ^ denote significance at 5, 1, 15, and 20 percent respectively.

Table A1. Sample Coverage

Country name	Start time	End time
ADVANCED		
Australia	1978q2	2013q3
Canada	1978q2	2011q2
Cyprus	2000q3	2007q4
Denmark	1980q2	2002q4
Iceland	1982q1	2008q3
Japan	1978q2	2013q2
Kuwait	1979q2	2013q1
Malta	1994q3	2007q4
New Zealand	1998q3	2011q2
Norway	1979q1	2010q1
Qatar	2004q3	2013q3
Sweden	1978q2	2006q2
Switzerland	1981q1	2013q2
UAE	1979q4	1984q4
UK	1978q2	2009q4
US	1978q2	2009q3
EMERGING COUNTRIES		
Argentina	1993q2	2013q3
Brazil	1997q1	2013q3
Chile	1978q3	2013q2
China	1995q1	1999q4
Colombia	1987q2	2013q3
Czech Rep	1993q1	2013q3
Egypt	1991q3	2013q2
Hong Kong	1996q4	2003q2
Hungary	1988q4	2013q3
India	1990q3	2013q3
Indonesia	1986q1	2013q3
Israel	1979q1	2010q1
Jordan	1991q4	2013q3
Korea	1994q3	2013q3
Malaysia	1986q4	2013q2
Mexico	1993q4	2013q3
Pakistan	2004q1	2013q2
Peru	1985q4	2013q3
Philippines	1986q4	2013q3
Poland	1987q3	2006q4
Russia	1994q3	2013q3
Singapore	1978q2	2003q4
South Africa	1978q2	2011q3
Thailand	1978q2	2013q3
Venezuela	1984q1	2013q2

Country name	Start time	End time
LOW INCOME COUNTRIES		
Albania	1999q1	2013q3
Algeria	1994q1	2003q4
Angola	1998q4	2013q3
Antigua Barbuda	1982q4	2013q2
Armenia	1995q1	2013q3
Azerbaijan	1999q1	2013q3
Bahrain	1991q2	2013q3
Barbados	1981q1	2010q3
Belarus	1994q4	2013q3
Belize	1985q4	2013q3
Bolivia	1987q1	2013q2
Bosnia Herzeg	2002q1	2013q3
Botswana	1980q1	2011q3
Bulgaria	1991q4	2013q3
Burundi	1990q1	2013q2
CAR	1985q3	1996q3
Cameroon	1987q3	1996q3
Cape Verde	1997q2	2013q3
Chad	1990q1	1996q3
Congo	1987q2	1996q3
Costa Rica	1982q1	2013q2
Croatia	1992q1	2013q2
Dominica	1982q4	2013q2
Dominican Rep	1994q4	2013q2
Ecuador	1987q2	2007q2
El Salvador	1989q1	2000q4
Equat Guinea	1990q2	1996q3
Estonia	1992q3	2010q4
Ethiopia	1999q2	2004q1
Fiji	1992q4	2013q2
Gabon	1990q2	1996q3
Gambia	1984q3	2008q3
Georgia	1996q1	2013q3
Ghana	1983q3	1988q4
Grenada	1990q3	2013q2
Guatemala	1989q4	2013q3
Guinea-Bissau	1992q1	1997q1
Guyana	1987q4	2010q2
Haiti	1995q1	2013q2
Honduras	1982q1	2013q3
Iraq	2004q4	2013q2
Jamaica	1978q2	2013q2
Kenya	1979q4	2013q3
Kyrgyz Rep	1996q1	2013q3
Lao	2000q3	2006q2
Latvia	1993q3	2013q3
Lebanon	1982q1	2013q3

Country name	Start time	End time
LOW INCOME COUNTRIES		
Lesotho	1980q1	2013q3
Liberia	1981q4	2013q2
Lithuania	1993q1	2010q4
Madagascar	2002q3	2008q4
Malawi	1994q4	2005q4
Mauritius	1980q3	2009q4
Moldova	1995q4	2013q3
Mongolia	1993q2	2013q3
Montenegro	2005q4	2013q3
Mozambique	1997q4	2013q3
Namibia	1991q1	2013q2
Nepal	1995q3	2006q1
Nicaragua	1988q1	2013q3
Nigeria	1978q2	2013q2
Oman	1985q4	2013q3
Panama	1990q2	2013q3
Papua New G.	1983q1	2013q2
Paraguay	1990q1	2013q3
Romania	1994q1	2013q3
Rwanda	1996q1	2006q4
Samoa	2002q1	2013q2
Sao Tome Pr	1995q4	2007q3
Sierra Leone	1985q1	2007q3
Slovak Rep	1993q1	2008q4
Solomon Is	1990q3	2013q3
Sri Lanka	1982q2	2013q1
St Kitts N	1990q3	2013q2
St Vincent Gr	1990q2	2013q2
Suriname	1990q4	2013q3
Swaziland	1978q2	2011q3
Syria	2005q2	2011q1
Tajikistan	1998q4	2013q1
Tanzania	1984q4	2013q2
Tonga	1992q3	2013q3
Trinidad Tob	1987q3	2013q2
Uganda	1994q3	2013q2
Ukraine	1998q1	2013q3
Uruguay	1978q2	2013q2
Vanuatu	1997q3	2006q1
Viet Nam	1996q1	2013q1
Yemen	1996q1	2001q2
Zaire	2006q1	2013q3
Zambia	1982q3	2013q3
Zimbabwe	1989q3	2007q4

Notes: The classification of countries into advanced, emerging and LICs follows Rogoff, et. al. (2004). Emerging market economies are those that are included in the Morgan Stanley Capital International (MSCI) index. With the exception of Israel, which is in the MSCI index, advanced economies are those that are classified as upper income economies by the World Bank. All other economies constitute low-income countries (LICs).

Table A2. Data Sources

Variable	Data Source
Money base	IFS line 14
Bank lending rate	IFS line 60
Deposit money bank assets/GDP	Beck, Demirguc-Kunt and Levine (2009)
Bank concentration	Beck, Demirguc-Kunt and Levine (2009)
Stock market capitalization / GDP	Beck, Demirguc-Kunt and Levine (2009)
Regulatory Quality	Kaufman, Kraay and Mastruzzi (2009)
International Financial Integration	Dhungana (2008)

Figure A1.

Quantile Impulse Responses from the Panel SVAR

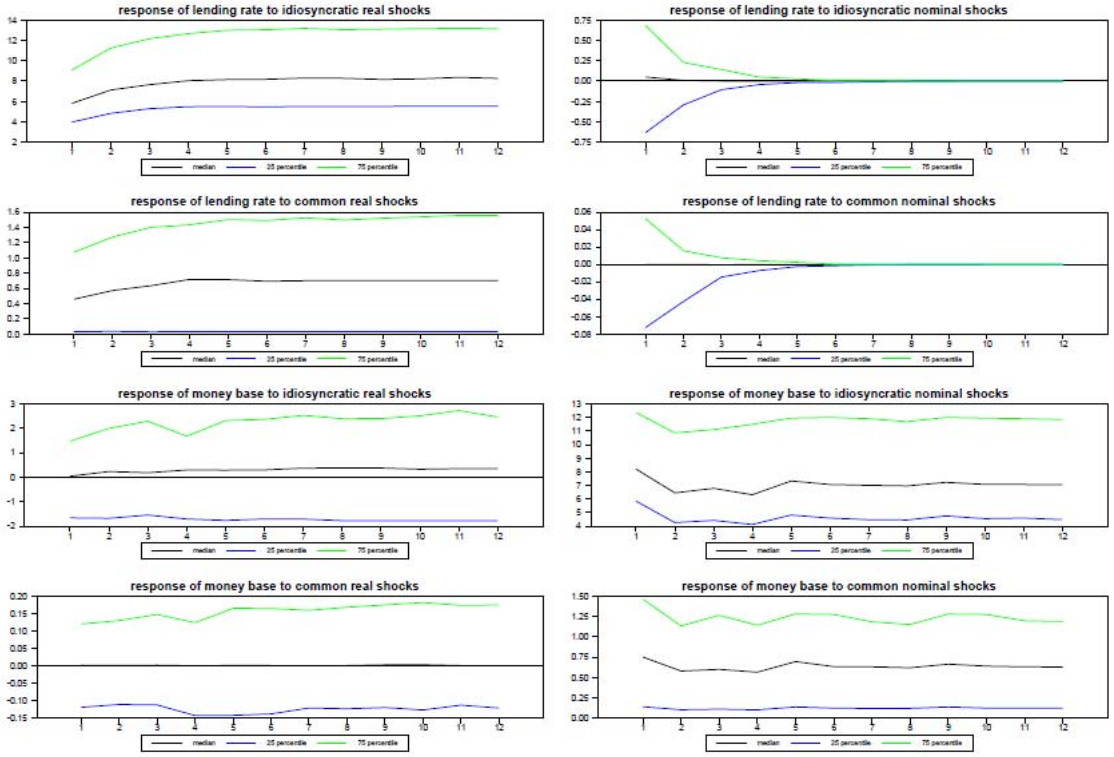


Figure A2.

Quantile Variance Decompositions as Shares of Variations due to Composite Shocks

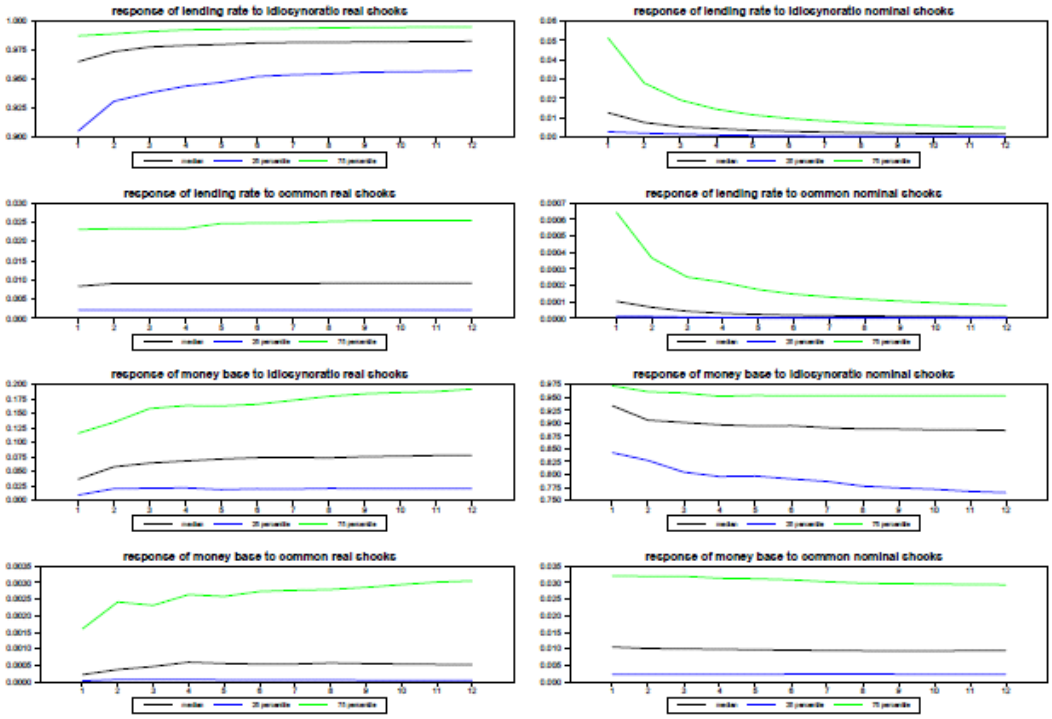
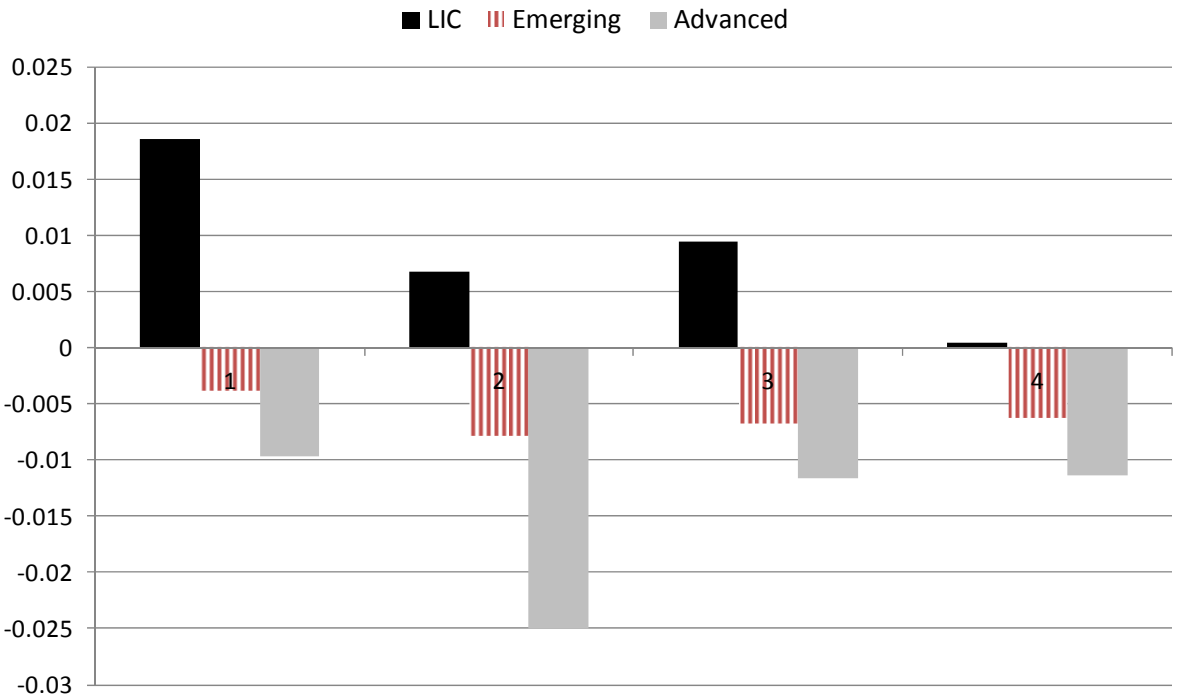


Figure A3. Predicted Four-Quarter Impulse Responses Conditional on Country Specific Characteristics: Weighted Regressions



Notes. The predicted responses are based on the coefficient estimates in Table 3 (including the constant) and country-group means shown in Table 1.