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How Effective Is Monetary Transmission in Developing Countries? A Survey of the Empirical Evidence*

Prachi Mishra
Research Department, IMF

Peter Montiel
Williams College

Antonio Spilimbergo
European Department, IMF

Abstract:

This paper surveys the evidence on the effectiveness of monetary transmission in developing countries. We summarize the arguments for expecting the bank lending channel to be the dominant means of monetary transmission in such countries, and present a simple model that suggests why this channel may be both weak and unreliable under the conditions that usually characterize those economies. Next, we review the empirical methodologies that have been employed in the recent literature to assess monetary policy effectiveness, both in developing countries as well as in industrial and emerging economies, essentially based on vector autoregressions (VARs). It is very hard to come away from this review of the evidence with much confidence in the strength of monetary transmission in developing countries. We distinguish between the "facts on the ground" and "methodological deficiencies" interpretations of the absence of evidence for strong monetary transmission. We suspect, however, that "facts on the ground" are indeed an important part of the story. The fact that a wide range of empirical approaches have failed to yield evidence of effective monetary transmission in developing countries, and that the strongest evidence for effective monetary transmission has arisen for relatively prosperous and more institutionally-developed countries such as some central and Eastern European transition economies (at least in the later stages of their transition) and Tunisia, makes us doubt whether methodological shortcomings are the whole story. If this conjecture is correct, the stabilization challenge in developing countries is acute indeed, and identifying the means of enhancing the effectiveness of monetary policy in such countries is an important challenge.

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In the vast majority of developing countries, fiscal policy has not traditionally represented a viable instrument for macroeconomic stabilization, and indeed has often represented a source of macroeconomic shocks, behaving procyclically and/or aggravating the effects of exogenous shocks.[1] At the same time, the degree of central bank autonomy in these countries has often been limited, leaving little room for the exercise of an independent monetary policyHowever, recent economic reforms among developing countries have resulted in central banks becoming increasingly independent, not just *de jure*, but also *de facto*. With the reform of fiscal institutions usually lagging that of monetary ones, the responsibility for stabilization policy in developing countries has increasingly fallen on the newly-independent central banks.

For central banks to be able to implement this responsibility, the policy instruments at their disposal must be effective in influencing aggregate demand. However, for a variety of institutional reasons, the link between monetary policy instruments and aggregate demand – the monetary transmission mechanism – may be significantly weaker in developing countries than it is in advanced and emerging economies. In particular, the bank lending channel is likely to be the dominant channel of monetary transmission in developing countries, but its effectiveness, which depends on the domestic institutional environment, the structure of the banking system, and the intrinsic stability of the domestic macroeconomic environment, is problematic.

Weak and unreliable monetary transmission would suggest restraint in the use of monetary policy (see Mishra, Montiel, and Spilimbergo 2010). In light of the shortcomings of fiscal policy, the restricted use of monetary policy would create a serious challenge for macroeconomic stabilization policy in low-income countries. Assessing the empirical effectiveness of monetary policy in such countries is an important topic for research.

In this paper we take stock of the systematic evidence on the effectiveness of monetary transmission in developing countries to determine how much confidence we can place on the proposition that central banks in such countries can exert strong and systematic effects on aggregate demand. The structure of the paper is as follows. In the next section, we summarize the arguments for expecting the bank lending channel to be the dominant means of monetary transmission in such countries, and present a simple model that suggests why this channel may be both weak and unreliable under the conditions that usually characterize those economies. Section II presents a review of the empirical methodology that has been employed in the recent literature to assess monetary policy effectiveness, both in developing countries as well as in industrial and emerging economies, essentially based on vector autoregressions (VARs). Our review of the state of knowledge on this topic in developing countries is presented in Section III. Section IV summarizes our findings and their implications.

An organizing principle for the survey is necessary. The number of developing countries is quite large, and while their institutional and banking structures tend to differ systematically from those of advanced and emerging economies, they are also quite heterogeneous among themselves. As discussed in Mishra, Montiel, and Spilimbergo (2010), the channels of monetary transmission depend on an economy's financial structure as well as on certain aspects of its

[1] As of 2010, 134 of the IMF's 187 member countries were classified as developing countries. This total refers to member countries that are not classified by the institution as either advanced or emerging economies.

nonmonetary policy regimes – especially on the presence or absence of barriers to international capital movements and on the exchange rate regime. Because the financial structure, in turn, is heavily influenced by a country's legal and institutional environment, which have strong regional commonalities, and because countries in the same geographic region often adopt similar exchange rate regimes as well as exhibit similarities in their links to international financial markets, differences in the characteristics that matter for monetary transmission are likely to be much more pronounced among countries in different geographic regions than among those in the same region. Accordingly, our review of the literature in Section III is structured regionally, as is the summary table presented in an appendix.

I. Monetary transmission and the bank lending channel in developing countries

In an advanced economy, monetary transmission is assumed to operate mostly through four mechanisms: the interest rate channel, the asset channel, the credit channel, and the exchange rate channel. In a nutshell, central bank policies that alter the supply of bank reserves affect the interest rate that commercial banks charge for very short-term lending (typically to each other, in the form of money-market rates), and arbitrage across the maturity spectrum transmits these effects to the rate of return on long-term bonds. With price stickiness and rational expectations, long-term real interest rates are affected, influencing the demand for a broad range of capital goods. This represents the interest rate channel. Arbitrage between long-term bonds on the one hand, and equities and real assets, on the other, affects stock market values and real estate prices, which in turn affect household wealth and consumer spending, constituting the asset channel. Arbitrage between assets denominated in domestic and foreign currencies affects the real exchange rate, which alters the composition of both consumption and investment spending between domestic and foreign goods. This constitutes the exchange rate channel. Finally, credit market frictions imply that some borrowers have access to external funds only through bank credit, while others must pay a premium over the risk-free rate that depends on their net worth (the external finance premium). The credit channel captures the dual effects that changes in the supply of banking system reserves exert on aggregate demand through changes in the terms on which bank customers have access to loans (the bank lending channel) as well as through changes in the external finance premium (the balance sheet channel).

There are strong *a priori* reasons, based on the structure of the financial systems in many developing countries, to believe that the monetary transmission mechanism in such countries should differ substantially from that in advanced and emerging economies. Developing countries are characterized by the absence of well-functioning markets for fixed-income securities, equities, and real estate, by very imperfect links with private international capital markets, and by heavy central bank intervention in foreign exchange markets.[2] This leaves little scope for the functioning of the conventional interest rate channel, the asset channel, or the exchange rate channel. Because these other channels are likely to be weak, and because banks are by far the dominant formal financial intermediaries in such economies, the bank lending channel is likely to be dominant in developing countries, with the balance sheet channel operating as a financial

[2] See Mishra, Montiel, and Spilimbergo (2010).

accelerator – i.e., as a factor that magnifies the effect of the bank lending channel by increasing the external finance premium when bank credit is plentiful and reducing it when such credit is scarce. In short, the bank lending channel, supplemented by a derivative balance sheet channel, is likely to be the dominant channel for monetary transmission in developing countries.

If monetary transmission in developing countries is dominated by the bank lending channel, the effectiveness and reliability of monetary transmission in these countries depends on the properties of this specific channel. The relevant properties concern two links in the causal chain from monetary policy actions to aggregate demand: that between monetary policy actions and the availability and cost of bank credit, and that between the availability and cost of bank credit and aggregate demand. When the formal financial sector is small, as is true in the vast majority of developing countries, the second of these links is likely to be weak. But the link between monetary policy actions and the availability and cost of bank credit may be weak as well. Specifically, the literature suggests that it may be undermined by two factors:[3]

- If the banking industry is noncompetitive, changes in banks' costs of funds may be reflected in bank profit margins, rather than in the supply of bank lending.

- If a poor institutional environment increases the cost of bank lending, banks may restrict lending activity in a manner that weakens the effects of monetary policy actions on the supply of loans.

In the rest of this section we develop a simple model of bank lending behavior that illustrates the possible roles of both of these factors, implying that the actual strength of the bank lending channel, even in bank-dominated financial systems such as those that characterize most developing countries, is an empirical issue.

Consider a representative commercial bank that manages a portfolio consisting of loans (L), government securities (B), as well as reserves (R), and finances it by issuing deposits (D) and obtaining central bank credit (C). The bank's demand for central bank credit is therefore given by:

$$C = L + B + R - D \tag{1}$$

To capture the role of imperfect competition in the banking sector, assume that the bank has market power in both the loan and deposit markets, so it faces a demand for loans given by:

$$L = L(i_L),\ L' < 0, \tag{2a}$$

and a supply of deposits:

$$D = D(i_D),\ D' > 0, \tag{2b}$$

[3] See, for example, Cottarelli and Kourelis (1994), as well as Kwapil and Scharlet (2006).

where i_L and i_D are respectively the loan and deposit rates set by the bank. However, the bank has no market power in the market for government securities, where it faces the market interest rate i_B. As is well known, credit market frictions (asymmetric information and costly contract enforcement) make lending a costly activity and justify the existence of banks. To capture this phenomenon, costs of intermediation are taken to be an increasing and convex function of the volume of loans intermediated:

$$c = c(L), \text{ with } c' > 0,\ c'' > 0 \tag{3}$$

The more unfavorable the domestic institutional environment is for financial intermediation, the more rapidly these costs increase with the volume of funds being intermediated – i.e., when the institutional environment is very unfavorable, as in the case of many developing countries, we should expect $c'' >> 0$. The idea is that in such an environment, lending becomes more costly as banks expand beyond their traditional customers that they know well, and that this effect is stronger in countries with weak institutional settings.

The "lemons" problem associated with asymmetric information about loan quality makes bank loans illiquid, and the absence of a secondary market for government securities makes those instruments illiquid as well. The bank therefore values reserves because they provide the only available liquid buffer against unanticipated deposit withdrawals (for simplicity, we assume that there are no required reserves). This "liquidity premium," which we denote ρ, is a decreasing and convex function of the ratio of reserves to deposits, i.e.:

$$\rho = \rho(R/D), \text{ with } \rho' < 0 \text{ and } \rho'' > 0. \tag{4}$$

The central bank charges the interest rate i_C for credit extended to commercial banks, but rations this credit among individual commercial banks. Thus each bank faces the constraint:

$$C \leq C_{bar}, \tag{5}$$

with C_{bar} denoting the maximum amount of central bank credit available to this bank.

Under these conditions, the bank's problem is to set its lending and deposit rates, and to choose its holdings of government securities and reserves, so as to maximize profits, subject to its balance sheet constraint (1) and the supply of central bank credit (5). In other words, its problem is to:

$$Max\ \pi\ (i_L, i_D, B, R) = i_L L(i_L) + i_B B + \rho(R/D)R - c(L) - i_D D(i_D) - i_C C$$

subject to (1) and (5), as well as to nonnegativity constraints on its balance sheet variables. We will assume that the nonnegativity constraints are not binding, but that the central bank's credit constraint (5) is. Under these assumptions, the first-order conditions are given by:

$$L + i_L L' - c'L' - i_C L' - \lambda L' = 0 \tag{6a}$$

$$-\rho'(R/D)^2 D' - D - i_D D' + i_C D' + \lambda D' = 0 \tag{6b}$$

$$i_B - i_C - \lambda = 0 \tag{6c}$$

$$\rho - \rho'(R/D) - i_C - \lambda = 0 \tag{6d}$$

Notice from (6c) that for the central bank credit constraint to be binding (i.e., for $\lambda > 0$), we must have $i_B > i_C$. The intuition is straightforward: as long as the return on government securities exceeds the interest rate on bank credit, the bank would always prefer to borrow additional amounts from the central bank in order to purchase more government securities. We assume that the condition $i_B > i_C$ holds. Notice also from (6c) that $i_C + \lambda = i_B$. Substituting this expression in (6d) yields the bank's demand for reserves as a function of its deposit base and the interest rate on government securities:

$$R = h(i_B)D, \text{ where } h' = 1/\rho'(1 - \eta) < 0.^{4} \tag{7}$$

From (6a) and (6c) we can express the optimal lending rate as:

$$i_L = (1 + 1/\xi_L)\,(i_B + c'(L)\,), \tag{8}$$

where ξ_L is the elasticity of loan demand. This equation expresses the loan interest rate as a markup $(1 + 1/\xi_L)$ over the marginal cost of loanable funds, where the latter is given by the foregone return on government securities plus marginal intermediation costs. This markup is larger the less competitive the banking environment – i.e., the less elastic the demand for loans facing an individual bank. Finally, using (6c), (6d) and (7) in (6b), the deposit rate is given by:

$$i_D = (1 + 1/\xi_D)^{-1}\,[i_B\,(1 - h\,) + \rho h], \tag{9}$$

where ξ_D is the deposit supply elasticity.

Our primary concern is with the "pass-through" from the interest rate on government securities, which is the policy rate determined by the central bank, and commercial banks' lending rates.[5] Assuming a constant loan demand elasticity, equation (8) and the loan demand equation (2a) together determine the optimal lending rate and loan supply as a function of the interest rate on government securities and the elasticity of loan demand. Substituting (2a) into (8) and differentiating, we can derive the "pass-through" coefficient:

$$di_L/di_B = \frac{(1 + 1/\xi_L)}{1 - c''L'(1 + 1/\xi_L)} > 0 \tag{10}$$

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[4] η is the elasticity of the liquidity premium with respect to the reserve/deposit ratio. For an interior solution, we must have $0 < \eta < 1$, which implies $1/\rho'(1 - \eta) < 0$.

[5] Notice that i_C does not serve as the policy rate. This follows from the assumption that the central bank credit constraint is binding -- i.e. it does not extend unlimited amounts of credit at this rate.

The key point for our purposes is that this "pass-through" coefficient is a decreasing function of c'', the slope of the marginal intermediation-cost curve. What this means is that if a deficient institutional environment causes problems of asymmetric information and costly contract enforcement to generate a steeply rising cost of financial intermediation when banks try to expand their lending, banks are less likely to adjust their lending rates in response to changes in the central bank's policy rate. Moreover, since equations (2a) and (8) imply that the lending rate depends only on i_B, any other central bank action, such as changes in the supply of credit to banks or in the discount rate, would also leave the lending rate unchanged so long as such actions do not change the policy rate i_B. Finally, it is easy to see that it is not just the strength of the pass-through effect that is at issue here, but also its reliability, since any factor that unexpectedly alters the shape of commercial banks' intermediation cost curve (including changes in the stability of the domestic macroeconomic environment, in the policy regime, or in the institutional framework governing financial intermediation) will also affect the extent of pass-through from policy to lending rates through c''.

In short, while the bank lending channel may be dominant in the developing-country context, its effectiveness and reliability cannot be taken for granted. Its effectiveness depends on the extent to which central bank policy actions affect commercial bank lending rates, and its reliability on the extent to which factors that determine commercial banks' intermediation costs prove to be stable. Since such factors may include non-structural ones that are subject to frequent change in developing countries, the upshot is that the transmission mechanism may prove both weak and unreliable in such countries. The issue is an empirical one.

II. Empirical methodology

In recent years, a large literature has emerged that has attempted to measure the empirical effect of monetary policy on aggregate demand. Much of this literature has focused on the experience of the United States and other advanced countries, as well as (to a significantly lesser extent) on emerging economies. However, there is now a substantial body of work on developing countries as well. Because several aspects of the methodologies employed remain controversial, before turning to an examination of this evidence it is useful to consider several methodological issues.

1. Methodological challenges

Providing evidence on the effectiveness of monetary transmission confronts several serious methodological challenges:

First, since the issue in question concerns the *independent* effect of monetary policy on aggregate demand, isolating this effect requires controlling for the influence of other variables on aggregate demand. This is a potentially difficult proposition, since the number of such influences is potentially large.

Second, the exercise requires an empirically observable indicator of the stance of monetary policy. While the central bank may ultimately seek to influence aggregate demand, and

while it conducts monetary policy by altering the size of its balance sheet, in practice it alters the size of its balance sheet so as to seek to determine the value of some financial variable which it believes to be linked to aggregate demand through the monetary transmission mechanism. This financial variable – the central bank's intermediate target – may be a monetary aggregate, a short-term interest rate, the exchange rate, or some combination of these variables (e.g., a monetary conditions index). If the intermediate target of monetary policy is mis-identified, then the correlation between the variable that is mistakenly taken by the investigator as an indicator of the central bank's intermediate target and the state of aggregate demand may reflect the common influence of third factors on both variables, rather than the sought-for independent effect of monetary policy on aggregate demand. Such factors are likely to be sample-specific, so that the correlation between the chosen target and aggregate demand will vary from sample to sample, depending on the sources of shocks that prove to be dominant in each sample. This would provide no information on the true effect of monetary policy on aggregate demand.

Third, having identified the intermediate target of policy, it is necessary to discriminate between anticipated and unanticipated changes in the monetary policy variable – i.e., between monetary policy *actions* (changes in the targeted variable, whether predictable on the basis of past information or not) and monetary policy *shocks* (innovations in the targeted variable). The reason is that only monetary policy innovations represent changes in monetary policy that are at least potentially exogenous. Monetary policy actions, by contrast, may reflect the influence of other variables on the policies adopted by the central bank, and those other variables may also exert an independent influence on aggregate demand.

Finally, even if, say, a short-term domestic interest rate can be taken as the intermediate target of monetary policy, and innovations in the behavior of this interest rate can be identified, it is necessary to deal with the potential problem of *contemporaneous* endogeneity of the interest rate innovation, to the extent that such an innovation is correlated with innovations in other macroeconomic variables. It may be, for example, that interest rates are unexpectedly raised during a given period *because* the monetary authorities observe an innovation in aggregate demand. In other words, it is necessary to identify the *exogenous* component of the innovation in the policy variable. This is the standard identification problem.

2. The VAR approach

To address these challenges, it has become customary to investigate the effects of monetary policy using a VAR methodology, based on a set of macroeconomic variables that includes an indicator of aggregate demand and the assumed intermediate target of monetary policy. While the VAR approach has become the methodology of choice for studying monetary transmission in advanced countries over the past two decades, it has particular advantages over model-based approaches in the developing-country context, where the poorly-understood macroeconomic functioning of the economy makes the exclusion restrictions required in structural approaches even less credible than they are in the advanced-country context.

The VAR approach addresses the challenges posed above as follows:

First, as long as the residuals in the VAR represent true innovations (i.e., as long as they are not serially correlated), all potential determinants of aggregate demand other than monetary policy need not be explicitly accounted for in the VAR, since the effect of such variables will be captured by the innovation in the indicator of aggregate demand.[6] To accurately capture monetary policy innovations, however, the VAR must also include any other variables (information variables) that enter the reaction function of the monetary authorities. Aggregate demand determinants other than monetary policy must therefore be included in the VAR to the extent that they influence the behavior of monetary policymakers.[7]

The second of the challenges listed above has proven harder to tackle. The intermediate target of monetary policy has typically been identified on *a priori* grounds, based on prior knowledge about the operating procedures of the monetary authorities. An alternative approach has been to include the candidates for intermediate targets (typically a short-term interest rate and a narrow monetary aggregate) in the VAR and impose restrictions on the reduced-form VAR innovations designed to extract the structural monetary policy innovations. For example, Gordon and Leeper (1994) estimated a monthly VAR for the United States with seven variables consisting of the unemployment rate, real output, the price level, a long-term interest rate, commodity prices, the stock of reserves, and the federal funds rate. They then specified the following structural model for the reserves market:

$M = a_1R + a_2P + a_3Y + e^d$ (demand for reserves)

$R = a_4M + a_5R_{10} + a_6CP + e^s$ (supply of reserves)

where Y, P, R_{10}, CP, M, and R denote respectively the reduced-form VAR innovations in real output, the price level, the long-term interest rate, commodity prices, the stock of reserves, and the federal funds rate, and e^d and e^s are respectively structural shocks to the demand and supply of reserves.[8] These equations can be estimated directly from the VAR residuals, allowing e^d and e^{s-} to be estimated. In this setup, e^s is the relevant monetary policy shock. A similar approach, using a different model of the reserves market, was adopted by Bernanke and Mihov (1998). These approaches have the virtue that rather than specifying the intermediate target *a priori*, they allow the data to identify it.

The third challenge mentioned above (distinguishing between anticipated and unanticipated monetary policy measures) is handled directly by the VAR methodology, since the

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[6] See the discussion of this issue in Sims and Zha (1998).

[7] For example, early work on monetary transmission in the United States identified a "price puzzle" in which contractionary monetary policy was associated with a transitory increase in the price level. Subsequent work, however, showed that the price puzzle went away when a measure of commodity prices was included in the VAR (Christiano, Eichenbaum, and Evans 1996). The interpretation is that an increase in commodity prices predicts future inflation, and since such an increase is observable by the Fed when it makes monetary policy decisions, it leads to monetary contraction in order to combat such inflationary pressures.

[8] For brevity, we will use these symbols to represent the indicated variables (or their equivalent versions) throughout the rest of the paper, and will introduce new symbols only as new variables are introduced.

residuals in the reduced-form VAR equations for the monetary policy variable or variables are precisely innovations in those variables and thus contain only the unanticipated component of monetary policy.

3. Identification of monetary policy shocks

However, the fourth challenge -- extracting the exogenous component of the monetary policy innovation (the monetary policy shock) from these reduced-form VAR residuals -- is another matter entirely, because it requires departing from the "atheoretic" stance on which the VAR approach is based. Not surprisingly, therefore, it has proven to be the most controversial aspect of the methodology. As indicated above, the problem is that monetary policy may respond contemporaneously to other variables in the system, so the innovation in the monetary policy variable may represent some combination of an exogenous monetary policy shock and an endogenous contemporaneous response of monetary policy to innovations in other variables. To clarify the discussion, consider the following structural model of the economy

$$AY_t = \sum_{i=1}^{H} B_i Y_{t-i} + \varepsilon_t$$

$$= B(L)LY_t + \varepsilon_t \qquad (1)$$

where Y_t is an n-dimensional vector of endogenous variables, A and the B_i are n x n matrices, the ε_t are "primitive" unobservable shocks (including the monetary policy shock) that are serially uncorrelated with covariance matrix given by the identity matrix (i.e., the shocks are mutually orthogonal and are assumed without loss of generality to have unit variance), and $B(L)$ is given by:

$$B(L) = B_0 + B_1L + B_2L^2 + \ldots B_HL^1.$$

where L is the lag operator. By pre-multiplying by A^{-1}, we can write this system as the reduced-form vector autoregression:

$$Y_t = \sum_{i=1}^{L} D_i Y_{t-i} + u_t,$$

$$= D(L)L\ Y_t + u_t \qquad (2)$$

where $D_i = A^{-1} B_i$ and $u_t = A^{-1}\varepsilon_t$. Note that this makes each element of the vector u_t a linear combination of the contemporaneous values of the vector ε_t. This means that while the u_t will still be serially uncorrelated, they will in general be contemporaneously correlated. Equation (2) can be consistently estimated equation-by-equation with OLS. Estimation of (2) yields estimates of the D_i and the u_t, from which the variance-covariance matrix of the u_t can be constructed.

The identification question is whether estimates of the structural parameters of (1), including of the monetary policy shock, can be recovered from the estimates of the reduced-form VAR (2). Estimation of the VAR yields estimates of the $D_i = A^{-1} B_i$ and the $u_t = A^{-1}\varepsilon_t$. Note that since $B_i = AD_i$ and D_i is observable, if we had an estimate of A, we could recover all the B_i. This means that what we need to identify are the *contemporaneous* parameters of the structural model

– i.e., the n^2 elements of the matrix A. Because the information on D_i is needed to recover the B_i, all we have to work with in doing so are the estimates of $u_t = A^{-1}\varepsilon_t$. and the associated covariance matrix of the reduced-form residuals given by $Eu_tu_t' = M$. Notice that A has n^2 unknown elements, but the symmetric matrix M contains only $n(n + 1)/2$ distinct elements, so to achieve identification we require $n^2 - n(n + 1)/2 = n(n - 1)/2$ additional restrictions.

This issue has been addressed in several ways:

i. Choleski decompositions

Under a Choleski decomposition, the relationship among the reduced-form innovations is assumed to be recursive, so that if variables are ordered according to their place in the recursive chain, the reduced-form innovation in the first variable is assumed to be structural, while that in the second is a structural innovation in the second variable combined with a contemporaneous response to the structural innovation in the first variable, that of the third is a structural innovation in the third variable combined with a contemporaneous response to the structural innovations in the first two variables, and so on, making the A matrix lower-triangular. Christiano, Eichenbaum and Evans (1999) therefore refer to this as the "recursiveness assumption." Notice that since all of the above-diagonal elements of the A matrix are set equal to zero, this involves imposing $n(n - 1)/2$ zero restrictions.

Crude implementations of the Choleski scheme have tended to order the monetary policy variable first, on the implicit assumption that innovations in this variable are exogenous, but may affect the other variables in the VAR contemporaneously. In a three-variable system, for example, containing real output, the price level, and a monetary policy variable, the monetary policy variable would be ordered first, followed, say, by real output and the price level (M, Y, P). The identifying assumptions are that monetary policy does not react contemporaneously to innovations in real output and the price level, and that innovations in the price level do not affect real output contemporaneously.

However, this neglects the possibility that innovations in other macro variables (such as real output and the price level) may be part of the information set available to monetary policymakers, and that they may therefore respond to innovations in such variables contemporaneously. Bernanke and Blinder (1992) proposed a recursive identification scheme based on the information available to policymakers and the speed with which policy variables affect the endogenous macro variables. This scheme has been applied widely. In an estimation based on monthly data for the United States, they argued that the monetary policy variable should actually appear *last* in the Choleski ordering, on the assumption that the endogenous macro variables in their VAR could be observed contemporaneously by policymakers, but that monetary policy variables would tend to affect the endogenous macro variables with a lag.[9] The alternative ordering in this case would place real output first, followed by the price level and the monetary policy variable.

[9] In another well-known application, Bernanke and Gertler (1995) ordered variables as Y, P, CP, and R. The assumption was again that the Fed observed all of (Y, P and CP) in making its policy decision, but the federal funds rate R did not affect these variables within the period.

The policy variable has not always been ordered last, however. Peersman and Smets (2001), for example, investigated the monetary transmission mechanism in the Euro area using VARs based on quarterly data and imposing a Choleski decomposition ordered as real GDP, consumer prices, a domestic nominal short-term interest rate (the monetary policy variable) and the real exchange rate. The assumptions in this case were that in setting its monetary policy, the ECB looks at real GDP and consumer prices, but not at the exchange rate, while the exchange rate is affected contemporaneously by all the variables ordered before it, and neither the interest rate nor the exchange rate has any effect on real GDP and consumer prices within the quarter. In short, this approach to identification assumes that the monetary policy shock is orthogonal to the variables in the central bank's information set: the shock is not influenced contemporaneously by variables in the information set, and does not influence such variables contemporaneously.

ii. Non-recursive (simultaneous) identification

A problem with this approach, however, is that the central bank may be able to observe variables that it can affect contemporaneously, and even if it does not seek to influence these variables directly, it may react to them anyway, since they may convey information about variables that the central bank does care about. In the Peersman and Smets four-variable system, for example, the central bank may choose to respond to innovations in the exchange rate because it conveys information about future prices. This would invalidate one of Peersman and Smets' exclusion restrictions. Whenever non-predetermined variables enter the central bank's information set, the recursiveness assumption fails, and additional *a priori* restrictions are required equal in number to the number of non-predetermined variables included in the central bank's information set.[10]

As long as those additional restrictions also satisfy the rank condition for identification, the monetary policy shock can be identified in a fully simultaneous system. An influential approach to doing so was developed by Sims and Zha (1998). To describe their approach in a simplified setting, consider the Peersman and Smets four-variable system augmented with a money stock variable, yielding a five-variable VAR. The order condition requires 10 restrictions in this case. Assuming that real output is not affected contemporaneously by any of the other variables in the system and the price level is only affected by real output yields 7 exclusion restrictions. Interpreting the innovation in the money stock as arising from innovations in money demand allows the exchange rate to be excluded from that equation, yielding an eighth restriction. Finally, if the central bank can observe the exchange rate and the relevant monetary stock contemporaneously, but not real output and the price level, this yields the final two exclusion restrictions required for identification in the interest rate equation. In this framework, the exchange rate is allowed to respond to all the other variables contemporaneously. Note that

[10] One way to see the difficulty in this case is that when the monetary policy shock is no longer orthogonal to the variables in the central bank's information set, the shock can no longer be extracted from a simple OLS regression of the policy variable on the variables in the central bank's information set. If the VAR contains at least some variables that are predetermined with respect to monetary policy, however, the monetary policy shock can be extracted with an IV regression of the policy variable on the variables in the central bank's information set, using the predetermined variables as instruments.

shocks to real output and the price level can be solved for recursively in this system, but the shocks to monetary policy, money demand, and the exchange rate must all be solved for simultaneously.[11]

iii. Identification with long-run restrictions

From equation (2), the response of the endogenous variables to the reduced-form disturbances is given by:

$$Y_t = [I - D(L)L]^{-1} u_t$$

and to the structural disturbances by:

$$Y_t = [I - D(L)L]^{-1} A^{-1}\varepsilon_t,$$

$$= Z(L)\varepsilon_t, \qquad (3)$$

where $Z(L) = \sum_{j=0}^{\infty} Z_j L^j$ is the economy's impulse response function (IRF), giving the effects of time-t shocks on all future values of Y. If the variables in Y are entered in the VAR in first differences, then the long-run response of the *levels* of these variables to the structural shocks is given by $Z(1) = \sum_{j=0}^{\infty} Z_j$ (the *sum* of the impulse responses of the first differences). Since $Z(L) = [I - D(L)L]^{-1} A^{-1}$, this long-run response is given by $Z(1) = [I - D(1)]^{-1} A^{-1}$. Solving this for A^{-1} yields $A^{-1} = [I - D(1)]\, Z(1)$. Since $E\varepsilon_t\varepsilon_t' = I = E(Au_tu_t'A') = AMA'$, it follows that $M = A^{-1}A^{-1\,\prime}$, which implies:

$$[I - D(1)]^{-1} M[I - D(1)]^{-1\,\prime} = [I - D(1)]^{-1} A^{-1}A^{-1\,\prime}[I - D(1)]^{-1\,\prime}$$

$$= Z(1)\, Z(1)'. \qquad (4)$$

Since both $D(L)$ and M are estimated, the symmetric matrix on the left-hand side of this equation is observable, and has $n(n + 1)/2$ distinct terms. $Z(1)$ contains n^2 distinct unknown elements. To solve for them, we thus need $n^2 - n(n + 1)/2 = n(n - 1)/2$ additional restrictions on the cumulative long-run effects $Z(1)$. If we can impose such long-run restrictions, we can identify A^{-1} from $A^{-1} = [I - D(1)]\, Z(1)$.

Once identification of monetary policy shocks is achieved through any of these means, assessment of the strength of monetary transmission is conducted by inspection of the impulse response function (3) to the monetary policy shock for endogenous aggregate demand variables such as real output or the price level. The statistical significance of such responses can be determined by computing confidence intervals for the impulse responses, typically through a bootstrap method. Much of the literature to be reviewed in the next section proceeds in this way.

[11] If the central bank does not react to the exchange rate, this scheme becomes similar to that of Gordon and Leeper (1994) and Bernanke and Mihov (1998), which require only the money demand and monetary policy shocks to be solved for simultaneously.

4. Exploring channels of transmission

Finally, though our ultimate concern is with the effectiveness of monetary transmission in developing countries, as indicated in the last section our priors on this issue are based on the view that several conventional transmission channels are likely to be inoperative in such countries, and that there are reasons to suspect that the channel that is most likely to be operative – the bank lending channel -- may be weak and/or unstable. Several of the papers that we will review in the next section explicitly investigate the strength of particular transmission channels. Before moving to the evidence, therefore, it is worth pausing to consider how this is done.

There are essentially two approaches, both of which require the inclusion in the VAR of a variable (or variables) intended to serve as an indicator of a specific channel of transmission. Consider, for example, the bank lending channel. To assess the role of this channel, the stock of bank credit and/or the bank lending rate would be included among the endogenous variables in the VAR. Assuming that monetary policy shocks are found to have significant effects on aggregate demand (as revealed by effects on real output or the price level), the contribution of the bank lending channel to this outcome can be assessed as follows:

i. The first approach determines whether the monetary policy shock has a statistically significant effect (as reflected in the IRF) on the lending rate or the stock of bank credit in the direction predicted by theory (i.e., a monetary contraction should produce a contraction in bank credit and/or an increase in the lending rate). An affirmative answer suggests a statistically well-defined role for the bank lending channel, but does not indicate the quantitative strength of that channel.

ii. To assess the latter, Ramey (1993) suggested a simulation approach, based on a comparison of impulse response functions of the aggregate demand indicator to a monetary policy shock when the bank lending variable is permitted to respond endogenously to the shock and when it is treated as an exogenous variable. The difference between the two IRFs provides a measure of the quantitative strength of the bank lending channel.

III. The evidence

There is a large number of studies that have applied this VAR methodology to the estimation of the effects of monetary policy in developing countries. This section examines the results of these studies, focusing on recent papers.[12] The focus on recent papers is motivated by the fact that, beginning in the early 1990s, many developing countries have undertaken extensive domestic financial liberalization and reform, have liberalized their capital accounts, and have

[12] There are also several studies that have explored the bank lending channel using a micro approach, following Kashyap and Stein (1995). For reasons explained in Appendix 1 we exclude these studies from our review. Appendix 2 provides a summary table for the studies included in our survey.

altered their exchange rate regimes. All of these changes can potentially affect the monetary transmission mechanism, so studies based on more recent data are likely to be much more informative on the current strength of this mechanism in the reforming countries. Unfortunately, this means that many of the studies to be reviewed in this section have yet to be published, which deprives us of a convenient filtering device. The vast majority of these papers are in mimeo or working paper form. They have largely been prepared by researchers at central banks or international financial institutions.

Not surprisingly, most of the literature on the effectiveness of monetary transmission in developing countries focuses on the bank lending channel. The model of Section I identified some features of the developing-country financial environment that raise doubts about the strength of links between central bank policy actions and bank lending rates in such countries. Consistent with these doubts, evidence on the role of the bank lending channel in individual developing countries is in fact rather mixed.

As indicated in the last section, the empirical methodology of choice for investigating monetary transmission in developing countries has been the estimation of impulse response functions (IRFs) and forecast variance decompositions based on VARs with a small number of macro variables. Note that establishing the empirical strength of monetary transmission requires documenting the effects of central bank policy actions on aggregate demand – i.e., on real output and/or the price level. As mentioned previously, in the case of the bank lending channel, this involves two steps: from central bank policy actions to the bank lending rate and/or the supply of credit, and from the latter to aggregate demand. Unfortunately, much of the existing literature on developing countries focuses on one step or the other. Few papers consider both steps, though in some cases the issue investigated is the reduced-form effect of central bank policy variables on an indicator of aggregate demand (output or prices). In a small number of cases, the role of specific channels of transmission is investigated using the Ramey methodology.

For the reasons explained in the introduction, our examination of the literature is organized by geographic regions.

1. Sub-Saharan Africa

Consistent with the model of Section I, several authors have argued that the importance of the bank lending channel in many sub-Saharan African countries is limited by the small size of and imperfections in the financial sector. Sacerdoti (2005), for example, noted that banks in Africa tend to extend limited amounts of credit to the private sector, as the result of underdeveloped institutional means to cope with credit market frictions that increase the cost of financial intermediation. Instead, these banks have tended to hold 30-50 percent of their deposits as reserves at the central bank and in the form of short-term foreign assets. To the extent that credit market frictions make deposits at the central bank, government bonds, and foreign securities much closer substitutes among themselves than these alternative assets are with private

sector credit, this situation would tend to weaken the transmission mechanism through the bank lending channel.[13]

This hypothesis is supported by several studies that examine the strength of links between policy rates and ultimate macro objectives in a variety of African countries. Beginning with multi-country studies, Saxegaard (2006), for example, estimated that excess reserves amounted to over 13 percent of deposits on average in sub-Saharan banking systems in 2004, reflecting banks' unwillingness or inability to lend, and argued that the impact of monetary policy on bank credit is likely to be limited under such circumstances. He tested this prediction by estimating four-variable (with output, inflation, the exchange rate, and monetary policy as the endogenous variables) threshold VARs (TVARs) for the countries in the Central African Economic and Monetary Community (CEMAC), as well as for Nigeria and Uganda, where the threshold variable was the existence of excess reserves over an estimated desired level of precautionary reserves. Identification was achieved for the policy variables by the Bernanke-Blinder approach -- assuming that non-policy variables do not react contemporaneously to the policy variables, but the latter do react to the nonpolicy variables. Saxegaard found evidence that monetary policy shocks indeed have weaker effects on output and inflation in Nigeria and Uganda in the excess-reserve regime, but have equally weak effects under both regimes in the CEMAC countries.

Along the same vein, Buigut (2009) examined monetary transmission in three countries (Kenya, Tanzania, and Uganda) belonging to the East African Community (EAC). He used a three-variable VAR approach with real output, inflation and a policy interest rate as endogenous variables, and also relied on the Bernanake-Blinder approach to identify structural shocks, ordering output first and the policy rate last, on the assumption that the policy rate is based on contemporaneously-observed output and inflation numbers, but does not affect output and inflation contemporaneously. He found that changes in policy interest rates had small and statistically insignificant effects on output and inflation, and concluded that monetary transmission is weak in these three countries.

Similarly, Lungu (2008) examined monetary transmission in Southern Africa, using a seven-variable VAR containing industrial production, prices, M2, the monetary base, the central bank policy rate, the supply of bank loans, and bank lending and deposit rates. In contrast with the two previous studies, Lungu identified monetary shocks using an atheoretic Choleski decomposition with the central bank policy rate ordered first, implying that monetary policy does not react contemporaneously to any of the other variables in the system. He found mixed evidence for the bank lending channel in Botswana, Malawi, Namibia, and Zambia. The general pattern was that while bank lending and deposit rates responded to innovations in the policy rate in the expected direction, such innovations seemed to have little effect on total bank lending, on output, or on prices.

Several country-specific studies have been conducted in sub-Saharan Africa, mainly by investigators in central banks or at the IMF. Abradu-Otoo, Philip, Amoah, and Bawumia (2003) studied monetary transmission in Ghana over the period 1969-2002 using a seven-variable

[13] In addition to banks' preference for liquidity, Laurens (2005) argued that the transmission from policy instruments to market interest rates in Africa is also hindered by shallow or dormant interbank markets.

vector-error-correction (VEC) model containing the inflation rate and the growth rate, as well as changes in the real exchange rate, credit to the private sector, broad money, the T-bill rate, and the international oil price. They computed IRFs using generalized impulse responses.[14] However, they were unable to identify statistically significant effects of monetary policy shocks (either in the form of shocks to M2 or to the T-bill rate), except in the short run on the monetary policy variable itself, and the point estimates in their IRFs were often inconsistent with theory (e.g., a positive innovation in the T-bill rate was associated with increased inflation and a depreciated exchange rate).

Cheng (2006) examined monetary transmission in Kenya using more sophisticated identification strategies. He estimated a five-variable VAR which included real output, the price level, the money stock, the central bank's policy rate, and the nominal effective exchange rate, and used two identification techniques: a recursive scheme based on the order listed above (similar to Peersman and Smets 2001), and a structural scheme based on Sims and Zha (1998) in which real output does not respond contemporaneously to any other variables in the system, the price level responds only to real GDP, the money stock responds to all variables but the exchange rate, the central bank policy rate responds only to the money stock and the exchange rate (on the assumption that real output and prices cannot be observed by the central bank contemporaneously), and the exchange rate responds to all the other variables in the system. Under both schemes, he found that policy-driven interest rates had a considerable impact on the price level and the foreign exchange value of the shilling, but not on real output. Interestingly, Cheng concluded from these results that monetary policy affected the price level through aggregate *supply* in the form of exchange rate pass-through, rather than through aggregate demand.

More recently, Ngalawa (2009) examined the experience of Malawi using a seven-variable VAR, similar to Cheng (2006), but augmented with bank loans and reserve money. In Ngalawa's system, real output does not respond contemporaneously to any other variables in the system, the price level responds only to real GDP, bank loans respond to all the other variables in the system, the exchange rate responds contemporaneously only to real output and the price level, broad money responds to real output, the price level and the bank rate (essentially a money demand function), the bank rate responds contemporaneously only to the exchange rate, and reserve money responds to all variables except real GDP and the price level. Ngalawa conducted his estimations using several restricted models in addition to the seven-variable model, as well as separately for a sample that spanned Malawi's 1994 switch from a fixed to a floating exchange rate and a post-1994 sample. Focusing on the full model and the post-1994 sample, he found that changes in the bank rate affected bank lending, real output, and the price level in the

[14] The Generalized Impulse Responses (GIR) method involves shocking the innovations in the reduced-form equations for the other variables in the system at the same time as that in the equation for the money policy variable, by an amount that is proportional to the correlation between the relevant reduced-form residuals. This method avoids imposing *a priori* identifying restrictions on the contemporaneous innovations, but at the cost of yielding IRFs that are difficult to interpret structurally.

theoretically-expected direction, but none of those impulse responses turned out to be statistically significant.

Note that none of these studies provide compelling evidence for effective monetary transmission in sub-Saharan Africa. While we were able to find two studies with more positive results, they both proved to suffer from serious flaws.

Specifically, Uanguta and Ikhide (2002) considered both steps in the transmission mechanism for Namibia. Because Namibia maintains a currency board pegged to the South African rand, they estimated a VAR with Namibian private investment, consumer prices, bank credit, and lending rates, the repo rate of the South African Reserve Bank (SARB), and the Namibian broad money supply. Structural innovations were identified using a Choleski decomposition based on the ordering just described, relying on assumptions regarding the speed with which each variable responds to shocks. Their main finding was that changes in the South African Reserve Bank's policy rate is transmitted to lending rates in Namibia, as well as to private investment. Both approaches, therefore, were taken to support the effectiveness of the bank lending channel in Namibia. Note, however, that this procedure treats the SARB's repo rate not only as an endogenous variable in the VAR, but as one that is affected by the contemporaneous values of several macro variables in Namibia. The implicit and dubious assumption then, is that the SARB sets its repo rate with reference to the behavior of macroeconomic variables in Namibia.

Ogunkula and Tarawalie (2008) used a vector error-correction model to analyze monetary transmission in Sierra Leone over the period from 1990 to 2006, during which the exchange rate was flexible and domestic interest rates were market-determined. They employed a recursive identification scheme with the monetary policy variable ordered last. Unlike most other investigators focusing on sub-Saharan African countries, they found that monetary policy had effects on real GDP and bank credit in the directions predicted by the bank credit channel. However, their study also suffered from several flaws. For example, although they described base money as the Bank of Sierra Leone's operating instrument and broad money as its intermediate target, they used the Treasury bill rate as the monetary policy variable in their VAR In addition, their IRFs suggest permanent effects from monetary policy shocks, their results are characterized by a price puzzle, and no confidence intervals are presented.

2. Transition economies in central and Eastern Europe (CEE)

Evidence for the effectiveness of monetary transmission has been more mixed in some other regions. While low-income countries (LICs) with very poor institutional environments are heavily represented in sub-Saharan Africa, the transition economies in Central and Eastern Europe (CEE) are at the other end of the developing-country income and institutional spectrum, with most of these countries having substantially higher levels of income per capita than sub-Saharan African LICs, and several of them having recently been granted accession to the EU. Monetary transmission has been studied extensively in these economies, and in addition to studies of individual countries, there are several multi-country studies of both steps in monetary transmission (from policy to financial variables and from financial variables to aggregate demand).

A useful early survey for these economies by Ganev et al. (2002) found some weak evidence (using a variety of methodologies) for transmission from central bank policy rates to commercial bank lending rates in individual country studies, but almost no evidence for the effects of bank lending rates on aggregate demand. Ganev et. al.'s own estimates were something of a mixed bag. Positive innovations in money market interest rates (the second step in transmission) dampened output in Slovakia, Hungary and Slovenia, but *increased* output in Lithuania, Estonia, the Czech Republic, and Poland. No clear pattern emerged for Bulgaria, Latvia, and Romania.[15] Short-run effects on the inflation rate were negative in Hungary, Lithuania, and Slovenia, but positive in Bulgaria, the Czech Republic, Romania and Slovakia. Thus, the expected effects of monetary tightening on *both* output and inflation were obtained only for Hungary and Slovenia.

More recently, several authors have conducted multi-country studies. Anzuini and Levy (2007), for example, used 5-variable VARs (with P, Y, M, R, CP) to examine the effectiveness of monetary transmission in the Czech Republic, Hungary and Poland. They used both a recursive scheme (ordered as indicated above, with the interest rate as the monetary policy variable) and a structural identification in which monetary policy does not respond to contemporaneous shocks to prices or output, but does respond to the exchange rate, and the demand for money is allowed to respond to the interest rate. They found that, after excluding the early years of transition in these economies, the responses of the variables in their system to monetary policy shocks were conventional and qualitatively similar to those of more advanced economies in Europe, but quantitatively significantly weaker. They attributed this result to the lower level of financial development in these countries.

Elbourne and de Haan (2009) also compared recursive and structural VAR results for several European transition economies (the Czech Republic, Hungary, Poland the Slovak Republic, and Slovenia). They employed a 7-variable system with the recursive ordering (CP, R*, Y, P, M, R, ER, where ER is the nominal exchange rate and R* is the German call money rate). Their structural version followed Kim and Roubini (2000). They treated CP as unaffected by other shocks; R* and Y (industrial production) as affected only by CP; P as affected by both CP and Y; M as unaffected contemporaneously by CP, R*, or ER; R (the monetary policy variable) as contemporaneously unaffected by (unobservable) Y and P; and ER as potentially contemporaneously affected by all the other variables. The sample period was chosen to correspond to single monetary policy regimes, as judged by the authors. Elbourne and de Haan found the structural identification scheme to give uniformly superior results for the five countries, in the sense that the qualitative effects of monetary policy shocks were more consistent with theory. However, the effects of a uniform monetary shock differed across countries, with larger and theory-consistent effects in the Czech Republic and Poland, but small and/or counterintuitive results in Hungary, Slovakia, and Slovenia.

Individual country studies for the European transition economies have found mixed results for the link between policy instruments and aggregate demand, often generating price or

[15] We use the term "innovation," rather than "shock," advisedly here, because Ganev et. al. used a GIR methodology to identify the "monetary" innovation.

exchange rate "puzzles"— i.e., counterintuitive responses of these variables to monetary policy. For example, Lang and Krznar (2004) estimated a five-variable VAR for Croatia, including changes in real GDP and in the price level, the ratio of the current account to GDP, the exchange rate, and the ratio of bank excess reserves to total reserves. The last of these represented the monetary policy variable. Since Croatia engaged in exchange rate targeting over the period of estimation, Lang and Krznar achieved identification for monetary policy by assuming that the excess reserve ratio responded contemporaneously to the exchange rate, but not to innovations in any of the other variables in the VAR. They found that a monetary contraction reduced real GDP in the short run and improved the current account, but counterintuitively increased the price level. Similarly, Arnostova and Hurnik (2005) used a VAR with six endogenous variables (Y, P, CP, R, ER, M) to investigate monetary policy effectiveness in the Czech Republic. Her VAR also included German real GDP as an exogenous variable. She used a recursive identification with the variables ordered as listed above and with the short-term interest rate R treated as the monetary policy variable. During the sample period of 1994 to 2004, the Czech Republic suffered a currency crisis (in 1997) which caused it to transition from a fixed to a floating exchange rate regime. Arnostova and Hurnik estimated her VAR both for the full sample and for the 1998-2004 floating rate regime. For the full sample, they found that a monetary tightening resulted in an output contraction, but counterintuitive exchange rate depreciation and price level increases in the short run. None of these results were statistically significant. Including a foreign interest rate in the VAR did not alter these results. Restricting the sample to the post-crisis 1998-2004 period removed the exchange rate puzzle, but did not produce statistically significant effects.

Egert and Macdonald (2009) recently surveyed the literature on monetary transmission in transition economies. The studies they examined were consistent with the view that pass-through from monetary policy rates to money market rates, and from money market rates to retail lending rates, was reasonably complete at the short end of the maturity spectrum in these countries, but transmission to longer-maturity rates was weak. Pass-through is higher in the Baltic states and lower in the Czech Republic and Slovenia. Lower bank concentration, fewer bank loans, and more foreign ownership in the banking sector were associated with greater pass-through. However, support for the bank lending channel and the overall strength of monetary transmission remained limited in these countries by the absence of evidence of significant links between bank lending rates and aggregate demand. According to Egert and Macdonald,

> all kinds of results can be found for a given country. In this sense, the price puzzle, a permanent decline or a temporary fall in the inflation rate after a monetary policy contraction can be obtained for the same country. Also, output may increase, decline permanently or exhibit a humped shape following a monetary policy shock. (p. 312)[16]

[16] As an illustration of such contrasting results, despite Egert and Macdonald's conclusion that transmission from policy rates to money market rates has been strong in these countries, Lyziak, Przystupa and Wrobel (2008) investigated the link between monetary policy and bank loan supply in Poland, using a 7-variable VAR with two alternative recursive identification schemes that differed with respect to the assumptions made about the information available to monetary policymakers, as well as with respect to the nature of contemporaneous interactions between the exchange rate and the interest rate. They found that the bank lending channel was very weak, primarily because of banks' use of excess reserves to stabilize loan supply in response to monetary policy changes. Benkovskis (2008) obtained a similar result for Latvia.

The only patterns they were able to discern were that studies that covered the entire transition period and used recursive identification schemes tended to deliver a price puzzle, while those that split the sample, used time-varying coefficients, or relied on more sophisticated identification schemes uncovered more conventional results. The suggestion is that the failure to identify evidence of strong monetary transmission in these relatively advanced developing countries may reflect both facts on the ground (the limited development of the domestic financial system in the early transition period) as well as methodological shortcomings in the research.

3. Transition economies in central Asia

Various studies have examined transition economies in central Asia, though there appear to be no region-wide surveys comparable to those available for central and Eastern Europe, and few multi-country studies. With respect to the latter, Isakova (2008) looked at the reduced-form effects of policy changes on indicators of aggregate demand in Kazakhstan, the Kyrgyz Republic, and Tajikistan, using a 5-variable VAR of the form (Y, P, M, R, ER) and a recursive identification following this ordering. Consistent with results for the transition economies in central and Eastern Europe, even though changes in policy rates were found to have been effectively passed through to money market interest rates, weak responses of prices and output to innovations in the policy rate suggested that the bank lending channel has been weak in these countries.

Similar results have been found in the small number of individual country studies that are available. Dabla-Norris and Floerkermeier (2006) found that policy rates were transmitted to bank lending rates in Armenia, but bank lending rates appeared to have little effect on output. Bordon and Weber (2010) followed this up by examining whether the weak effects of monetary policy in that country had changed in more recent years, primarily as the result of de-dollarization and the adoption of inflation targeting. They estimated a monthly VAR over the period 2000M1 to 2010M5 with the endogenous variables (Y, P, R, M, ER), and with world oil prices and the US Federal Funds rate as exogenous variables. They adopted a recursive approach to identification, following the ordering given above. For the sample period as a whole, they found that monetary policy had a statistically significant effect on output in the expected direction, but not on the price level. They found evidence of a regime switch in mid-2006 associated with crossing a dollarization threshold. Comparing IRFs for monetary policy shocks in the two regimes, they found much stronger effects on both output and prices in the expected direction in the low-dollarization regime, though price level effects were statistically insignificant under both regimes.

For Georgia, Bakradze and Billmeier (2007) estimated a five-variable VAR (Y, P, M, FX, ER), where FX is the stock of foreign exchange reserves, over 1999Q1 to 2006Q4. Their monetary policy variable (M) was currency in circulation, and their identification followed the recursive ordering listed above. They were able to find positive and statistically significant effects of monetary policy shocks on output only for the first two quarters, and did not find statistically significant effects on the price level. Consistent with these results, Samkharadze (2008) found that, while the bank lending channel appeared to operate in the expected direction in Georgia, the effects of bank interest rate changes on real output were very weak.

4. The Middle East and North Africa (MENA)

There is comparatively little work on monetary transmission in Middle Eastern and North African (MENA) developing countries. Beginning once again with multi-country studies, Ziaei (2009) found a negative association between policy rates and bank lending in cointegrating vectors estimated by dynamic least squares (DOLS) for ten MENA countries. He concluded that changes in policy rates moved bank lending in the opposite direction to the change in the policy rate in these countries, at least in the short run, consistent with the bank lending channel. However, he did not address the second step in the transmission channel from bank lending to aggregate demand. Neaime (2008) used four-variable VARs (Y, P, R, ER) to investigate this second step for Egypt, Jordan, Lebanon, Morocco, and Tunisia, using a recursive approach to identification. While the point estimates in the IRFs were generally in the expected direction, statistically significant effects of monetary shocks were detectable only in the case of Tunisia.

Boughrara (2008) used a four-variable VAR system to examine monetary transmission in Tunisia and Morocco. He identified monetary policy innovations using a Bernanke-Blinder type of Choleski identification scheme in which macro outcome variables (Y and P) were ordered first, followed by "transmission" variables (either the exchange rate, the money stock, or a stock market index, entered separately). The monetary policy variable (a money-market rate) was ordered last, on the Bernanke-Blinder assumption that policy reacts contemporaneously to all the macro variables in the system, but does not contemporaneously affect any of them. Boughrara supplemented this with a Ramey (1993) approach to identifying the role of the bank lending channel – i.e., he contrasted the impulse response functions (IRFs) of prices and output to a monetary policy shock when bank loans were treated as an endogenous variable in the VAR to the responses of the same variables when bank lending was treated as exogenous.

Boughara derived several results that are of interest for our purposes. First, he found no effects of monetary policy innovations on either the exchange rate or asset prices in either country, as would be expected from the heavily-managed exchange rates and small asset markets in these countries. Second, he found significant differences between the two sets of IRFs (with loans endogenous and exogenous) in Morocco, but less so in Tunisia.[17] Third, he tested for the bank lending channel by running a recursive VAR with the ordering (P, Y, M, R, L, R_L), where L is the stock of loans and R_L is the bank lending rate. He argued that for the bank lending channel to be operative, a monetary contraction would have to be associated (in the impulse response functions) with a contraction in real output as well as a contraction in bank lending and an increase in lending rates. He found that such a pattern did hold for Morocco, but – surprisingly – only in the long run (after 12 quarters) even though output responded in the expected direction after one year. For Tunisia, the emergence of the expected pattern was more immediate. Boughara's results thus provide stronger support for the lending channel in Tunisia than in Morocco.

[17] Unfortunately, he did not construct confidence intervals for the IRFs, so these conclusions were based on comparisons of pint estimates.

Turning to studies for individual countries, Moursi, Mossallamy, and Zakareya (2007) examined monetary transmission in Egypt using a variant of the Bernanke-Mihov (1998) semi-structural six-variable (Y, P, CP, TR, UR, R, where TR and UR denote total and unborrowed reserves respectively) VAR approach to identify monetary policy shocks (they used the three-month deposit rate instead of the federal funds rate). They found that, while their estimated monetary policy shock variable accorded well with *a priori* beliefs about episodes of monetary tightening in Egypt, effects on real output and prices proved to be either ambiguous or negligible. Interestingly, effects on the IRF of real output continued to be negligible even when the signs of the IRFs for the deposit rate, unborrowed reserves, and the price level were constrained to satisfy theoretical priors following an approach due to Uhlig (2005). Moursi, Mossallamy, and Zakareya concluded that "monetary policy shocks in Egypt have virtually no real effect" (page 26).

Al-Mashat and Billmeier (2007) built on the Moursi, Mossallamy, and Zakareya (MMZ) analysis for Egypt by using their measure of the intermediate target of monetary policy in a VAR with the form (OIL, FF, Y, P, R, ER), where OIL (the international oil price) and FF (the US Federal Funds rate) were both treated as exogenous variables in the VAR, and R was the monetary policy indicator constructed by MMZ. They achieved identification through the recursive ordering (Y, P, R, ER) among the endogenous variables. Consistent with MMZ, real output showed little response to a monetary policy shock in the short run in their baseline results, and while the response of the price level was in the right direction, neither effect proved to be statistically significant over any horizon. The results were robust to the use of a monetary aggregate as the intermediate target, as well as to reversing the positions of the monetary policy indicator and the exchange rate in the causal ordering.

To investigate the bank lending channel more closely, Al-Mashat and Billmeier estimated several expanded systems. The first was of the form (Y, P, R_L, R_D, R, ER), where R_D is the deposit rate. For this version, they found that while both bank interest rates moved in the appropriate direction in response to a monetary policy shock, only the change in the deposit rate proved to be statistically significant in the relevant IRF.[18] Secondly, they experimented with various credit aggregates in the position between the price level and the monetary policy indicator. They found that for total credit, output and price responses mimicked those of their baseline specification. When credit to the private and public sectors were disaggregated and a Ramey (1993) approach was used to measure the strength of the credit channel, they found the puzzling result that credit to the public sector had a larger impact than that to the private sector.[19]

Poddar, Sab, and Khashatryan (2007) derived almost identical results for Jordan. They used a three-variable VAR with a recursive ordering (Y, FX, R – R*), where R – R* is the differential between Jordanian and US interest rates, taken to be the monetary policy variable.

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[18] They do not report how this modification affected real output and price level responses to monetary policy shocks.

[19] While this appears to be inconsistent with the theoretical role of the credit channel, it may be rationalized in terms of the large role of public enterprises in the Egyptian economy. Al-Mashat and Billmeier do not emphasize this point, however.

Real output responses to monetary policy shocks were found to be small and statistically insignificant. To examine the role of various channels of transmission, they augmented their basic specification by inserting the real lending rate, real credit, a stock price index, and the exchange rate one at a time between real output and foreign exchange reserves. Contractionary monetary policy shocks tended to increase the lending rate, but to have essentially no effect on real output in any of these specifications.

5. Asia-Pacific

There is a similar scarcity of evidence for developing countries in the Asia-Pacific region. Mallick (2009) investigated monetary transmission in India using a five-variable VAR with the recursive ordering (Y, P, R, R_{LT}, ER), where R_{LT} is a long-term interest rate, and with *a priori* sign restrictions on the impulse responses to identify the monetary policy shocks, following Uhlig (2005). These restrictions required a contractionary monetary policy shock to be associated with increases in both short-term and long-term interest rates, as well as with reductions in the price level, over the first two quarters after the shock, but left the output response to be determined by the data. The contractionary monetary policy shock was indeed associated with a statistically significant reduction in real output, but monetary policy shocks accounted for a small part of the forecast error variance in real output, leading Mallick to conclude that demand shocks have been of "relatively limited importance" in India (page 21).

Agha et al (2005) investigated monetary transmission in Pakistan by implementing the Ramey (1993) approach in the context of a four-variable recursive VAR with the ordering (Y, P, X, R), where X was alternatively the stock of real bank credit, a stock price index, and the real exchange rate. They also implemented a version of their system with all three of these variables included. In their baseline results (excluding X), they found a negative output response to a monetary contraction. However, they did not report confidence bands, so the statistical significance of this response is hard to assess. In addition, their baseline results featured a "price puzzle." Including real bank credit in the model dampened the response of real output to a monetary policy shock, but comparing the response of real output to a change in monetary policy when bank credit is allowed to respond endogenously and when it is not, they detected a notable difference, at least after six months. Again, however, the absence of confidence bands makes it impossible to determine whether either the response of output, or the impact of the credit channel is statistically significant. Alam and Waheed (2006) also used recursive VARs (with three variables in their case, ordered Y, P, R) to examine monetary transmission in Pakistan, both at the aggregate and sectoral level. They did report confidence bands, and found that, while the response of aggregate output to a monetary policy shock had the right sign, it was small and statistically insignificant. Statistically significant effects over any horizon were found only for manufacturing and wholesale and retail trade. Inclusion of the nominal exchange rate in the system did not alter these results, and the results were also little changed by restricting the sample to the period following important financial sector reforms in Pakistan. Similarly, Ahmad (2008) used a VAR framework with recursive ordering for Fiji and Papua New Guinea, and showed that innovations in bank reserves and deposits played an important role in explaining output variation in Fiji, while bank loans were dominant in Papua New Guinea.

6. Latin America and the Caribbean

Research on the effectiveness of monetary transmission in Latin America and the Caribbean has reached somewhat contradictory conclusions. Two multi-country studies for the Caribbean illustrate this observation. Kendall (2001) examined the first stage of transmission from monetary policy (in the form of changes in discount rates, required reserve ratios, and short-term Treasury bill rates) to bank lending rates in six Caribbean countries (Bahamas, Barbados, Belize, Guyana, Jamaica, and Trinidad). To do so, he used six-variable VARs, with recursive identification ordered as (R^*, R_L, R_D, rr, R, R_{TB}), where R^* is the US Treasury Bill rate, rr is the domestic reserve ratio, R is the discount rate, and R_{TB} is the domestic Treasury bill rate. He also considered an alternative ordering in which the lending rate was placed last. Kendall found that responses of lending rates were highly heterogeneous in these countries, both with respect to magnitude as well as duration.[20]

In an early country-specific paper, Robinson and Robinson (1997) explored transmission in Jamaica using an 8-variable recursive VAR of the form (R_{RP}, R_{TB}, M0, L, M3, ER, P, Y), where R_{RP} is the repo rate, M0 is the monetary base, and M3 is broad money. Impulse responses suggested a *positive* short-run response of real activity to monetary tightening (in the form of an increase in the repo rate), as well as a sustained price puzzle. They did not report confidence intervals for these IRFs.

Ramlogan (2007) examined monetary transmission in Trinidad and Tobago using a six-variable VAR of the form (G, D, L, PY, P, RR) where G is government spending, D and L refer respectively to deposits and loans in the banking system, PY is nominal GDP, and RR is required reserves. He employed a structural identification scheme, taking G as exogenous, the stock of deposits as affected by all variables except the volume of lending, the stock of loans as contemporaneously unresponsive to government spending shocks or shocks to deposits, nominal income as responding to all variables except required reserves, the price level as affected by shocks to nominal income, and required reserves as affected by all variables except the stocks of deposits and loans. Required reserves were considered to be the monetary policy variable. Ramlogan found that monetary tightening (an increase in required reserves) resulted in a contraction in bank credit that was accompanied by slower growth and lower inflation, but he did not report confidence intervals for the IRFs.

Finally, Duran-Viquez and Esquivel-Monge (2008) considered the effect of policy interest rates on commercial bank loan and deposit rates in Costa Rica (the first stage in the bank lending channel). They found that the policy rate Granger-caused both bank deposit as well as lending rates. Using a vector error-correction (VECM) approach, they found that pass-through from policy rates to both deposit and loan rates was essentially full in the long run (though the point estimates for the lending rate were larger than for the deposit rate). Pass-through rates were larger for private than for government-owned banks. Duran-Viquez and Esquivel-Monge did not investigate the effects of bank lending rates on aggregate economic activity.

[20] He did not report confidence intervals, however.

IV. Summary and conclusions

It is very hard to come away from this review of the evidence with much confidence in the strength of monetary transmission in developing countries. We failed to uncover *any* instances in which more than one careful study confirmed results for the effects of monetary shocks on aggregate demand that are similar to the consensus effects in the United States or other advanced countries. The question is how to interpret this state of affairs. As suggested by Egert and Macdonald (2009) (for the case of transition economies in central and Eastern Europe), it is likely to reflect some combination of the facts on the ground and shortcomings in the empirical methods that have been applied to this issue. For the reasons we indicated in the introduction, it is vitally important to determine the contributions of each of these factors.

There is no doubt that methodological shortcomings abound in this literature. For example:

- Open-economy considerations are not always included in the estimated VAR systems. There is substantial evidence that policymakers in developing countries react to external variables. The "fear of floating" literature, for example, suggests an important role for the exchange rate in the monetary authorities' reaction function. More generally, in an open-economy context, the interaction between monetary and exchange rate policy cannot be ignored. The frequent cases in which this is done suggest that the monetary policy shock is often misspecified in these papers.

- Few – if any – papers base their specification of the behavior of the monetary authorities on independent evidence about how monetary policy has been actually been conducted in the relevant country. In general, identification assumptions concerning the information available to the monetary authorities and lags in policy effects appear to be largely arbitrary.

- While there are exceptions, surprisingly little attention has been paid to within-sample changes in factors that could affect the workings of the transmission mechanism, such as financial reforms, the exchange rate regime, and capital account restrictions.

Distinguishing between the "facts on the ground" and "methodological deficiencies" interpretations of the absence of evidence for strong monetary transmission will therefore have to await studies on individual countries that pay careful attention to factors such as these.

We suspect, however, that "facts on the ground" are indeed an important part of the story. The facts that a wide range of empirical approaches have failed to yield evidence of effective monetary transmission in developing countries, and that the strongest evidence for effective monetary transmission has arisen for relatively prosperous and more institutionally-developed countries such as some central and Eastern European transition economies (at least in the later stages of their transition) and Tunisia, make us doubt whether methodological shortcomings are

the whole story. If this conjecture is correct, the stabilization challenge in developing countries is acute indeed, and identifying the means of enhancing the effectiveness of monetary policy in such countries is an important challenge.

Appendix 1 The Microeconomic Approach

Following Kashyap and Stein (1995), several investigators have examined whether the loan-supply behavior of individual banks in several developing economies has been affected by characteristics such as the size, liquidity, and capitalization of banks. In the context of well-developed securities markets, such as those of the United States, Kashyap and Stein had hypothesized that such characteristics would determine whether banks would have access to non-deposit sources of funds, and thus not find their lending constrained by the supply of reserves made available to the banking system by the central bank. A finding that smaller, less liquid, and less well-capitalized banks tend to react more strongly to central bank policy actions would support the view that the financial frictions on which the credit channel is based are important, even in an economy such as that of the United States. Although this question is less pertinent in our context (precisely because financial frictions tend to be so strong in developing countries that securities markets are absent), this type of research would appear to remain relevant for what it

can tell us about whether banks of *any* type react to monetary policy actions, and whether the banking system in specific countries does so in the aggregate.

There are several recent examples of this micro-based approach. Using country-specific dynamic panels estimated by GMM, for example, Matousek and Sarantis (2009) found that smaller and less liquid banks in the CEE countries altered their loan supply more strongly in response to changes in short-term interest rates (which they used as their indicator of monetary policy) than did larger and more liquid banks, though bank capitalization did not seem to matter.[21] Their interpretation was that the larger and more liquid banks could rely on alternative sources of funding when monetary policy tightened, though Matousek and Sarantis did not indicate what those might be in the context of the CEE economies. To investigate the consequences for the bank lending channel in the aggregate, they estimated dynamic panels at the country level and examined whether the shares of large, liquid, and well-capitalized banks in each country affected the response of aggregate bank loans to monetary policy actions. Their negative answer to this question suggested to them that the bank lending channel has not been weakened by the presence of large, liquid, and well-capitalized banks in those countries.[22] Matousek and Sarantis also found that the partial correlation of output growth with bank loan growth was positive, which they interpreted as supporting the second step in the bank lending channel. In contrast with these findings, Jimborean (2009), using micro data for ten Central European transition economies, found very weak evidence for a link between central bank policy rates and loan growth, with such links being detectable only for small banks with moderate liquidity. Individual country micro-based studies for the European transition economies have found mixed results for the link between policy instruments and bank lending rates.[23]

Unfortunately, however, the micro approach adopted in these studies suffers from an important shortcoming for our purposes. Specifically, this procedure does not explicitly attempt to distinguish between monetary policy *actions* and monetary policy *shocks* – i.e., they do not specifically focus on the effects of unanticipated changes in monetary policy. For that reason, we cannot tell in principle whether the measured reaction of bank loan growth to the indicator of monetary policy used by these authors is a reaction to monetary policy itself or to the variables in the central bank's information set. Even worse, since these loan supply functions tend to be estimated by GMM, with lagged explanatory variables used as instruments, *by construction* they remove monetary policy innovations from the monetary policy variable whose effects they seek to capture. It is important to emphasize that this is a shortcoming only from the perspective that matters to us – the empirical identification of monetary policy effects on aggregate demand – and not for the purpose that Kashyap and Stein initially developed the methodology – the detection of persisting financial frictions even in countries with well-developed and fluid securities markets. For the latter purpose, it is the asymmetric response of banks with different

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[21] Notice that since half of the countries that they examined (Slovenia and the Baltic states) had adopted hard exchange rate pegs, it is not clear that short-term interest rates can be interpreted as monetary policy indicators.

[22] Unfortunately, however, they do not report the effects of changes in their monetary policy variable on aggregate loan growth.

[23] See, for example, Pruteanu (2004) for the Czech Republic, and Vika (2007) for Albania.

characteristics to a monetary policy *action* that matters, since what is at issue is heterogeneous responses by individual banks to a uniform aggregate shock.

Appendix 2 - Summary of Individual Country Studies on the Bank Lending Channel in Developing countries				
Region	**Paper**	**Country and sample period**	**Methodology**	**Main findings**
Sub-Saharan Africa	Cheng (2006)	Kenya, monthly, 1997:1 to 2005:6.	5-variable VAR; recursive and structural identification	Changes in policy rates have a significant impact on the price level and exchange rate, but not on output.
	Uanguta and Ikhide (2002)	Namibia, monthly, 1990 to 1999.	Narrative approach (De Fiore (1998) and Morsink and Bayoumi (1999)); VAR with Cholesky	(i)Interest rate higher and private investment lower after tightening episodes. (ii) Changes in South African Reserve Bank's policy rate are transmitted to lending rates and

			ordering	private investment in Namibia
	Abradu-Otoo, Amoah, and Bawumia (2003)	Ghana, quarterly, 1969Q1 to 2002Q4.	7-variable VEC with generalized IRFs.	No statistically significant effects with either the T-bill rate or M2 as the policy variable, several puzzles.
	Sacerdoti (2005)	Broad sample of sub-Saharan African countries	Descriptive	Banks extend limited credit to the private sector; instead they hold 30-50% of deposits as reserves in the Central Bank and in the form of short-term foreign assets.
	Saxegaard (2006)	Central African Economic and Monetary Community (CEMAC), Nigeria and Uganda, quarterly, 1990Q1 to 2004Q4.	Non-linear structural or threshold vector autoregressive (TVAR); identification for policy variables by assuming that non-policy variables do not react contemporaneously to policy variables but latter do react to the former.	The impact of monetary loosening on credit expansion is likely to be limited under conditions of excess liquidity.
	Buigut (2009)	Kenya, Tanzania and Uganda, yearly, 1984 (1985 for Uganda) to 2005 (2006 for Kenya)	VAR; Cholesky ordering	Bank lending channel is not important. The effect of a monetary policy shock on output and inflation is not significant.
	Lungu (2008)	Botswana, Malawi, Namibia, South Africa and Zambia, monthly, 1990 to 2006	VAR; Cholesky ordering	Mixed evidence on the bank lending channel. While bank lending and deposit rates respond to innovations in the policy rate, the impact on prices, output and bank lending is limited.
	Ogunkula and Tarawalie (2008)	Sierra Leone, quarterly, 1990Q1 to 2006Q2	Reduced-form VEC, with T-bill rate ordered last.	Monetary tightening leads to contraction in real GDP and bank credit. However, permanent effects on all variables, price puzzle, and no confidence intervals for IRFs.

	Ngalawa (2009)	Malawi, monthly, 1988:1 to 2005:12	Structural VAR	Bank lending channel is important. (i) an unanticipated increase in the bank rate of about 2.2 percent causes bank lending to decline, bottoming at 2 percent below baseline after 18 months. This response is significant between 6 and 24 months. (ii) a 7.2 percent sudden increase in reserve money leads to an increase in bank loans, peaking at 1.5 percent above baseline after 3 years. This response is not significant. (iii) an unexpected 5.5 percent rise in bank loans, on the other hand, leads to an increase in both output and consumer prices.
Central and Eastern Europe	Ganev et. al. (2002)	Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovakia, monthly, 1995:1 to 2000:12.	Single equation model	Weak evidence for transmission from bank policy rates to bank lending rates and no evidence for the effects of bank lending rates on aggregate demand
	Anzuini and Levi (2007)	Czech republic, Hungary, Poland, monthly, 1993:1 to 2002:1	VAR; recursive scheme and structural identification.	After excluding the early years of transition, the responses of the variables in their system to monetary policy shocks were qualitatively similar to those of more advanced economies in Europe, but quantitavely significantly weaker.
	Elbourne and de Haan (2009)	Czech Republic (1998:1 to 2004:10), Hungary (1995:3 to 2001:8), Poland (1998:6 to 2004:6), Slovak Republic (1998:10 to 2004:7), Slovenia (1993:1 to 2003:11), monthly.	VAR; recursive scheme and structural identification	The structural identification scheme gives (qualitatively) superior results for all the countries. However, the effects of a uniform monetary shock differed across countries.
	Lang and Krznar (2004)	Croatia, monthly, 1999:6 to 2003:12	Structural VAR	A monetary contraction reduces real GDP in the short run and improves the current account, but counter-intuitively increases the price level.

	Arnostova and Hurnik (2005)	Czech Republic, quarterly, 1994:1 to 2004:4	Recursive VAR	(i) Full sample analysis: Monetary tightening results in an output contraction, but also in an exchange rate depreciation and a price level increase. (ii) 1998-2004 sample: It removes the exchange rate puzzle, but the results are not statistically significant.
	Lyziak, Przystupa, Wrobel (2008)	Poland, quarterly and monthly, 1998:1 to 2006:1 (5)	Structural VAR	Bank lending channel is weak, due to banks' holding of excess reserves.
	Benkovskis (2008)	Latvia, quarterly, 1998:2 to 2006:4.	Standard panel level regression using bank-level data	(i) Some banks have a statistically significant negative reaction to a domestic monetary shock, but the weighted average reaction of loan growth is not statistically significant. (ii) a domestic monetary shock has only a distribution effect and affects banks that are small, domestically owned and have lower liquidity or capitalization (iii) The bank lending channel is limited to the supply of lats loans, which dramatically reduces the importance of this channel.
	Jimborean (2009)	Bulgaria, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Rep., Solvenia, yearly, 1998 to 2006	Individual bank balance sheet data; Kashyap and Stein (1995) approach to control for heterogeneity across banks	Evidence for existence of a bank-lending channel through small banks with moderate liquidity only; applies in the short-run to several, but not all, of the analyzed banks.
	Egert and MacDonald (2009)	Estonia, Latvia, Lithuania, Romania, Slovakia	Literature review. Micro bank-level data and Error correction model/VAR	Evidence from micro/bank-level data: Banks react differently to monetary policy changes depending on certain characteristics e.g. size, liquidity, capitalization, ownership structure and cost of funds. Evidence from VEC/VAR models (i) Pass-through from monetary policy key rate to short-term money market rates is very high or complete. (ii) pass-through from money market rates to market interest rates of shorter maturity is also very high (iii) pass-through to long-term market rates is unstable (iv) the results are very similar to the findings for

				the euro area
Central Asia	Dabla-Norris and Floerkemeier (2006)	Armenia, monthly, 2000:5 to 2005:12	VAR; Cholesky ordering	Bank lending channel remains weak. Lending rate responds immediately and significantly to an unexpected change in the repo rate. However, output and prices do not respond significantly to lending rate shocks.
	Bordon and Weber (2010)	Armenia, monthly, 2000:1 to 2010:5	VAR; Cholesky ordering	(i) Full sample: Monetary policy has a statistically significant effect on output in the expected direction, but not on the price level. (ii) pre 2006 regime (low dollarization): Stronger effects on both output and prices in the expected direction, but price level effects are not statistically significant.
	Bakradze and Billmeier (2007)	Georgia, quarterly, 1999:1 to 2006:4	VAR; Choleski ordering	Monetary policy shocks have positive and statistically significant effects on output only for the first two quarters, but no significant effects on the price level.
	Samkharadze (2008)	Georgia, monthly, 2002:6 to 2007:5	VAR; Choleski ordering	Bank lending channel operates in the expected direction in Georgia, but the effects of bank interest rate changes on real output are very weak.
	Isakova (2008)	Kazakhstan (1995:1 to 2006:12), Kyrgyz Republic (1995:9 to 2006:12), Tajikistan (2001 to 2006:12), monthly.	VAR; Cholesky ordering	The bank lending channel has been unimportant even though changes in policy rates are effectively passed through to market interest rates.
Middle East and North Africa	Boughrara (2008)	Tunisia (1989:1 to 2005:4), Morocco (1990:1 to 2005:4), quarterly	Structural VAR; Ramey (1993) approach to identify the bank lending channel	Lending channel is operative in Morocco and Tunisia. A tight monetary policy induces a decrease in the quantity of bank loans, the effects are less pronounced in Morocco.
	Neaime (2008)	Egypt, Jordan, Lebanon, Morocco, Tunisia, quarterly, 1990:1 to 2006:4	Recursive VAR	The point estimates in the IRFs are generally in the expected direction, but only Tunisia shows statistically significant effects of monetary policy.

	Moursi et al. (2007)	Egypt, monthly, 1985 to 2005	Semi-sturcutral VAR using a variant of Bernanke and Mihov (1998)	While the estimated monetary policy shock variable accorded well with *a priori* beliefs about episodes of monetary tightening in Egypt, effects on real output and prices are either ambiguous or negligible.
	Al-Mashat and Billmeier (2007)	Egypt, monthly, 1996:1 to 2005:6	Recursive VAR	(i) Baseline: The response of the price level and real output to a monetary policy shock is in the right direction, but neither effect is statistically significant over any horizon. (ii) Model distinguishing between deposit and lending rates: Both interest rates move in the right direction, but only the change in the deposit rate is statistically significant. (iii) Credit aggregates between the price level and the monetary policy indicator: For total credit, output and price responses mimic those of the baseline. However, hen credit to the private and public sectors are disaggregated credit to the public sector has a larger impact than that to the private sector.
	Poddar et al. (2007)	Jordan, quarterly, 1996:1 to 2005:1	Recursive VAR	Contractionary monetary policy shocks tend to increase the lending rate, but they essentially do not have any effect on real output.
	Ziaei (2009)	10 MENA (Middle East and North Africa) countries: Algeria, Bahrain, Egypt, Kuwait, Lebanon, Morocco, Oman, Qatar, Tunis and Turkey, quarterly, 1991:4 to 2006:4.	Johanson co-integration and dynamic ordinary least square (DOLS)	Bank lending channel is likely to be an effective monetary transmission mechanism in MENA countries. In particular, bank credit to the private sector increases with a monetary expansion.
Asia and Pacific	Agha et al (2005)	Pakistan, monthly, 1996:7 to 2004:3	VAR; Ramey (1993) to identify the bank lending channel	Bank lending channel has played an important role in transmitting monetary policy changes to economic activity in Pakistan

	Mallick (2009)	India, quarterly, 1996:2 to 2009:1	Structural VAR following Uhlig (2005)	A contractionary monetary policy shock is associated with a statistically significant reduction in real output, but monetary policy shocks accounted for a small part of the forecast error variance in real output.
	Alam and Waheed (2006)	Pakistan, quarterly, 1973:1 to 2003:4	Recursive VAR	The response of aggregate output to a monetary policy shock has the right sign, but it is small and statistically insignificant. Statistically significant effects over any horizon are found only for manufacturing and wholesale and retail trade. The inclusions of the nominal exchange rate in the model as well as the restriction of the sample period following important financial sector reforms do not alter the results.
	Ahmad (2008)	Fiji , Papua New Guinea	VAR; Cholesky ordering	Innovations in bank reserves and Deposits) play an important role in explaining output variation in Fiji, while bank loans are dominant in Papua New Guinea.
Latin America and the Caribbean	Kendall (2001)	Bahamas, Barbados, Belize, Guyana, Jamaica, Trinidad. Quarterly, 1991:1 to 1998:4	Recursive VAR	(i) Divergence in lending rate responses across the region to similar monetary policy shocks. The differences in response relate not only to the magnitude but also to the duration of the response. (ii) There can also be differences in the direction of changes in lending rates. No confidence intervals reported.
	Robinson and Robinson (1997)	Jamaica, monthly, 1991:9 -	Recursive VAR	(i) Following a unit shock to the reverse repo, the inflation rate decelerates within two months by approximately 0.1 percent per month. (ii) There are very strong, albeit temporary, real sector effects, as real economic activity declines by approximately 2.0 percent in four months. No confidence intervals reported.
	Ramlogan (2004)	Quarterly data; Jamaica and Barbados: 1970: 1 to 1999:4 , Trinidad and Tobago: 1970:1 to 2000:2, Guyana: 1970:1 to 1998:4	Structural VAR	(i) In each country except Barbados a shock to loans accounts for over 28 per cent of the variance in output over the long run. (ii) In Barbados although credit shocks are not as important as exchange rate shocks at any time horizon, a shock to loans retains a large role in explaining output variability

				compared to the role of money shocks. (ii) In Jamaica credit shocks are more important in the long run while exchange rate shocks are more important in the short to medium term. (iii) In Trinidad and Tobago credit shocks are at least as important as the exchange rate early
	Ramlogan (2007)	Trinidad and Tobago, quarterly 1970:1 to 2000:2	Structural VAR	Overall, shocks to required reserves have the expected qualitative effects on lending, output and prices, but no confidence intervals reported.
	Costa Rica, monthly 1996:1 to 2007:12	Durán-Víquez and Esquivel-Monge (2008)	Non-linear asymmetric VECM	(i) Complete long-run pass-through of the policy rate to bank deposit and lending rates. On average, loan and deposit rates take 9.4 and 5 months respectively to fully pass a shock of policy rate.

Note. In this table, we use a broad definition of Developing countries to include all countries classified as developing in Rogoff et. al., 2004.

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