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Research Summaries

Explaining the Recent Slump in Investment: The Role of Expected Demand and Uncertainty*

Matthieu Bussière, Laurent Ferrara, and Juliana Milovich

The recent weakness in business investment among advanced economies has revived interest in investment models and has opened a debate on the main drivers of the "investment slump" and what the policy response should be, if any. In particular, it is essential to assess precisely whether the investment slump stems mostly from weak aggregate demand, financial constraints or uncertainty, as these different explanatory factors have different policy implications. This paper presents an empirical investigation of the main determinants of business investment for a panel of 22 advanced economies. The main contribution is that we present results from an augmented accelerator model using vintage forecast data as a measure of expected demand and show that this forward-looking variable goes a long way in explaining

The Quest for Stability in Housing Markets

Hites Ahir

Recent developments in global house prices have led to seemingly contradictory concerns about both overheating and slow recovery, reflecting house price booms in some countries and declining prices in others. This note discusses developments in global housing markets since the Great Recession—drawing on IMF staff assessments—and it also discusses attempts by policymakers to maintain stability in housing markets through macroprudential policies.

Housing Markets: A Global Overview

On average, global house prices continue to march upward slowly (IMF 2016). The IMF's Global House Price Index—a simple average of real house prices for 64 countries—has edged higher for the past sixteen quarters (Figure 1). There is also a clear shift in momentum: between mid-2007 and mid-2012, far more countries had declining real house prices than increasing prices, but since mid-2012, these trends have reversed.

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Explaining the Recent Slump in Investment: The Role of Expected Demand and Uncertainty

the weakness in investment since the global financial crisis. Moreover, our results also underline the importance of uncertainty, whereas measures of capital cost seem to play a more modest role. Finally, we show that systematically over-optimistic GDP growth forecasts since 2008 have supported business investment to a large extent.

In recent years, total private investment has been particularly sluggish among advanced economies: its year-on-year growth rate has barely reached 2.1 percent between 2010 and 2014, against 3.3 percent during the precrisis period (between 1997 and 2006). This is especially surprising since one would have expected a strong rebound from the 2008–09 financial crisis, which saw a sharp fall in investment, by 2.6 percent in 2008 and 11.1 percent in 2009.[1] While part of these developments can be accounted for by housing investment, following the exuberance of the housing markets in the run-up to 2008, business investment has also been particularly sluggish. Business investment has declined for advanced economies during the period between 2008 and 2014 and today stands 20 percent below precrisis forecasts (IMF, 2015). The weakness of business investment is a concern, not only because it is a key component of GDP and as such an important driver of short-term economic fluctuations, but also because it has a strong influence on long-term output growth.

The persistent weakness in business investment among advanced economies has revived interest in investment models and opened a debate on the main drivers of the "investment slump" and what the policy response should be—if any. Indeed, it is important to fully understand the reasons behind the investment slump, as different possible explanatory factors have different implications for the appropriate policy response and for the outlook. The first reason one may put forward is that aggregate demand has been weak since 2008, which obviously does not provide strong incentives for entrepreneurs to invest significantly. In this case, the investment slump may simply reflect the weakness of aggregate demand and does not necessarily require a response that is aimed specifically at the investment sector. Looking forward, investment may rebound as the global recovery takes place, helped by the exceptionally accommodative policies put in place in key economic regions.

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[1] The source of these data is the IMF *World Economic Outlook,* April 2015 issue.

However, other explanations should not be neglected. One of them is uncertainty. The role of uncertainty in determining investment was put forward already by Bernanke (1983) and this theme has been further developed recently by Baker and others (2013) and Bloom (2014). In particular, substantial uncertainty may deter entrepreneurs from investing now and lead them to postpone investment decisions. In addition, financial constraints may have played a role too, as the global financial crisis has reduced the supply of credits to businesses. If such frictions are strong, they may delay the recovery in investment (and the global recovery as a consequence). This is perhaps especially the case in Europe, where financing conditions have been altered substantially for so-called "periphery" economies (financial market fragmentation).

This paper presents an empirical investigation of the main determinants of annual business investment growth for a set of 22 advanced economies using a panel estimation approach. Our main innovation is that we use vintage macroeconomic forecasts of GDP growth as a measure of expected demand and we integrate those measures into augmented accelerator models, together with various measures of uncertainty and financial constraints. Keeping in mind that the model is not a structural one, we did many robustness checks to assess our results, especially by taking a large number of measures for expected demand (expected domestic GDP growth, global demand, fiscal stance, etc.), uncertainty (volatility measures, Economic Policy Uncertainty index, disagreement among forecasters, index of news, etc.) and user cost of capital.

The first result to underline is that this forward-looking variable goes a long way in explaining investment, and improves upon backward-looking approaches. This result is robust to various measures of expected demand such as external and domestic demands. Second, the results suggest that there is also a role for uncertainty in explaining the weakness in investment. Obviously, uncertainty is not directly observable and many measures have been recently put forward in the empirical literature. Our findings show that the level of uncertainty as measured by the historical volatility of stock returns, as well as the VIX index, seems to have a large impact on investment decisions, while there is less clear evidence using alternative measures of macroeconomic uncertainty. Moreover, our results also emphasize that financial constraints as measured by the real user cost of capital do not seem to play a major role in describing business investment, for the countries taken as a whole (but our country-by-country decomposition allows to nuance this result slightly for some countries, in particular those of the so-called euro area "periphery"). This result

appears to be robust to alternative measures of financial constraints and to a battery of robustness checks.

When trying to disentangle the contributions of the various determinants of business investment growth since the global financial crisis, the main finding that comes out of the analysis is that the business investment slowdown in our panel of advanced economies is mainly due to expected demand (negative contribution of more than 80 percent), while uncertainty has also played a role (negative contribution of 17 percent). By contrast, capital costs do not contribute very much to this drop for the countries taken as a whole.

A final consideration worth underlining in the context of our forward-looking model is that forecast errors have actually supported investment since the outburst of the crisis. Indeed, if GDP forecasts had been perfect and not systematically over-estimated, our estimates suggest that investment would have been around 12 percentage points lower; as GDP growth forecasts have been over-optimistic since the crisis, investors who base their decisions on official output forecasts would likely have invested less, if they had known how weak global growth really was.

From a policy perspective, our empirical results underline the importance of expected aggregate demand as a key driver of business investment. Thus, economic policies aiming at boosting expected demand represent the most effective tool that can be used to stimulate investment. Having said that, the role of the other factors should not be neglected.

The cost of capital seems to play a more modest role for most of the countries, but our country-by-country decomposition reveals that it had an important contribution for some of the euro area periphery countries. In addition, it seems that uncertainty plays a role as well. Reducing global uncertainty should lead to additional investment growth, in line with economic theory. One possible issue to highlight, however, is that uncertainty is still a somewhat elusive concept and the channels through which uncertainty can be reduced are not entirely clear. In this respect, the Juncker plan of the European Commission is a key step forward as it aims to reduce uncertainty on the supply side through the development of a more investment-friendly environment.

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## The Quest for Stability in Housing Markets
(continued from page 1)

Figure 1: Global House Price Index
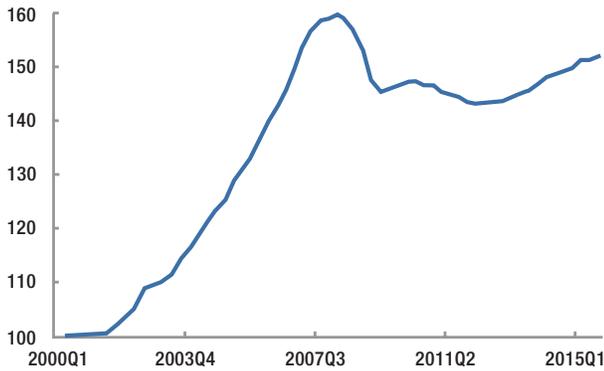
Sources: Bank of International Settlements, Colliers
International, European Central Bank, Federal Reserve
Bank of Dallas, Savills, and national sources

More recently, global economic growth has slowed, especially in emerging markets, which may be affecting housing markets already. The latest available data shows that 7 out of 35 advanced economies are experiencing a decline in real house prices, compared with 10 out of 28 emerging economies (Figure 2). Over the past year, median real house price growth was nearly 4 percent in advanced economies, on average, compared with about 2.5 percent in emerging economies.

Figure 2a: Real House Prices in Advanced Economies
(2015:Q3 or latest, in annual percent change)
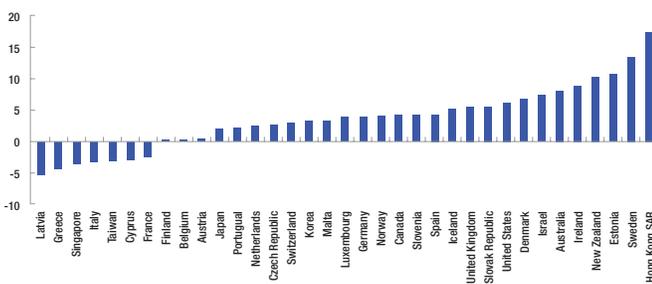
Sources: Bank of International Settlements, Colliers
International, European Central Bank, Federal Reserve
Bank of Dallas, Savills, Sinyi Real Estate Planning and
Research, and national sources

Figure 2b: Real House Prices in Emerging Economies
(2015:Q3 or latest, in annual percent change)
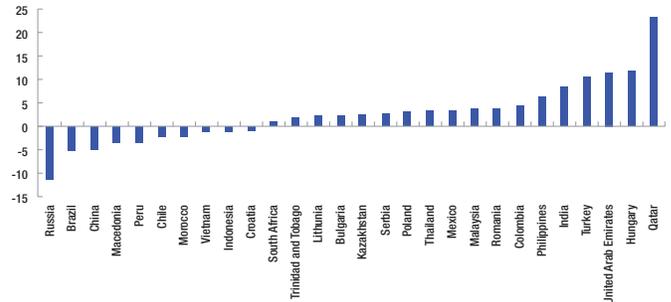
Sources: Bank of International Settlements, Colliers
International, European Central Bank, Federal Reserve
Bank of Dallas, Savills, Sinyi Real Estate Planning and
Research, and national sources

A Closer Look at Housing Markets

Understanding the disparate developments in housing markets across countries requires a closer look at the underlying developments and policies in each country. In its country surveillance, the IMF has been active in following house price developments, with coverage of housing sector issues having increased significantly in recent years (see Figure 3).

Figure 3: Number of Search Results for "House Prices" Using IMF eLibrary
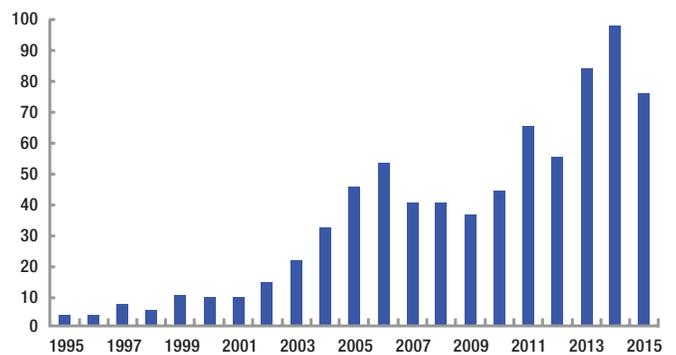
Source: IMF eLibrary

Out of 180 *Article IV Consultations* and *Selected Issues Papers* published in 2015, nearly half had some reference to housing and about a quarter had deeper analysis of housing markets and policy assessments and recommendations (Table 1).

Table 1. IMF Coverage of the Housing Markets in 2015

	By Geographic Region					
	Total	Africa	Asia and the Pacific	Europe	Middle East and Central Asia	Western Hemisphere
Total number of IMF member countries	188	45	34	44	31	34
Total number of Article IV Consultations and Selected Issues Paper published	180	38	30	55	24	33
Total number of reports containing information on housing:						
Any type of reference	81	7	18	29	13	14
Description	77	6	18	27	13	13
Analysis	47	2	8	22	7	8
Policy Recommendation	42	2	8	20	7	5
In percent of the total number of the published reports						
Any type of reference	45.0	18.4	60.0	52.7	54.2	42.4
Description	42.8	15.8	60.0	49.1	54.2	39.4
Analysis	26.1	5.3	26.7	40.0	29.2	24.2
Policy Recommendation	23.3	5.3	26.7	36.4	29.2	15.2

Source: IMF and author's calculations

Three features of the recent IMF analysis of housing markets are noteworthy:

- There is increasing use of disaggregated data to see if house price booms in countries are restricted to particular cities or regions.
- There is increased discussion of the extent to which supply constraints are driving house prices.
- Not surprisingly, there is extensive discussion of macro-prudential measures that could be used to manage the housing market and attempts to assess the effectiveness of these measures.

The use of disaggregated data has proved important in assessing the extent to which house prices booms should be a source of concern. For instance, in the first half of 2015 in Australia, property prices increased by 16 percent year-on-year in Sydney, Australia, compared with 10 percent in other capital cities (IMF 2015a). The median price in Sydney corresponds to around nine times the average income, also the highest among capital cities. Within Belgium, there are big regional differences in the levels of house prices—with houses in Brussels being twice as expensive as those in Wallonia—recent rates of house price increases across regions have been quite comparable (IMF 2015b). In Canada much of the aggregate appreciation in house prices has been driven by Calgary's housing market (though declines in oil prices are now taking their toll there), and increases in prices of single-family homes in Toronto and Vancouver (IMF 2015c).

In addition to increased discussion of within-country housing developments, the role of supply constraints in driving house prices is also receiving increased attention. In Israel, boosting housing supply, through measures such as providing support to local governments for construction of high density residential buildings, is considered important to contain further increases in housing prices (IMF 2015d). In Sweden, differences in housing supply conditions across cities have contributed to divergences in house prices. In the big cities, the housing stock has not expanded at a pace commensurate with demand that is driven by immigration inflows, rapid urbanization, and income growth (IMF 2015e).

Effectiveness of Macroprudential Measures

For the past few years, macroprudential policy has been the new policy buzzword and the "go-to" tool for many policymakers around the world. A growing literature on the use and effectiveness of macroprudential policy has sprung up.

In terms of policy related work, the IMF has put together a framework to inform country-specific advice on macroprudential policy (IMF 2013). Regarding the relationship with fiscal policy, one IMF report says that imposing taxes during a boom can make bubbles less likely; or the announcement of future tax relief on asset returns can support asset prices during a bust. During the global financial crisis, countries used tax measures to bolster house prices by removing stamp duties on housing transactions. Stamp duties have also been used in a number of countries to lean against house price appreciation. Such measures may have a role to play in particular when house prices are driven by capital inflows that by-pass the domestic financial system. However, these measures can also introduce further distortions and may ultimately increase price volatility.

The IMF staff's advice on the use of macroprudential policy tools is addressed in a policy paper (IMF 2014c). Regarding which indicators can help in deciding when to loosen macroprudential policies, the policy paper says that they should be relaxed when there are signs of increased frictions in housing markets that result in a spiral of falling house prices, falling mortgage credit, and increasing defaults and foreclosures. In general, while a fall in house prices can be a useful early-warning indicator for the emergence of such frictions, a softening housing market alone is not a sufficient indicator for the relaxation of macroprudential tools, and staff should look for further evidence supporting the need for a relaxation of macroprudential tools.

Other papers have documented the use of macroprudential policies across countries and regions and have assessed their effectiveness. A new paper examines the use of macroprudential policies for 119 countries over the 2000–13 period (Cerutti and others 2016). They find that macroprudential policies can have some impact on growth in house prices.

Vandenbussche and others (2015) in an article in the *Journal of Money, Credit and Banking* investigate if macroprudential policy measures have had an impact on housing price inflation in Central, Eastern, and South-Eastern Europe (2015). They find that that some—but not all—measures had

an impact. Zhang and Zoli (2014) find that Asian economies appear to have made greater use of macroprudential tools, especially housing-related measures, than their counterparts in other regions. Their analysis suggests that macroprudential policy and capital flow measures have helped curb housing price growth. The instruments that have been particularly effective in this regard include loan-to-value ratio caps, and housing tax measures.

In sum, while there is some evidence on effectiveness of macroprudential policies, it is mixed and it is difficult to be confident given the short time-series used in the econometric work. Therefore, country-by-country assessment and detailed case studies of the use and effectiveness of macroprudential measures are useful.

In terms of macroprudential policy recommendations, in Kuwait potential risks posed by rapid credit growth to the real estate sector can be addressed by sectoral capital requirements, and caps on loan-to-value ratios and debt-service-to-income ratios, adjusted at different stages of the credit cycle (IMF 2015f). In Namibia, IMF staff recommends loan-to-value limits on non-primary residences to constrain house purchases financed with mortgage loans for investment purposes (IMF 2015g).

Assessing Macroprudential Policies: A Tale of Two Countries

The challenges in implementing macroprudential policies, and evidence of their effectiveness, are well illustrated by a case study of Israel and the Netherlands (Ahir 2016). Both economies have been doing well in recent decades. This tends to put upward pressure on house prices because there are strong underlying supply constraints in both countries. Nevertheless, the house price booms in these economies in the period before the global financial crisis occurred for different reasons: in Israel, supply constraints played an important role, in the Netherlands it was easy credit. When the global financial crisis hit, both countries had to make policy adjustments.

In Israel, the central bank lowered the monetary policy rate from 3.75 percent at the beginning of 2008 to almost zero (0.25 percent) at the end of 2014. So with the monetary policy rate already lowered to counter a deceleration in GDP and to withstand the effects of the global economic downturn, Israel has had to implement macroprudential policies to deal with house price increases (See Figure 4a).

Figure 4a: Israel: Real House Price Index and Macroprudential Policies
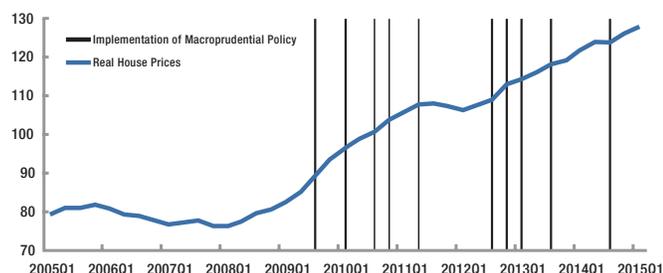
Sources: Organisation for Economic Co-operation and
Development (OECD) and Ahir 2016

In the Netherlands, macroprudential policies have been used to reduce existing vulnerabilities in the housing market. Prior to the global financial crisis, households in the Netherlands accumulated substantial mortgage debt at generous loan-to-value ratios (LTV), spurred in part by advantageous mortgage interest deductibility (MID). More specifically, during the upswing in housing prices in the Netherlands, LTV ratios on new mortgages averaged 114 percent in 2007, and over 120 percent in 2010. It is important to note that there was no formal LTV requirement on mortgage lending.

Figure 4b: Netherlands: Real House Price Index and Macroprudential Policies
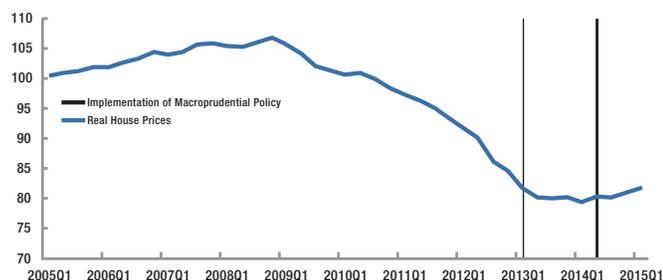
Sources: OECD and Ahir 2016

However, in 2009, real GDP declined by -3.3 percent. Also, house prices started to fall. To reduce the vulnerabilities in the housing market, the Netherlands also implemented several macroprudential policies (See Figure 4b).

What have been the effects of macroprudential policy in Israel? In Israel, even after implementing several measures of macroprudential policies, real house prices have continued to rise (Figure 4a). Here it is important to note three points.

First: Israel could not use monetary policy because raising the monetary policy rate would have lead to a deceleration in activity across all sectors of the economy. Second: it was hard to tighten macroprudential policies. An example is the difficulty in tightening the LTV ratios for first time home buyers since politically it was difficult to introduce regulations that make it difficult for young couples to buy a home. Third: there is evidence that the rise in house prices are explained largely by supply constraints. In Israel, the state owns 93 percent of the land, and there is a long process for obtaining licenses, building permits, and finishing construction.

So in the presence of a strong housing demand, but with supply constraints, house prices will tend to rise sharply. Recognizing this, the government has introduced measures to increase supply, including facilitating coordination between different housing bodies and initiating urban renewal programs.

What have been the effects of macroprudential policy in the Netherlands? In the Netherlands, macroprudential policies have started to reduce the vulnerabilities in the housing market, but challenges remain. In contrast to Israel, as noted earlier, the Netherlands was hit hard by the global financial crisis. So it had to implement macroprudential policies gradually in order not to destabilize the housing market in an environment of weak economic activity and falling house prices.

We can see this in the way the Netherlands plans to gradually bring down the LTV ratio and the tax deductibility of interest on mortgage loans. The LTV ratio will be gradually reduced by one percentage point per year until January 2018 when it will reach 100 percent. However, an LTV ratio of 100 percent would still be high compared to international levels. LTV ratios should be in place before household debt problems arise. So further work still remains in terms of LTV ratio limits.

Finally, even though the housing market is characterized by high LTV ratios, there are two specific risk mitigating factors that limit the risk of mortgage defaults in the Netherlands. The first factor is that Dutch banks have full recourse to all the assets and income of borrowers who default on their mortgage loan. The second factor is substantial savings.

There are four lessons that can be learned from the case of managing housing markets in Israel and the Netherlands. First: macroprudential policies work in reducing housing related risks to financial stability. Second: macroprudential policies can be politically and economically hard to

implement. Third: macroprudential policies work better as ex-ante rather than ex-post tools. Fourth: the institutional setting of the market matters.

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Q&A Seven Questions on Estimating the Monetary Transmission Mechanism in Low-Income Countries

Bin Grace Li, Christopher Adam, and Andrew Berg

The use of conventional vector auto-regression (VAR)-based methods to identify the monetary transmission mechanism (MTM) in low income countries suggests the MTM may be weaker and less reliable than in advanced and emerging market economies. But are structural VARs identified via short-run restrictions fit for this purpose? Are they capable of detecting a transmission mechanism when one exists, under the structural and research conditions typical of these countries? This Q&A article provides brief answers to seven questions on estimating the monetary transmission mechanism in low-income countries.

Question 1. Why does understanding the monetary transmission mechanism matter in low-income countries (LICs)?

The monetary transmission mechanism (MTM) describes the link between monetary policy instruments under the direct control of the central bank—usually a short-term policy interest rate—and the ultimate economic outcomes it is seeking to influence, typically aggregate demand and inflation.

Transmission occurs along multiple channels: directly through the effect of interest rates on private consumption and investment, and indirectly through exchange rates on import prices and external competitiveness; through the quantity and price of credit from the banking and non-bank financial sectors; through asset prices and wealth effects; and through private sector inflation expectations. The transmission of monetary policy signals via these different channels depends on a range of factors including the depth and development of financial markets, the structure and credibility of the monetary policy regime, and the volatility of the domestic and external economic environment.

A fundamental challenge in the conduct of monetary policy is for central banks to develop robust estimates of the speed, direction, and relative strength of transmission of its policy actions through each channel. This is a particularly difficult task in low-income countries where financial markets are thin, the economy is undergoing rapid structural change and policy regimes are seeking to adjust to this change, and where limitations in the quantity, timeliness, and quality of macroeconomic data are widespread. Structural factors that play a role in ensuring the transmission mechanism in LICs may be relatively weak compared to those in advanced and emerging market economies. Shallow interbank and money markets may impair the transmission from short-run policy interest rates to the structure of rates in the broader financial markets, while low levels of financial inclusion and widespread market power in the financial systems may impede transmission from the financial sector to the real economy.

Question 2. How do VAR methods seek to uncover the MTM?

Vector auto-regression (VAR) models are perhaps the most widely used methodology to analyze the MTM empirically. VARs used for monetary policy analysis entail the imposition of identifying restrictions on macro time-series data in order to trace the impact of innovations to interest rates or other monetary instruments (e.g., reserve money) on the evolution of a vector of macroeconomic aggregates, usually inflation, the output gap, exchange rates, and interest rates themselves but possibly also money and credit aggregates. Using VARs for monetary policy analysis, dating back to the seminal work of Sims (1980), confronts the researcher with formidable model specification and identification challenges—see for example Christiano and others (1999) for a discussion. To tackle these and respond to perceived weaknesses with the standard recursive VAR estimation, other methods have been applied to the advanced and emerging countries, including: generalized non-recursive SVARs (Sims and Zha, 1995; Kim and Roubini, 2000); sign restrictions (Uhlig, 2005); and factor-augmented VARs (Bernanke, Boivin, and Eliasz, 2005).

Most studies of the monetary transmission mechanism in LICs, such as those reviewed by Mishra, Montiel, and Spilimbergo (2012) and Mishra and Montiel (2013), still tend to rely on conventional SVAR models, with the majority identifying the monetary policy shock using recursive or block-recursive ordering or similar exclusion restrictions.

Question 3. What does the conventional VAR-based evidence tell us about the monetary transmission mechanisms in LICs?

The capsule summary of the extensive body of evidence surveyed by Mishra, Montiel, and Spilimbergo (2012) and Mishra and Montiel (2013) is that the MTM in low income countries is "relatively weak" and "less reliable" compared to advanced and emerging market economies. Movements in short-term policy rates are estimated to have a relatively weak pass-through on average to market rates, and movements in market rates have a similarly relatively weak estimated effect on aggregate demand and inflation. At the same time, these econometric estimates are less reliable in that they are bounded by much wider confidence intervals than is the case elsewhere, leaving considerable statistical uncertainty about the true MTM.

Question 4. Is the MTM really "weaker and less reliable" in LICs than elsewhere? What could affect the estimation when applying VAR methods to LICs?

There are two broad possible explanations for these findings:

- *Facts on the ground:* As suggested earlier, formal financial markets in LICs are small and poorly arbitraged and exchange rates are often heavily managed so that the link between the short-term policy interest rates that central banks can control and the variables that matter for aggregate demand (e.g., longer-term interest rates, the exchange rate) may be weak or absent. Even the bank lending channel may be weak when the formal financial sector is small, financial frictions are severe, and the banking industry is characterized by imperfect competition.

- *Limitations of the method:* The MTM is not in fact weak, but the VAR-based methods typically used to evaluate the MTM empirically are not capable of measuring its strength accurately in the research environment characteristic of LICs.

If the "facts on the ground" explanation is correct, this suggests that managing monetary policy successfully may be particularly difficult in low-income countries. Along with other features of the LIC environment, such as frequent large supply shocks, weak and uncertain transmission may exacerbate short-run interest rate

volatility, and make it more difficult for policymakers to keep inflation within narrow bounds and stabilize activity in the face of demand shocks.

On the other hand, if the missing MTM mainly reflects methodological limitations, then the results of the VAR-based literature should be discounted by policymakers and researchers evaluating the strength and reliability of the MTM should seek empirical approaches that are more robust to the peculiar weaknesses of these methods in LIC-like environments.

Question 5. How do LIC-style environments affect VAR-based inference on the MTM?

In a forthcoming IMF working paper (Li and others, 2016), we employ a simulation (Monte Carlo) approach to discriminate between these two candidate explanations for the "missing MTM." We generate data from a dynamic, stochastic general-equilibrium (DSGE) model of a small open economy in which a strong MTM is present. We first show that the monetary transmission mechanism can be cleanly and precisely identified in a favorable "advanced economy" research environment (think, for example, of Canada) and then seek to uncover this MTM using cleanly-identified SVAR methods, except for where we systematically introduce elements of the research environment that characteristically confront researchers and policymakers in LICs.

We find a surfeit of plausible explanations for the "missing MTM." First, low interest rate and exchange rate elasticities in the goods market make the MTM harder to detect. Perhaps more interestingly, a low degree of smoothing in the interest rate reaction function, possibly a feature of less well-developed monetary policy frameworks, has similar effects on the strength of transmission and the ability of the VAR to detect. Of course, this feature could change rapidly with the policy regime.

What about the challenges of the research environment? We focus on three key features, both separately and in combination, although in each case we maintain the assumption that a strong and correctly-identified true MTM is present.

- *Short data samples:* Macroeconomic regime shifts, such as changes in the exchange rate and/or monetary policy regimes or wide-ranging structural reforms in the

financial sector often preclude the use of long historical data series, even when these exist. Compounded with data-collection limitations (in many low-income countries, for example, quarterly data on the real economy go back only about a decade) this means researchers are attempting to draw inference from relatively short spans of relevant historical data.

- *Measurement error:* Macroeconomic variables display greater volatility at business-cycle frequencies in low-income countries than in higher-income countries, due in part to measurement errors in data-collection methods for output and inflation.

- *High-frequency supply shocks and conventional filtering methods:* A defining characteristic of LICs is their greater exposure to high-frequency supply-side shocks, including climatic shocks to agricultural output. In these circumstances, the practice of proxying potential GDP with a smooth slow-moving trend may decant additional measurement error into output gaps computed by conventional filtering methods.

When present, these characteristics undermine inference in a consistent and intuitive manner (see Figure 1). Short data samples result in the estimated impulse response functions exhibiting a discernible attenuation over the early periods of the response (relative to the case where data are more abundant) and a widening of confidence bands around these estimates. Classical measurement error and errors arising from "over-smoothing" have qualitatively similar effects on inference, biasing the median estimated response functions towards zero and widening the error bounds relative to the baseline.

In reality, these factors rarely occur in isolation. When allowed to play out together, the effects, while individually quite modest in scale, are exacerbated: the median estimated response of output to an interest rate shock falls very sharply relative to its true value while the confidence interval around this median widens. The VAR loses virtually all power to reject the false null of no transmission.

Question 6. Is robust measurement of the MTM even feasible in low-income countries?

The challenge for researchers and policymakers is whether the dominant VAR-based approaches can be bolstered, either by improved VAR methods or by complementary

approaches that can help researchers triangulate on the true MTM. We have assumed that the VAR research can identify the monetary policy shocks, but the LIC environment this assumption—always a strong one—especially brave. The complex nature of policy regimes, often with an unclear and time-varying role for interest rates, money aggregates, and the exchange rate, is a deep challenge. Improved VAR-based methods may help here. For example, generalized non-recursive SVARs provide more flexibility in identifying structural shocks. Imposing sign restrictions is a more agnostic approach, restricting itself to defining only the signs on the impulse responses of certain shocks. Factor-augmented VARs allow for the use of simultaneous information contained in other variables. These can and should be complemented by approaches that are less reliant on crisp identification of macroeconomic data. Examples of alternative approaches include Berg and others (2013) who use a case-study approach to identify the impact of the large and coordinated monetary policy intervention by the central banks of Kenya, Uganda, Tanzania, and Rwanda in 2011, and Abuka and others (2015) who use loan-level data to assess the bank-lending channel in Uganda.

Question 7. What should monetary authorities do in low-income countries?

Even when inference is based on best practice VAR-based methods and bolstered by complementary approaches, uncertainty about the MTM is likely to continue to face central banks in low-income countries. Statistical uncertainty about VAR-based estimates is not, however, evidence of the absence of the MTM, and though it remains plausible that transmission in LICs is generally weaker and more uncertain than in other countries, neither is a reason for policy inaction. The notion that effective policy must be conditioned on precise and reliable quantitative understandings of the MTM is clearly a myth: the best must not stand as the enemy of the good. Monetary policymaking in all central banks, but arguably more so in LICs, entails a degree of "tatonnement," of assessing the state of the economy, adjusting policy instruments accordingly, evaluating new data and the feedback evidence from the economy, and repeating this process. And for those LICs in particular that are in the process of reforming and revising their monetary policy frameworks, there is no real alternative to learning by doing, as well as effects of these reforms on the transmission mechanism itself (see IMF, 2015).

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Figure 1. Estimating Impulse Responses in Hostile Empirical Settings
("True" and SVAR-estimated impulse response functions of output to interest rate shocks)

Small Data Sample

Measurement Error

IID Supply Shock

A Combined Scenario with Small Data Sample,
Measurement Error, and IID Supply Shock
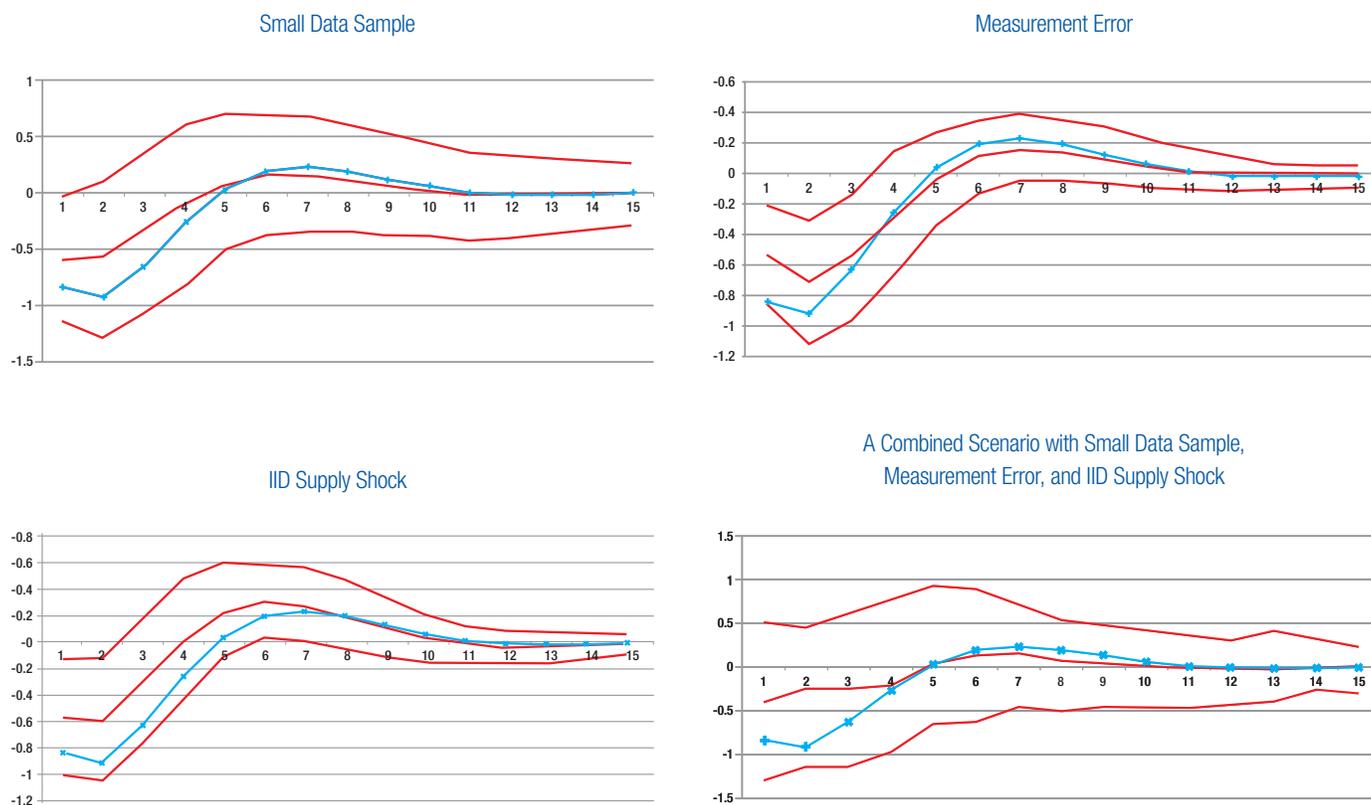
Source: Li and others (forthcoming, IMF Working Paper).

Note: The dotted blue line corresponds to the "true" impulse responses of the output gap to an interest rate shock, derived from the underlying DSGE model. The solid red lines correspond to the estimated median impulse response function and its 90 percent confidence interval derived from a recursively estimated SVAR model under alternative data characteristics.

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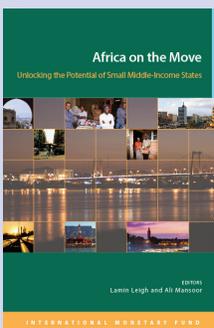
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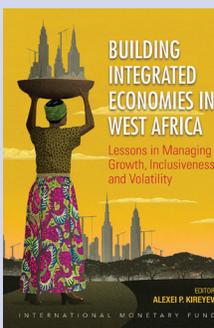
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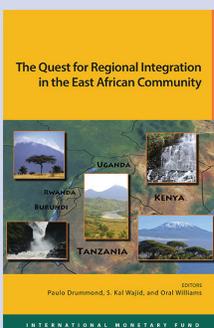
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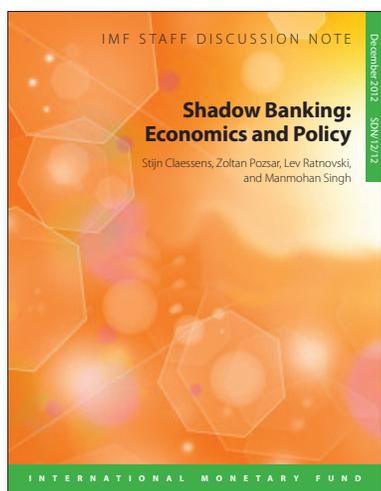
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