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Who is to Blame: Foreign Ownership or Foreign Funding?

By

Inessa Love
Roberto Rocha
Erik Feyen
Samuel Munzele Maimbo
Raquel Letelier

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Inessa Love, Roberto Rocha, Erik Feyen, Samuel Munzele Maimbo, and Raquel Letelier[1]

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Abstract

We investigate whether the credit contraction that followed the global financial crisis is due to high foreign ownership or high reliance on foreign finding. We apply panel vector autoregressions to quarterly data for 41 countries and find that domestic credit growth is highly sensitive to cross-border funding shocks around the world. However, high foreign ownership *per se* does not appear to increase the sensitivity of credit to foreign funding shocks. Rather, the sensitivity is higher in countries with high reliance on foreign funding and high loan-to-deposit ratios. These findings have important policy implications for many countries involved in cross-border funding.

JEL Classification: G01, G21, F36.

Key words: Global financial crisis, bank credit, foreign banks, funding models.

I.   Introduction

Although most countries across the world experienced a severe contraction of credit during the recent global financial crisis, the Eastern Europe and Central Asia (ECA) region was hit harder than most of the developing countries. One possible reason for the severe decline lies in close economic and financial links with Western Europe, including a high degree of foreign ownership (i.e. foreign equity) and greater reliance on foreign funding (i.e. foreign liabilities) in the banking sector. The credit crunch was generally driven by foreign banks, as they initiated efforts to repair their balance sheets and retrench to home markets. The concerted policy response, including the Vienna Initiative, succeeded in mitigating a severe credit contraction in the participating countries (de Haas et al, 2012). However, these events triggered a renewed debate about the benefits and costs associated with the presence of foreign banks, cross-border finance, and financial integration.   We use the special case of ECA countries to provide new evidence on the relative role that foreign ownership and foreign funding play in the transmission of global financial crises.

Previous research has established that foreign banks have much to contribute to financial sector development (see Claessens and Van Horen, 2014, for a comprehensive review of the literature).[2] However, as the global financial crisis has made clear, their presence can also have large destabilizing impacts (Mishkin, 2007). Recent research shows that foreign banks drove the

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[2] Specifically, foreign banks can accelerate financial development by lowering the cost of financial intermediation, increasing the quality of and access to financial services (Giannettia and Ongena, 2012), increasing competition in the host country, bringing in up-to-date technology to the market, introducing new, more diversified products and services, and pressing regulators to reform and modernize the regulation and supervision of financial systems. Allen et al (2012) also discuss costs and benefits of cross-border banking in detail.

credit boom in ECA before the crisis and exacerbated the credit contraction after the crisis.[3] Even the US branches of foreign banks were significantly affected (Cetorelli and Goldberg, 2012). Concerned about their potentially destabilizing impact, many countries are reconsidering the merits of limits on foreign bank ownership.[4]

Despite the widespread agreement that foreign banks have amplified the transmission of the global shocks to host countries, the evidence appears more nuanced and there is significant heterogeneity among the foreign banks. For example, foreign banks that focused on deposit-based funding contracted lending less than domestic banks during the crisis (Claessens and Van Horen, 2013, Ongena et al 2012). Also, foreign banks which were more integrated into a network of domestic co-lenders reduced lending less during the crisis (De Haas and Van Horren, 2013). Kapan and Minoiu (2013) show that banks with stronger balance sheets were better able to maintain lending during the crisis, while those more dependent on market funding—which is typically shorter term and more fickle—reduced the supply of credit more than other banks. Cerutti and Claessens (2013) point that market-based measures of vulnerabilities of banking systems to shocks were more important than accounting based measures in explaining bank deleveraging. In addition, Choi, Gutierrez, and Martinez Peria (2013) find that banks with better capitalized parents were more stable in their lending.

These findings suggest that the type of bank funding models, along with the regulatory standards and supervisory arrangements, maybe more important for stability than foreign ownership *per se*. Foreign banks can finance their operations predominantly with local deposit-

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[3] Cetorelli and Goldberg (2011), de Haas and Van Lelyveld (2014), de Haas et al (2012), Cull and Martinez Peria (2012), Popov and Udell (2012), Feyen and González del Mazo (2013), Impavido et al (2013).
[4] For example, Indonesia and Namibia have imposed new restrictions on foreign banks in 2013.

based funding, as they do in most Latin American countries, or with the foreign funding from their parent banks or cross-border wholesale funding sources, as in most ECA countries. Casual observation suggests that the source of funding played an important role during the recent crisis. For example, some Eastern European countries with a high degree of foreign ownership but less reliance on foreign funding seem to have been less affected (e.g. Czech Republic, Slovakia), while other countries with a lower degree of foreign ownership but strong reliance on cross-border funding were highly affected (e.g. Kazakhstan and the Ukraine). It is important for policymakers to know whether the destabilizing impact of foreign banks depends on the origin of bank funding (i.e. liabilities) or the origin of bank ownership (i.e. equity).

While other authors have argued that cross-border funding is one of the main channels of transmission of global crises, earlier studies cited above lacked the direct measures of reliance on foreign funding because they used bank-level data, mostly from Bankscope database, which does not include information on the origin of bank liabilities.[5] Thus, the previous research has not been able to directly pinpoint the foreign funding channel as the culprit of the foreign-bank induced credit crunch.

In this paper we provide direct evidence on the impact of foreign funding on credit growth, which has immediate implications for the regulatory debate on cross border banking. We make several contributions to the ongoing research efforts to disentangle the role of foreign ownership and foreign funding in the transmission of the global financial crisis. First, we use precise measures of a country's reliance on foreign funding using data on foreign liabilities of

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[5] While some previous authors use the ratio of deposits to assets to proxy for the levels of foreign funding, this variable is crude and does not accurately measure the exposure to foreign funding, and thus have only indirect relevance for the policy debate.

the banking system. Second, we compare how factors affecting credit growth were different in ECA vs. other regions. Third, we follow a different methodology – Panel Vector Autoregression (PVAR) – allowing us to examine the dynamic relationship between funding structures and credit growth over time.

There are several advantages in using PVAR methodology to study the importance of different factors in explaining credit growth. First, in VAR, all variables are treated as endogenous and interdependent so all the feedback effects are explicitly included in the model. Thus, VARs are designed to explicitly address the endogeneity problem, which is a serious challenge in studying the empirical relationships between credit growth and funding sources. Second, unlike single country VARs that need long time series for efficiency, PVARs can be used with relatively short time-series. This is important for our study since the quarterly data on foreign liabilities are only available for about 10 years. Third, the PVAR methodology can distinguish between the short-term impacts of each of the factors based on the impulse-response functions and the long-term cumulative impacts of shocks based on variance decompositions. Fourth, as in any panel-based method, PVAR allows us to control for country- and year- fixed effects. Country-fixed effects will capture time-invariant country characteristics that can explain credit growth, such as institutions, the rule of law, the quality and depth of credit information and other relatively static features of the business environment. Year-fixed effects capture global shocks affecting finance and growth, such as the effect of the global financial crisis that is common for all countries in the same time period. Fifth, the VAR model can distinguish whether demand (e.g. GDP) or supply (e.g. foreign liabilities and deposits) factors drove the decline of the private credit, which is important because all these variables deteriorated simultaneously

6

during the crisis. Thus, PVAR is a methodology that is very well-suited to the questions this study aims to address.

Our results can be summarized as follows. We apply PVARs to a global panel that consists of quarterly data for 41 countries in ECA, Asia, Latin America, and the Middle East and Africa for the period 2000-2011. We document four main findings. First, we find that private credit growth is highly sensitive to cross-border funding shocks around the world. Second, we find that this relationship is significantly stronger in the average ECA country compared to the rest of our sample. Specifically, the response is 72% higher in the initial period and about three times higher after one quarter. Third, we show that countries with high loan-to-deposit ratios and high reliance on foreign funding exhibit a stronger response of private credit to foreign funding shocks. However, foreign ownership *per se* does not lead to different response in our sample of countries. Fourth, we show more directly that high loan-to-deposit ratios and high foreign funding are able to explain the differences between ECA and the rest of the world, while high foreign ownership by itself is insufficient to explain these differences.

Taken together, our findings suggest that funding model differences were at the heart of ECA's protracted post-crisis credit growth contraction, not its high prevalence of foreign bank ownership. These finding have important policy implications. Rather than trying to curtail and scale back foreign bank presence, this paper suggests regulators ought to focus on business models of local affiliates of international banks and the regulation of cross-border funding. We discuss policy implications in more detail in the conclusions of the paper.

II.   Data

We compile a panel database with quarterly data covering 41 countries in various regions with about 11 years of data available for most countries. Table 1 provides a description of the variables and sources. We have two sets of variables: the time series variables are used for the panel VAR and the cross-country variables are used for sample splits. We describe each of these sets of variables in detail below.

II.1.   Panel VAR Variables

There four main variables in our PVAR model, which are taken from the IMF's International Financial Statistics (IFS): private credit, foreign liabilities, GDP, and deposits. For most of the countries in our sample these variables are available quarterly starting with Q2, 2001 and ending with Q4, 2011.[6] The private credit variable measures the quarter-on-quarter real growth rate of private credit. Private credit isolates credit issued to the private sector and therefore excludes credit issued to governments, government agencies, and public enterprises. Private credit also excludes credits issued by central banks. The foreign liabilities variable measures the quarter-on-quarter real growth rate of foreign liabilities. These liabilities include claims of non-residents on the domestic banking system which include deposits, securities, loans, financial derivatives and other liabilities. GDP is the quarter-on-quarter, seasonality-adjusted growth rate of real GDP. The deposits variable measures quarter-on-quarter real growth rate of

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[6] Some countries have shorter series due to data availability, details available on request.

bank deposits, consisting of the domestic time, savings, and demand deposits of deposit money banks. All variables are denominated in local currency.

For all variables we first calculate quarter-on-quarter nominal growth rates. Then we construct real growth rates by subtracting the quarter-on-quarter percent change in the CPI index.[7] Thus, our main PVAR variables are expressed in growth rates, which ensures their stationarity.

Table 2A shows that the mean real quarterly growth rates of foreign liabilities were higher than those of private credit and deposits, and its standard deviation was considerably higher, by a factor of three or larger. This result reveals the major weakness of foreign funding – its volatility in periods of crisis. The mean growth rates of foreign liabilities and private credit were much higher in the case of ECA countries, relative to Non-ECA countries, reflecting the greater reliance of the ECA region on foreign funding and the key role played by cross-border finance in ECA's pre-crisis credit boom. Interestingly, the standard deviation of foreign liabilities in the ECA and non-ECA regions are similar, revealing that countries in the two regions are potentially exposed to the same volatility in periods of crisis, but ECA countries are much more exposed, given their greater reliance on foreign funding. This result will be further explored in Section V.

II.2. Sample Split Variables

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[7] We have also used GDP deflator to adjust GDP growth rates, but it had less coverage. All our results hold using the GDP deflator, however the GDP results become slightly less significant perhaps because of the added noise. In addition, we removed significant country-specific seasonality in GDP growth rates. To do that we regressed real GDP growth rates on country-specific quarter dummies and subtracted the predicted values.

One of the objectives of this paper is to understand what drives the differences in the response of private credit to other PVAR variables between ECA and the rest of the world. In doing so, we use three variables hypothesized to explain these differences: the loan-to-deposit ratio (LDR), foreign ownership, and foreign funding. LDR is calculated as the ratio of private credit to deposits, both variables were defined above. LDR proxies the extent to which domestic bank credit is funded by domestic deposits. An LDR in excess of 100 percent implies that credit has been financed with other sources of funding such as unsecured wholesale funding in the international or domestic interbank markets. These types of funding are typically short-term and highly sensitive to market conditions in contrast with (retail) deposits which are usually much more stable. The foreign funding measure is a proxy of the banking system's reliance on foreign sources of funding relative to total funding. It is calculated as the ratio of foreign liabilities to the sum of foreign liabilities and deposits, which roughly represents total debt funding. Lastly, foreign ownership measures the fraction of banking system assets that are majority-owned by non-residents. These data are taken from the World Bank's Bank Regulation and Supervision Survey.

To gauge the impact of these variables, we split the sample based on their pre-crisis values.[8] Table 2B reports the pre-crisis country averages for our three sample-split variables broken for ECA and non-ECA countries. Table 2B shows that LDR, foreign funding and foreign ownership are significantly higher in ECA countries, relative to non-ECA countries. However, the standard deviations also suggest that there is substantial variation across countries within

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[8] We use 2007:Q4 values for LDR and foreign funding. We use the closest available observation for foreign ownership, which is 2008 for most countries.

each of the two regions. This is an important result that will also be further explored in Section V.

III.   Trends and descriptive statistics

For our graphical analysis we break down the ECA region into the Commonwealth of Independent States (CIS) and the Central, Eastern and Southeastern Europe region (CESEE). Many countries in both samples enjoyed a credit boom prior to the global financial crisis, the CIS growing by 50-60% per year while the CESEE growing at 30%-40% between 2005 and mid-2008 (Figure 1, Panel A). Among other regions, only the Gulf Cooperation Council (GCC) countries grew at a similar pace, while the non-GCC countries in the Middle East and North Africa (MENA) region, and the Latin American and Asia regions showed moderate rates of credit growth during that period.

Deposit growth rates in these economies were also growing at high rates (Panel B), although lower than the rates of credit growth, as reflected in the growing loan-to-deposit ratios (Panel F). Loan-to-deposit ratios in the CIS went as high as 170% before the crisis, and continued to increase even after the crisis, reaching almost 180% at its peak in mid-2009. CESEE reached its maximum ratio in early 2009, with levels of 140%, while GCC went as high as 125% around the same period. Conversely, other emerging regions showed more steady levels, and in the case of non-GCC and Emerging Asian countries, always below 100%.

These trends can be largely explained by differences in banking models across regions. While LAC, non-GCC and Asia financed their credit growth with local deposits (keeping their

loan-to-deposit ratios under 100%), CESEE, CIS and GCC countries were heavily reliant on foreign borrowing. Figure 1, Panel D displays the share of foreign liabilities to total liabilities (i.e. it is the foreign funding measure described above) and shows the different paths these regions followed. While foreign liabilities in LAC, non-GCC and Asia were in the range of 10%-20% of total liabilities, foreign borrowing in CESEE, CIS and GCC increased prior to the crisis, exceeding on average 40% of total liabilities in early 2008.

The ECA region is generally known for the dominant presence of foreign ownership in comparison with emerging peers, but this is only true for the CESEE countries (Panel G). By 2008, 80% of the banking system in CESEE was in foreign hands, a figure that barely surpassed 40% in LAC and 30% in other emerging regions. The levels of foreign ownership were lower in the large CIS countries, especially in countries like Russia and the Ukraine, where foreign banks accounted for less than 20% of total assets.

After the onset of the crisis in 2008, credit experienced a significant slowdown in all emerging regions. This was more acutely felt in those regions where credit had been increasing at a rapid pace and GDP contracted heavily in 2009, such as CESEE and CIS (Panel C). As a consequence of the credit crunch, these regions witnessed an increasing deterioration in asset quality, as shown by the ratio of nonperforming loans to total loans (Panel E).[9]

III.1. Correlations

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[9] High NPLs in CIS are exacerbated by Kazakhstan, which experienced a housing market collapse, leading to a deterioration in the quality of banks' assets, who were large investors in the real estate market.

Panel A of Table 3 presents the correlations between our PVAR variables for the full sample, as well as separate correlations for ECA and the rest of the sample ("non-ECA"). As expected, the correlation between deposits and private credit is high in all samples. We also observe that foreign liabilities are correlated with private credit (0.40). However, this correlation is almost twice as high in ECA compared to non-ECA (0.50 vs. 0.23). This suggests credit in the ECA region could be much more vulnerable to foreign funding shocks than in the rest of the world, a hypothesis we formally test with PVARs in Section V.

Panel B of Table 3 displays the correlations for the sample split variables. It illustrates the different funding model in ECA reflected in the high correlation between foreign funding and LDR in ECA, but the absence of such correlation in the non-ECA region. Indeed, many banks in ECA funded their operations by attracting foreign funding to supplement domestic deposits in order to sustain high credit growth, resulting in elevated loan-to-deposit ratios. The correlations suggest this practice was not as widespread in non-ECA countries.

While foreign funding and foreign ownership are positively correlated, the correlation is not very high: 0.35 in the full sample and near zero in ECA (Table 3, panel B). The positive correlation is expected, as foreign owned banks often obtain funding from parent banks and have better access to international funding markets. However, in ECA there are many cases of countries with high levels of foreign liabilities but low levels of foreign ownership and vice versa. For example, Kazakhstan and Ukraine had relatively low levels of foreign ownership, but high levels of foreign liabilities, while Czech Republic and Slovakia had high levels of foreign ownership (around 90 percent of assets) but limited reliance on foreign funding (around 10 percent of liabilities). These correlations suggest that many domestically-owned banks in ECA, especially those in CIS, relied to a significant extent on foreign funding.

13

III.2.   T-tests: Is ECA Different from the Rest of the World?

In this section we test whether the patterns discussed above are statistically significant. Our main focus is on the differences between ECA and the rest of the world (i.e. non-ECA). Therefore, we split our sample into an ECA and non-ECA subsample and run basic mean comparison t-tests. Specifically, we track the evolution of our variables before (2005-07), during (2008-2009), and after (2010-2011) the global financial crisis hit.

Table 4 presents the results. Panel A documents the ECA vs. non-ECA differences for the PVAR variables: private credit, foreign liabilities, GDP, and deposits. We observe that in the pre-crisis period, ECA was significantly different from the rest of the sample in terms of the growth of foreign liabilities, private credit, and deposits. The real rate of growth of foreign liabilities and private credit for ECA was more than double relative to non-ECA: 10.06% vs. 3.64% for foreign liabilities and 7.87% vs. 3.15% for private credit. These differences are statistically significant and highlight the distinctiveness of the ECA cross-border, wholesale funding model which consists of rapid private credit growth sustained by inflows of foreign funding. The resulting ECA credit boom is demonstrated by higher average real deposit growth (5.42% vs. 2.65%), but it did not result in significant differences in real GDP growth (0.95% vs. 0.51%).

Next, we study the PVAR variables during the peak of the crisis in 2008-2009. During this period, GDP growth fell significantly more in ECA compared to non-ECA (-1.86% vs. -

0.51%), while the private credit growth was still significantly higher in ECA (2.15% vs. 1.45%). Yet, deposit growth differences are not statistically significant. The difference for foreign liabilities was not statistically significant in this period (even though the means are still higher for ECA, there was substantial variation within the region). This may point to the lag in adjusting banks operations, which squares well with our ordering of the foreign liabilities as first (i.e. the variable that responds to all others with a lag).

In the immediate post-crisis years (2010-2011), many non-ECA countries had started their recovery as evidenced by the return of positive growth in foreign liabilities, private credit, and deposits. In contrast, foreign liabilities and credit growth were significantly lower in ECA, reflecting the onset of the EU's sovereign and banking crisis, which had protracted effects on cross-border lending.. The continuation of the crisis in the EU is also reflected in the lower GDP and deposit growth rates in ECA, although the differences are not statistically significant. These findings suggest that non-ECA countries have recovered faster from the impact of the crisis.

Given such distinctive differences in the impact of the global crisis and the path of recovery in ECA vs. non-ECA economies, we seek to understand what key pre-crisis features of financial systems in ECA could be responsible for such differences. As discussed, we hypothesize the differences could be attributed to dissimilarities in the funding model and/or the extent of foreign ownership. Therefore, to gauge funding model differences we perform t-tests on LDR, foreign ownership and foreign funding. Table 4, Panel B shows the results.

The average LDR in ECA is significantly higher than in non-ECA (126.4% vs. 98.4%). Since ECA's LDR exceeds 100% by a wide margin, ECA had to fund its liquidity gap with other wholesale sources, which are typically regarded as less stable than retail deposits. These wholesale sources were often of foreign nature in ECA as evidenced by the fact that foreign

funding was twice as high ECA compared to non-ECA (31.9% vs. 15.8%). While these foreign sources of funding can act as stabilizers when stress originates from the domestic financial sector (e.g. De Haas and Van Lelyveld, 2014, they can also function like conduits of foreign financial stress. The ECA funding model contrasts sharply with the one of foreign bank affiliates in Latin America which typically source their funding in domestic markets—mostly retail deposits— which impedes excessive credit expansion and the transmission of foreign stress.

At the same time, we find that foreign ownership is also very high in ECA. In the average non-ECA country, 31.4% of banking assets are majority-owned by non-residents compared to 66.7% in the average ECA country.

While ECA has high averages of all three ratios, not all countries have equally high foreign bank ownership and high foreign funding dependence, as we discussed above. We use this variation to assess which of these two factors is responsible for the differences in credit growth in our PVAR analysis below.

IV.   Methodology

PVARs combine the advantages of the traditional Vector Autoregression (VAR) with the advantages of panel-data models. Basic VARs allow for the simultaneous analysis of the evolution of a system of endogenous variables. Moreover, the PVAR allows us to separately study demand and supply factors to better understand the evolution of private credit. The prime benefit of VARs is that the dynamic impact of orthogonal shocks can be evaluated—i.e. the isolated impact of a shock of one variable on the system over time, keeping the shocks of the other variables equal to zero.

The PVAR technique is particularly suitable for our purposes because we seek to model the evolution of a system of our four variables of interest—private credit, foreign liabilities, GDP, and deposits—in a set of countries which significantly differ along various dimensions such as the development of their financial and economic systems, financial regulation and supervisory effectiveness, and exchange rate regimes. These unobservable country-specific differences are captured with country fixed effects in our model.

Moreover, these countries are faced with common exposures such as the global cycle, global risk appetite, key interest rates, extraordinary measures of large central banks, and other global financial and economic shocks. Controlling for these common exposures is also important because our sample includes the period of the global financial crisis during which financial stress rapidly spilled over to other parts of the world significantly increasing the size of common risk factors. These common time shocks are captured with time fixed effects in our model.

The structure of our baseline PVAR model can be written in reduced form as follows:

$$Z_{it} = \Gamma_0 + \Gamma_1 \, Z_{it\text{-}1} + f_i + d_t + e_{it} \quad (1)$$

where Z_{it} is a vector of our four variables for quarter t and country i and modeled as a function of the first-order lags of all variables in the system. The f_i and d_t terms are country fixed effects and time fixed effects respectively.

The country fixed effects present an estimation challenge which arises in any model which includes lags of the dependent variables: the fixed effects are correlated with the regressors and therefore the mean-differencing procedure commonly used to eliminate fixed effects would create biased coefficients. Our PVAR implementation follows Love and Zicchino

(2006).[10] Specifically, to remove fixed effects we use forward mean-differencing, also referred to as the `Helmert procedure' (see Arellano and Bover, 1995).[11] This procedure removes only the forward mean, i.e. the mean of all the future observations available for each firm-year. This transformation preserves the orthogonality between transformed variables and lagged regressors, which allows us to use lagged regressors as instruments and estimate the coefficients by system Generalized Method of Moments (GMM).[12] The time-fixed effects are removed by time-differencing all the variables prior to GMM estimation, which is equivalent to putting time dummies in the system. Finally, to minimize the influence of outliers, we winsorize all variables by replacing the data below/above the $1^{st}/99^{th}$ percentile with the value of the $1^{st}/99^{th}$ percentile.[13]

The PVARs allow us to model the impact of an isolated shock or innovation of a single variable on the whole system over time, while setting the innovations of all other variables equal to zero. This produces so-called impulse-response functions, which take into consideration the estimated coefficients matrix (given by Γ_1 in equation 1), as well as the correlation of residuals across equations (i.e. e'e).

However, the errors across the variables in the system are typically correlated which inhibits the attribution of the impact of an innovation of a single variable to that variable only. To isolate the impact of innovations, it is necessary to decompose the residuals in such a way that they become orthogonal. The common solution is to adopt a particular variable ordering which

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[10] More recently, Love and Turk Ariss (2014) have used the same PVAR estimation methodology to evaluate the impact of macroeconomic shocks on bank loan portfolio quality in Egypt.

[11] The forward mean differencing is an alternative to first differencing. It is preferable because it preserves more data, preserves the variance, and does not induce first order autocorrelation, which then need to be corrected for as in the case of first differencing.

[12] In our case the model is "just identified" because the number of regressors equals the number of instruments, therefore system GMM is mathematically equivalent to equation-by-equation 2SLS. Also, there are no overidentifying restrictions because the number of instruments is equal to the number of variables in the model.

[13] We choose to winsorize the data to avoid a significant reduction in our sample size by dropping these outliers. However, our results are robust to excluding these observations from the system (results available upon request).

assumes that variables that come earlier in the order affect all following variables contemporaneously, while variables that come later affect previous variables only with a lag. While all the variables are treated as endogenous, the ordering only affects the timing of the responses as the variables that come later in the ordering have a delayed response on the variables that come earlier in the ordering. In other words, the correlation between the residuals of two variables is allocated to the variable that comes first in the ordering. The ordering can therefore have implications for the shape of impulse-response functions and for variance decompositions. This procedure is known as a Choleski decomposition of the variance-covariance matrix of residuals and is equivalent to transforming the system into a "recursive" VAR for identification purposes (see Hamilton (1994) for the derivations and discussion of impulse-response functions).

In our baseline model, we assume the following ordering: foreign liabilities, GDP, deposits and private credit. We place foreign liabilities first since it is to a large extent driven by external supply factors such as global risk appetite, parent bank health, economic conditions in a home country, and global funding markets. This assumption implies that foreign liabilities affect all other variables contemporaneously. In contrast, the other variables can only affect foreign liabilities with a 1-quarter lag. This is a reasonable assumption since reversing the flow of foreign liabilities is likely to take some time.

We place private credit last in the order because arguably private credit can react to all other factors quickly, i.e. in the same quarter; however, the private credit only affects other variables with a 1-quarter lag. Indeed, typically there is a delay between loan origination and loan deployment, so an impact on other variables can only be expected with a lag.

Having established foreign liabilities and private credit as first and last in the order, respectively, in our baseline model we put GDP second, followed by deposits. Our rationale is that GDP has a more immediate impact on deposits as money demand responds more quickly to changes in GDP, while changes in deposits are likely to affect GDP only with a lag. However, the alternative ordering in which deposits enter second and GDP third produces qualitatively similar results (available on request).

To analyze the impulse-response functions we need an estimate of their confidence intervals. Following Hamilton (1994) we calculate confidence intervals with Monte Carlo simulations.[14]

Finally, we also employ variance decompositions to understand the cumulative impact of the shock of a particular variable on the system. Variance decompositions show the percent of the total variation in one variable that is explained by the shock of another variable after a certain amount of time. They therefore provide an indication of the magnitude of the total effect one variable exerts on another. We report the total effect accumulated over 10 quarters, but longer time horizons produced equivalent results since after 10 quarters the effect of a shock has mostly worked its way through the system (and most impulse responses have converged to zero in our estimations).

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[14] Specifically, we randomly generate a draw of coefficients Γ_0 and Γ_1 from Equation (1) using the model estimations and the variance-covariance matrix and re-calculate the impulse-responses. We repeat this procedure 200 times and then generate the 5th and 95th percentiles of this distribution which we use as confidence intervals.

V.   Empirical Results

V.1.   *The Baseline Model for the Entire Sample*

Our baseline PVAR models the interaction between private credit, foreign liabilities, GDP, and deposits using Generalized Method of Moments (GMM) estimations for our entire sample of 41 countries. The baseline model will provide a good idea of the basic interactions between the variables for an average country and help us interpret the findings when we start splitting the sample.

We report the coefficient estimates of our reduced form PVAR models for the full sample, and the ECA and non-ECA subsamples in Table 5. Since our main focus is to isolate how shocks to one variable affect another variable, we don't focus on the coefficient estimates and instead turn our attention to the impulse-response functions, which take into account the coefficients, as well as the variance-covariance matrix of the errors.

Figure 2 shows 16 impulse-response functions for our baseline model. Each row corresponds to a particular variable and shows 4 impulse-response functions which display how this variable responds to an isolated shock of each of the variables in the system (i.e. including the variable itself). Each response is traced for 6 periods (i.e. 1.5 years) after which the shock has mostly worked its way through the system and any residual impact is minimal. For example, the graph in row 1, column 4 reports the response of foreign liabilities to a shock in private credit and the graph in row 4, column 1 reports the response of private credit to a shock in foreign liabilities. Because private credit comes later in the ordering, its impact on foreign liabilities is delayed by one period (and hence there is no effect at time zero), while the impact of foreign

liabilities on private credit is immediate and positive at time zero. Each graph shows the point estimates of the impulse-response function (the middle line) as well as the 5% and 95% confidence bounds (the top and the bottom lines) based on Monte Carlo simulations. The response is statistically significant if the confidence interval does <u>not</u> include the zero line.

Given our research objective to explain the behavior of private credit, we focus on row 4 which displays how private credit responds to various shocks. The same point estimates of the impulse responses plotted on the Figure 2 (i.e. the middle line) are also reported in Table 6. We document a significantly positive response of private credit to a shock in foreign liabilities. A one standard deviation shock in foreign liabilities results in a 1.24% increase in private credit growth at time zero which is large given that average private credit growth in our entire sample is 3.2% and its standard deviation is 5.12% (see Table 2). This is a key result which we will study further in order to understand response differences in ECA vs. non-ECA countries.

We also find a positive response of private credit to GDP, which in our model captures the demand for credit. This response is also statistically significant, but somewhat smaller in magnitude: 0.59% at time zero. Finally, we observe a positive and significant response of private credit to a deposits shock: 1.53% at time zero. Thus, we conclude that all our supply and demand factors are significant drivers of private credit.[15]

Other impulse-response functions in Figure 2 show interesting and intuitive results that are statistically significant. For example, foreign liabilities respond positively to a private credit shock (row 1, column 4) suggesting that a sudden increase in credit can be funded by foreign liabilities which can typically be attracted on short notice. At the same time, deposits also

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[15] Takáts (2010) finds that both demand and supply factors contributed to the fall in gredit during the crisis, but the impact of supply factors was stronger.

respond positively to a private credit shock (row 3, column 4) but the magnitude is smaller than for foreign liabilities, arguably because it is more difficult to significantly raise deposits in the short term. Together, these findings imply that foreign sources of funding can be useful to temporarily fill domestic funding gaps. We also find that a foreign liabilities shock has a positive impact on deposits (row 3, column 1) which implies that banks pursue deposit growth when foreign funding increases, possibly to avoid a relative over-reliance on foreign funding. Alternatively, an increase in deposits could be due to the perception that better performing banks are able to attract foreign funding. We also confirm that a private credit shock boosts GDP which is expected since private credit typically expands consumption and investment. This corroborates with results of the finance and growth literature (e.g. Levine, 2005).

While impulse-response functions show the short-term response of each variable to a shock in another variable, the long-term cumulative impact of a shock is captured by the variance decompositions. Table 7, Panel A displays the variance decomposition for our baseline model. Each cell in the table shows what percent of variation in the row variable is explained by the column variable after the 10 quarters, i.e. 2.5 years. Note that for all variables their own shocks explain most of the variance (i.e. the diagonal of Table 7, Panel A contains the largest values).

Row 4 of Table 7, Panel A reports that a foreign liabilities shock explains a relatively large part of the variance in private credit (9.7%). The deposits shocks explain an even larger portion of the variance (14.2%), while a shock to GDP explains relatively little variance at 2.4%. Taken together, our PVAR model explains a substantial portion of the variation in private credit (i.e. 26.2% is explained by other variables and 73.8% is explained by its own shocks). While our model explains smaller portion of the variation in the other variables, it works reasonably well to fulfill our main objective, which is to explain the behavior of private credit.

Before we proceed with our sample splits, we conduct various robustness checks to our baseline model (results of these additional tests are available on request). First, we include an additional lag of all variables in the model and find that our results are robust, even with decreasing degrees of freedom.[16] Second, we change the ordering of the variables where we interchange deposits and GDP and find our main results still hold. Finally, we find that dropping large outliers (i.e. extreme observations above 99th percentile and below 1st percentile) rather than winsorizing the data does not affect the results. Therefore, in the remainder of this paper, we use the ordering of the baseline model and include 1 lag only.

V.2.   *Sample Splits: Is ECA Different from the Rest of the World?*

In this section we formally test whether private credit in the ECA region responded differently compared to the rest of the world. To do that, we split our full sample into ECA and non-ECA subsamples and run separate PVARs for each subsample. The two subsamples are roughly equal in size: (ECA: 22 countries, 947 observations; non-ECA: 19 countries, 820 observations). Figure 3 presents the results. For space considerations, we only present impulse-response functions and variance decompositions for private credit, our key variable. In other words, only the fourth row of graphs from Figure 2 is presented for the split samples. The first and second rows in Figure 3 show the private credit responses to shocks of all four variables for the ECA and non-ECA subsamples, respectively. Both rows exhibit very similar patterns to our

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[16] Adding an additional lag to the model significantly increases the number of coefficients that have to be estimated – i.e. from 16 in our baseline model to 32 – and reduces the number of observations from 1,591 in the baseline model to 1,554 because one year of data is lost. The loss in degrees of freedom is particularly relevant for models for subsamples.

baseline findings and confirm our key result: the significant and positive response of private credit to a foreign liabilities shock. We also observe positive and significant responses in both samples to GDP and deposits shocks.

The key question, however, is whether the magnitude of the private credit response to a foreign liabilities shock is significantly different between the ECA and non-ECA subsamples. Visual inspection of the 95th percentile bound of the first two rows shows that response to a foreign liabilities shock is substantially larger in the ECA sample: 1.71% vs. 1.10% in non-ECA. Table 6 reports the actual point estimates for the impulse-response functions in period zero: 1.53 and 0.89 in ECA and non-ECA, respectively. The ECA response is thus 0.64 percentage points higher (72%), which is an economically relevant difference. The difference is even more pronounced after 1 quarter: the response in period 1 in ECA is 0.74, while in non-ECA it is 0.23 (i.e. the response is about 3 times higher in ECA). This pattern continues for several quarters: in quarter 3 the ECA response is at 0.28, while the non ECA is at 0.07. Thus, the impact of foreign liabilities shocks in ECA is not only stronger in magnitude, but also lasts longer.

To assess whether this difference is statistically significant, we calculate the impulse-response functions of the *difference* between ECA and non-ECA. Because the two subsamples are independent, the impulse-responses of the differences are equal to the difference in impulse-responses. To calculate the confidence interval, we merge the distributions of errors produced by Monte-Carlo simulations with 200 repetitions each for both samples and generate a new distribution which is the difference between errors generated in each of the repetitions (i.e. each of the 200 errors now contains the difference between the distributions). From this new distribution we generate new 5th and 95th percentile bounds.

Figure 3, row 3 presents the result of the difference in impulse responses ("Sample: Difference"). Row 3, column 1 confirms the difference in responses of private credit to foreign liabilities shock is indeed significant (i.e. the zero line is outside of the confidence interval). Other impulse-response functions in row 3 show that private credit does not behave differently in ECA in response to a GDP shock, while there is a slightly larger response to a deposits shock after 1 period.

Lastly, we compute the variance decompositions in the ECA and non-ECA subsamples to study the cumulative longer-term impact of various shocks on private credit. Table 7, Panel B reports the results. To save space, we only report the decompositions for the private credit variable. The first row is the baseline decomposition for the whole sample, replicated from Panel A. The second and third rows show the decompositions for the ECA and non-ECA subsamples, respectively. A foreign liabilities shock explains 6.0% of the private credit variation in non-ECA countries and 12.9% of the variation in the ECA subsample, which is more than twice as large. These findings establish the second of our key results: private credit in ECA has been more heavily influenced by shocks to foreign liabilities.

V.3.   *Further Sample Splits: Explaining Differences in Private credit Responses*

After establishing that private credit is significantly more responsive to foreign liabilities shocks in ECA compared to non-ECA countries, this section seeks to identify the factors that could drive the difference. As discussed earlier, the banking sector in ECA is markedly different from those in non-ECA countries along our sample split variables: ECA countries exhibit

significantly higher foreign ownership, higher reliance on foreign funding and higher LDR ratios.

To determine which of these factors can explain the differential responses of private credit to foreign funding shocks, we perform sample splits using each of the three sample-split variables one at a time. In each case we split the whole sample in two subsamples of equal size based on the median value of the variable in question. The sample-split approach is similar to interacting each of the factors with the responsiveness of private credit to foreign liabilities.[17]

First, we test whether LDR is driving the response differences. We calculate the pre-crisis median LDR ratio in our full sample using data from the fourth quarter of 2007. We then split the full sample into high and low LDR subsamples of equal size based on the median and rerun our baseline model for each sample. The impulse-response results are presented in Figure 4 and the variance decompositions are presented in Table 7, Panel B. We find that the difference between the response of private credit to a foreign liabilities shock in both high LDR and low LDR samples is positive and statistically significant.[18] The variance decomposition shows that in the high LDR subsample, a foreign liabilities shock explains 14.1% of the variation in private credit, while it explains only 5.6% of the variation in the low LDR sample. This finding suggests that high LDRs are associated with a stronger response of private credit to foreign funding shocks. While this does not present a direct proof, this finding suggests that high LDRs are at least partially responsible for higher response of private credit to foreign funding shocks in ECA.

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[17] Note that such interactions cannot be modeled directly in a VAR setting.
[18] The significance is at about 5% in period 1 because the bottom 5th percentile line is touching the zero line, while it is stronger in periods 0 and period 2 and 3.

Next, we perform another sample split to test whether foreign funding dependence is driving the difference. Similarly, we use pre-crisis foreign funding values for all countries from the fourth quarter of 2007 and split the sample into high and low foreign funding subsamples. The impulse-response results are presented in Figure 5 and the variance decompositions are presented in Table 7, Panel B. We find that the response of private credit to a foreign liabilities shock is significantly higher in the high foreign funding sum-sample. The variance decompositions show that in the high foreign funding subsample a foreign liabilities shock explains 12.9% of the variation in private credit, while it only explains 6.9% in the low foreign funding subsample. These results suggest that high reliance of countries on foreign funding is associated with stronger response of private credit to foreign funding. Again, the results are in line with the hypothesis that high reliance on foreign funding is responsible for explaining the difference between the ECA and non-ECA samples.

Lastly, we split our full sample using foreign ownership. Based on the latest pre-crisis data, we create high and low foreign ownership subsamples. The impulse-response results are presented in Figure 6 and the variance decompositions are presented in Table 7, Panel B. We find that the difference between the responses of private credit to a foreign liabilities shock in the high and low foreign ownership samples are not statistically significant (row 3). This is in contrast to previous findings of sample splits on LDR and foreign funding. The variance decompositions show that in the high foreign ownership subsample a foreign liabilities shock explains 10.0% of the variation in private credit while it explains 9.1% in the low foreign ownership subsample. These two values are not materially different here, while there was substantial difference in the two previous sample splits. These results suggest that in the whole

sample foreign ownership is not associated with a stronger response of private credit to foreign liabilities.

Taken together, our findings suggest that high LDR and high foreign funding in ECA are associated with stronger response of private credit to foreign funding shocks, while high foreign ownership does not appear to drive this difference. These results suggest that ECA funding model is at the heart of ECA's vulnerability to external financial shocks rather than the strong presence of foreign banks in the region *per se*. However, while these results are suggestive of the reasons for why ECA is different, they do not directly demonstrate this because we have used our whole sample to do the sample splits. In the next section we present a more direct evidence to explain the differences between ECA and non-ECA.

V.4.   *What factors explain differences of ECA and the rest of the world?*

In this section we provide more direct evidence on the factors that drive the differences in ECA and the rest of the world. While all three factors – LDR, foreign funding and foreign ownership – are higher in ECA, not all factors are present in all countries, as we discussed above. This allows us to investigate which of the three factors is driving the difference between ECA and non-ECA in terms of the measured response of private credit to foreign funding shocks.

The intuition for our procedure is as follows. We create a "truncated ECA sample" which is constructed to resemble to the non-ECA sample in one of the three indicators, without restricting the other two factors. For example, we make a "truncated ECA sample" by removing from ECA sample countries with extra high LDR. In practice, we drop countries with LDR that is higher than the median LDR in ECA. This "truncated ECA sample" is more similar to the rest

29

of the world based on average LDR because the highest LDR countries are now removed. Then, we run our PVARs on this "truncated ECA sample" and compare the results with the non-ECA sample. If we still find the difference between ECA and the rest of the world, we conclude that the specific factor (i.e. LDR) is _not_ driving such difference (because now ECA is similar to non-ECA based on this factor). If, however, we no longer find a difference between ECA and non-ECA, we conclude that this factor was indeed responsible for the observed difference between ECA and non-ECA. This procedure provides a more direct test of which factors are responsible for the differences between ECA and non-ECA in our PVAR framework, which is less flexible than a simple regression framework (i.e. we cannot implement the interaction terms directly because of the lag structure).

First, we remove from the ECA sample countries that are high on LDR. We use the median LDR in ECA (pre-crisis) to make this truncated sample. Table 4, Panel C reports the t-tests for comparison of this "truncated ECA" sample and non-ECA sample. The t-test shows that truncated ECA sample is not significantly different from non-ECA sample based on average LDR ratios. Figure 7 presents the differences between ECA and non-ECA samples in the impulse responses of the response of private credit to foreign liabilities shock. The graph in Panel Ashows that there is no longer a significant difference between ECA and non-ECA samples. Thus, LDR appears to be a factor responsible for observed differences between the (full) ECA sample and non-ECA sample.

Second, we remove from the ECA sample countries that are high on foreign funding. Again, we use the median foreign funding in ECA (pre-crisis) to make this truncated sample. The resulting sample contains ECA countries with relatively low foreign funding. However, even the "relatively low" foreign funding countries in ECA still have significantly higher foreign

funding: 20% in the truncated ECA sample, vs. 11% in the non-ECA sample. This difference is statistically significant (Table 4, Panel C). Ideally, we would like the truncated ECA sample to not be statistically different from non-ECA sample. However, while not "ideal", this truncated ECA sample stacks the cards toward finding the differential impact in the truncated ECA sample (which still is relatively high on foreign funding) and the non-ECA sample. In other words, this sample is biased toward finding the statistically significant differences in impulse responses. We then compare such truncated ECA sample with the rest of the world. Graph in Panel B in Figure 7 shows that the difference between the truncated ECA and the rest of the world is not significantly different from zero. This suggests that very high foreign funding is indeed a factor that explains the difference between the (full) ECA sample and the non-ECA sample.

Third, we remove from the ECA sample countries that are high on foreign ownership. Again, we use the median foreign ownership in ECA (pre-crisis) to make this truncated sample. This truncated sample is not significantly different in the average foreign ownership than non-ECA sample (Table 4, Panel C). The results in Panel C in Figure 7 show that there still is a significant difference between truncated ECA sample and non-ECA sample. Thus, even after removing half of the ECA sample with highest foreign ownership the remaining sample still shows a significant difference in impulse-responses relative to non-ECA countries. Before we make a final conclusion, we note that the truncated ECA sample still has a relatively high foreign ownership. The average foreign ownership in the truncated sample is 39%, while it is 33% in the rest of the world. However, this difference is not statistically significant (Table 4, Panel C). Nevertheless, to be sure, we perform even a stricter test. We drop four remaining high foreign ownership countries (Serbia, 75%, Latvia, 68%, Poland 68% and Armenia 60%). In other words, we removed from ECA sample any country with foreign ownership above 51%. This further

31

truncated sample (referred to as "foreign ownership 2" in Table 4, Panel C) has the average foreign ownership of 23%, which is way below the average foreign ownership in the non-ECA sample (i.e. 33%), although t-test shows that this difference is not statistically significant. Finally, we compare the behavior of this restricted sample with the non-ECA sample. Again, we find the two samples show statistically significantly different responses of private credit to foreign ownership (Panel D). In other words, even when the ECA looks statistically the same in terms of average foreign ownership as our non-ECA sample, there is still a significant difference in the responses of private credit to foreign funding shocks. Therefore, we conclude that foreign ownership does not appear to be the factor that is driving the difference between (full) ECA and non-ECA samples.

To summarize the results of this section, we show that removing from the ECA sample countries with very high foreign funding or very high LDR makes the "remaining ECA" sample to be similar to the rest of the world in the response of private credit to foreign funding shocks. This suggests that high foreign funding and high LDR are indeed the factors that are driving the observed differences between (full) ECA and non-ECA samples. However, high foreign ownership is not driving these differences because even when high foreign ownership countries are removed from the ECA sample and the "remaining ECA" has lower average foreign ownership than non-ECA sample, there is still a significant difference in the responses of private credit to foreign funding shocks. These results provide more direct evidence that high foreign funding and high LDR ratios were they key factors explaining higher sensitivity of private credit to foreign funding shocks in ECA, while high foreign ownership per se was not the main culprit.

VI.   Summary and Policy Implications

By applying PVARs to a global country panel database, we show that growth in bank credit to the domestic private sector is highly sensitive to cross-border funding shocks around the world. We find that this relationship is significantly stronger in the average ECA country where the response is larger and lasts longer compared to the average country in the rest of the world. At the same time, we show that foreign ownership *per se* does not explain the different credit responses in our sample of countries. Instead, our results indicate stronger responses in countries with high loan-to-deposit ratios and stronger reliance on foreign funding. Higher loan-to-deposit ratios make banks more vulnerable to general wholesale funding shocks while high reliance on foreign funding specifically implies exposure to more volatile cross-border financing flows and sensitivity to foreign shocks. Taken together, our findings therefore suggest that funding model differences with the rest of the world were at the heart of ECA's post-crisis credit growth contraction, and that this contraction was not simply due to the high prevalence of foreign bank ownership in the region.

Our findings provide an illustration of the potential downside risks of financial opening or financial integration in the absence of adequate regulatory and supervisory frameworks. The easy access to parent funding and direct wholesale borrowings abroad exposed many ECA countries to substantial funding risks which materialized when cross-border flows were interrupted by the global crisis and parent bank health deteriorated. The sudden slowdown of the

pace of funding contributed to a sharp slowdown of bank credit and GDP growth, as well as an accumulation of non-performing loans in many countries.[19]

The "Spanish model", in which standalone bank subsidiaries are fully funded locally, is likely to be an extreme solution for a region that shares a common market and a regulatory framework.[20] Thus, eradicating cross-border funding altogether and promoting a fully domestically funded subsidiary model also appears suboptimal as it may lead to costly pockets of inert liquidity and capital within banking groups. The important question therefore is what regulatory and supervisory approaches would allow ECA countries to reap most of the benefits of financial integration in the coming years, while mitigating the risks.

The full implementation of Basel III may contribute to the achievement of such an objective as it is expected to boost capital and liquidity and also promote more stable funding through the Net Stable Funding Ratio (NSFR). The Basel III approach also opens room for the introduction of additional capital charges on banks with domestic and regional systemic importance, such as Western European banks with a network of subsidiaries in the ECA region. However, the extent to which Basel III will effectively address the problems identified in the crisis remains to be seen.

There are other complementary measures that could also contribute to the achievement of this objective. For example, in 2012 Austrian regulators introduced a cap of 110 percent on the loan-to-deposit ratios of all subsidiaries of Austrian parent banks (see Austrian Financial Market Authority and Austrian National Bank (2012)). The approach of Austrian regulators does imply

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[19] The credit boom exposed ECA countries to other risks as well, including credit, interest rate, and exchange rate risks in their consumer, mortgage and SME portfolios.
[20] Fiechter et al (2011) discuss the choice between branches and subsidiaries and the implications for financial stability and Martel et al (2012) discuss business models of international banks in more detail.

some flexibility relative to the "Spanish model", although it was still met with reservations by many host regulators and parent banks when it was introduced.

Therefore, home and host regulators in Europe still face the challenge of designing an effective regulatory framework for cross-border banking in the coming years. Such a framework may include supplements to Basel III to prevent the funding and credit growth excesses of the past decade and the risk of another crisis, while allowing banking institutions to benefit from the centralized management of capital, liquidity, and funding. Additional measures can be taken by either home or host authorities, imposed at either the parent or subsidiary level. European authorities may also consider if specific supervisory guidance on cross-border funding is needed. Meeting this challenge will be important for ECA countries, especially smaller ones that face more constraints to develop local capital markets, and that may continue depending relatively more on parent and other sources of cross-border bank funding.

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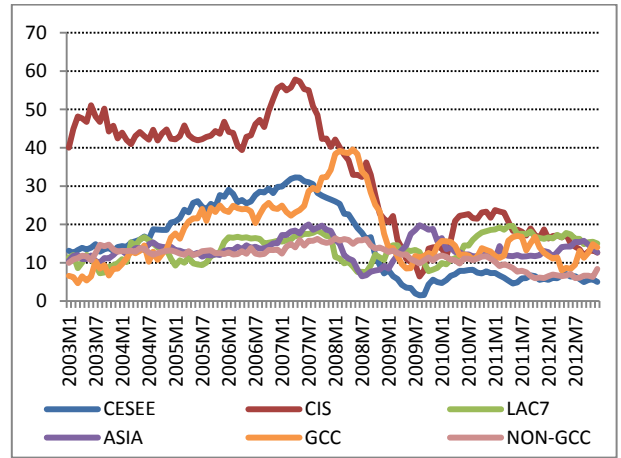
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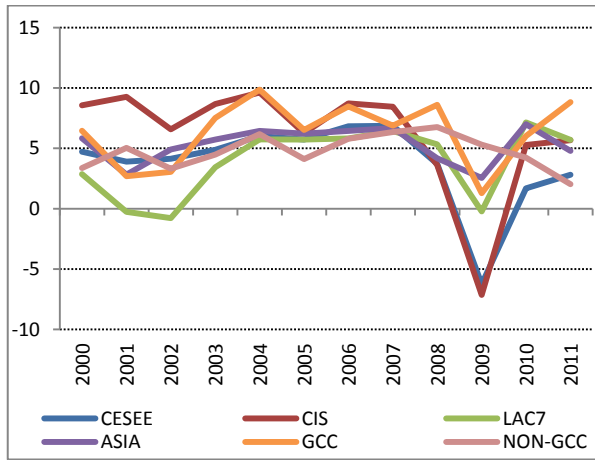
Figure 1 – Financial Sector Trends

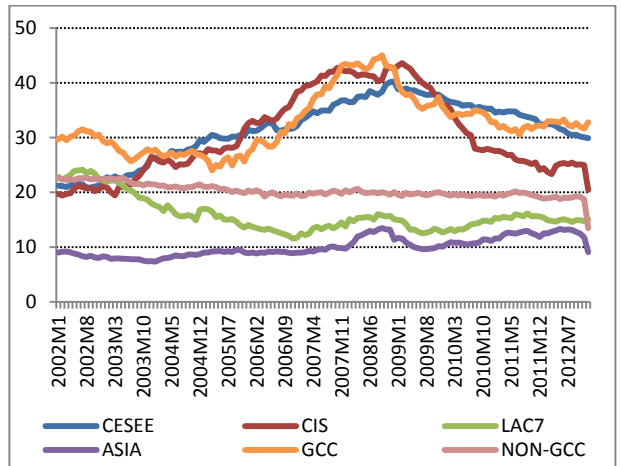**Panel A: Annual credit growth (regional average, %)**
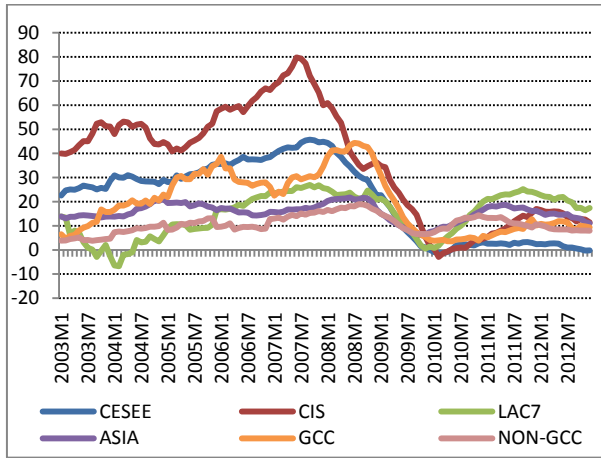
Panel B: Annual deposit growth (regional average, %)

Panel C: Annual GDP growth (regional average, %)

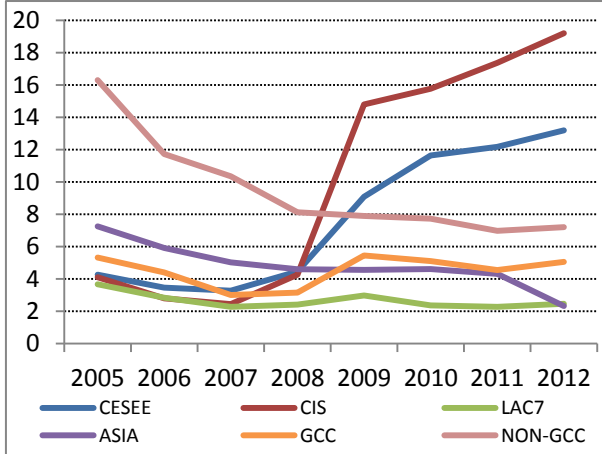**Panel D: Foreign liabilities to total liabilities (regional average, %)**

Source: IMF, International Financial Statistics

CESEE: Central, Eastern and Southeastern Europe, CIS: Commonwealth of Independent States, LAC: Latin America and Caribbean, GCC: Gulf Coast Countries.

Figure 1 – Financial Sector Trends, cont

Panel E: Nonperforming loans to total loans (regional average, %)

Source: IMF, Global Financial Stability Report

Panel F: Loan-to-deposit ratio (regional average, %)

Panel G: Asset share of foreign-owned banks (regional average, %)
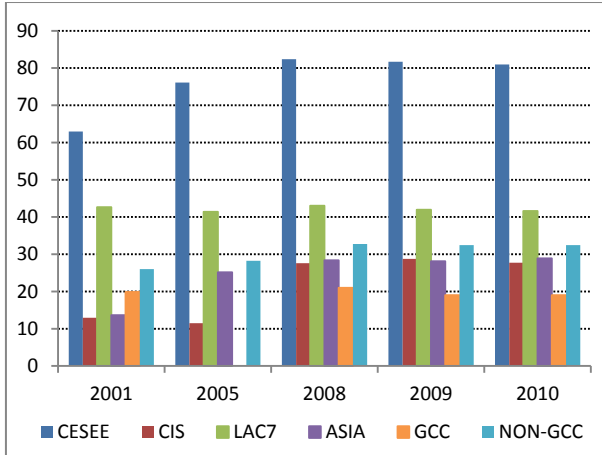
Source: World   Bank,   World   Development Indicators

Figure 2 - Baseline Panel Vector Autoregression Model

The figure displays impulse-response functions of the baseline 1-lag PVAR model which is based on 4 variables: foreign liabilities, GDP, deposits, and private credit.

Errors are 5% on each side generated by Monte-Carlo with 200 reps

Figure 3 - ECA vs. Non-ECA Sample Split

The figure shows impulse-response functions of private credit due to various shocks. The first and second rows provide the functions for the ECA and non-ECA subsamples, respectively. The third row provides the difference functions between these subsamples. The shocks are as follows: "foreign" is foreign liabilities, "gdp" is GDP, "deposits" is deposits, and "privcred" denotes private credit itself.

Figure 4- Sample Split by High and Low Loan-to-Deposit Ratios

The figure shows impulse-response functions of private credit due to various shocks. The first and second rows provide the functions for the high LDR and low LDR subsamples, respectively. The split is based on the median value (see text for details). The third row provides the difference functions between these subsamples. The shocks are as follows: "foreign" is foreign liabilities, "gdp" is GDP, "deposits" is deposits, and "privcred" denotes private credit itself.
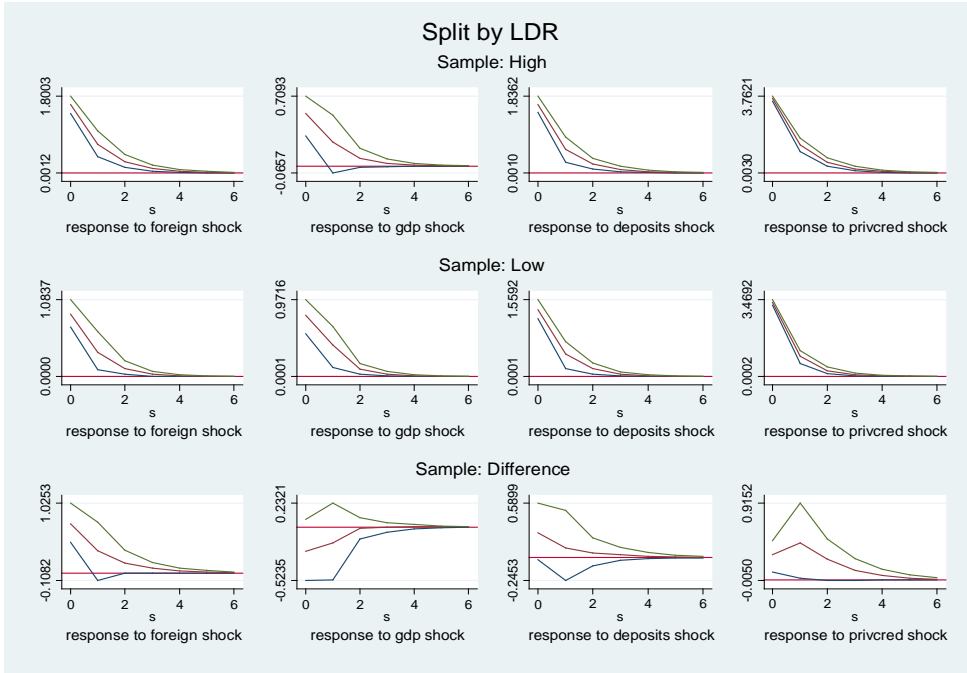
Figure 5 - Sample Split by High and Low Foreign funding Dependence
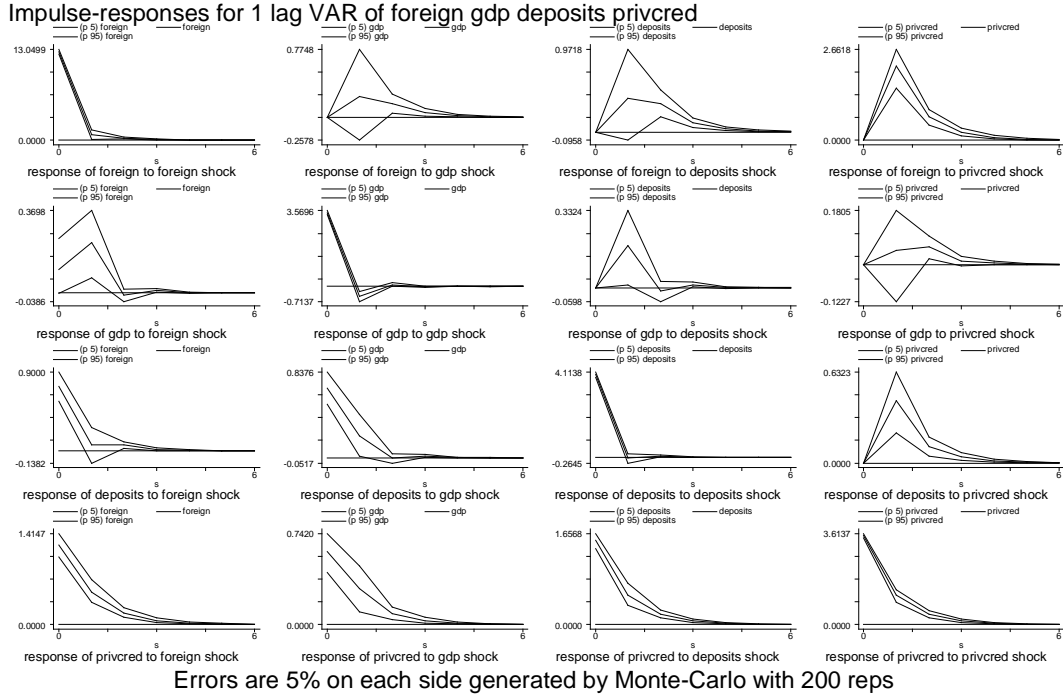
The figure shows impulse-response functions of private credit due to various shocks. The first and second rows provide the functions for the high foreign funding and low foreign funding subsamples, respectively. The split is based on the median value (see text for details). The third row provides the difference functions between these subsamples. The shocks are as follows: "foreign" is foreign liabilities, "gdp" is GDP, "deposits" is deposits, and "privcred" denotes private credit itself.
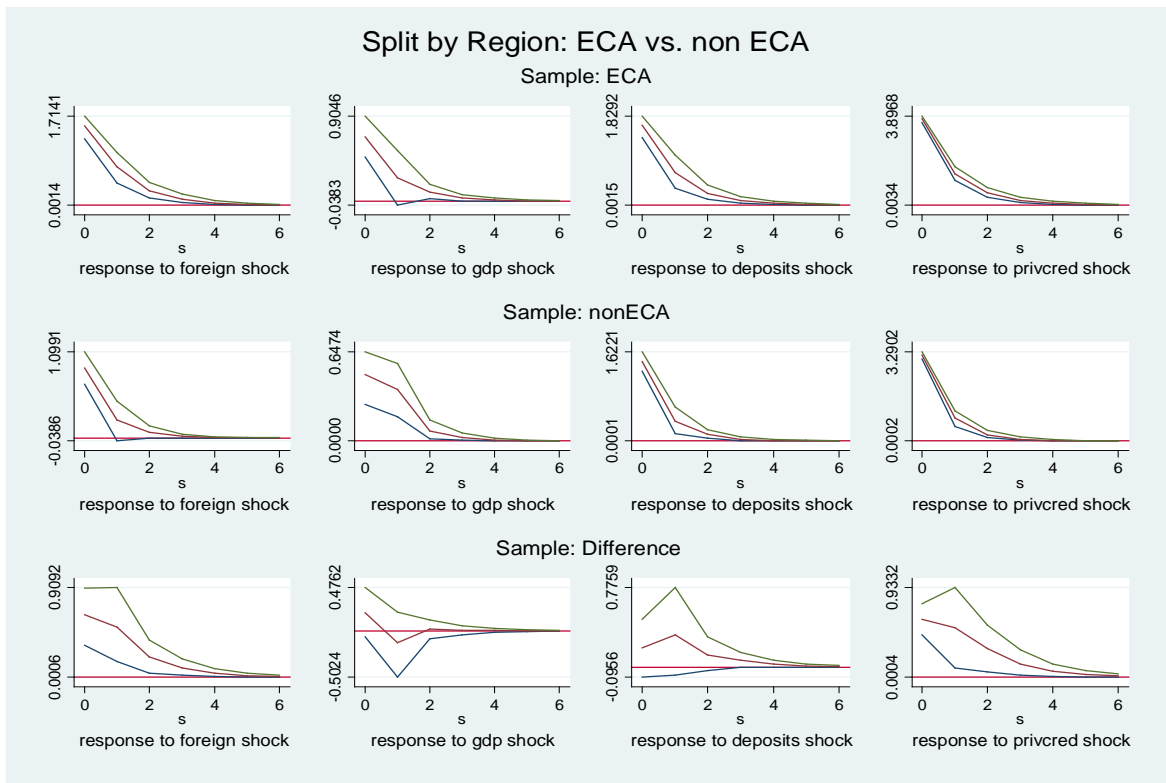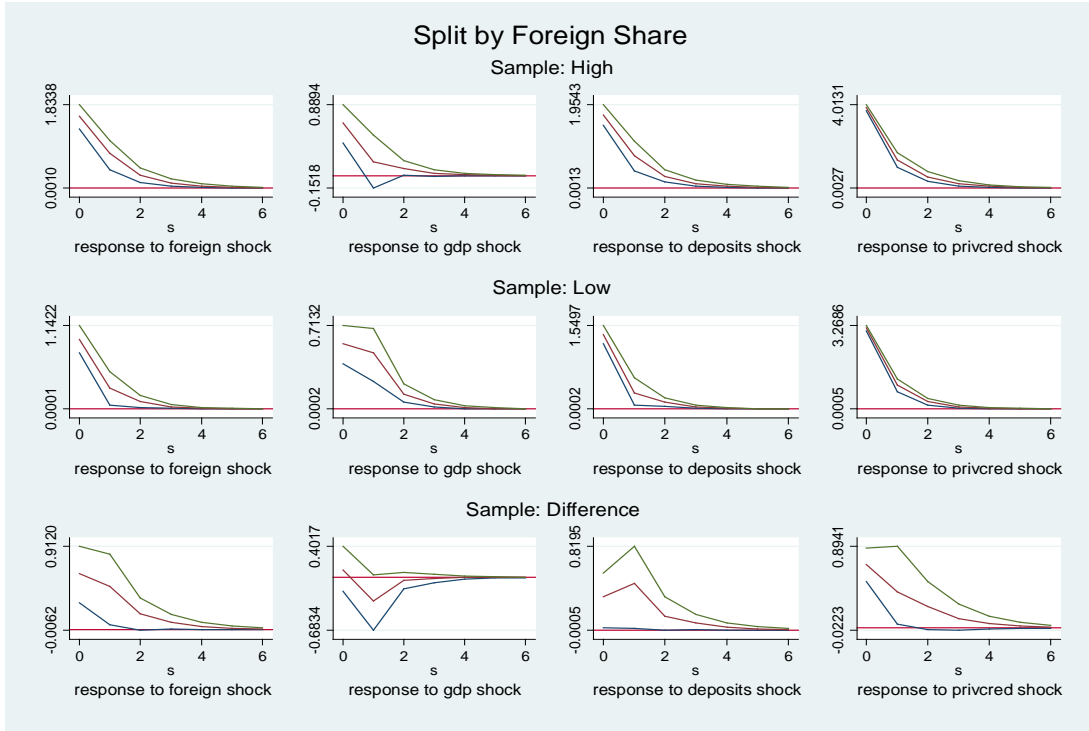
Figure 6 - Sample Split by High and Low Foreign ownership

The figure shows impulse-response functions of private credit due to various shocks. The first and second rows provide the functions for the high foreign ownership and low foreign ownership subsamples, respectively. The split is based on the median value (see text for details). The third row provides the difference functions between these subsamples. The shocks are as follows: "foreign" is foreign liabilities, "gdp" is GDP, "deposits" is deposits, and "privcred" denotes private credit itself.
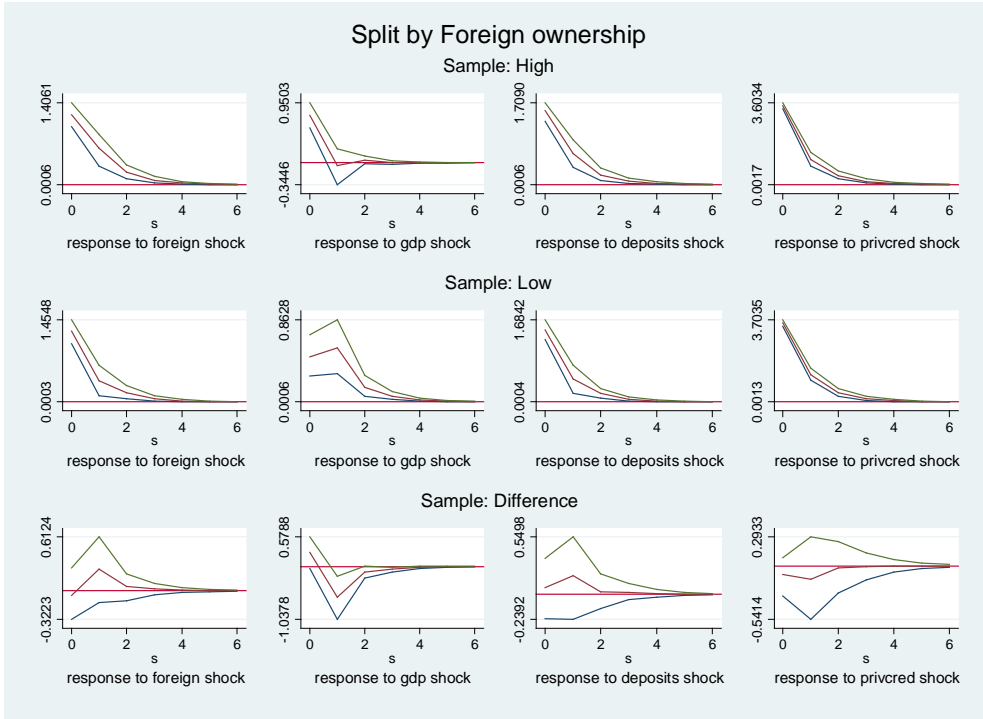
Figure 7. Truncated ECA sample vs. non-ECA

The graphs show differences in responses of private credit to foreign liabilities in truncated ECA samples vs. the rest of the sample. Each truncated ECA sample is constructed by removing from the ECA sample countries above the median for each of the three characteristic (one at a time): foreign ownership, foreign funding and LDR. The graph in column 2, row 2 removes additional 4 countries which have foreign ownership above 51%.

Panel A: ECA without high LDR versus non-ECA

Panel B. ECA without high foreign funding vs. non-ECA
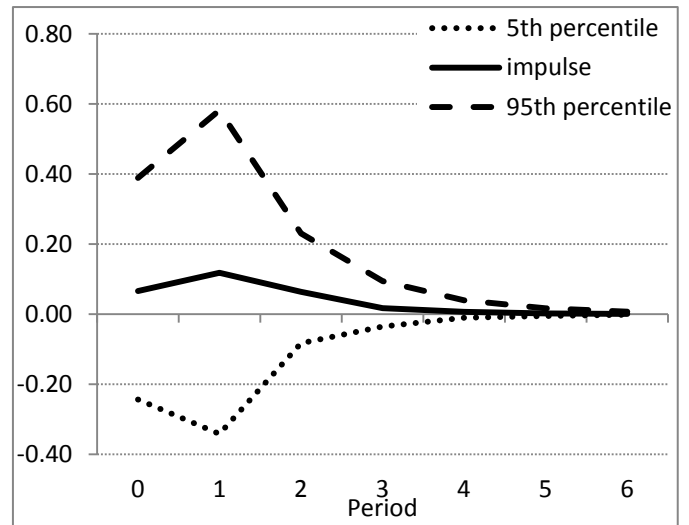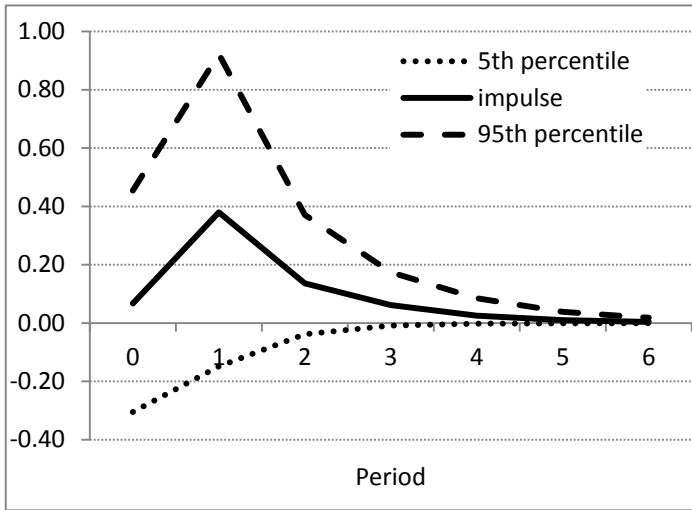
Panel C. ECA without high foreign ownership versus non-ECA

Panel D. ECA without high foreign ownership (above 51%) versus non-ECA

47
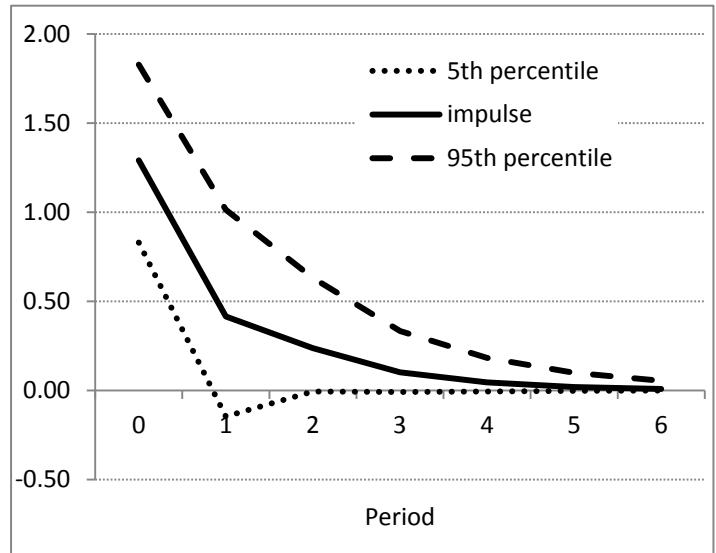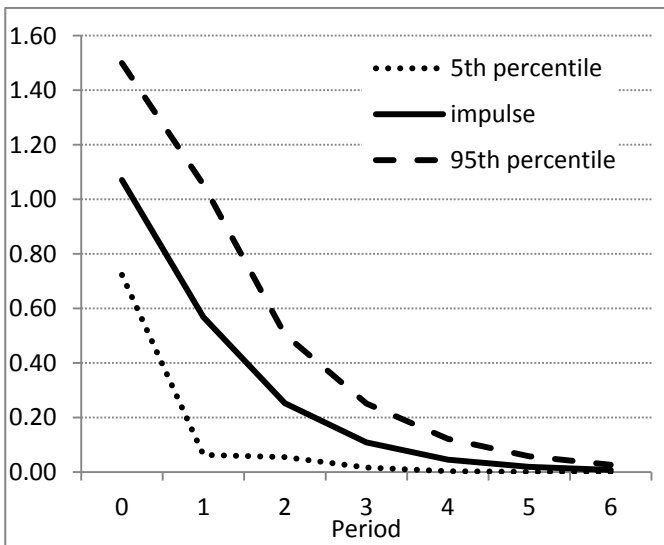
Table 1 - Variable Definitions and Sources

Variable Name	Full Name	Definition	Source
GDP	GDP	Gross Domestic Product, Nominal. Quarterly growth rates from figures in national currency (in percentage).	IMF, International Financial Statistics. For Albania, Colombia, Sri Lanka, Egypt, Tunisia and Nigeria, the sources are respective central bank websites.
private credit	Private credit	Other Depository Corporations, Line 22d (Claims on Private Sector). Quarterly growth rates from figures in national currency (in percentage).	IMF, International Financial Statistics. For Bulgaria, Czech Republic, Hungary, Latvia, Lithuania and Poland, the sources are respective central bank websites.
foreign liabilities	Foreign Liabilities	Other Depository Corporations, Line 26c (Liabilities to Non-residents). Quarterly growth rates from figures in national currency (in percentage).	IMF, International Financial Statistics
deposits	Deposits	Other Depository Corporations, Line 24 (Transferable Deposits Included In Broad Money) + line 25 (Other Deposits Included In Broad Money). Quarterly growth rates from figures in national currency (in percentage).	IMF, International Financial Statistics
foreign ownership	Foreign ownership of Banks	Share of banking system's assets where foreigners own 50% or more equity (in percentage). End-of-year figures.	World Bank, Bank Regulation and Supervision Survey
LDR	Loan-to-deposit Ratio	Private credit/Deposits*100	IMF, International Financial Statistics
foreign funding	Share of foreign liabilities	Foreign liabilities/(foreign liabilities + Deposits)*100	Authors calculation based on the original data from above sources

Table 2A - Summary Statistics for Quarterly PVAR Variables

All variables are expressed as quarterly real growth rates (%).

i) Full sample

	FOREIGN LIABILITIES	PRIVATE CREDIT	GDP	DEPOSITS
N	1,767	1,767	1,767	1,767
mean	3.86	3.23	-0.01	2.62
Sd	13.66	5.12	3.53	4.67
p1	-28.10	-10.72	-11.05	-9.80
p25	-4.42	0.11	-1.55	-0.10
p50	2.36	2.66	0.07	2.08
p75	9.97	6.00	1.71	4.85
p99	52.40	19.42	9.21	16.70

ii) ECA

	FOREIGN LIABILITIES	PRIVATE CREDIT	GDP	DEPOSITS
N	947	947	947	947
mean	5.75	4.55	-0.05	3.41
Sd	14.07	5.78	4.18	5.42
p1	-29.13	-10.79	-13.67	-10.61
p25	-2.99	0.61	-1.82	-0.07
p50	4.37	4.56	0.06	2.82
p75	12.43	8.18	2.05	6.59
p99	55.20	20.31	10.55	20.50

iii) Non-ECA

	FOREIGN LIABILITIES	PRIVATE CREDIT	GDP	DEPOSITS
N	820	820	820	820
mean	1.68	1.71	0.03	1.70
Sd	12.84	3.70	2.60	3.40
p1	-27.09	-9.55	-7.31	-7.26
p25	-5.72	-0.33	-1.28	-0.18
p50	-0.13	1.61	0.08	1.67
p75	7.12	3.60	1.40	3.56
p99	43.67	11.36	6.48	10.30

Table 2B - Summary Statistics for Split Variables

All variables are expressed as percentages (%).

i) Full sample

	LDR	FOREIGN FUNDING	FOREIGN OWNERSHIP
N	41	41	41
mean	115.10	0.22	50.02
p50	99.58	0.17	51
Sd	48.96	0.16	31.47

ii) ECA

	LDR	FOREIGN FUNDING	FOREIGN OWNERSHIP
N	22	22	22
mean	127.22	0.32	64.64
p50	115.5	0.28	79.61
Sd	47.30	0.16	31.48

iii) Non-ECA

	LDR	FOREIGN FUNDING	FOREIGN OWNERSHIP
N	19	19	19
mean	101.07	0.11	33.09
p50	83.53	0.10	29.93
Sd	48.27	0.06	21.94

Table 3 - Correlations

Panel A. PVAR Variables

	foreign liabilities	GDP	deposits	private credit
Full Sample				
foreign liabilities	1			
GDP	**0.05**	1		
deposits	**0.24**	**0.18**	1	
private credit	**0.40**	**0.16**	**0.51**	1
ECA				
foreign liabilities	1			
GDP	0.05	1		
deposits	**0.30**	**0.20**	1	
private credit	**0.50**	**0.18**	**0.54**	1
non ECA				
foreign liabilities	1			
GDP	0.06	1		
deposits	**0.13**	**0.11**	1	
private credit	**0.23**	**0.11**	**0.42**	1

Bold numbers indicate statistical significance at 5%.

Panel B. Sample Split Variables

	foreign ownership	foreign funding	LDR
Full Sample			
foreign ownership	1		
foreign funding	**0.35**	1	
LDR	0.08	**0.54**	1
ECA			
foreign ownership	1		
foreign funding	-0.06	1	
LDR	-0.12	**0.96**	1
non ECA			
foreign ownership	1		
foreign funding	0.30	1	
LDR	-0.11	-0.02	1

Bold numbers indicate statistical significance at 5%.

Table 4 - Mean Tests for ECA vs. Non-ECA

Reported are means and t-tests for differences in means between ECA and non-ECA countries. Variables are quarterly growth rates (%). T-test significance is indicated by stars: ***, ** and * represent 1%, 5% and 10% respectively.

Panel A: Key Differences for PVAR Variables (growth rates in %)

	Sample: Non-ECA		Sample: ECA		T-test Significance
	N(1)	Mean(1)	N(2)	Mean(2)	
	Years 2005-2007				
foreign liabilities	300	3.64	286	10.06	***
GDP	239	0.51	263	0.95	**
deposits	312	2.65	286	5.42	***
private credit	312	3.15	286	7.87	***
	Years 2008-2009				
foreign liabilities	214	0.74	192	2.33	
GDP	160	-0.51	176	-1.86	***
deposits	222	1.59	192	1.34	
private credit	222	1.45	192	2.15	*
	Years 2010-2011				
foreign liabilities	214	3.62	192	-0.02	***
GDP	159	0.09	176	-0.11	
deposits	222	1.81	192	1.59	
private credit	222	2.19	192	0.67	***

Panel B: Key Differences for Sample Split Variables

Variables are measured at pre-crisis levels: 2007 Q4 for LDR and Foreign funding and 2008 for foreign ownership.

Variable	Sample: Non-ECA		Sample: ECA		T-test Significance
	N(1)	Mean(1)	N(2)	Mean(2)	
LDR	19	101%	22	127%	**
foreign funding	19	11%	22	32%	***
foreign ownership	19	33%	22	65%	***

Panel C: Key Differences for Sample Split Variables for truncated ECA sample

Variables are measured at pre-crisis levels: 2007 Q4 for LDR and Foreign funding and 2008 for foreign ownership. Truncated ECA sample is constructed by removing from ECA sample countries above the median for each of the indicator one at a time. The "foreign ownership 2" sample is truncated further to remove 4 more countries with high foreign ownership: (Serbia, 75%, Latvia, 68%, Poland 68% and Armenia 60%), in effect it removes all countries with foreign ownership above 51%.

Variable	Sample: Non-ECA		Sample: truncated ECA		T-test Significance
	N(1)	Mean(1)	N(2)	Mean(2)	
LDR	19	101%	11	92%	
foreign funding	19	11%	11	20%	***
foreign ownership	19	33%	11	39%	
foreign ownership 2	19	33%	7	23%	

Table 5 - GMM Estimates of the Reduced-Form PVAR Models

This table reports system estimates in which each of the dependent variables is regressed on the lags of the other variables in the system, estimated by system GMM in which the original variables are transformed using forward orthogonal deviations. The instruments are lags of the untransformed variables as described in text. All variables enter as real quarterly growth rates.

	Dependent Variable:							
	foreign liabilities		GDP		deposits		private credit	
	Coef	*T-stat*	Coef	*T-stat*	Coef	*T-stat*	Coef	*T-stat*
Full Sample								
L.FOREIGN	0.01	*0.33*	0.02	*2.01*	0.00	*-0.33*	0.00	*0.72*
L.GDP	-0.01	*-0.10*	-0.14	*-3.28*	0.05	*1.38*	0.03	*0.78*
L.deposits	-0.14	*-1.44*	0.04	*1.41*	-0.05	*-1.39*	0.01	*0.23*
L.CREDIT	0.61	*5.95*	0.01	*0.49*	0.12	*3.44*	0.33	*8.89*
ECA								
L.FOREIGN	0.00	*0.01*	0.02	*1.90*	0.00	*-0.24*	0.01	*0.89*
L.GDP	-0.02	*-0.13*	-0.15	*-2.61*	0.03	*0.64*	-0.00	*-0.06*
L.deposits	-0.18	*-1.54*	0.03	*0.76*	-0.04	*-0.77*	0.02	*0.40*
L.CREDIT	0.69	*4.83*	-0.01	*-0.38*	0.09	*1.74*	0.36	*7.10*
Non ECA								
L.FOREIGN	0.02	*0.44*	0.00	*0.63*	0.00	*-0.12*	0.00	*-0.08*
L.GDP	0.00	*0.00*	-0.12	*-2.56*	0.11	*2.41*	0.10	*2.03*
L.deposits	-0.05	*-0.28*	0.07	*2.52*	-0.09	*-1.66*	-0.01	*-0.18*
L.CREDIT	0.47	*3.30*	0.05	*1.87*	0.19	*4.14*	0.27	*4.93*

Table 6 - Impulse Response Functions for Private credit Growth

Each cell shows a response of private credit to a shock in a column variable in a period specified in the Period column. The same responses are plotted in the middle line in the last row of graphs in Figure 2 for the full sample and Figure 3 for ECA vs. non-ECA sample split.

Period	foreign liabilities	GDP	deposits	private credit
Full Sample				
0	1.24	0.59	1.53	3.53
1	0.51	0.29	0.54	1.16
2	0.18	0.09	0.18	0.40
3	0.06	0.03	0.06	0.14
4	0.02	0.01	0.02	0.05
5	0.01	0.00	0.01	0.02
6	0.00	0.00	0.00	0.01
ECA				
0	1.53	0.68	1.63	3.76
1	0.74	0.25	0.68	1.35
2	0.28	0.10	0.24	0.53
3	0.11	0.04	0.10	0.20
4	0.04	0.01	0.04	0.08
5	0.02	0.01	0.01	0.03
6	0.01	0.00	0.01	0.01
Non-ECA				
0	0.89	0.49	1.45	3.16
1	0.23	0.37	0.35	0.84
2	0.07	0.07	0.12	0.23
3	0.02	0.03	0.03	0.07
4	0.01	0.00	0.01	0.08
5	0.00	0.00	0.00	0.01
6	0.00	0.00	0.00	0.00

Table 7. Variance Decompositions

Panel A. Baseline PVAR Model

Each cell shows the percent of variation in the row variable explained by a shock of the column variable after 10 quarterly periods.

	foreign liabilities	GDP	deposits	private credit
Baseline Model				
foreign liabilities	96.7%	0.0%	0.1%	3.1%
GDP	0.5%	99.2%	0.2%	0.0%
deposits	3.2%	3.0%	92.6%	1.2%
private credit	9.7%	2.4%	14.2%	73.8%

Panel B. Variance Decomposition for Private credit Growth in Various Sample Splits

Each cell reports the percent of variance in private credit explained after 10 quarters by a shock to the column variable.

	Obs	foreign liabilities	GDP	deposits	private credit
Full Sample	1,767	9.7%	2.4%	14.2%	73.8%
ECA	947	12.9%	2.3%	13.9%	70.9%
Non-ECA	820	6.0%	2.6%	15.7%	75.6%
High LDR	895	14.1%	1.6%	13.9%	70.5%
Low LDR	872	5.6%	4.8%	13.2%	76.3%
High foreign funding	799	12.9%	1.9%	14.7%	70.4%
Low foreign funding	968	6.9%	3.8%	13.8%	75.5%
High foreign ownership	886	10.0%	3.0%	15.2%	71.8%
Low foreign ownership	881	9.1%	3.0%	12.8%	75.2%