North American Journal of Economics and Finance 52 (2020) 101140

Contents lists available at ScienceDirect

North American Journal of Economics and Finance

journal homepage: www.elsevier.com/locate/najef

The role of credit supply shocks in pacific alliance countries: A TVP-VAR-SV approach

Carlos Guevara[a,b,1], Gabriel Rodríguez[a,c,*,2]

[a] Pontificia Universidad Católica del Perú, Peru
[b] Central Reserve Bank of Peru, Peru
[c] Fiscal Council of Peru, Peru

ARTICLE INFO

Keywords:
Loan supply shocks
Time-varying parameter VAR with stochastic volatility
Sign restrictions
Impulse-response function
Historical decomposition
Business cycles
Pacific alliance bloc
Chile
Peru
Mexico
Colombia

JEL classification:
C32
E32
E51

ABSTRACT

This paper analyzes the effect of loan supply shocks on the real economic activity of Pacific Alliance countries using a Time-Varying Parameter VAR with Stochastic Volatility (TVP-VAR-SV) model which is identified by sign restrictions. Two main results arise from the analysis. First, loan supply shocks have an important impact on real economic activity in all Pacific Alliance countries: about 1% in Colombia, Mexico, and Peru, and about 0.5% in Chile. Thus, its contribution to business cycle fluctuations is similar to that of aggregate supply shocks and aggregate demand shocks in both stability and slowdown periods. Second, the power of loan supply shocks to affect economic activity do not remain constant over the time and its evolution across periods is heterogeneous among all Pacific Alliance countries. The sensitivity analysis indicates that the results of the model are robust to different priors specifications and to multiple sets of sign restrictions.

1. Introduction

Recent work on both the theoretical and empirical fronts emphasizes the role of financial intermediaries as a source of shocks defined as loan supply shocks. In the field of theoretical research, Goodfriend and McCallum (2007) introduce banks in DSGE models

This paper is drawn from Carlos Guevara's Thesis at the Department of Economics of the Pontificia Universidad Católica del Perú (PUCP). We thank the useful comments by Professor Paul Castillo B. (Central Reserve Bank of Peru, BCRP, and PUCP), Oscar Dancourt (PUCP), participants in the 4th Annual Congress of the Peruvian Economic Association (APE, Lima, August 11-12, 2017), the XXXVI Economists Meeting of the Central Bank of Peru (Lima, October 30-31, 2018), and the 43rd Symposium of Spanish Association (SAEE, Universidad Carlos III, Madrid, Spain, December 13-15, 2018). Very useful comments from the Editor and one anonymous referee have helped to improve the paper and are gratefully acknowledged. The views expressed in this paper are those of the authors and do not reflect necessarily the positions of the Central Reserve Bank of Peru and the Fiscal Council of Peru, respectively. Any remaining errors are our responsibility.

* Corresponding author.
E-mail addresses: enrique.guevara@pucp.pe, carlos.guevara@bcrp.gob.pe (C. Guevara), gabriel.rodriguez@pucp.edu.pe (G. Rodríguez).
[1] Central Reserve Bank of Peru, 441 Sta. Rosa Street, Lima 1, Lima, Peru.
[2] Department of Economics, Pontificia Universidad Católica del Perú, 1801 Universitaria Avenue, Lima 32, Lima, Perú.

https://doi.org/10.1016/j.najef.2019.101140
Received 15 August 2019; Received in revised form 29 November 2019; Accepted 16 December 2019
Available online 19 December 2019
1062-9408/ © 2019 Elsevier Inc. All rights reserved.

and formulate explicit shocks originated in the supply side of credit markets, thus they estimate that LS shocks contribute moderately to the business cycle. Christiano, Motto, and Rostagno (2010), meanwhile, propose a model where frictions are located on the demand side of credit; i.e., entrepreneurs, and detect that the effect of shocks arising from financial system is weak. However, Gerali, Neri, Sessa, and Signoretti (2010) adopt a model with imperfectly competitive banking sector and show that financial system acts as a source of variability that affects business cycle fluctuations which is reinforced by results of theoretical model of Jermann and Quadrini (2012), Gertler and Karadi (2011), Cúrdia and Woodford (2010), Atta-Mensah and Dib (2008) and Hafstead and Smith (2012)[3].

Regarding the empirical literature, the evidence from early research on LS shocks supports both a high importance and a low relevance of such disturbances for real economic activity; see, for instance; Stock and Watson (1989), Friedman and Kuttner (1992), Ramey (1993), Kashyap, Lamont, and Stein (1994) and Faust (1998). In fact, Bernanke and Gertler (1995) argue that this lack of consensus is explained by and identification problem where it is difficult to isolate output or credit movements due to a shift in credit demand or supply. To facing the identification problem, an emerging thread in the literature proposes sign restrictions as a method of identification. Bean, Paustian, Penalver, and Taylor (2010) propose that credit supply shocks can be isolated from demand shocks by restricting supply shocks to affect credit volume and loan rates in different directions. By using this identification scheme, the authors estimate that credit supply shocks have real effects. Helbling, Huidrom, Kose, and Otrok (2011), Hristov, Hü lsewig, and Wollmershäuser (2012) and Halvorsen and Jacobsen (2014) by imposing restrictions in additional variables estimate that credit market shocks have a considerable impact on output. More recently, Barnett and Thomas (2014), Bijsterbosch and Falagiarda (2015) and Gambetti and Musso (2017) analyze the real effects of loan supply shocks and reinforce previous evidence, but they also detect that the potential effects do not remain stable over time[4].

Nevertheless, this literature focuses on countries where capital markets have greater role as a source of funds than banking system. In this context, it is expected that loan supply shocks contribute only partially to the business cycle. For this reason, in order to shed light about the importance of shocks arising from the banking system, this research assesses the effects of loan supply shocks in economies where the banking sector is the main source of funds. In particular, the countries under study are Chile, Colombia, Mexico, and Peru; i.e., the members of the Pacific Alliance (PA) bloc[5].

In the countries under study, the banking sector has expanded considerably, which may suggest that the dynamics between the banking system and real economic activity may not remain constant over time, as documented by Barnett and Thomas (2014) for other cases. Along these lines, the model used in this research is a time-varying parameter VAR with stochastic volatility (TVP-VAR-SV) similar to the specification suggested by Bijsterbosch and Falagiarda (2015) and Gambetti and Musso (2017). The use of time-varying parameters in the model allows to estimate the time-varying dynamics between variables while, according to Nakajima (2011), the introduction of stochastic volatility is expected to improve the estimation of the model. In order to identify the loan supply shocks, sign restrictions are employed. Four kinds of shocks are identified: aggregate demand (AD) shocks, aggregate supply (AS) shocks, monetary policy (MP) shocks, and loan supply (LS) shocks. The model is estimated using Bayesian techniques, which is suitable for the high dimensionality of the parameter space and for the non-linearities of the model.

The first principal result from the analysis is that LS shocks have an important effect on real economic activity in all PA countries. The impact over GDP growth is estimated to be around 1% in Colombia, Mexico, and Peru and about 0.5% in Chile. Thus, the results indicate that LS shocks contribute noticeable to GDP growth, in a similar way to that of AS shocks and AD shocks in both stability and slowdown periods. Specifically, during stability periods, it is estimated that the average contribution of LS shocks to GDP growth is on average 0.23 percentage points in all PA countries. Regarding to slowdown periods, its contribution is estimated to be higher. In particular, during the Russian and Asian crises of the late 1990s, LS shocks diminished GDP growth by about -0.67 percentage points in Chile, Colombia, and Peru while in the 2008 crises LS shocks contributed to reduce GDP growth by about -1.19 percentage points in Mexico, Chile, and Peru.

The second principal result is that the distribution of the impulse response functions (IRFs) shows significant differences across the analyzed periods and that the power of LS shocks to affect GDP growth has evolved in a heterogeneous way among PA countries. In Colombia and Peru, the impact in recent periods is estimated to be higher than in the 1990s, while in Mexico and Chile the impact has increased considerably, although at a certain point it started to decline to levels close to those at the beginning of the sample.

In order to assess the robustness of the results, two sensitivity analyses are performed: different prior specifications and multiple sets of sign restrictions. In most specifications the results do not differ much from baseline, indicating that the analysis is robust. However, in the case of Mexico and Chile, the results estimated using the sign restrictions of Gertler and Karadi (2011) and Cúrdia and Woodford (2010) are quantitatively different from baseline specification, but qualitatively similar. Although results differ, it is observed that such alternative specification and the baseline are linkaged by the probability space of IRFs. Moreover, as can be

[3] For a comprehensive review, see Mumtaz, Pinter, and Theodoridis (2018).

[4] Meeks (2012) criticizes previous literature and argues that restrictions must be imposed only on pure financial variables. In this way, the author uses a VAR model and identifies the model by imposing restrictions only on spreads and default rates and assuming an agnostic position on the response of GDP. He finds that LS shocks have a lesser impact on economic activity in stable times, but are highly important during economic crises, which confirms the stance of Bernanke and Gertler (1995).

[5] For references for other countries, see, for instance, Abildgren (2012) for Denmark; Bäurle and Scheufele (2016) for Switzerland, Busch, Scharnagl, and Scheithauer (2010) for Germany; Deryugina, Kovalenko, Pantina, and Ponomarenko (2015) for Russia; Duchi and Elbourne (2016) for Netherlands; Halvorsen and Jacobsen (2014) for Norway; Houssa, Mohimont, and Otrok (2013) for South Africa; Mwabutwa, Viegi, and Bittencourt (2016) for Malawi; Kabashi and Suleva (2016) for Macedonia; Hosszú (2018) for Hungary; Pereira and da Silva Fonseca (2012) for Brazil:

observed in the baseline model and all other set of sign restrictions, the response of real economic activity to LS shocks is restricted to be positive. This may cause the true effect not to be captured. For that reason, the response of GDP growth to LS shocks is not restricted. This idea follows the agnostic identification proposed by Uhlig (2005). The results indicate that, even in this agnostic identification, the response of real economic activity remains positive and significant.

The paper is structured as follows. Section 2 lays out the econometric model, explains the statistical methodology for estimating the parameters, provides a brief description of the data, and discusses the identification scheme. Section 3 presents and discusses the results of the model. Section 4 discusses the robustness of the results. Sections 5 provides the conclusions.

2. Empirical methodology

2.1. The empirical model

The empirical approach follows the model proposed by Primiceri (2005), which is a TVP-VAR-SV model. On one hand, the inclusion of time-varying coefficients attempts to capture the evolution of macroeconomic dynamics. On the other hand, multivariate stochastic volatility allows to capture shocks heteroskedasticity which improves estimates according to Nakajima (2011). Consider the reduced-form VAR:

$$y_t = B_{0,t} + \sum_{i=1}^{p} B_{i,t}y_{t-i} + u_t, \tag{1}$$

where y_t is an $n \times 1$ vector of endogenous variables, $t = 1, 2...,T$, $B_{0,t}$ is an $n \times 1$ vector of time-varying intercepts, $B_{i,t}$ is an $n \times n$ matrix of time-varying coefficients, and u_t is the heteroskedastic innovation, such that $E(u_t) = 0$ and $E(u_t u_t') = \Sigma_t$, where $[\Sigma_t]_{ij} \neq 0$ for each $i \neq j$. The variance-covariance matrix Σ_t is factorized by triangular decomposition $\Sigma_t = A_t^{-1}H_tH_t'A_t^{-1'}$, where A_t is an $n \times n$ lower triangular matrix that associates variance of structural innovation with variance of the model in its reduced form; i.e. contemporaneous coefficients, and H_t is an $n \times n$ diagonal matrix that contains the standard deviations of the structural errors.

In order to obtain a tractable model, the VAR is transformed into a simultaneous equation model. Let $Z_t' = \left[1, y_{t-1}', ..., y_{t-p}'\right]$ be a row vector of exogenous variables and $B_t = [B_{0,t}, B_{1,t}, ...B_{p,t}]$a matrix of time-varying coefficients. Then, the elements of B_t are stacked such that $\beta_t = vec(B_t')$, where *vec* is the column stacking operator. Thus, Eq. (1) can be written as:

$$y_t = [I_n \otimes Z_t']\beta_t + A_t^{-1}H_t \epsilon_t, \tag{2}$$

where the operator $\otimes$is the Kronecker product and $u_t = A_t^{-1}H_t \epsilon_t$, where the term ϵ_t are the structural shocks, such that $E(\epsilon_t \epsilon_t') = I_n$.

In order to establish the dynamics of the model, it is required to collect the components of H_t and A_t. In this way, the $i < j$ elements of A_t are compiled in a vector $\alpha_t = [\alpha_{21,t}, \alpha_{31,t}, ..., \alpha_{n(n-1),t}]'$ and the diagonal elements of H_t in a vector $\sigma_t = [\sigma_{1,t}, \sigma_{2,t}, ..., \sigma_{n,t}]'$. Then, β_t and α_t are modeled as random walk process while σ_t is modeled as a geometric random walk process. The innovations to each coefficient is assumed to be orthogonal.

The moving average representation of (1) is:

$$y_t = \mu_t + \Psi_t(L)u_t, \tag{3}$$

where μ_t is the time-varying mean of y_t and $\Psi_t(L) = \sum_{j=1}^{\infty} \Psi_{j,t}L^j$ is the time-varying multiplier of the Wold decomposition. The IRFs are determined by $\Psi_t(L)$, but the targets are structural IRFs defined by $\Psi_t(L)A_t^{-1}H_t$. To achieve this objective, sign restrictions are used. The implementation of sign restrictions need an orthogonal matrix R such that $RR' = R'R = I_n$. By using this matrix, the innovation of the reduced form is such that $u_t = A_t^{-1}H_tR \epsilon_t$ and the IRFs are $IRF = \Psi_t(L)A_t^{-1}H_tR$. Note that although the expression of ϵ_t has changed, since matrix R is orthogonal, the decomposition of Σ_t is not altered. Nevertheless, matrix R is not unique. For that reason, many draws are simulated for each possible value of R.

2.2. Estimation procedure

Given the context of high dimensionality of the parameter space and non-linearity (Primiceri, 2005; Koop & Korobilis, 2010; Bijsterbosch & Falagiarda, 2015), we use a Bayesian approach to estimate the model. [6] The parameters to be estimated are β_t, α_t, $\ln\sigma_t$, Σ_β, Σ_α, and Σ_σ. The following priors are assumed for these parameters: $\beta_0 \sim N(\widehat{\beta}, \widehat{V}_\beta)$, $\alpha_0 \sim N(\widehat{\alpha}, \widehat{V}_\alpha)$, $\ln\sigma_0 \sim N(\ln\widehat{\sigma}_0, I_n)$, $\Sigma_\beta \sim W(s_1k_1\widehat{V}_\beta, s_1)$, $\Sigma_\alpha \sim W(s_2k_2\widehat{V}_\alpha, s_2)$, $\Sigma_\sigma \sim W(s_3k_3I_n, s_3)$ where $N(a, b)$ represent the Normal distribution with mean a and variance b, and $W(Z, h)$represent the Wishart distribution with scale matrix Z and h degrees of freedom. The priors are calibrated with the estimation of $\widehat{\beta}$, $\widehat{\alpha}$, $\widehat{V}_\beta$, $\widehat{V}_\alpha$ and $\ln\widehat{\sigma}_0$ by *OLS*. The values s_1, s_2 and s_3 are the degrees of freedom of each prior, and are set equal to the corresponding number of rows of Σ_β, Σ_α and Σ_σ, respectively. The parameters k_1, k_2 and k_3 control the tightness of the priors. In the context of TVP-VAR-SV models, these parameters represent the prior beliefs of time variation. In particular, k_1, k_2 and k_3 are set to 0.0005, 0.05, and 0.5, respectively, which are similar to the priors used by Gambetti and Musso (2017). These parameters are modified in the sensitivity section.

[6] For the detailed process of the estimation, see the online Appendix of Galí and Gambetti (2015).

Finally, the simulation is performed for 10,000 Gibbs iterations, discarding the first 5,000 and collecting one of every 5 iterations from the remaining 5,000. Thus, 1,000 draws are collected. The first sampling of the priors is estimated by OLS.

2.3. Data

The variables analyzed are six ($n = 6$): real GDP annual growth, annual inflation, loan volume annual growth, the loan rate, the short-term interest rate, and Standard & Poor's General Stock Commodity Index (SPGSCI) annual growth. The definitions and sources of variables associated with each country, as well as the methodology to construct each series is detailed in Guevara and Rodríguez (2018). The sample period for the analysis is restricted to availability of the loan rate. This causes the span of data to vary among the countries under study. In particular, data for Chile, Colombia, Mexico, and Peru are available for the periods 1990Q1–2017Q1, 1994Q1–2017Q1, 1995Q3-2017Q1, and 1993Q2-2017Q1, respectively.

The analyzed series are presented in Fig. 1. In the case of GDP growth, it is observed that all the economies show periods of contractions at the end of the 1990s and during 2008–2009 period. Such stages of contraction of economic activity in all PA countries are associated with international economic crises, specifically the Asian-Russian crisis and the global financial crisis. Thus it is observed that the business cycle in PA countries are synchronized. In the case of inflation, it shows a declining behavior in all countries, reflecting the corrective measures implemented in response to the high-inflation periods experienced in the past and the subsequent implementation of inflation targeting schemes by the countries. In recent periods inflation stabilizes around a range between 3% and 4.5% in all countries.

Regarding to credit markets variables, in the first part of the sample, credit showed high growth rates in all PA countries as a result of the financial liberalization policies that allowed access to external funding and the subsequent expansion of banking system. In the next periods, the explosive growth rate stabilized. In the late 1990s, as a result of the Asian-Russian crisis and associated sudden stop episodes, credit compressed in all countries, but with less severity in Chile. In the second part of the sample, credit recovered and entered into a more stable stage. In the case of loan rate, it shows a marked negative trend, from levels between 20%-45% to levels close to 10%. Moreover, it is observed that the volatility of lending rates decreases as the sample progresses.

As in the case of the loan rate, the short-term interest rate in all countries shows its highest values in the first part of the sample. It is also observed that in such periods the interest rates register high levels of volatility compared to the second half of the sample. This result is consistent with the adoption of inflation targeting by all PA central banks. During the last part of the sample, which is associated with a more stable macroeconomic behavior, the short-term interest rates range at around 3.5% in Chile and Peru, and around 6.5% in Colombia and Mexico.

Finally, as PA countries are low- and middle-income economies, they are subject to external shocks, as documented by Castillo and Salas (2010) and Rodríguez, Villanueva Vega, and Castillo Bardalez (2018). In this regard, the external conditions are introduced into the model by the SPGSCI (Standard & Poor's Goldman Sachs Commodity Index), which represents the general level of commodity prices and world economic activity. The SPGSCI growth show an evolution according to global economy. In the late 1990s, moderate negative growth rates are observed, which reflect the negative consequences on world activity of the Asian and Russian crises. In the following periods, it started a more uniform pattern. Nevertheless, its stability period was interrupted by the 2008 crisis, where it records a strong fall. In the subsequent periods, SPGSCI recovers but it slowed as commodity boom finished on periods close to 2014.

2.4. The identification of loan supply shocks

The chosen methodology to identify the LS shocks is sign restrictions. However, as Paustian (2007) argues, it is necessary to identify as many shocks as possible to identify a particular shock. Thus, four kinds of shocks are identified: AD shocks, AS shocks, MP shocks, and LS shocks.

Regarding to an AD shock, theoretical literature agrees that these kinds of shocks drive GDP growth and inflation in the same direction. However, the impact on credit markets does not seem to be clear. For example, a positive consumption shock increases credit demand; thus, the loan volume increases, but agents requiring to raise their consumption withdraw their bank deposits, so bank funds decrease and the loan volume cannot expand, or can even decrease. In this regard, the loan volume is not restricted. On the other hand, in the context of an AD shock, central banks react by raising the interest rate to avoid inflationary pressures in line with the monetary policy rule, in turn boosting the loan rate due to the link between interest rates and the monetary policy rate. Thus, the short-term interest rate and the loan rate are restricted to be positive.

In the case of AS shocks, GDP growth and inflation move in opposite directions. Regarding credit markets, a negative AS shock that pushes up costs may decrease investment and the loan volume. However, firms may attempt to fund their higher costs through loans, which may increase credit volume. Moreover, as GDP growth is falling and inflation is rising, there is no clear central bank response, so the effect on the short-term interest rate is unclear, as well as the response of the loan rate. Because of these unclear effects, the responses of credit volume, the short-term interest rate, and the loan rate are unrestricted.

In the case of MP shock, it rises the short-term interest rate, decreases GDP growth and reduces inflation. The effect on the loan volume is ambiguous. On the one hand, as a result of the high opportunity cost of money, agents prefer to save; thus bank funds increase, which means that credit to the private sector could rise. On the other hand, the higher interest rates makes borrowing more expensive, so agents demand less credit. In the model proposed by Gerali et al. (2010) and Atta-Mensah and Dib (2008), the loan volume responds negatively to a positive MP shock, while in the model proposed by Christiano et al. (2010) the sign is unclear. As the response of the loan volume in credit markets seems unclear, the response of the loan rate may also be uncertain. In this context, both variables are unrestricted.

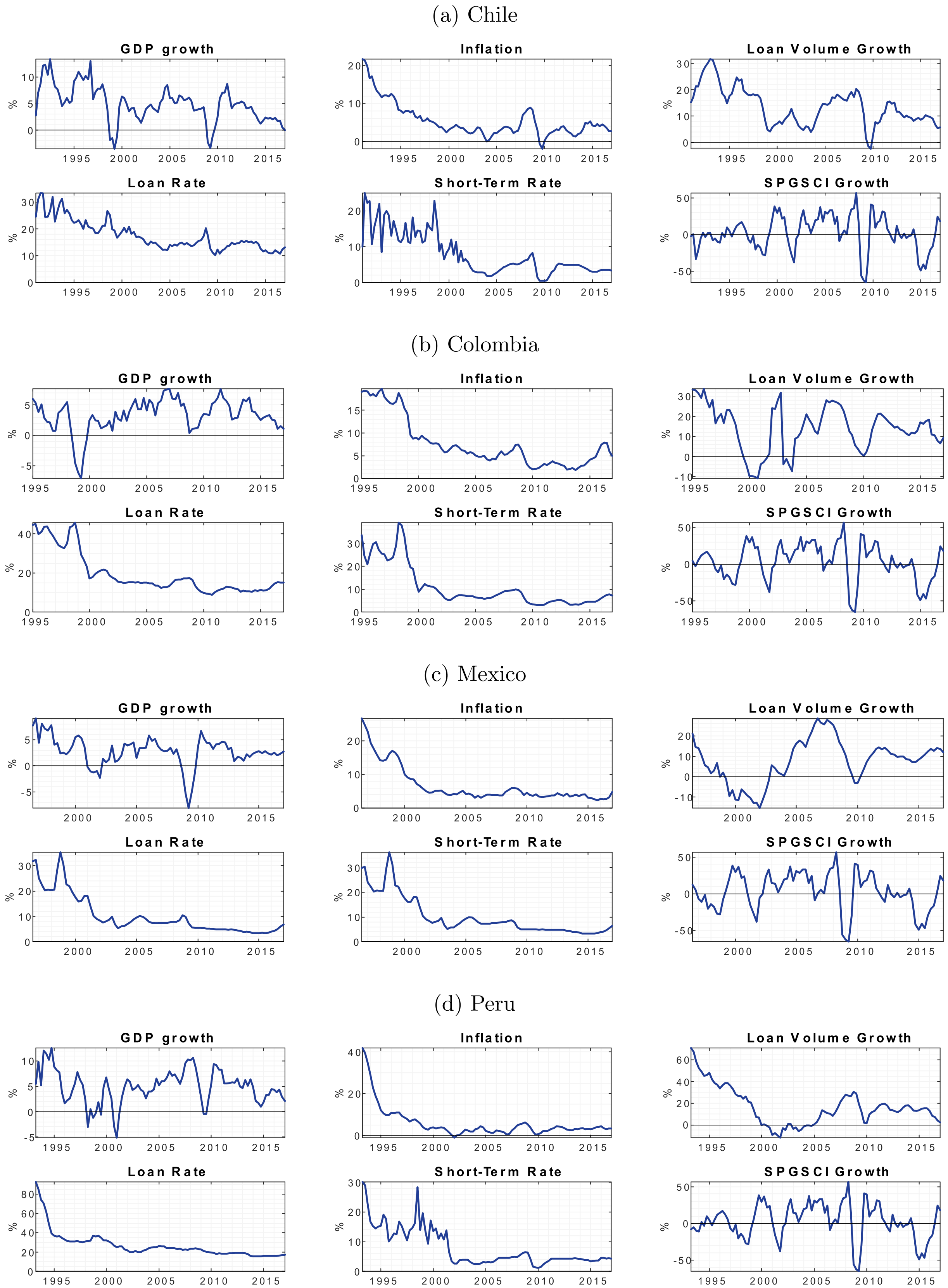


Fig. 1. Series in Annual Growth Rates.

Table 1
Sign Restrictions.

Structural Shocks	Responses of Variables					
	GDP Growth	Inflation	Loan Volume Growth	Loan Rate	Short-Term Rate	SPGSCI Growth
Aggregate Demand (AD)	+	+	NR	+	+	NR
Aggregate Supply (AS)	+	−	NR	NR	NR	NR
Monetary Policy (MP)	−	−	NR	NR	+	NR
Loan Supply (LS)	+	+	+	−	NR	NR

Notes: Sign restrictions are imposed on the impact; NR = Not Restricted.

In the case of LS shocks, it increases the availability of credit for the private sector, thereby pushing up the loan volume beyond the market equilibrium and creating an oversupply. This excess of funds in the market pushes down the loan rate. Thus, a LS shock drives the loan volume and the loan rate in opposite directions; see Christiano et al. (2010) and Gerali et al. (2010). Since these restrictions are not sufficient to differentiate LS shocks from other disturbances, other variables are restricted, as suggested by Hristov et al. (2012). In particular, the responses of GDP growth and inflation are restricted. In this regard, given that credit becomes inexpensive, firms increase their investment and households demand more for consumption, thus GDP increases. At the same time, as economic activity expands, firms expect higher prices; thus, they increase their current prices. Regarding to this issue, in theoretical literature there is no consensus about the response of inflation. However, most of empirical literature supports that the response of inflation is positive; thus, the response of inflation is restricted to be positive. On the contrary, the response of the short-term interest rate is unrestricted. This specification is proposed because, in a similar way as in the case of AS shocks, LS shocks are difficult to observe by the central bank. Therefore, leaving the short-term interest rate unrestricted may be appropriate.

Table 1 summarizes the sign restrictions used to identify each shock in the model. It should be noted that while there are six variables, only four shocks are identified. Conceptually, the remaining shocks, which are not identified, are loan demand shocks and external shocks, the latter related to the SPGSCI. In this respect, first, the loan demand shock is not identified because of lack of theoretical evidence describing its potential effects. Second, although there is evidence of the effects of external shocks, the literature does not assess the role of these shocks when the banking sector is included in the model. Although these shocks are not identified, they may act as a buffer and capture the effect of omitted variables. Finally, regarding the response of the SPGSCI to identified shocks, it is unrestricted in all cases because PA countries are considered small economies and cannot influence the global economy.

In order to identify the proposed shocks, sign restrictions are only imposed at the time of impact. In case of estimation, those draws that satisfy the proposed sign restrictions are collected from the orthogonal R matrices generated, and all the others cases are discarded. From the pool of draws, the result of interest is the median of (IRFs) and the 16% and 84% percentiles for the standard deviations that represent the 5% significance level.

3. Results

3.1. The Evidence of Time-Varying Parameters and Stochastic Volatility

In order to assess the presence of time-varying parameters three tests are performed: the trace test, the Kolmogorov–Smirnov test, and the t-test. In the first case, the trace test reports whether the prior of the variance-covariance matrix associated with the movement law of the parameters is smaller than the posterior. According to Cogley and Sargent (2005), if the trace is lower than the percentiles, there is evidence that the coefficients are subject to multiple shocks, so they do not remain constant. In the other cases, the Kolmogorov-Smirnov test indicates whether two samples belong to the same continuous distribution and the t-test determines if the mean of two random samples belongs to the same normal distribution. The tests are performed for elements of matrices B, H and A resulting from the estimation of the model for each country.[7]

The results are presented in Table 2. The analysis is performed for two different periods in two cases, the beginning of the sample against the middle of the sample (symbolized by 1–2), then the middle of the sample against the end of the sample (symbolized by 2–3). In general, the tests reveal the existence of time variation in the parameters estimated for each country. In the case of the trace test, it is estimated that the trace value is lower than the 16%, 50%, and 84% percentiles, indicating that coefficients are subject to multiple shocks that made them not to remain constant over the time. On the other hand, results from the Kolmogorov-Smirnov test indicate that most of the estimated parameters of B, H and A present significant differences across their distributions when comparing the samples in the two cases, which indicate that parameters evolve over time. Moreover, results from the t-test suggest that the difference in mean between the samples of most of the coefficients is significant, which confirms the previous results. Thus, the evidence suggests that the model specification, a TVP-VAR-SV, is appropriate for the analyzed data.

The results of volatility suggest that it does not remain constant; instead, it appears to evolve over time for all PA countries. In the case of Chile and Colombia it is observed levels close to 2% at the beginning of the sample. Then, at the end of the 1990s, volatility

[7] For results of stochastic volatility, variance decomposition and remaining variables that are not commented in this document, the reader is referred to Guevara and Rodríguez (2018).

Table 2
Testing Time Variation in Coefficients and Volatility.

	Trace Test				Kolmogorov–Smirnov Test[a]						t-test[b]					
					B		*H*		*A*		*B*		*H*		*A*	
	Value	16%	50%	84%	1–2	2–3	1–2	2–3	1–2	2–3	1–2	2–3	1–2	2–3	1–2	2–3
Chile	0.36	6.1	12.2	27.5	41/42	39/42	6/6	6/6	15/15	14/15	39/42	37/42	6/6	5/6	14/15	15/15
Colombia	0.24	1.7	2.6	4.6	39/42	31/42	6/6	6/6	15/15	15/15	34/42	25/42	5/6	6/6	15/15	15/15
Mexico	0.27	1.9	2.9	5.0	39/42	35/42	6/6	6/6	14/15	15/15	38/42	34/42	6/6	6/6	13/15	14/15
Peru	0.17	1.4	2.3	3.8	41/42	32/42	6/6	6/6	13/15	15/15	38/42	30/42	6/6	6/6	13/15	14/15

Notes: The matrix$B$ contains the regression lagged coefficients, the elements of$H$ are the variance of innovations and A contains the contemporaneously relations; [a]Kolmogorov-Smirnov test for two samples. It is performed for each elements of B, H and A. The numerator indicates the number of parameters that changed across the sub-samples according to the test at 0.05 level of significance. The denominator indicates the total number of parameters of each matrix; [b] t-test for two samples. It is performed for each elements of$B$, H and A. The numerator indicates the number of parameters that changed across the sub-samples according to the test at 0.05 level of significance while the denominator indicates the total number of parameters of each matrix.

increased to levels ranging between 3% and 4% for Colombia and 5%–8% for Chile. In the case of Peru, it is observed that volatility have increasing and decreasing pattern around 8% during the first part of the sample. After these episodes, volatility shows a negative trend in all mentioned countries, interrupted partially by the uncertainty generated by 2008 financial crisis. In recent periods, volatility is located below 2% and with few fluctuations. In the case of Mexico, volatility is registered to be high at the beginning of the sample but it decreases systematically throughout the sample; see Guevara and Rodríguez (2018).

3.2. The impact of loan supply shocks

In the context of time-varying parameters, the shocks may generate multiple non-uniform trajectories in the variables, which make analysis diffuse.[8] For this reason, the effects of LS shocks are normalized with respect to the loan rate. In particular, the median response of the loan rate is set to be -0.5% at the time of impact over the whole sample for all the countries. The responses of the remaining variables are weighted according to this restriction. This allows to compare the effects of LS shocks across periods and among countries.

3.2.1. The average loan supply shock

The mean IRF of LS shocks is reported in Fig. 2.[9] It is estimated that LS shocks have an important effect on real economic activity in all PA countries. It is observed that, on average, in Colombia, Mexico, and Peru an expansionary credit supply shock boosts GDP growth by about 1%, while the effect in Chile is around 0.5%. These results are explained by the different financial structures of these countries. On the one hand, the banking system has an important participation in lending activity of Colombia, Mexico, and Peru, with banks taking a share of around 90% of total credit to the private sector. On the other hand, Chile has a more developed capital market than other PA countries. For instance, market capitalization as a percentage of GDP is about 98% in Chile, while in the remaining countries it ranges between 30%-40%. This suggests that firms in Chile can substitute bank loans, so the banking system plays a more critical role in Colombia, Mexico, and Peru than in Chile.

Regarding inflation, as in the case of GDP growth, the impact of the positive credit supply shock is estimated to be important but with a heterogeneous dynamic across countries. In particular, results from Mexico and Peru indicates an effect of LS shocks on inflation of about 0.45% at the time of impact and with a short duration, up to two quarters following the shock. In contrast, it is observed that in Chile the impact is estimated to be 0.2% and it lasts one quarter. The response of inflation in Colombia is estimated to be about 0.5% and to be more persistent than in the other countries. This persistent effect is linked to dynamic estimated for the loan rate that increases rapidly and extendedly after falling by 50 basis points, which translates into a prolonged increase in prices following the shock.

In the case of credit market variables, the effect of an expansionary LS shock is estimated to be higher on credit volume growth than in the case of GDP growth, thus reflecting the importance of LS shocks for explaining credit dynamics. Furthermore, it is estimated that the effect on the credit volume tends to last more than three quarters in all countries, more than in the case of GDP growth. These results show that while in the medium run credit markets expand after the shock, real economic activity does not. Regarding to the loan rate, their trajectory following the LS shock appears to have broad uncertainty bands and an increasing behavior in all PA countries. This result correspond to the moderate degree of credit market concentration in these countries, which

[8] For instance, the LS shock that reduced the loan rate by -1% in 1999 may generate a smaller effect on other variables than the LS shock that decreased the loan rate by -5% in 2007.

[9] The results for IRFs are the median, the 84th and the 16th percentiles. Given that the model has time-varying parameters, the results are obtained for each quarter over the whole sample. Thus, formally speaking, the mean IRF is the average of the median IRF corresponding to all periods in the entire sample.

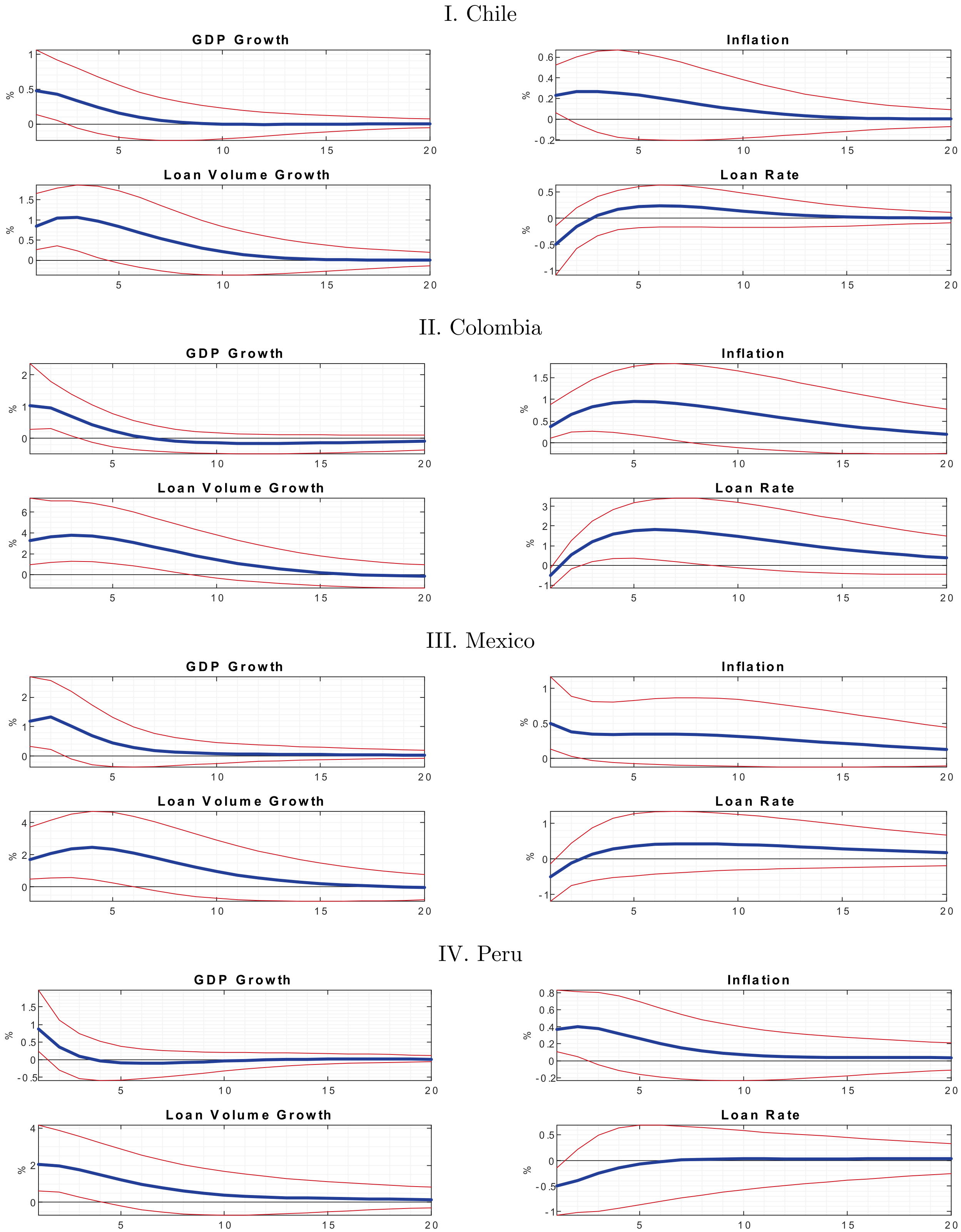


Fig. 2. Average Impulse Response to a Loan Supply (LS) Shock. The Blue lines correspond to the average of the Median corresponding to every moment of time. The Upper and Lower Red lines represent the Confidence Intervals that correspond to the 84th and 16th percentiles, respectively.

makes the trajectory of the loan rate diffuse. For instance, Martin, Domínguez, Perea, Saca, and Sánchez (2011) report a Herfindahl–Hirschman Index of 1052, 1168, 2145 for Colombia, Chile, and Peru, respectively, in 2009, while Rodríguez (2012) reports an index of 1404 for Mexico in 2010 which implies that in these economies the banking system is concentrated in few companies.

In order to assess the quantitative importance of LS shocks over business cycle fluctuations, historical decomposition is performed. These results are presented in Fig. 3. The estimation indicates that LS shocks are an important factor driving business cycle fluctuations, contributing in a similar way as AS shocks and AD shocks in both stability and slowdown periods. In the case of weak economic activity periods, during the late-1990s crisis, LS shocks diminished GDP growth by about −0.67 percentage points in Chile, Colombia, and Peru due to the sudden stop of external capital flows triggered by increased global risk during the Russian and Asian crises. Mexico, instead, did not face major negative shocks like other countries during the late 1990s, but the negative effects of LS shocks hit the economy with a lag after 2000. In the recent 2008 crisis, LS disturbances accounted for a significant reduction of GDP growth in most countries. Chile, Mexico, and Peru registered the highest negative impacts, with credit shocks reducing GDP growth by about −1.19 percentage points, while the contribution was lower in Colombia, with shocks reducing GDP growth by −0.36 percentage points. Regarding to stability periods, after the late-1990s turbulence and before the financial crisis, LS shocks accounted for a considerable share of GDP growth in all countries. By taking the absolute value of the contribution (in order to focus on the magnitude rather than the sign), it is estimated that the average contribution of LS shocks to GDP growth is about 0.23 percentage points in 2002–2006.

In the case of inflation, it is estimated that LS shocks drive inflation as much as other shocks, but its quantitative importance is heterogeneous among countries. In the case of Chile and Peru, AS shocks are the main driver of inflation fluctuations, as expected, and LS shocks contribute to the evolution of inflation as much as AD and MP shocks. In Colombia, LS shocks are estimated to be the main driver of inflation fluctuations at the beginning of the sample, then its average contribution decreased. In Mexico, most of the increase in inflation in the late 1990s is due to AD shocks and LS shocks. In the following periods, it is estimated that the reductions in inflation below average respond mostly to LS shocks.

The results also suggest that LS shocks have been an important factor driving credit volume growth. These shocks appear to have had a large negative contribution to loan volume growth in the period following the Russian and Asian crises, which lingered for several years up to 2005. A common feature among PA countries is that the net incurrence of liabilities to non-residents decreased during the above mentioned period, implying that local financial institutions faced financing restrictions in that period, which might explain the prolonged negative effect. Particularly, in Peru the prolonged negative effect is explained by the fact that this economy is more dependent on foreign funds than the other countries. In the following periods, these economies faced favorable economic outcomes that allowed credit volume to expand. However, in 2009, when the financial crisis hit them, the contribution of LS shocks turned negative, accounting for a decline of about −1.5 percentage points in loan volume growth in all countries. Nevertheless, the sudden-stop episodes were brief and the LS shocks turned positive in the following quarters in all countries, although Chile registers negative values in the last part of the sample. The fact that the negative contribution of LS shocks coincides with sudden capital flow stops is consistent with Lane and McQuade (2014), who provide empirical evidence of the close link between capital flows and local credit growth for several advanced and emerging economies.

In the case of the loan rate, it is estimated that the importance of LS shocks for driving loan rate fluctuations varies between periods and countries. During the first half of the sample for all countries, LS shocks are estimated to account for a large part of the movements of the loan rate, as much as the contribution of shocks that arose from the real sector. In the case of Colombia and Peru, the contribution of LS shocks diminished and loan rate fluctuations are mainly driven by AS and AD shocks. Mexico shows small deviations from the mean, but most of these deviations are due to LS and MP shocks. On the other hand, all shocks are estimated to contribute similarly to loan rate fluctuations in Chile.

3.2.2. The impact of loan supply shocks over time

In order to investigate how the effects of LS shocks have evolved over time, an analysis of the evolution of the IRFs is performed. As a first step, some statistical test are performed. Table 3 shows results obtained using the t-test, which compares the means, and the Wilcoxon rank sum test, which compares the median. Specifically, the tests are estimated on the distributions of IRFs for two different periods in two cases: 1996Q4 against 2006Q1 and 2006Q1 against 2017Q1 for all the countries. Both t-test and Wilcoxon rank sum test indicate that the effect of LS shocks at the time of impact has significantly changed across the periods evaluated.

The evolution of the impulse-response function to a LS shocks at different horizons ($h = 1, 4, 8, 12, 16, 20$) and the 68% confidence interval are presented in Fig. 4. At the impact moment ($h = 1$), the results indicates that the power of LS shocks to affect GDP growth has evolved in a heterogeneous way among PA countries. In the case of Chile, the effect of LS shocks at the time of impact has increased from the beginning of the sample until late 2009. This behavior corresponds to the expansion of the banking sector in this country. For instance, the ratio of banking credit to GDP in Chile was about 42.1% in 1990 and increased to 69.6% in 2009. However, from 2009 onwards, the effect of LS shocks declines to levels close to those at the beginning of the sample, which is explained by the stock market development that expanded funding sources and reduced the participation of the banking system in lending activities.

In Colombia, the effect of LS shocks on GDP growth at the time of impact rose during the first half of the sample. This behavior is explained by the changes in financial structure of Colombia, evolving from specialized banking to a mixed banking system where banks are allowed to offer multiple services to the private sector. In particular, banks increased the participation of direct investments in their total portfolios during the period 1994–2005, thus increasing its importance over real activity. However, in the periods following 2005, the effect of LS shocks decreases slightly and then remains stable around 0.9%. Particularly, after 2005, banks' direct investment decreases and portfolio investment rises, which explain the consequent evolution of the impact of the shock.

Regarding Mexico, the impact of LS shocks on real economic activity at the time of impact shows a gradually increasing behavior

I. Chile

II. Colombia

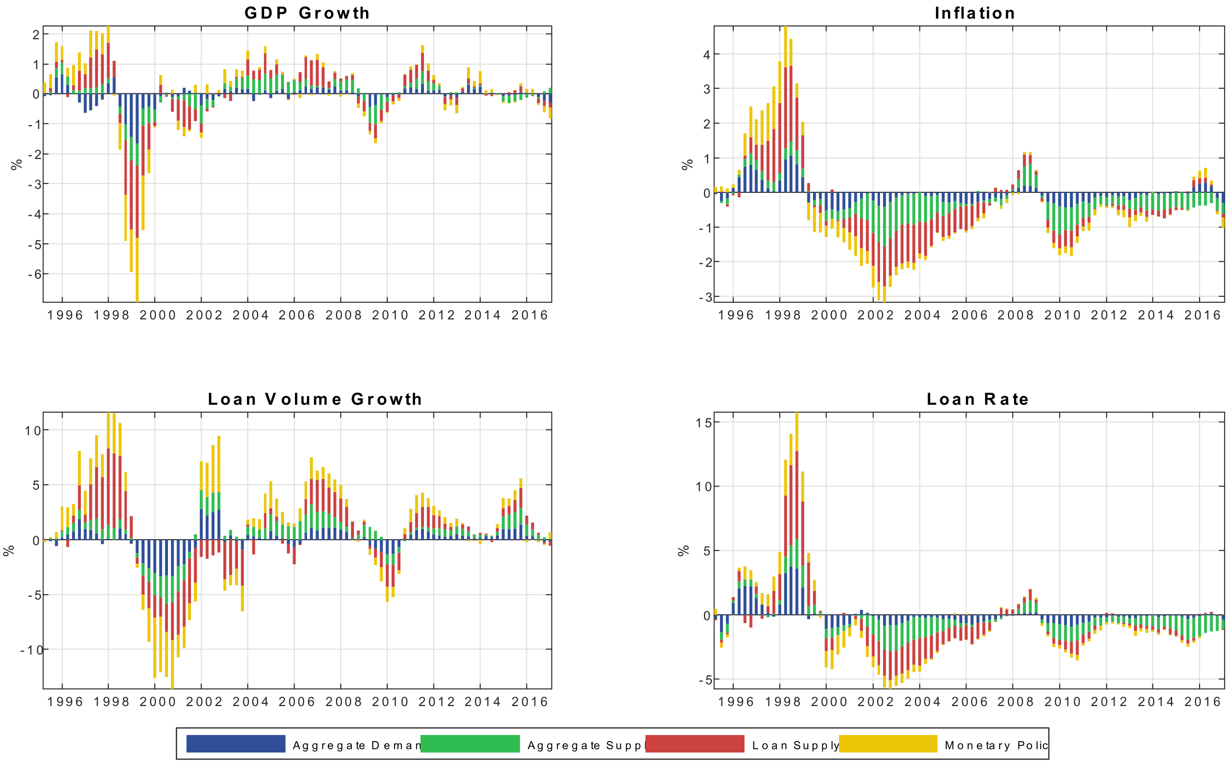
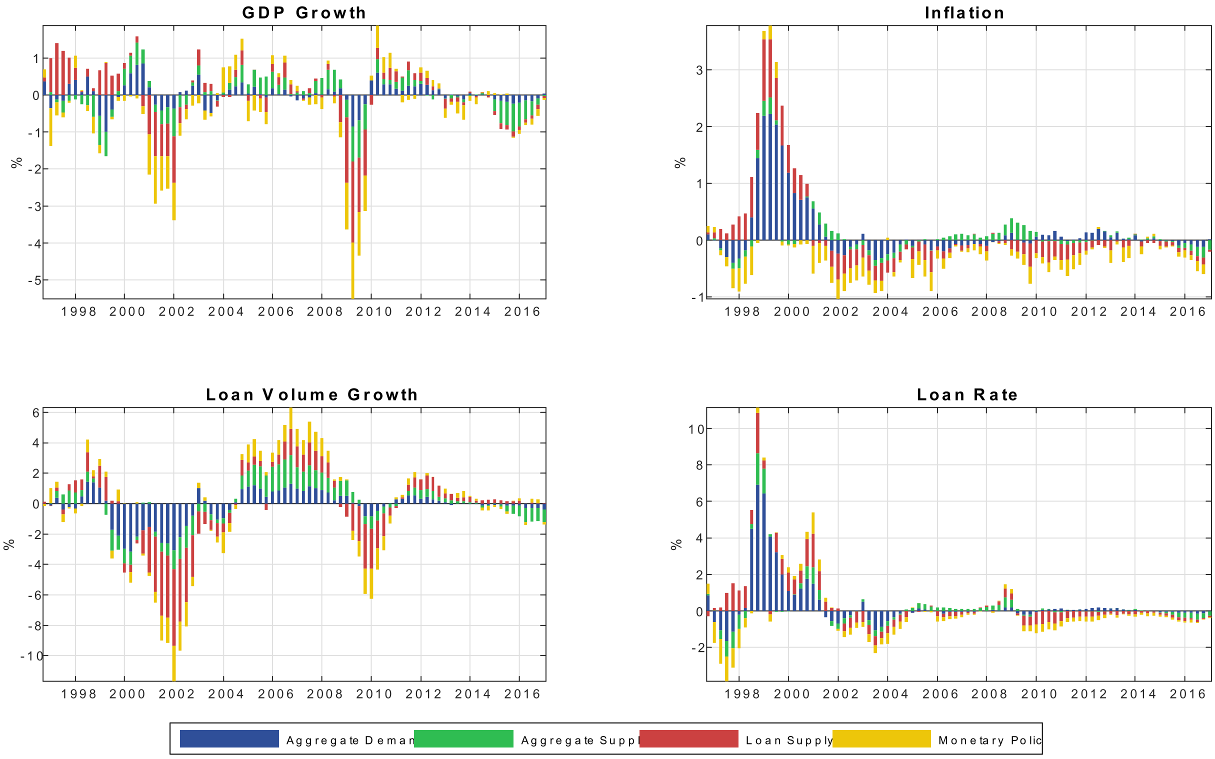


Fig. 3. Historical Decomposition (HD). The HD is calculated using the estimated parameters for each specific time. The Blue, Green, Red and Yellow colors represent the contributions of AD, AS, LS and MP Shocks, respectively.

III. Mexico



IV. Peru

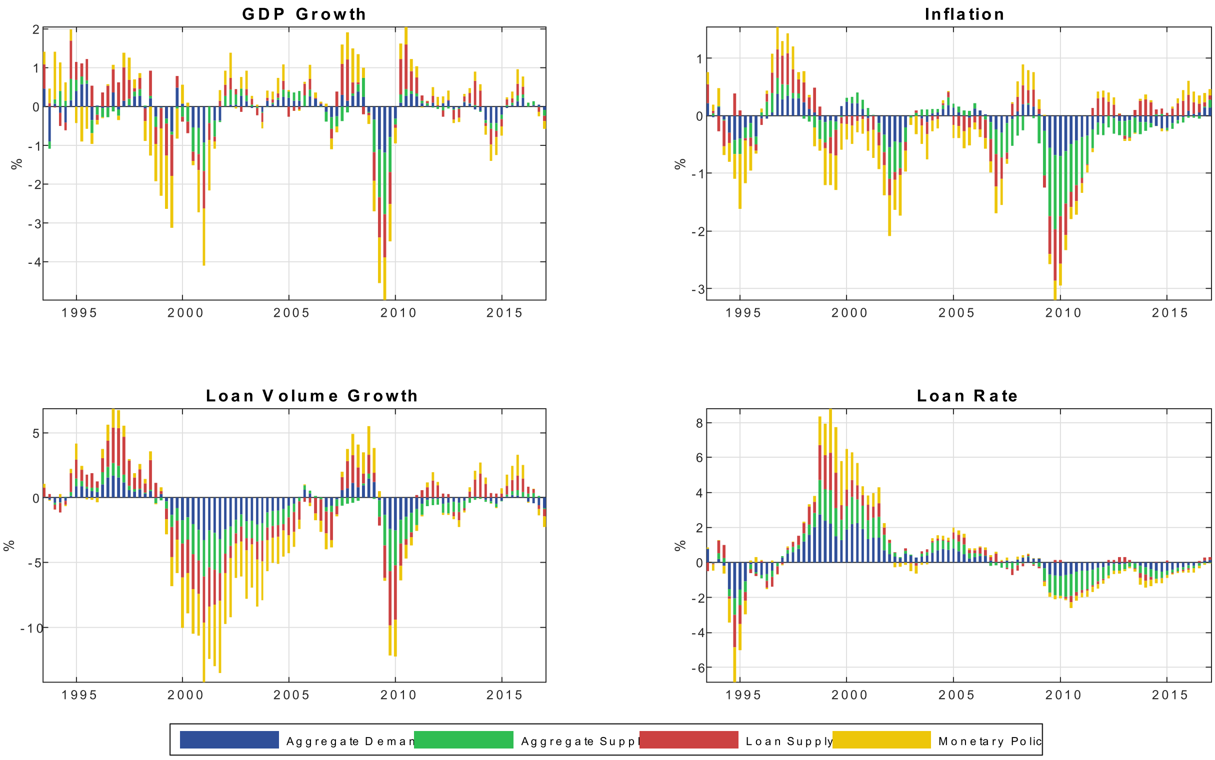


Fig. 3. (*continued*)

Table 3
Evolution of the Effect of Loan Supply Shock.

Country	t-tets										Wilcoxon Rank Sum Test									
	y		π		*lv*		*lr*		*stir*		*y*		π		*lv*		*lr*		*stir*	
	a	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*
Chile	$=$	$\neq^-$	$\neq^+$	$\neq^-$	$\neq^+$	$\neq^-$	$\neq^+$	$\neq^-$	$\neq^+$	$\neq^-$	$=$	$\neq^-$	$\neq^+$	$\neq^-$	$\neq^+$	$\neq^-$	$=$	$=$	$\neq^+$	$\neq^-$
Colombia	$\neq^+$	$=$	$\neq^+$	$\neq^+$	$\neq^+$	$=$	$\neq^-$	$=$	$\neq^+$	$=$	$\neq^+$	$=$	$\neq^+$	$\neq^+$	$\neq^+$	$=$	$=$	$=$	$\neq^+$	$\neq^-$
Mexico	$\neq^+$	$\neq^-$	$\neq^+$	$=$	$\neq^+$	$\neq^-$	$\neq^-$	$=$	$\neq^-$	$\neq^+$	$\neq^+$	$\neq^-$	$\neq^+$	$=$	$\neq^+$	$\neq^-$	$=$	$=$	$\neq^-$	$\neq^+$
Peru	$=$	$\neq^+$	$\neq^+$	$\neq^+$	$\neq^+$	$\neq^+$	$=$	$=$	$\neq^-$	$\neq^+$	$=$	$\neq^+$	$\neq^+$	$\neq^+$	$\neq^+$	$\neq^+$	$=$	$=$	$\neq^-$	$\neq^+$

Notes: The tests are implemented to the 50% percentile of the impulse responses density at the time of impact $h = 1$. The variables y, π, lv, lr and $stir$ are the output growth, inflation, loan volume growth, loan rate and short-term interest rate, respectively. The effects on SPGSCI are omitted. The letters a and b represent the comparison between 1995Q2 vs 2006Q1, and 2006Q1 vs 2017Q1, respectively. Chosen dates are the same for all countries. The symbol $\neq$ means that the null hypothesis of two samples come from the same distribution is rejected, the positive superscripts $\neq^+$ indicates that the mean (t-tets) or median (Wilcoxon Rank Sum test) has increased significantly, while superscripts $\neq^-$ indicates the opposite. The symbol $=$ indicates that null hypothesis is not rejected. The results are computed at the 0.05 significance level.

from 1996 to 2011. This progressive increase is explained by the reprivatization of financial entities implemented after 1994 as an effort to reconstruct and promote the banking system. Nevertheless, from 2012 onwards, the effect of LS shocks decreases. An explanation is that agents in Mexico employ multiple sources of credit in addition to commercial banks. Particularly in Mexico, 79.5% of enterprises (on average in 2011–2017) reported to be financed by credit from suppliers, while 36.1% also reported to be financed by the banking sector, which could indicate that the participation of suppliers in real economic activity is as important as that of the banking system.

In Peru, the impact of LS shocks shows an increasing pattern during the first part of the sample. During this period, the country experienced a financial liberalization process that resulted in an expansion of banking system, which translates into an increase in the impact of LS shocks on real economic activity. However, after 2000, the effect began to decline as a result of the Asian and Russian crises, which caused a severe sudden stop in the economy. The result from this event is that 15 financial institutions went bankrupt between 1998 and 2001. Later, in the periods following 2006, the banking sector recovered and the effect of LS shocks increased to a range around 0.94%.

At the following horizons, the effect of LS shocks over GDP growth is estimated to be weaker than the impact and not persistent. At $h = 4$ the effect is only significant during the following periods: 1997–1999 for Chile, 2002–2005 for Colombia and 1995–1996 for Mexico. For the remaining horizons the impact of LS shocks are not statistically different from zero, except for the case of Peru at $h = 8$ where it is estimated a negative significant effect during the period 2008–2010.

4. Sensitivity

In order to assess the robustness of the previous results, modifications are introduced in the baseline estimation. First, the model is estimated using different priors specifications. Then, different sets of sign restrictions are implemented.[10]

Regarding the first sensitivity analysis aimed at evaluating if results are determined by data rather than imposed by the priors specification, two priors sets are used. In the baseline model, the priors set is $k_1 = 0.0005$, $k_2 = 0.05$, and $k_3 = 0.5$. The second specification consists of a priors set similar to Primiceri (2005), which are more flexible: $k_1 = 0.0001$, $k_2 = 0.01$, and $k_3 = 0.01$. The third specification is based on a more restrictive set such that $k_1 = 0.001$, $k_2 = 0.1$, and $k_3 = 0.1$.[11] The results from both specifications are reported in Fig. 5. The estimation of stochastic volatility, average and evolution of IRFs under the new specifications indicates that the results for Mexico and Peru are qualitatively and quantitatively similar to the baseline model. In the case of Colombia and Chile, the results show some minor quantitative changes, but no major changes emerge while analyzing the trends of results. This suggests that the main results are robust to the different priors specifications.

The second sensitivity analysis consist of estimating the model using multiple sets of sign restrictions for LS shocks. In particular, two additional sets of sign restrictions are used. The first set corresponds to the theoretical model by Cúrdia and Woodford (2010), hereafter CW, that introduces a moral hazard friction and the model of Gertler and Karadi (2011), hereafter GK, that assume the financial friction as households that cannot engage in financial contracting other than through the intermediary sector. The results of these models is that LS shocks have a positive effect on the short-term interest rate and have the same effects on the remaining variables as in the baseline specification. The second set is based on the model by Gerali et al. (2010), hereafter GNSS, that introduces working capital frictions and on the model of Atta-Mensah and Dib (2008), hereafter AMD, where financial frictions are modeled as

[10] The results of the sensitivity analysis are only presented in terms of average impulse response and the evolution of the impulse response function at the time of impact for the case of GDP growth. Additionally, to the mentioned modifications, the model is also estimated replacing the SPGSCI with the Terms of Trade of each country, and results do not differ significantly. Full results of the sensitivity analysis are available upon request, see also Guevara and Rodríguez (2018).

[11] In the case of Mexico, it is not possible to estimate the last priors specification; thus, the set $k_1 = 0.003$, $k_2 = 0.1$, and $k_3 = 0.1$ is used, which also captures the objective of estimating the model with lower priors.

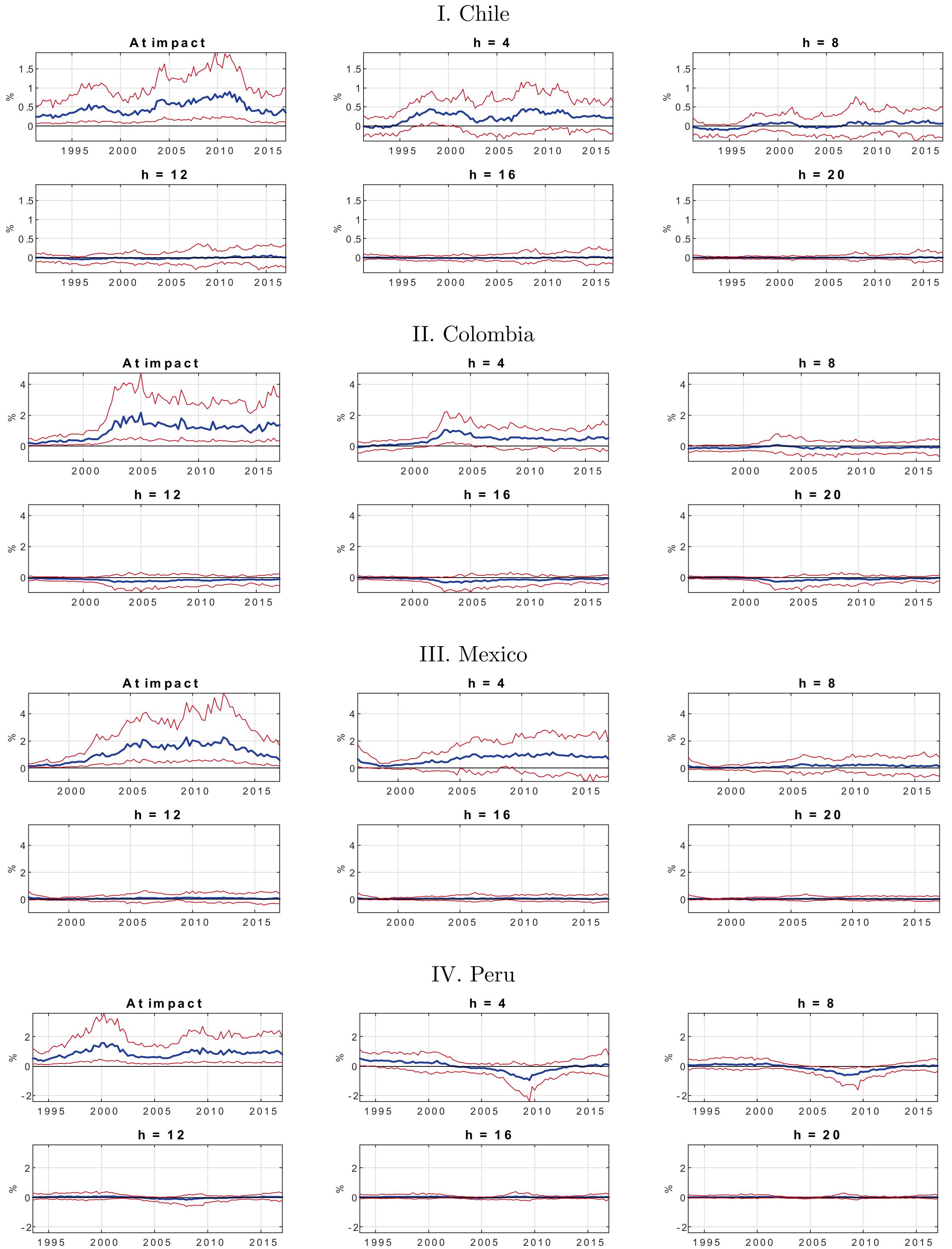


Fig. 4. Evolution of response of GDP growth to a LS Shock at different horizontal times. The results are the evolution of the Median of distribution of the IRFs. The Blue lines represent the Median.

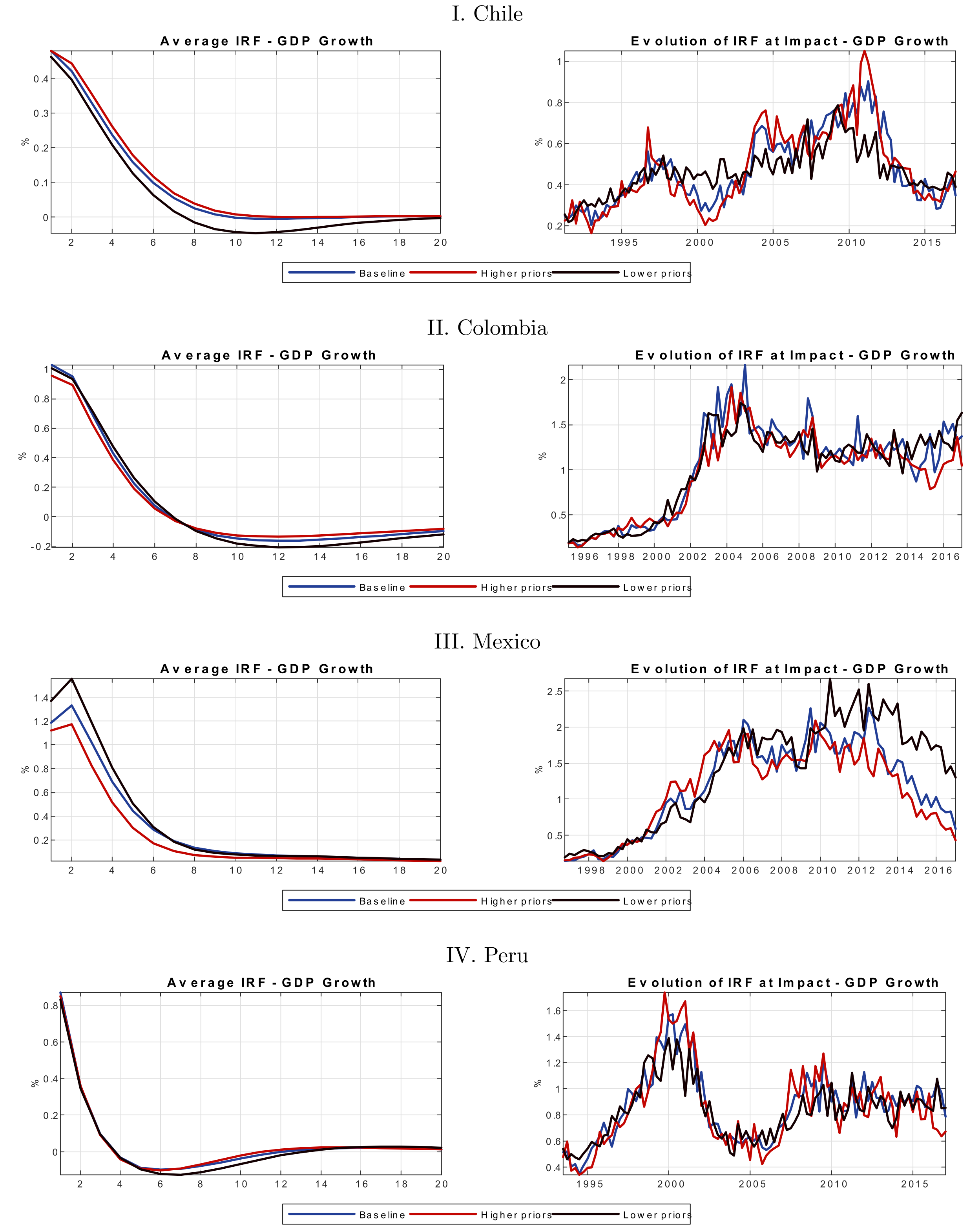


Fig. 5. Sensitivity 1: Baseline, Higher and Lower priors. The Blue line represents the results using the Baseline specification. The Red line represents the estimation using higher priors. The Black line represents the results using lower priors.

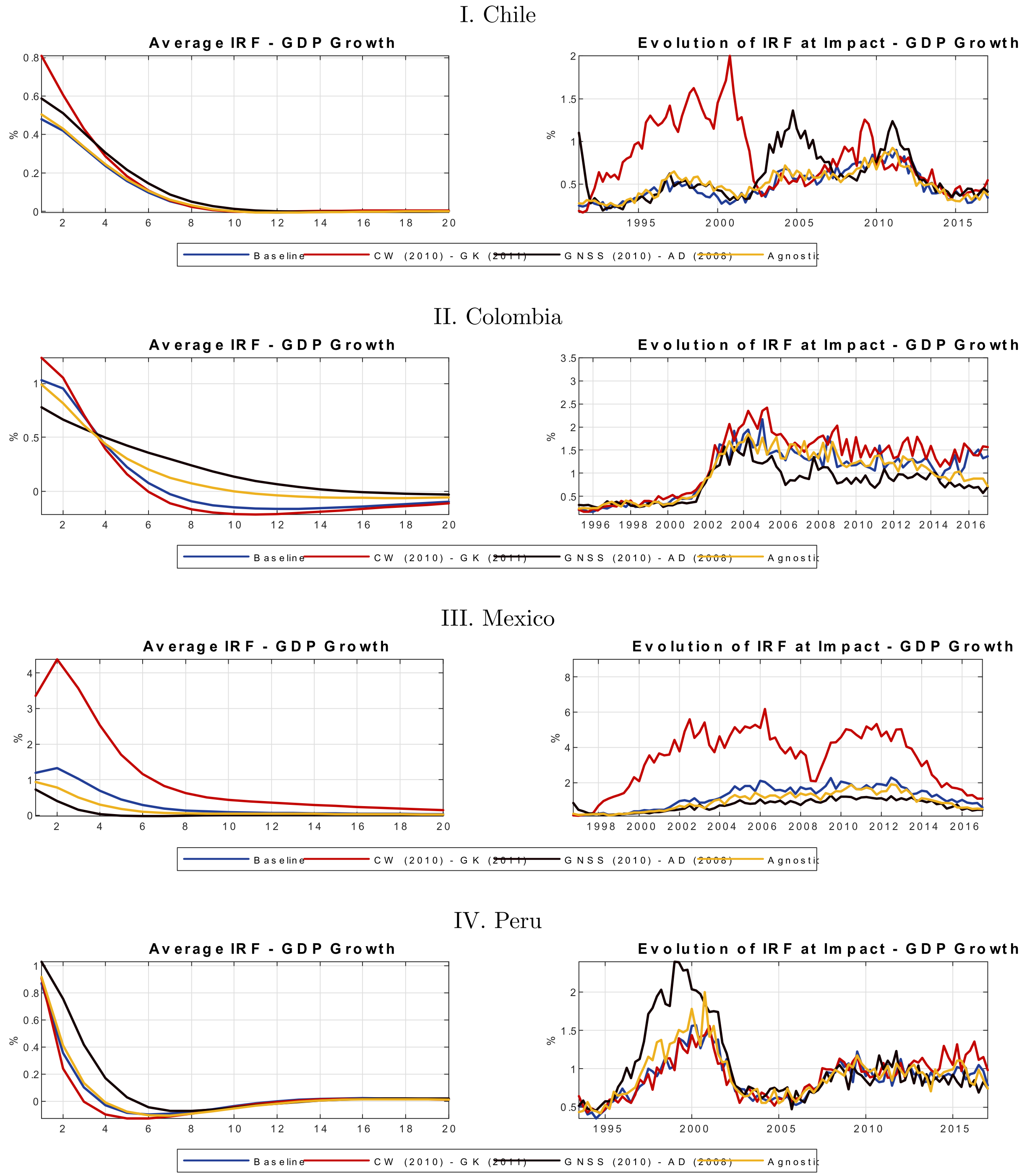


Fig. 6. Sensitivity 2: Different Sets of Sign restrictions. The Blue line represents results from Baseline specification. The Red line represents results using sign restrictions used in Cúrdia and Woodford (2010) and Gertler and Karadi (2011), both denoted by CW (2010)-GK (2011). The Black line represents results using sign restrictions used in Gerali et al. (2010) and Atta-Mensah and Dib (2008), both denoted by GNSS (2010)-AD (2008). The Yellow line represents results considering an agnostic specification where GDP Growth and Inflation responses to LS shocks are set to be unrestricted.

spreads between deposit and loan interest rates. In this case both models introduce monopolistic competition and find that LS shocks drive GDP growth and inflation in opposite directions and that the response of the short-term interest rate and loan rate also are driven in the same directions. The results are presented in Fig. 6. In the case of Colombia and Peru, the results of the two sets of sign restrictions are similar to those of the reference model in both quantitative and qualitative terms. However, in the case of Mexico results are estimated to be quantitatively different from baseline in the case of restrictions from CW and GK, but not for the case of GNSS and AMD. In the case of Chile it is observed substantial differences in the first half of the sample for the model of CW and GK, but not for the case GG and AMD. These results are related to the type of models analyzed and its implications for interest rate spread. GK analyze a capital quality shock and CW examine a loss rate shock. As it was previously mentioned, both shocks drive short-term interest rate and loan rate in opposite directions. The main implication of this result is that interest rate spread increases. In the model of CW and GLK fluctuations of interest rate spread affect assets prices, therefore changing the banks' balance sheet. The result of this channel is that the ability of banks to provide loans is even greater, which leads to a greater effect on economic activity. On the other hand, GNSS examine a bank capital shock and AMD analyze a credit conditions shock. In their specification short-term interest rate and loan rate respond in the same direction. The underlying result of this specification is that the interest rate spread remains stable, implying that there are no changes in asset prices and in banks' balance sheet, so the effect on economic activity is not amplified. The amplification effect of CW and GK is clearly observed in Mexico rather than in the other countries. This result is explained by the high variability of interest rate spread in this country that is registered to be the largest among all PA economies (in the period 1995–2016, sample used for this country in the estimation, standard deviation is estimated to be 4.0 in Mexico while it is estimated to be ranging between 3.4 and 1.1 for the remaining countries). This feature of Mexican economy implies that channel of assets prices and balance sheet is observed in this economy for the case of CW and GK restrictions. In the case of Chile, the amplification effect of CW and GK above the baseline specification is observed during the period 1990–2003, then the effect converges to the magnitude of baseline specification. Particularly, during this period variability of interest rate spread is calculated to be higher than the one for subsequent period (standard deviation is 1.4 in the period 1990–2013 and is estimated to be 1.1 in the period 2004–2017) meaning that in such period the CW and GK restrictions have implications on the assets prices and balance sheet channel. Although the differences for these countries are moderate for CW and GK, the baseline specification is still valid as a result that in the case of Mexico the baseline is estimated to be inside the probabilistic space of the CW and GK and in the case of Chile the mean IRFs of the alternative specification is estimated to be inside the probabilistic space of the baseline. Moreover, by analyzing the results in other horizons different than the time of impact, the differences among specifications decreases.

As can be observed in the baseline model, the response of real economic activity to LS shocks is restricted to be positive. This produces known results by construction. For that reason, by taking a different approach, the response of GDP growth to LS shocks is set to be unrestricted. As a result the estimated response might be interpreted as the genuine response. This idea follows the agnostic identification proposed by Uhlig (2005). The estimation is also presented in Fig. 6. The results indicate that even in this agnostic identification, where GDP growth is unrestricted, the response of real economic activity remains positive and significant in all PA countries, which reinforces the idea that LS shocks are an important factor boosting GDP growth.

5. Conclusions

This research assesses the impact of LS shocks over real economic activity in PA members. The analyzed countries are characterized by an expanding banking system, which implies that the dynamics between the real sector and the financial system has not remained constant. In this context, the proposed model is a TVP-VAR-SV, which is suitable for the analyzed countries. In order to assess the relevance of the time-varying parameters and stochastic volatility in the model the trace test, the Kolmogorov–Smirnov test, the t-test and an analysis of evolution of volatility are performed. The results reveal the existence of significant time variation in the parameters of the models and a volatility that it does not remain stable across the periods analyzed.

The first important result from the baseline model is that LS shocks have an important effect on real economic activity in all PA countries. The impact over GDP growth is estimated to be around 1% in Colombia, Mexico, and Peru and about 0.5% in Chile. Thus, the results indicate that LS shocks are an important factor driving business cycle fluctuations, contributing in a similar way as AS shocks and AD shocks in both stability and slowdown periods. The second important results is that the distribution of the IRFs to a LS shocks shows significant differences across the time and that the power of LS shocks to affect GDP growth has evolved in a heterogeneous way among PA countries. In Colombia and Peru, the impact in recent periods is estimated to be higher than in the 1990s, while in Mexico and Chile the impact has increased considerably, although at a certain point it started to decline to levels close to those at the beginning of the sample.

In order to assess the robustness of the baseline results, two sensitivity analyses are applied. First, the model is estimated with higher and lower priors than the original set. Second, the IRFs are estimated with a different set of sign restrictions. In most specifications the results do not differ much from the baseline specification, suggesting that the main results are robust. However, in the case of Mexico and Chile, the results estimated from restrictions of Cúrdia and Woodford (2010) and Gertler and Karadi (2011) are quantitatively different from baseline, but qualitatively similar. Although results differ, it is observed that such alternative specification and the baseline are linkaged by the probability space of impulse response function. Moreover, by applying an agnostic identification and making the response of GDP growth to be unrestricted, the impact of loan supply shocks remains positive and significant.

The results previously discussed show evidence that LS shocks are an important factor driving of business cycle fluctuations. These results suggest that monetary authorities of PA countries need to monitor closely the supply conditions of banking institutions. A policy measure to improve this monitoring is the implementation of a credit standards survey conducted to the same banking institutions. Unlike PA countries, developed economies such as USA and United Kingdom have such kind of surveys which according to Lown and Morgan (2006) improve the identification of shocks arising from banking sector and allow monetary authorities to monitor constantly supply conditions of credit markets. Furthermore, the evidence presented show that LS shocks are the main driving factor of credit cycles and its contribution is present in all periods. For the PA countries it is important to smooth credit cycle as a result that credit is an important source of funds. Monetary authorities can increase the use of macroprudencial instruments as the reserve requirements to regulate liquidity and smooth credit cycles.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, athttps://doi.org/10.1016/j.najef.2019.101140.

References

Abildgren, K. (2012). Financial structures and the real effects of credit-supply shocks in Denmark 1922–2011. *European Review of Economic History, 16*(4), 490–510.
Atta-Mensah, J., & Dib, A. (2008). Bank lending, credit shocks, and the transmission of Canadian monetary policy. *International Review of Economics & Finance, 17*(1), 159–176.
Barnett, A., & Thomas, R. (2014). Has weak lending and activity in the United Kingdom been driven by credit supply shocks? *The Manchester School, 82*(S1), 60–89.
Bäurle, G., & Scheufele, R. (2016). Credit Cycles and Real Activity: The Swiss Case. Swiss National Bank Working Papers 2016-13.
Bean, C., Paustian, M., Penalver, A., & Taylor, T. (2010). Monetary Policy After the Fall, Paper Presented at the Jackson Hole Economic Policy Symposium. Bank of England.
Bernanke, B. S., & Gertler, M. (1995). Inside the Black Box: the Credit Channel of Monetary Policy Transmission. NBER Working Paper 5146.
Bijsterbosch, M., & Falagiarda, M. (2015). The macroeconomic impact of financial fragmentation in the euro area: Which role for credit supply? *Journal of International Money and Finance, 54*, 93–115.
Busch, U., Scharnagl, M., & Scheithauer, J. (2010). Loan Supply in Germany During the Financial Crisis. Discussion Paper Series 1: Economic Studies 2010(5).
Castillo, P., & Salas, J. (2010). *The terms of trade as drivers of economic fluctuations in developing economies: An empirical study, Premio de Banca.* Central Rodrigo Gó mez.
Christiano, L. J., Motto, R., & Rostagno, M. (2010). Financial Factors in Economic Fluctuations. European Central Bank Working Paper Series 1192.
Cogley, T., & Sargent, T. J. (2005). Drifts and volatilities: Monetary policies and outcomes in the post WWII US. *Review of Economic Dynamics, 8*(2), 262–302.
Cúrdia, V., & Woodford, M. (2010). Credit spreads and monetary policy. *Journal of Money, Credit and Banking, 42*(S1), 3–35.
Deryugina, E., Kovalenko, O., Pantina, I., & Ponomarenko, A. (2015). Disentangling loan demand and supply shocks in Russia. Bank of Russia Working Papers 3.
Duchi, F., & Elbourne, A. (2016). Credit supply shocks in the Netherlands. *Journal of Macroeconomics, 50*, 51–71.
Faust, J. (1998). The robustness of identified VAR conclusions about money. *Carnegie-Rochester Conference Series on Public Policy, 49*, 207–244.
Friedman, B. M., & Kuttner, K. N. (1992). Money, income, prices, and interest rates. *The American Economic Review, 82*(3), 472–492.
Galí, J., & Gambetti, L. (2015). The effects of monetary policy on stock market bubbles: Some evidence. *American Economic Journal: Macroeconomics, 7*(1), 233–257.
Gambetti, L., & Musso, A. (2017). Loan supply chocks and the business cycle. *Journal of Applied Econometrics, 32*(4), 764–782.
Gerali, A., Neri, S., Sessa, L., & Signoretti, F. M. (2010). Credit and banking in a DSGE model of the Euro area. *Journal of Money, Credit and Banking, 42*, 107–141.
Gertler, M., & Karadi, P. (2011). A model of unconventional monetary policy. *Journal of Monetary Economics, 58*(1), 559–588.
Goodfriend, M., & McCallum, B. T. (2007). Banking and interest rates in monetary policy analysis: A quantitative exploration. *Journal of Monetary Economics, 54*(5), 1480–1507.
Guevara, C., & Rodríguez, G. (2018). The Role of Loan Supply Shocks in Pacific Alliance Countries: A TVP-VAR-SV Approach, Working Paper 467, Department of Economics, Pontificia Universidad Católica del Perú.
Hafstead, M. & Smith, J. (2012), Financial Shocks, Bank Intermediation, and Monetary Policy in a DSGE Model, manuscript.
Halvorsen, J. I., & Jacobsen, D. H. (2014). How important can bank lending shocks be for economic fluctuations? *The North American Journal of Economics and Finance, 29*, 104–123.
Helbling, T., Huidrom, R., Kose, M. A., & Otrok, C. (2011). Do credit shocks matter? A global perspective. *European Economic Review, 55*(3), 340–353.
Houssa, R., Mohimont, J., & Otrok, C. (2013). Credit Shocks and Macroeconomic Fluctuations in Emerging Markets. CESIFO Working Paper 4281.
Hosszú, Z. (2018). The impact of credit supply shocks and a new Financial Conditions Index based on a FAVAR approach. *Economic Systems, 42*(1), 32–44.
Hristov, N., Hü lsewig, O., & Wollmershäuser, T. (2012). Loan supply shocks during the financial crisis: Evidence for the Euro area. *Journal of International Money and Finance, 31*(3), 569–592.
Jermann, U., & Quadrini, V. (2012). Macroeconomic effects of financial shocks. *The American Economic Review, 102*(1), 238–271.
Kabashi, R., & Suleva, K. (2016). Loan supply shocks in Macedonia: A Bayesian SVAR approach with sign restrictions. *Croatian Economic Survey, 18*(1), 5–33.
Kashyap, A. K., Lamont, O. A., & Stein, J. C. (1994). Credit conditions and the cyclical behavior of inventories. *The Quarterly Journal of Economics, 109*(3), 565–592.
Koop, G., & Korobilis, D. (2010). Bayesian multivariate time series methods for empirical macroeconomics. *Foundations and Trends in Econometrics, 3*(4).
Lane, P. R., & McQuade, P. (2014). Domestic credit growth and international capital flows. *The Scandinavian Journal of Economics, 116*(1), 218–252.
Lown, C. S., & Morgan, D. P. (2006). The credit cycle and the business cycle: new findings using the loan officer opinion survey. *Journal of Money, Credit, and Banking, 38*(6), 1575–1597.
Martin, M. A., Domínguez, J. C., Perea, J. L., Saca, F., & Sánchez, S. (2011). La concentraci ón bancaria y su impacto en los mercados de capitales de los Países emergentes. Anales de Estudios Económicos y Empresariales 21, 159–177.
Meeks, R. (2012). Do credit market shocks drive output fluctuations? Evidence from corporate spreads and defaults. *Journal of Economics Dynamics and Control, 36*, 568–584.
Mwabutwa, C. N., Viegi, N., & Bittencourt, M. (2016). Evolution of monetary policy transmission mechanism in Malawi: A TVP-VAR Approach. *Journal of Economic Development, 41*(1), 33–55.
Mumtaz, H., Pinter, G., & Theodoridis, K. (2018). What do VARs tell US about the impact of a credit supply shock? *International Economic Review, 59*(2), 625–646.
Nakajima, J. (2011). Time-varying parameter VAR model with stochastic volatility: an overview of methodology and empirical applications. *Monetary and Economic Studies, 29*, 107–142.
Paustian, M. (2007). Assessing sign restrictions. *The BE Journal of Macroeconomics, 7*(1), 1–33.
Pereira, P. L. V., & da Silva Fonseca, M. G. (2012). Credit shocks and monetary policy in Brazil: A structural favar approach. *Brazilian Review of Econometrics, 32*(2), 169–200.
Primiceri, G. E. (2005). Time varying structural vector autoregressions and monetary policy. *The Review of Economic Studies, 72*(3), 821–852.
Ramey, V. (1993). Interest rates and the central bank, reprinted. Carnegie-Rochester Conference Series on Public Policy 39, pp. 1–45. ())
Rodríguez, R. C. (2012). Bancos ligados a grupos económicos en México y concentración de mercado en la banca comercial. *Paradigma Econó mico, 4*(1), 5–26.
Rodríguez, G., Villanueva Vega, P., & Castillo Bardalez, P. (2018). Driving economic fluctuations in Peru: The role of the terms of trade. *Empirical Economics, 55*(3), 1089–1119.
Stock, J. H., & Watson, M. W. (1989). New indexes of coincident and leading economic indicators. *NBER Macroeconomics Annual, 4*, 351–394.
Uhlig, H. (2005). What are the effects of monetary policy on output? Results from an agnostic identification procedure. *Journal of Monetary Economics, 52*(2), 381–419.