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The interest rate sensitivity of output and prices with different levels of financial inclusion

Evidence from developing economies

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Abstract

Purpose – The purpose of this paper is to evaluate the interest rate (IR) sensitivity of output and prices in developing economies with different levels of financial inclusion (FI) for the period 2007Q1–2017Q4.
Design/methodology/approach – By using the PCA method to construct an FI index for each country, the author divides the sample into two groups (high and low FI levels). Then, with panel vector autoregressions on per group estimated to assess the strength of the impulse response of output and prices to IR shock.
Findings – The findings show that the impact of an IR shock on output and inflation is greater in economies with a higher degree of FI.
Practical implications – The finding indicates the link between FI and the effectiveness of IRs as a monetary policy tool, thereby helping Central banks to have a clearer goal of FI to implement their monetary policy.
Originality/value – This study emphasizes the important role of FI in the economy. From there, an FI solution is integrated into the construction and calculation of its impact on monetary policy, improving the efficiency of monetary policy transmission, contributing to price stability and sustainable growth.

Keywords Financial inclusion, Interest rate sensitivity, Monetary policy transmission mechanism

Paper type Research paper

1. Introduction

Financial inclusion (FI) delivered in a responsible and sustainable way has gained prominence in the policy agenda in developing countries over the past decade. Accordingly, the lack of access by a large percentage of population in these countries including Vietnam to formal financial services is a major policy concern. Because economic opportunities are linked to access to financial services, and that access particularly affects the poor as it allows them to save, invest and benefit from credit (Subbarao, 2009). From the efforts to get the majority of people access to formal financial services, it has contributed to increasing the overall efficiency of the economy and the financial system. However, such benefits are limited to developed economies, since most developing economies lack access to financial services (more than 90 percent of 1.7bn people in the world do not have an account at a financial institution – Demirguc-Kunt *et al.*, 2018). Hence, FI is not only important but also the main goal of top priority in these countries.

On the other hand, most of the research on FI has focused on issues of measuring (e.g. Sarma, 2008; Demirguc-Kunt and Klapper, 2012; Park and Mercado, 2015; Camara and Tuesta, 2014; Mialou *et al.*, 2017), poverty reduction and inclusive growth (Chibba, 2009;

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Park and Mercado, 2015; Okoye *et al*., 2017; Okere and Ozuzu, 2018) or financial stability (e.g. Hannig and Jansen, 2010; Khan, 2011; Han and Melecky, 2013; Morgan and Pontines, 2014; Garcia, 2016; Neaime and Gaysset, 2018). However, the level of access to financial services of all economic segments in society, especially services which allow for saving and borrowing at a market interest rate (IR), is potentially relevant for monetary policy and in particular the strength of the monetary transmission mechanism. Meanwhile, empirical research on this topic in developing countries is rather limited. Only a few studies such as Mehrotra and Yetman (2014, 2015) and Mehrotra and Nadhanael (2016) had attempted to investigate the link between the effectiveness of IRs as a policy tool and FI.

In addition, in Keynes's standard neo-macroeconomic models, the transmission of monetary policy depends on private expenditures being interest elastic, so that a rise/fall in the policy IR induces a fall/rise in private expenditures, which in turn affects real output and inflation, because most standard neo-Keynesian macroeconomic models contain no explicit modeling of the financial system. Thus, implicitly, it is assumed that consumers have access to financial services at the going market IR for these services, i.e. they can borrow and save at market IRs (Berg *et al*., 2006; Clarida *et al*., 1999; Svensson, 2000). However, this is not possible in many developing countries, because most people are excluded from access to financial services and especially access to credit. Consumers cannot borrow to smooth their consumption in the face of an income shock. It can be seen that, in principle, this financial exclusion would reduce the IR elasticity of private spending and thus weaken the IR transmission of monetary policy. So, whether or not there is a change in the IR sensitivity of output and prices to the different levels of FI in developing countries. This is also the main research question of this article. From this, it can be seen that this study is necessary and worthwhile. Because, by answering this research question, we can find the link between the effectiveness of IRs as a monetary policy tool and FI, thereby helping policy makers, in particular Central bankers, have a clearer goal of FI to implement their monetary policy.

Based on the FI index built by the principal component analysis (PCA) method, we divide the sample into two FI groups: high and low degree of FI. By using panel vector auto-regression (PVAR), the study examines the impact on the output gap and inflation of a shock to IR in the two groups of economies with different levels of FI to answer the main research question.

The remainder of this paper is structured as follows. Section 2 provides an overview of the theoretical basis and associated empirical evidence. Section 3 discusses the data and methodology. Subsequently, we report our findings and discussion in Section 4. Finally, Section 5 provides conclusion and policy implications.

2. Literature review

2.1 Concept of financial inclusion

There is growing literature addressing the definition of FI. Despite the difference in the definition of this concept, it is generally acknowledged that FI is the process of ensuring that people have easy access to and use of financial services from the formal financial institutions in a timely, adequate, affordable manner, especially for the financial disadvantaged group (Sarma, 2008; De Koker and Jentzsch, 2013; Joshi *et al*., 2014). For the World Bank (2018), FI means as individuals and businesses have access to useful and affordable financial products and services that meet their needs (transactions; payments; savings; credit and insurance) delivered in a responsible and sustainable way.

Over the years, scholars as well as policy makers have made great efforts to measure FI. One of the first attempts to measure the financial sector's access to nations was made by Beck *et al*. (2007). Accordingly, the authors have designed new indicators of bank access for three types of services including deposits, loans and payments through two

dimensions of access and use of financial services. Demirguc-Kunt and Klapper (2012) and Demirguc-Kunt *et al.* (2015, 2018) have provided a set of indicators to measure the level of savings, borrowing, payment and risk management of adults in the world. However, FI is a multidimensional concept that cannot be accurately captured by individual indicators. Because, when used alone, these indicators can only provide partial and incomplete information about the comprehensiveness of the financial system. Even the use of individual indicators can lead to misunderstandings about the level of FI in an economy (Sarma, 2016). Thus, the measurement of FI of a country is realized by the FI index. Along with that, there are many methods to develop the FI index (e.g. Sarma, 2008, 2015, 2016; Demirguc-Kunt and Klapper, 2012). However, it assigns weights to all variables and dimensions based on the author's experience, and assumes that all parameters have the same effect on FI. That is also the cause of criticism in the academic community. Therefore, the contribution of Amidžić *et al.* (2014) in providing an index using factor analysis (FA) or PCA method of Camara and Tuesta (2014) to determine the appropriate weights for calculating the FI index is an attempt to overcome the previous criticism, less arbitrary in proposing weights for variables and dimensions.

2.2 Theoretical and empirical literature

The common theoretical framework used to explain the monetary policy response to FI levels is the research model of Galí *et al.* (2004). In the model, the economy includes those who have access to financial markets and those who do not make savings or borrowings that consume their entire income. Accordingly, the resolution of parameter values under the Taylor rule shows that this greatly depends on the proportion of households that have access to financial markets. One major reason for the monetary policy outlook to become unstable when the level of FI falls is that financially excluded consumers are not directly affected by IRs, which makes monetary policy less effective (Mehrotra and Yetman, 2014). This shows the implications of limiting access to finance for the policy response function of the central bank and the effectiveness of monetary policy. Mehrotra and Yetman (2015) also argue that FI changes the behavior of businesses and consumers, which may affect the effectiveness of monetary policy. First, the increase in finance facilitates consumption, as households have easy access to tools for saving and borrowing. As a result, the output fluctuation is less costly, contributing to creating conditions for the central banks to maintain price stability. Second, enhancing FI may increase the importance of IRs in the transmission of monetary policy, enabling the central bank to improve the effectiveness of monetary policy. In asset market participation, Bilbiie and Straub (2012) also show how changes can lead to a change in the sign of the IR coefficient in the output Euler equation when asset market participation increases. Such considerations suggest that there could be important differences in the IR sensitivity of output and prices across economies, depending on the level of FI.

As mentioned in the introduction, the empirical literature on FI and monetary policy transmission in developing countries is rather limited. Several studies show that FI has a significant impact on monetary policy (e.g. Lapukeni, 2015; Lenka and Bairwa, 2016). However, these studies mainly focus on the impact of FI on monetary policy in the aspect of the central banks choosing to maintain and stabilize prices to implement monetary policy. Accordingly, inflation is used as a proxy for monetary policy. In contrast, Evans (2016) argues that although there is a one-way effect from monetary policy effectiveness to FI, there seems to be no impact in the opposite direction. However, the model used by the author lacks theoretical backing and therefore does not provide conclusive estimates of the relationship between FI and monetary policy.

Mehrotra and Yetman (2014) build on the Galí *et al.* (2004) model, in which financial excluded consumers are assumed to simply consume all their income each period, while

included consumers have access to financial markets. From a policy perspective, the key difference between the two is that included consumers can smooth their consumption in response to shocks that hit the economy, while excluded consumers cannot. By using a PVAR, the authors found that the ratio of output volatility to inflation volatility increased in the share of financially included consumers in the economy when monetary policy was conducted optimally. On the other hand, Mehrotra and Nadhanael (2016) evaluate the IR sensitivity of output and prices in emerging Asian economies with different levels of FI. This is done both by estimating output Euler equations (similar in spirit to Bilbiie and Straub, 2012) and examining the impact of IR shocks on output and prices in PVAR. From estimates of the real IR coefficient in output Euler equations and from vector autoregressions that consider impacts of nominal IR shocks on output and prices, they find that the IR sensitivity of output and prices is higher in economies with a greater degree of FI.

However, except for Mehrotra and Nadhanael (2016), none of these have investigated whether the IR sensitivity of output and prices changes for the degree of FI in developing economies. We therefore aim to address this gap in the literature. Our approach is similar in spirit to Bilbiie and Straub (2012) and Mehrotra and Nadhanael (2016). However, instead of using only the World Bank's indicator of account ownership in 2011 as the method of Mehrotra and Nadhanael (2016), we divided the sample into two separate groups (high and low FI levels) by using PCA to construct a composite FI index for each economy.

3. Methodology

3.1 Data

This study uses annual data collected from the results of financial access survey to calculate the FI index and quarterly data from international financial statistics of the International Monetary Fund for period 2007Q1–2017Q4 to analyze the impact of an IR shock on output and inflation in 21 developing countries (the list is attached in Appendix). Our research sample does not cover all developing countries because countries data are incomplete over the years. The starting year of the research period is 2007 because after the global financial crisis 2007–2008, the policy makers around the world re-recognize and determine that a need to focus on FI direction in a sustainable way can achieve financial stability and comprehensive growth (Garcia, 2016).

3.2 Research models and measurement variables

3.2.1 Financial inclusion index (FI index). As mentioned in the literature review, there are two parametric analyses commonly used for indexing: FA and PCA. However, PCA is preferred over FA as an indexing strategy because it is not necessary to make assumptions on the raw data, such as selecting the underlying number of common factors (Camara and Tuesta, 2014 cited in Steiger, 1979). Therefore, we develop an FI index via the PCA method. Because it is imperative that measures of FI reflect the multidimensional nature of FI.

In computing our FI index, we combine the approaches of Sarma (2008, 2015, 2016) and Camara and Tuesta (2014). Like Sarma, we use: access, availability and usage as dimensions of our FI index. And based on Camara and Tuesta (2014), we develop a composite FI index via PCA method which is displayed in the form of:

$$\mathrm{FII}_{ij} = \sum w_{ij} X_i, \tag{1}$$

where FII_{ij} is the FI index, w_{ij} is the weight on factor score coefficient and X_i is the respective original value of the components.

The variables in the model are as follows:

- Access (banking penetration): the number of deposit bank accounts per 1,000 adult population.
- Availability (availability of banking services): number of commercial bank branches per 100,000 adults, and number of ATMs per 100,000 adults.
- Usage: as proposed by Beck *et al.* (2007), Gupte *et al.* (2012), Lenka and Bairwa (2016) and Sarma (2016), we consider two basic services of the banking system to be credit and deposit. Accordingly, outstanding loans from commercial banks (% of GDP) and outstanding deposits with commercial banks (% of GDP) are used to measure this dimension.

By the PCA method, FII is constructed by combining these three dimensions and five elements.

3.2.2 The impact of an interest rate shock on output and inflation. Based on suggestions from Mehrotra and Nadhanael (2016), our approach is similar in spirit to Bilbiie and Straub (2012) from the Euler equations are based on hybrid models, we estimate PVAR models using the methodology proposed by Love and Zicchino (2006), with the vector of endogenous variables set as [y, ir, π]. In reduced form, PVAR frameworks are shown as follows:

$$Y_{i,t} = \alpha_i + \Gamma(L) Y_{i,t} + \varepsilon_{i,t}, \tag{2}$$

where $Y_{i,t}$ is a vector of endogenous variables: output gap (y) – the difference between actual GDP and potential GDP; interest rate (ir); inflation (π); $Y_{it} = (y_{t,i}, ir_{i,t}, \pi_{i,t})'$; α_i is a vector of constants; $\Gamma(L)$ is a matrix polynomial in the lag operator; $\varepsilon_{i,t}$ is a vector of error terms.

3.3 Methodology

3.3.1 Calculate a composite FI index. To divide the sample into two separate FI groups (high and low degrees of FI), we build the composite FI index for developing economies by employing the PCA method from Equation (1). If the economy has an average of the FI index > 0.5, then classify it into a group of high FI level and vice versa (i.e. average of the FI index $\leqslant 0.5$: low FI level).

3.3.2 Analyze the impact of an interest rate shock on output and inflation. Focusing again on two groups of economies that have been divided above, we estimate PVAR models (2) using the methodology proposed by Love and Zicchino (2006). After estimating the above reduced-form models, shocks are identified by the conventional Cholesky decomposition of the variance-covariance matrix. Then, we examine the magnitude of a one standard deviation shock to the IR and the impact of changes in IRs on output and prices in the two groups of economies. In addition, the output gap is based on data for real GDP, with the cycle extracted by means of a Hodrick–Prescott filter (supported from Stata software).

4. Results and discussion

4.1 FI index

Before using PCA, indicators of each dimension are normalized to have values between 0 and 1 to ensure that the scale in which they are measured is immaterial. Through the PCA method, we calculated eigenvalues of the all five factors (described in Table I). The highest eigenvalue of the components retains more standardized variance among others, and an eigenvalue greater than 1 is considered for the analysis (Kaiser, 1960). According to Lenka and Bairwa (2016), if the value contains more than one component, then we may consider more than one principal component (PC) in the financial analysis. Then, taking the weight of

Dimension/Variable	Description	Data sources
Access (penetration)		
Accounts	Deposit accounts with commercial banks per 1,000 adults	FAS – IMF
Availability		
Branch banks	Branches of commercial banks per 100,000 adults	FAS – IMF
ATMs	Automated Teller Machines (ATMs) per 100,000 adults	
Usage		
Deposits	Outstanding deposits with commercial banks (% of GDP)	FAS – IMF
Loans	Outstanding loans with commercial banks (% of GDP)	

Source: The authors

Table I. Summary of variables and data sources are used to build FI index

each factor (calculated by PCA) multiply it by the corresponding variable and add them to get the final index.

Table AII shows the results of the PCA. We can see the eigenvalues of the five PCs are 2.28, 1.35, 0.79, 0.35 and 0.23. This shows that there are two PCs have eigenvalue greater than 1, so we take the first two components and continue using PCA (Table AIV) to find the weights assigned to the PCs. After performing the KMO test (Tables AIII and AV) to examine the suitability of the factors and by doing so we get the composite FI index for developing countries as shown in Tables II and III.

From the above results, we divided the sample into two separate groups. The first group consists of countries with an average value of FI index > 0.5, known as a high FI level group (see Table II). The second group is a low FI level group (the remaining countries with the average value of FI index $\leqslant 0.5$ – see Table III).

4.2 Sensitivity analysis

On the basis of unit-root test results using Fisher-type unit-root test based on augmented Dickey–Fuller in Table IV, where all the three series (Panels A, B and C) are stationary at the 1 percent significance level, since the *p*-values are all smaller than 0.01. This means there are no unit roots in our panels under the given test conditions.

The choice of the lag length was determined as the minimum number of lags that merits the crucial assumption of time independence of the residuals. The results for the panel VAR lag order selection are shown in Table V.

	FI index								
Year	Bulgaria	Chile	Macedonia	Malaysia	Mauritius	South Africa	Thailand	Ukraine	Vietnam
2007	0.84	0.55	0.35	0.81	0.77	0.39	0.53	0.76	0.39
2008	0.94	0.64	0.49	0.80	0.81	0.45	0.61	0.89	0.38
2009	0.98	0.64	0.54	0.93	0.85	0.48	0.63	0.91	0.50
2010	0.99	0.65	0.56	0.91	0.92	0.48	0.64	0.91	0.58
2011	0.91	0.70	0.56	0.94	0.91	0.49	0.68	0.91	0.54
2012	0.92	0.74	0.59	0.96	0.93	0.53	0.75	0.98	0.53
2013	0.93	0.75	0.60	1.00	0.93	0.55	0.80	0.83	0.58
2014	0.89	0.75	0.63	0.98	0.95	0.59	0.83	0.81	0.62
2015	0.87	0.77	0.66	0.97	0.99	0.60	0.85	0.70	0.70
2016	0.83	0.78	0.65	0.94	0.94	0.60	0.84	0.67	0.79
2017	0.83	0.78	0.65	0.90	0.93	0.60	0.85	0.68	0.83
Mean	0.91	0.71	0.57	0.92	0.90	0.52	0.73	0.82	0.59

Source: Calculated by the authors using PCA method on Stata 14

Table II. Estimation of the FI index of high FI level group in developing countries

Table III.
Estimation of the FI index of low FI level group in developing countries

Year	FI index											
	Algeria	Armenia	Bolivia	Costa Rica	Guatemala	Hungary	India	Indonesia	Jamaica	Mexico	Peru	The Philippines
2007	0.12	0.03	0.00	0.38	0.23	0.40	0.20	0.10	0.20	0.14	0.07	0.05
2008	0.12	0.08	0.00	0.41	0.25	0.45	0.24	0.11	0.20	0.20	0.13	0.07
2009	0.12	0.15	0.06	0.42	0.27	0.46	0.27	0.12	0.20	0.21	0.14	0.08
2010	0.11	0.18	0.07	0.41	0.29	0.46	0.28	0.12	0.19	0.24	0.17	0.09
2011	0.10	0.27	0.10	0.45	0.31	0.47	0.30	0.17	0.18	0.21	0.20	0.11
2012	0.11	0.33	0.12	0.47	0.34	0.43	0.33	0.26	0.20	0.23	0.23	0.12
2013	0.13	0.38	0.15	0.54	0.38	0.41	0.36	0.32	0.21	0.27	0.27	0.16
2014	0.18	0.45	0.19	0.58	0.40	0.40	0.41	0.35	0.22	0.24	0.34	0.17
2015	0.20	0.46	0.24	0.54	0.41	0.37	0.44	0.37	0.23	0.26	0.57	0.19
2016	0.20	0.50	0.27	0.58	0.40	0.37	0.46	0.39	0.25	0.28	0.55	0.22
2017	0.21	0.52	0.30	0.60	0.38	0.38	0.48	0.45	0.33	0.27	0.54	0.24
Mean	0.15	0.30	0.14	0.49	0.33	0.42	0.34	0.25	0.22	0.23	0.29	0.14

Source: Calculated by the authors using PCA method on Stata 14

		Statistic	*p*-value
Panel A: Fisher-type unit-root test for IR (based on augmented Dickey–Fuller tests)			
Inverse χ^2 (42)	*P*	141.1263	0.0000
Inverse normal	*Z*	−3.7963	0.0001
Inverse logit *t* (104)	*L**	−6.7283	0.0000
Modified inv. χ^2	Pm	10.8156	0.0000
Panel B: Fisher-type unit-root test for INF (based on augmented Dickey–Fuller tests)			
Inverse χ^2 (42)	*P*	190.8418	0.0000
Inverse normal	*Z*	−9.7501	0.0000
Inverse logit *t* (109)	*L**	−11.3288	0.0000
Modified inv. χ^2	Pm	16.2400	0.0000
Panel C: Fisher-type unit-root test for Ygap (based on augmented Dickey–Fuller tests)			
Inverse χ^2 (42)	*P*	432.5446	0.0000
Inverse normal	*Z*	−15.0169	0.0000
Inverse logit *t* (104)	*L**	−26.0654	0.0000
Modified inv. χ^2	Pm	42.6119	0.0000

Note: For the two statistics *Z* and *L**; if the realization is lower than the normal law level (−1.64 at the 5 percent significance level), rejects the null hypothesis
Source: Calculated by the authors using unit-root test on Stata 14

Table IV.
Panel unit-root test

lag	CD	*J*	*J p*-value	MBIC	MAIC	MQIC
1	0.999995	138.0161	1.1490848	−203.3547	24.01606	−66.0346
2	1	87.52919	0.0004277	−199.941	−8.470812	−84.30294
3	1	82.00171	0.0001017	−157.5567	2.001713	−61.19173

Source: Calculated by the authors using PVAR on Stata 14

Table V.
The result of lag length selection criteria

Based on the three model selection criteria by Andrews and Lu (2001), second-order panel VAR is the preferred model, since this has the smallest MAIC (−8.47) and MQIC (−84.3). In addition, according to these authors, for the smallest sample size, MAIC is the best of the three procedures. Thus, the underlying PVAR model is estimated using two lags.

After we estimate GMM by using GMM estimation implemented by PVAR (Table AVI) and then test for Granger causality (Table AVII), we can find IR, Granger-cause inflation (INF) and output gap (Ygap). This means changes in INF and Y gap have cause on the changes in IR.

The results from Table VI show that the moduli of the companion matrix based on the estimated parameters are all smaller than 1 (proposed by Hamilton, 1995; Lütkepohl, 2005). We conclude that the model is stable.

Low FI level group Eigenvalue			High FI level group Eigenvalue		
Real	Imaginary	Modulus	Real	Imaginary	Modulus
0.9986204	0	0.9986204	0.9554152	0.0381895	0.9561781
0.874434	−0.0241578	0.8747676	0.9554152	−0.0381895	0.9561781
0.874434	0.0241578	0.8747676	0.9043196	0	0.9043196
0.5811525	−0.3611747	0.6842408	0.7165484	−0.2688763	0.7653339
0.5811525	0.3611747	0.6842408	0.7165484	0.2688763	0.7653339
0.1548274	0	0.1548274	0.0650641	0	0.0650641

Source: Calculated by the authors using PVAR on Stata 14

Table VI.
Eigenvalue stability condition

See Figure 1, we can also see that the model is stable because the roots of the companion matrix are all inside the unit circle.

Based on the forecast error variance decomposition (FEVD) estimates from Table VII, we see that in high FI level group, nearly 2.7 percent of the variation in output gap and 6.3 percent of the variation in inflation can be explained by the shock of IRs. On the other hand, these rates in low FI level group are only 0.1 and 4.4 percent, respectively. This shows that the impact of changes in IRs on output and prices is much larger in countries with high FI level than it is in countries with a low FI level.

In our model, actually, estimates made for impulse response function (IRF) are the core of the research, because we are trying to understand what happens with output and prices, when a shock in the IR occurs. In order to obtain the needed results, we need to focus on the response of IR on the change of 1 standard deviation from itself and from output gap and inflation. The estimate results for IRF are shown in Table VIII.

The second column of Table VIII shows the magnitude of a one standard deviation shock to the IR in the two groups of economies. We see that short-term IRs are much more volatile in economies with a higher degree of FI ($1.025 > 0.56$). And the next two columns focus on the impact of IR shocks of one percentage point on the output gap and inflation. The estimates also suggest that the impact of an IR shock on output and inflation is larger in economies with a higher degree of FI. In particular, in the model with two lags, the point impact on output is

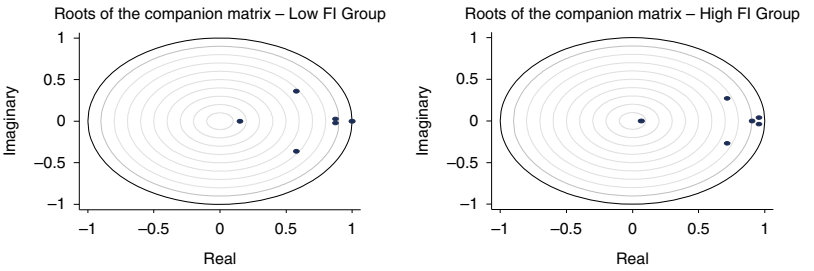

Figure 1.
Graph of eigenvalue stability condition

Source: Drawed by the authors using PVAR on Stata 14

	Low FI level group Impulse variable			High FI level group Impulse variable		
Response variable	IR	INF	Ygap	IR	INF	Ygap
IR	0.9985	0.0014	0.00001	0.98593	0.0139	0.00007
INF	*0.0440*	0.9559	0.00004	*0.06319*	0.9368	0.86106
Ygap	*0.0010*	0.0106	0.98842	*0.02665*	0.0249	0.94843

Table VII.
Variance decomposition

Source: Calculated by the authors using PVAR on Stata 14

	One standard deviation shock to interest rate (IR)	Response to 1% point shock in interest rate Output gap	Inflation
Low FI level group	0.5596	0.0036	0.4216
High FI level group	1.0254	−0.0125	1.0024

Table VIII.
Impact of shocks to interest rate

around 3.5 times as large (i.e. 0.0125 compared to 0.0036 – see the third column in Table VIII), and the impact on inflation approximately 2.4 times as big in these economies (i.e. 1.0024 compared to 0.4216 – see the last column in Table VIII), compared to those with less financial access. These results are in line with the findings of Mehrotra and Nadhanael (2016) and Mehrotra and Yetman (2014), where the ratio of output volatility to inflation volatility was found to increase with the share of financially included consumers in the economy.

Figure 2, graphs of the IRFs and the 5 percent error bands generated by Monte Carlo simulation, reports graphs of impulse responses for the model with three variables estimated for a sample of countries with low FI level (on the left), and countries with high FI (on the right). The black line represents the IRF and the gray band is the 95 percent confidence interval for the IRF.

Specifically, the bottom row of the graphs shows the impact of IR shock on output (IR: Ygap) and prices (IR: INF) in two groups (low and high FI levels). For high FI group, the initial impact of a structural one standard deviation shock to IR on inflation (prices) is 0.5033 (50.33 percent) and rises to a maximum of 1.1214 (112.14 percent) in the fourth quarter, thereafter it begins to dissipate. On the other hand, it is only 0.1776 (17.76 percent) for low FI group, rising to 0.4428 (44.28 percent) in the third quarter, before dissipating thereafter (data are in Table AVIII). It shows that the effect of an IR shock on prices (inflation) is greater than in economies with higher FI level. Similarly, the graph (IR: Ygap) also displays that the response of output volatility to IR shock is more pronounced for economies with a higher level of FI.

Consistent with the FEVD results (as mentioned in Table VII), the study indicates that the IR sensitivity of output and prices is larger for high FI group which suggests that economies with a higher degree of FI have stronger the IR sensitivity of output and prices than economies with a lower degree of FI.

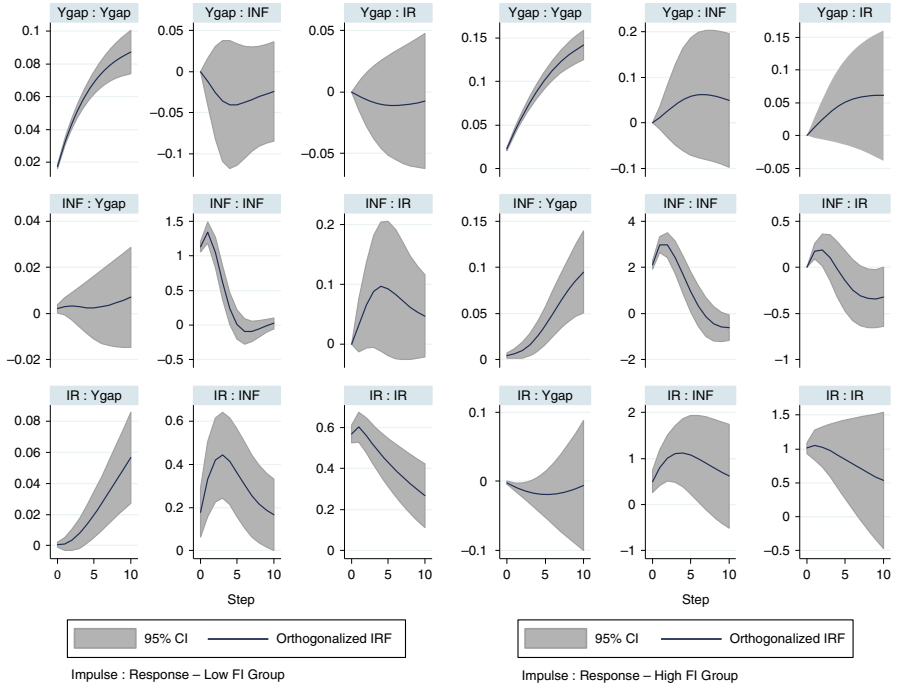

Figure 2. Graphs of impulse responses functions

Source: Drawed by the authors using PVAR on Stata 14

Overall, our findings have yielded results consistent with other scholars' studies (e.g. Mehrotra and Nadhanael, 2016; Mehrotra and Yetman, 2014). This is also in line with the theoretical model results of Bilbiie and Straub (2012), where changes in asset market participation can lead to a change in the sign of the IR coefficient in the output Euler equation when asset market participation increases. Approach research in this spirit, Mehrotra and Nadhanael (2016) also argued that the FI level is directly related to monetary policy. The most obvious channel is through the importance of IRs in the economy. Accordingly, economies with higher FI levels tend to exhibit the higher IR sensitivity of output and prices. This increases the importance of the IR channel in the transmission of monetary policy.

5. Conclusion and policy implications

This paper uses a PVAR approach to analyze the IR sensitivity of output and prices with different levels of FI in developing economies over the 2007Q1–2017Q4 period. The results show that short-term IRs are much more volatile in economies with a higher degree of FI. Similar to the magnitude of a one standard deviation shock to the IR, the impact of an IR shock on output and inflation is larger in economies with a higher degree of FI. Accordingly, this paper also indicates the link between the effectiveness of IRs as a monetary policy tool and FI. In other words, the effectiveness of monetary policy depends on the levels of FI in the economy, because a higher level of FI may facilitate increased participation of different sectors of the economy in the formal financial system. And as the proportion of the formal financial sector increases, it increases the effectiveness of IRs as an important policy tool for macroeconomic stability (Cecchetti and Kharroubi, 2012). Monetary policy operates primarily through its influence on the financial system. Therefore, any development affecting the structure or condition of the financial system will likely affect the transmission mechanism of monetary policy (Ma and Lin, 2016). So, the efforts of governments in developing economies should not only be on the behavior of macroeconomic variables to influence their monetary policy but also on FI.

It is clear that FI brings many economic benefits to individuals, small businesses and sustainable growth in general. It facilitates the attainment of macroeconomic goals including output growth, poverty reduction, bridging of income inequality and price stability (Beck *et al.*, 2007). However, its impact on monetary policy in general and the effectiveness of monetary policy transmission in particular are rarely mentioned. Thus, this study contributes to the advancement of the theory of the relationship between FI and monetary policy through IR tool. It also helps policy makers, the Central bank and communities see such importance of FI in the economy. From there, an FI solution is integrated into the construction and calculation of its impact on monetary policy, improving the efficiency of monetary policy transmission, contributing to price stability and sustainable growth.

For developing countries, the importance of FI for these countries has become much more evident in recent years. Many countries also have made a commitment to place a priority on FI. However, these economies are still largely based on cash transactions. A large portion of the adults has not yet used formal financial services. Therefore, the transition to a non-cash system needs to be prioritized in order to improve efficiency and promote economic development. In addition, one of the focal points that the governments of these countries need to toward is the strengthening of access to and use of financial services for the people. And the task of policy makers is to focus on innovation, diversifying financial services, improving financial infrastructure and accelerating the use of digital technology in the economy. In particular, focus on promoting the adoption of mobile money technology and increasing utilization of microfinance service initiatives. In addition, owning an account is an important first step toward FI. But to fully benefit from having an account, people need to be able to use it in safe and convenient ways. Thus, financial service providers need to offer safe, affordable and convenient products that make using accounts more appealing than using cash.

For policy outcomes in terms of output and inflation, in developing countries, most Central banks use Keynes's new standard macroeconomic models for policy analysis. Accordingly, the transmission mechanism of monetary policy largely depends on private investment as IR elasticity. Thus, an increase in the monetary policy IR induces a decrease in private investment and vice versa. Finally, real output and inflation are affected. So, if there are a large share of financially excluded households in an economy, the IR elasticity of private consumption will be reduced. This is because financially inclusive households are able to absorb shocks, and thus can consume more smoothly than financially excluded households.

From a policy perspective, therefore, monetary authorities in developing countries need to focus more on output growth than inflation. This could support income stabilization, allowing finely excluded households to consume smoothly. At the same time, it is necessary to enhance FI in the economy so that monetary policy can more fully achieve its objectives.

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Appendix

Table AI.
List of countries

Algeria	Hungary	Mexico
Republic of Armenia	India	Peru
Bolivia	Indonesia	The Philippines
Bulgaria	Jamaica	South Africa
Chile	Macedonia, FYR	Thailand
Costa Rica	Malaysia	Ukraine
Guatemala	Mauritius	Vietnam

Table AII.
Principal components/ correlation (five factors)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.2805	0.932842	0.4561	0.4561
Comp2	1.34766	0.553287	0.2695	0.7256
Comp3	0.794372	0.443765	0.1589	0.8845
Comp4	0.350607	0.123747	0.0701	0.9546
Comp5	0.22686	0	0.0454	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
zaccount	0.5323	0.1955	0.3024
zATM	0.4490	0.4877	0.2196
zBank	0.2302	0.5070	0.5328
zDepst	0.4129	−0.5676	0.1771
zloan	0.5400	−0.3805	0.14

Table AIII.
Kaiser–Meyer–Olkin test (five factors)

Variable	KMO
zaccount	0.6860
zATM	0.5302
zBank	0.5643
zDepst	0.4815
zloan	0.5668
Overall	0.5630

Table AIV.
Principal components/ correlation (two factors) (to find out weights)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.25711	0.514221	0.6286	0.6286
Comp2	0.74289	0	0.3714	1.0000

Principal components (eigenvectors)

Variable	Comp1	Unexplained
zFII1	0.7071	0.3714
zFII2	0.7071	0.3714

Table AV.
Kaiser–Meyer–Olkin test (two factors)

Variable	KMO
zFII1	0.5000
zFII2	0.5000
Overall	0.5000

Variable	Low FI level group	High FI level group
IR		
IR		
L1.	1.049***	1.006***
L2.	−0.140***	−0.044
INF		
L1.	0.028	0.081***
L2.	−0.004	−0.108***
Ygap		
L1.	−0.196	0.557
L2.	0.215	−0.552
INF		
IR		
L1.	0.214**	0.094
L2.	−0.025	0.070
INF		
L1.	1.185***	1.412***
L2.	−0.481***	−0.598***
Ygap		
L1.	−0.693	0.492
L2.	0.654	−0.536
Ygap		
IR		
L1.	0.000	−0.003*
L2.	0.004*	0.003**
INF		
L1.	−0.001	−0.001
L2.	0.000	0.002***
Ygap		
L1.	1.831***	1.896***
L2.	−0.832***	−0.900***

Notes: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table AVI. GMM estimation

	Low FI level group			High FI level group		
Equation\Excluded	χ^2	df	Prob > χ^2	χ^2	df	Prob > χ^2
IR						
INF	3.216	2	0.200	68.340	2	0.000
Ygap	0.636	2	0.728	2.807	2	0.246
All	4.874	4	0.300	92.787	4	0.000
INF						
IR	13.031	2	0.001	5.165	2	0.076
Ygap	1.107	2	0.575	2.026	2	0.363
All	15.193	4	0.004	5.315	4	0.256
Ygap						
IR	25.068	2	0.000	4.368	2	0.113
INF	1.033	2	0.597	42.045	2	0.000
All	32.560	4	0.000	93.625	4	0.000

Table AVII. Panel VAR-Granger causality Wald test

Response variable and forecast horizon	Low FI level group Impulse variable			High FI level group Impulse variable		
	INF	IR	Ygap	INF	IR	Ygap
INF						
0	1.13197	0.17763	0	2.11024	0.50331	0
1	1.34013	0.33180	−0.01205	2.98177	0.80421	0.01107
2	1.04976	0.42163	−0.02572	2.96665	1.00242	0.02572
3	0.61263	0.44280	−0.03554	2.43872	1.10334	0.03981
4	0.23853	0.41444	−0.04006	1.69672	1.12140	0.05099
5	0.00655	0.36154	−0.04016	0.94783	1.07832	0.05827
6	−0.0895	0.30423	−0.03755	0.31393	0.99693	0.06161
7	−0.0942	0.25414	−0.03385	−0.15162	0.89720	0.06154
8	−0.0559	0.21531	−0.03014	−0.44372	0.79428	0.05889
9	−0.0104	0.18692	−0.02694	−0.58622	0.69815	0.05449
10	0.02327	0.16608	−0.02435	−0.61628	0.61417	0.04911
Ygap						
0	0.00209	0.00050	0.01738	0.00413	−0.00240	0.02253
1	0.00311	0.00104	0.03182	0.00664	−0.00772	0.04271
2	0.00320	0.00359	0.04380	0.01013	−0.01246	0.06065
3	0.00286	0.00787	0.05372	0.01632	−0.0160	0.07651
4	0.00254	0.01341	0.06191	0.01632	−0.0160	0.07651
5	0.00252	0.01982	0.06863	0.03696	−0.01920	0.10266
6	0.00292	0.02682	0.07413	0.04974	−0.01869	0.11325
7	0.00367	0.03416	0.07860	0.06272	−0.01694	0.12236
8	0.00467	0.04166	0.08220	0.07498	−0.01417	0.13012
9	0.00581	0.04916	0.08508	0.08587	−0.01058	0.13663
10	0.00701	0.05655	0.08735	0.09502	−0.00639	0.14200

Table AVIII.
Orthogonalized IRF

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