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The Short- and Long-Run Relationship between House Prices and Bank Credit in Developed and Emerging Market Economies: A Comparative Study

Summary: This study compares the short- and long-term relationships between house prices and bank credit in developed and Emerging Market Economies. This fact is an essential issue because most financing is facilitated by bank credit. Using quarterly data from 22 developed and six Emerging Market Economies and the panel autoregressive distributed lag model method, this study found that real house prices are the prominent factor of bank credit. Moreover, the magnitude of house prices and gross domestic product relationship with domestic bank credit is considerably greater in Emerging Market Economies than in developed nations. Meanwhile, the foreign interest rate on bank credit is nearly four times greater in Emerging Market Economies. Further, the exchange rate-credit relationship is positive for developed countries, whereas negative for Emerging Market Economies. Therefore, authorities maintaining financial stability must pay close attention to real house price dynamics. Moreover, Emerging Market Economies must also consider the exchange rate and foreign interest rates in managing credit growth.

Keywords: House prices, Foreign interest rate, Bank credit, Cointegration, Panel ARDL.

JEL: E47, E51, E52, F65, G21.

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Financing is essential to the expansion of all businesses around the world. The bank sector plays a significant role in meeting the financing needs of private businesses and households. In the first quarter of 2018, the banking sector provided approximately 76% of credit to the private sector in Emerging Market Economies. In contrast, bank credit accounted for approximately 49% of total financing in developed nations during that period (see Table A1 in the Appendix). This fact suggests that changes in the volume of bank sector credit have significant implications for the financial system's stability (Boris Hofmann 2004; Moritz Schularick and Alan M. Taylor 2012).

The connection between bank credit and monetary policy has been extensively examined in economics academic literature (see, for example, Valentina Bruno and Hyun Song Shin 2015). An increasing number of scholarly works have analyzed the

relationship between bank credit and macroeconomic variables. Examples include the works of Kashif Imran and Mohammed Nishat (2013) and Emmanuel Alejandro Ramírez Guerra (2017). Nevertheless, a growing body of research has explored other factors, such as the relationship between property prices and bank credit. Examples include Hofmann (2004) and Mansor H. Ibrahim and Siong Hook Law (2014), who explained that the increase in house prices could stimulate bank lending activities by improving banks' balance sheet position, thereby increasing banks' willingness to lend. However, among this growing body of scholarly work, no study has empirically analyzed the relationship between house prices and other variables and credit from domestic banks to the private sector in a cross-country analysis of developed and Emerging Market Economies.

The remainder of this paper is structured in the following sequence. Section 1 presents a review of the literature. Section 2 presents stylized facts about bank credit, house prices, and macroeconomic variables. Section 3 provides the empirical framework utilized in the study, and Section 4 discusses the research findings and discussions. Finally, Section 5 concludes the paper and provides some policy recommendations.

1. Credit and Macroeconomic Variables: Review of the Literature

Scholarly work has extensively examined the nexus concerning credit from banks with monetary policy. This link is designated as the bank credit monetary policy channel of transmission mechanism, proposed by Ben S. Bernanke and Alan Blinder (1992), Nobuhiro Kiyotaki and John Moore (1997), and Bernanke, Mark Gertler, and Simon Gilchrist (1999). These articles empirically analyzed how changes in the stance of the Federal Reserve's monetary policy affect bank credit. This paper followed Bernanke and Gertler's (1989) argument that relaxing the assumptions of perfect substitutability between credit instruments and imperfect information resulted in credit constraints for households and firms. The implication of relaxing these assumptions is that economic agents must provide collateral in order to obtain credit. Roman Matousek and Nicholas Sarantis (2009), Piti Disyatat (2011), David Vera (2012), Bruno and Shin (2015), and Vasco Cúrdia and Michael Woodford (2016) all extended this transmission mechanism channel. This body of work found that an increase in the monetary policy rate of interest decreases bank credit, but the resulting decrease in bank credit occurs with a time lag.

Nevertheless, studies that analyzed the relationship between bank credit with foreign interest rates and currency exchange rates are currently limited. Luisa Zanforlin (2011) researched this topic and found that the relationship between bank credits and the cost of foreign funding is inverse. Furthermore, she found a positive relationship between bank credits and the real exchange rate. Similarly, Taufiq Carnegie Dawood et al. (2022) found a negative relationship between foreign interest rates and Islamic bank credit in Indonesia. However, this study found a negative relationship between the exchange rate and Islamic bank credit in Indonesia.

Similarly, current discussions of the relationship between bank credit and other macroeconomic variables are expanding. For instance, Imran and Nishat (2013) concluded that the nexus between bank credit and exchange rates and economic growth is

statistically significant for Pakistan. While (Stefan Avdjiev and Előd Takáts 2019) found a relationship between exchange rates and bank credit between the United States and Small Open Economies. However, this study found no significant relationship between bank credit and inflation rates. Meanwhile, Guerra (2017) found that GDP growth Granger-causes bank credit in Mexico and has a positive relationship.

An expanding body of work explores other factors like property prices and their relationship to bank credit. For example, Stefan Gerlach and Wensheng Peng (2005) found a relationship between residential property prices and bank credit in Hong Kong. Meanwhile, André K. Anundsen and Eilev S. Jansen (2013) found a long-run two-way relationship between house prices and credit in Norway. Moreover, Ibrahim and Law (2014) observed a significant relationship between house prices and bank credit in Malaysia. Finally, Daisy J. Huang, Charles K. Leung, and Baozhi Qu (2015) discovered that house prices in China were related to bank credit before 2008. However, after the great recession, which started in the United States, credit is positively correlated with house prices in China.

Nevertheless, cross-disciplinary research on this topic is still limited. Hofmann (2004) found that property prices have a long-run relationship with bank credit in developed countries. This paper also noted that an increase in property prices resulted in an increase in bank credit. Philip E. Davis and Haibin Zhu (2011) found a close relationship between property prices and bank credit in developed countries. Furthermore, Masahiro Inoguchi (2011) found a relationship between real estate prices and domestic bank lending in Singapore and Thailand following the Asian Crisis. While Youngkyung Ok, Jungmu Kim, and Yuen Jung Park (2019) found a relationship between real estate prices and domestic bank lending in Korea.

Despite the importance of the banking system to an economy's financial landscape and the findings on the relationship between house prices and bank credit, there is currently no empirical analysis that examines the relationship between house prices and bank credit in a cross-country analysis of developed and Emerging Market Economies. Therefore, this analysis aims to fill a scholarly gap by providing cross-country empirical evidence of the relationship between house prices and domestic private-sector credit from domestic banks in developed and Emerging Market Economies.

2. Stylized Facts about Bank Credit, House Prices, and Macroeconomic Variables

This section presents stylized data on bank credit and real house prices for a subset of the 28 countries considered in this study. The data employed in this analysis are a panel of quarterly data obtained from the Federal Reserve Economic Database, the Organization for Economic Cooperation and Development database, The Bank for International Settlements, and respective central banks. Figures A1 and A2 in the Appendix illustrate the bank credit to the private non-financial sector to GDP ratio (*creditGDPratio*), which is credit provided by domestic banks, includes non-financial corporations, households, and non-profit institutions, measured in percentages, and the real house price index (*houser*), which is an index of nominal residential property price indicators deflated by the consumer price index with the base year of 2010 (Bank for International Settlements 2022a, b). Five countries were chosen to represent the continents of North

America, South America, Europe, Asia, Africa and Australia. While Figures A3 and A4 illustrate the nominal exchange rate with credit to the private non-financial sector to GDP ratio (*creditGDPratio*). Figures A5 and A6 illustrate inflation with credit to the private non-financial sector to GDP ratio (*creditGDPratio*). Finally, Figures A7 and A8 illustrate GDP growth with credit to the private non-financial sector to GDP ratio (*creditGDPratio*).

Figures A1 and A2 in the Appendix show that in developed countries, the series of real house prices and bank credit to the private non-financial sector to GDP ratio track each other more closely than in Emerging Market Economies. Moreover, the magnitude of the credit-to-GDP ratio in developed economies is more significant than in Emerging Market Economies. Furthermore, in Emerging Market Economies, the graph for real house prices is higher than the graph for bank credit to the private non-financial sector to GDP ratio. Meanwhile, in many developed countries, the graph for bank credit to the private non-financial sector to GDP ratio tends to be higher than for real house prices. Note that the bank-credit-to-GDP ratio has been used in the literature as an indicator of financial development (see, for example, M. Shabri Abd. Majid et al. 2019). Accordingly, the aforementioned time series differences between developed and Emerging Market Economies may be due to differences in the financial sector's level of development. Finally, Figure 1 shows that real house prices and credit-to-GDP ratios are positively correlated across developed and Emerging Market Economies.

Figures A3 and A4 in the Appendix show that the exchange rate and bank credit to the private non-financial sector to GDP ratio across several developed and Emerging Market Economies are positively correlated. However, several developed and Emerging Market Economies depict episodes of negative correlation between these two variables (Australia, Hungary, Mexico, and Brazil). Figures A5 and A6 illustrate that across developed and Emerging Market Economies, inflation tends to negatively correlate with bank credit to the private non-financial sector to GDP ratio in developed and Emerging Market Economies. While Figures A7 and A8 illustrate that economic growth tends to be positively correlated with bank credit to the private non-financial sector to GDP ratio. However, a formal empirical analysis is required to determine the relationship between house prices (and other macroeconomic variables) and bank credit.

3. The Empirical Framework

3.1 Data and Pre-Testing

The analysis employs an unbalanced panel data set. Quarterly data from the Federal Reserve Economic Database, Organization for Economic Cooperation and Development database, The Bank for International Settlements, and respective central banks were used in this analysis. The data for the 22 developed countries considered in this study is an unbalanced panel spanning from the first quarter of 1970 to the third quarter of 2017. Data for the six Emerging Market Economies (Hungary, Indonesia, India, Mexico, Brazil, and South Africa) range from the first quarter of 2000 to the third quarter of 2017. The countries and data spans are selected based on data availability. These countries are among Emerging Market Economies in Europe, Asia, Africa, and

South America. In addition, Indonesia and India are relatively economically important among Emerging Market Economies in Asia. Similarly, Hungary is relatively economically significant among Emerging Market Economies in Europe. Furthermore, Mexico and Brazil are relatively economically important among Emerging Market Economies in South America. In addition, South Africa is an economically important Emerging Market Economy in Africa. Since these countries are economically significant Emerging Market Economies in their continents, if data on additional countries are available, it would not significantly affect the conclusions found in the article.

3.1.1 The Methodology Applied to the Analysis

In analyzing the effect of macroeconomic variables on bank credit, several empirical methods were applied in the literature. For example, Zanforlin (2011) studied bank credits and the cost of foreign funding with the dynamic panel model. Vera (2012) used the Vector Autoregressive method to analyze the relationship between monetary policy rate and bank credit in the United States. In comparison, Dawood et al. (2022) analyzed the effect of the International Bank Lending Channel on Islamic bank credit in Indonesia by applying the Autoregressive Distributed Lag method (ARDL) to analyze the short-run and long-run dynamics of the relationship. Similarly, Imran and Nishat (2013), in analyzing the nexus between bank credit and exchange rates and economic growth in the short-run and the long-run, employed the ARDL methodology.

In comparison, Guerra (2017) applied the Granger Causality methodology in analyzing the relationship between GDP growth and bank credit in Mexico. In comparison, Gerlach and Peng (2005) employed the Vector Error Correction Model to study the long-run relation between property prices and bank credit in Hong Kong. Similarly, Anundsen and Jansen (2013) applied the Vector Error Correction Model to study the long-run relationship between property prices and bank credit in Norway. Similarly, Ibrahim and Law (2014) applied the Vector Error Correction Model to analyze the short-run and long-run relationship between house prices and bank credit in Malaysia. Furthermore, while using the fixed effect model, Huang, Leung, and Qu (2015) studied the relationship between house process and bank credit in China. Finally, Hoffman (2004) applied the Vector Error Correction Model to analyze the short-run and long-run relationship between house prices and bank credit in developed countries.

Similarly, Davis and Zhu (2011) used the Vector Error Correction Model in studying the short-run and long-run relation between house prices and bank credit in developed countries. In comparison, Inoguchi (2011) applied the dynamic panel model to analyze house prices and bank credit relations in South East Asian Economies. In order to study the short-run and long-run relationship and to take into account that the variables are cointegrated and the different degrees of integration of the variables, based on the literature, the appropriate method to apply in the current study is the panel Autoregressive Distributed Lag method.

3.1.2 Panel Unit Root Test

The variables employed in the current study are quarterly data of credit provided by banks in the domestic economy channeled to the private sector (credit), which are measured in the respective domestic currency. Then, foreign interest rates (surrogated by the federal funds rate (*ffr*)), domestic interest rates (*rdom*), GDP growth, and Inflation in Consumer Price Index CPI are measured in percentages. Meanwhile, the exchange rate (*exchange*) is expressed in domestic currency units per US dollar. The final variable is the real house price index (*houser*) defined by The Bank for International Settlements (2022b). The Eviews 10 software package was applied for the pre-testing and estimation of the model.

To appropriately employ the panel autoregressive distributed lag model, we must test the unit root of the aforementioned time series. Therefore, the panel unit root test proposed by Gangadharrao S. Maddala and Shaowen Wu (1999) (ADF-Fisher and PP-Fisher), Andrew Levin, Chien-Fu Lin, and Chia-Shang James Chu (2002) (LLC) and Kyung So Im, M. Hashem Pesaran, and Yongcheol Shin (2003) (IPS) is used.

The Im, Pesaran, and Shin (IPS) test is obtained as an average of ADF statistics. IPS allows for heterogeneity in intercept and slope terms for the cross-section units and solves the serial correlation problem. The heterogeneous panel data model of IPS is given by the following.

$$\Delta y_{i,t} = \mu_i + \beta_i x_{i,t-1} + \sum_{k=1}^{p} \phi_k \Delta y_{i,t-k} + \gamma_i t + \varepsilon_{it} \quad , i = 1, \dots, N, t = 1, \dots, N.$$

The maintained hypothesis of common dynamics is relaxed, and the relevant hypotheses are:

$$H_0: \beta_i = 0, \forall \text{ i}, \;\; H_1: \exists i \; s.t. \; \beta_i < 0.$$

Levin, Lin, and Chu (LLC) consider a model in which the coefficients are restricted to be homogeneous across all panel units ($b_i = b \;\; \forall \;\; i$). However, the LLC model only allows for heterogeneity in the intercept and is given by the following.

$$\Delta y_{i,t} = \mu_i + \beta x_{i,t-1} + \sum_{k=1}^{p} \phi_k \Delta y_{i,t-k} + \gamma t + \varepsilon_{it}, \;\; i = 1, \dots, N, \;\; t = 1, \dots, N$$

corresponds to the maintained hypothesis of common dynamics, the null hypothesis and alternative hypothesis are given by:

$$H_0: \beta = 0, \;\; H_1: \beta < 0 \;\; \text{for all } i \; = \; 1, \dots, N.$$

The Augmented Dickey-Fuller test (ADF-Fisher) is represented by:

$$\Delta x_{i,t} = \; a_i + \beta_i x_{i,t-1} + \delta_i t + \sum_{j=1}^{p_i} \gamma_{i,j} \Delta x_{i,t-j} + \varepsilon_{i,t},$$

where p_i is the order of the ADF regression, the errors $\varepsilon_{i,t}$ ($i = 1, \dots, N$ and $t = 1, \dots, T$) are independently distributed across both i and t, with zero means and finite heterogeneous variances, σ_i^2. The null hypothesis of a unit root in the panel data is given by:

$H_0 : \beta_i = 0$ (unit root hypothesis), $H_1 : \beta_i < 0$ for all $i = 1, \ldots, N$.

While the Phillips-Perron (PP-Fisher) test assumes the error process to be an i.i.d. $(0, \sigma^2)$ Gaussian process, allowing the errors to be weakly dependent and heterogeneously distributed. Generally, the PP test is based on an estimate of the following regression:

$$\Delta x_t = a_0 + a_1 t + \beta x_{t-1} + \varepsilon_t,$$

where a_0 is a drift and t represents a time trend. Once the regression has been estimated, the null hypothesis of the unit root is tested:

$$H_0 : \beta = 0 \qquad H_1 : \beta < 0$$

Table 1 displays the results of the unit root testing. As shown in Table 1, the variables domestic bank credit (*credit*), real house price index (*houser*), and domestic interest rates (*rdom*) are integrated of order 1, (I(1)). Meanwhile, the remaining series are stationary at levels, implying that they are of zero order of integration, denoted as (I(0)). Therefore, based on the unit root results, the panel autoregressive distributed lag model is appropriate for this analysis (see Pesaran, Shin, and Ron P. Smith 1999).

Table 1 Unit Root Tests

	Level			
	LLC	IPS	ADF-Fisher	PP-Fisher
Credit	20.4983	20.5639	18.7371	12.2845
FFR	0.29506	−2.57905***	78.4272***	79.5761***
CPI	−1.83955**	−4.01524***	88.4460***	105.891***
houser	10.6839	11.4104	43.8068	29.4336
GDP	−13.6242***	−25.0860***	707.504***	752.497***
exchange	−2.20225***	−3.90728***	87.4520***	95.5444***
rdom	−0.33984	−0.52651	43.7285	59.2438*
	First difference			
	LLC	IPS	ADF-Fisher	PP-Fisher
Credit	−23.4190***	−28.1301***	791.287***	916.537***
FFR				
CPI				
houser	−19.3410***	−22.6760***	599.470***	653.136***
GDP				
exchange				
rdom	−41.0878***	−38.6625***	1163.39***	1183.41***

Notes: ***, **, and * denotes levels of significance at 1%, 5%, and 10%, respectively. LLC refers to Levin, Lin, and Chu (2002), IPS refers to Im, Pesaran, and Shin (2003), ADF is the Fisher is Augmented Dickey-Fuller-Fisher, PP-Fisher is the Phillip-Peron-Fisher Statistics.

Source: Author's calculations.

3.2 Panel Autoregressive Distributed Lag Model

This study employs the panel autoregressive distributed lag model (ARDL) for analysis. The ARDL model identifies short- and long-run relationships and can be categorized as an error correction model. The panel ARDL framework has the advantage of allowing mixed nature in the stationarity of the data used. This approach can test for possible long-run relationships irrespective of the integration order of the variables, whether I (1) or mutually integrated (I (0) and I (1)), except that the dependent variable is constrained to be I (1). However, this technique cannot be applied when the series are integrated of order 2 (I (2)). The unit root test reveals that some of the time

series considered in this study are $I(0)$, whereas others are $I(1)$. Furthermore, the panel ARDL model allows for non-linear relationships between bank credit and house prices, foreign interest rates, and other macroeconomic variables considered in this study (Pesaran, Shin, and Smith 1999). The panel ARDL model can be specified as follows:

$$\begin{aligned}\Delta lncredit_{it} = {} & \alpha_i + \gamma_{1i} lncredit_{it-1} + \gamma_{2i} ffr_{it-1} + \gamma_{3i} GDP_{it-1} + \gamma_{4i} rdom_{it-1} + \\ & \gamma_{5i} lnexc_{it-1} + \gamma_{6i} CPI_{it-1} + \gamma_{7i} houser_{it-1} + \sum_{j=1}^{m} \lambda_{1j} \Delta lncredit_{it-j} + \\ & \sum_{j=0}^{m} \lambda_{2j} \Delta ffr_{it-j} + \sum_{j=0}^{m} \lambda_{3j} \Delta GDP_{it-j} + \sum_{j=0}^{m} \lambda_{4j} \Delta rdom_{it-j} + \\ & \sum_{j=0}^{m} \lambda_{5j} \Delta lnExc_{it-j} + \sum_{j=0}^{m} \lambda_{6j} \Delta CPI_{it-j} + \sum_{j=0}^{m} \lambda_{7j} \Delta houser_{it-j} + \nu_{it}.\end{aligned} \tag{1}$$

The variables employed in the study are quarterly data credit from banks channeled to private firms and households (*credit*), foreign rates of interest (*ffr*), house prices (*houser*), domestic interest rates (*rdom*), GDP, domestic currency unit per US dollar exchange rate (*exc*.), and CPI. Symbolize Δ as the operator for the first difference. While m denotes the lag length and ν_{it} are white noise error terms. The choice of a lagged variable is based on the AIC (Akaike Information Criterion) and the Schwarz criterion (SBC: Schwarz Bayesian Criterion).

To test the existence of possible long-run relationships between variables, the ARDL bounds test was applied. The ARDL bounds test offers the ability to test the existence of eventual long-run relationships according to the following alternative hypotheses:

The null hypothesis of no cointegration in Equation (1) provides:

$$\begin{cases} H_0: \gamma_{1i} = \gamma_{2i} = \gamma_{3i} = \gamma_{4i} = \gamma_{5i} = \gamma_{6i} = \gamma_{7i} = 0 \ (absence\ of\ Long-run\ Relationship) \\ H_1: \gamma_{1i} \neq \gamma_{2i} \neq \gamma_{3i} \neq \gamma_{4i} \neq \gamma_{5i} \neq \gamma_{6i} \neq \gamma_{7i} = 0 \ (presence\ of\ Long-run\ Relationship) \end{cases}.$$

The bounds testing procedure is based on the Fisher statistic (F-statistic) or Wald statistic. Pesaran, Shin, and Smith (1999) have considered two bounds of critical values for a given significance level. The first assumes that all variables included in the ARDL model are I (0), whereas the other assumes that the variables are I (1). If the computed F-statistic exceeds the upper critical bounds value, then H_0 is rejected. If the F-statistic falls within the bounds, the cointegration test becomes inconclusive. If the F-statistic is lower than the lower bound value, then the null hypothesis cannot be rejected.

If the cointegration relationships are established, the long-run equation can be estimated. We obtain the short-term dynamic relationship in the third step by estimating an error correction model (ECM). The ECM is defined as follows: The panel ARDL model can be reparametrized to the following error correction form:

$$\begin{aligned}\Delta lncredit_{it} = {} & \alpha_i + \sum_{j=1}^{m-1} \beta_1 \Delta lncredit_{it-j} + \sum_{j=0}^{m-1} \beta_2 \Delta ffr_{it-j} + \\ & \sum_{j=0}^{m-1} \beta_4 \Delta rdom_{it-j} + \sum_{j=0}^{m-1} \beta_3 \Delta GDP_{it-j} + \sum_{j=0}^{m-1} \beta_5 \Delta lnExc_{it-j} + \\ & \sum_{j=0}^{m-1} \beta_6 \Delta CPI_{it-j} + \sum_{j=0}^{m-1} \beta_7 \Delta houser_{it-j} + \varphi_i (lncredit_{it-1} - \theta_0 - \theta_1 ffr_{it} - \\ & \theta_2 GDP_{it} - \theta_3 rdom_{it} - \theta_4 lnexc_{it} - \theta_5 CPI_{it} - \theta_6 houser_{it}) + \varepsilon_{it}.\end{aligned} \tag{2}$$

Symbolize β_0 as the constant term $\beta_1 \ldots \beta_7$ as the short-run parameters, whereas θ_0, $\theta_1 \ldots \theta_7$ are the coefficients for the long-run, γ as the adjustment speed of returning to long-run equilibrium. Meanwhile, m denotes the lag length, and ε_{it} denotes white noise error terms. The parameter φ indicates the speed of adjustment to the equilibrium level after a shock. It shows how quickly variables converge to equilibrium and must have a statistically significant coefficient with a negative sign.

The estimators of the panel ARDL model and all parameters are estimated by employing the pooled mean group (PMG) estimator, as treated by Pesaran, Shin, and Smith (1999). This estimation technique, grounded on the maximum likelihood estimator, is considered the most consistent because it accounts for the individual characteristics (e.g., country) and provides a superior evaluation of the long-term relationship. Therefore, the PMG estimators obtained are asymptotically and normally distributed (Pesaran, Shin, and Smith 1999).

4. Results and Discussion

4.1 Estimation Results

Table 2 presents the estimation results of the panel ARDL model. We found that the most important bank credit determinant in developed and Emerging Market Economies is real house prices, followed by the exchange rate. Meanwhile, foreign interest rates and GDP are the third most important determinants of domestic bank credit in Emerging Market Economies and developed countries.

In addition, we found that the magnitudes of the relationship between real house prices and domestic bank credit differ significantly between developed and Emerging Market Economies. We found that the magnitude of the relationship between real house prices and domestic bank credit in Emerging Market Economies is nearly one-half (44%) of that of developed countries. Furthermore, we found a long-run positive relationship between real house prices and bank credit in developed and Emerging Market Economies. The argument for the positive relationship is that these findings are consistent with that of Hofmann (2004) and Davis and Zhu (2011) for developed countries and Inoguchi (2011) for three South East Asian Emerging Market Economies. However, we found that this relationship is positive and significant for both country groups in the short-run. This finding indicates that real house prices are by far the most important factor influencing domestic bank credit, and their dynamics can significantly impact financial stability (Inoguchi 2011).

The argument for the positive relationship between house prices and bank credit is *via* wealth effects. This argument is related to the role of asymmetric information in credit markets which gives rise to moral hazard or adverse selection problems (Bernanke and Gertler 1989; Bernanke and Blinder 1992; Kiyotaki and Moore 1997; Bernanke, Gertler, and Gilchrist 1999). These models consider the credit market imperfect due to asymmetric information between borrowers and lenders. Borrowing conditions are determined by the net value of real estate assets, which are used as collateral for bank lending. Increases in real estate prices make the banks less concerned about moral hazard and adverse selection, as borrowers have more to lose from default. For the banks, real estate prices affect their capital position and, thus, lending capacity

directly through valuations of their holdings of real estate assets and indirectly *via* changes in non-performing loans. An increase in real estate prices increases the value of bank assets, thereby increasing the value owned by the bank and held as collateral. As a result, it reduces the probability of financial distress by lowering the risk on bank assets.

Furthermore, the rise in real estate prices will raise bank stability and lower the probability of default. (Ok, Kim, and Park 2019). Ultimately this results in lower external finance premium and improved credit availability for borrowers. By contrast, falling real estate prices may generate downward-spiral movements in the value of real estate assets, and the volume of bank loans as credit rationing intensifies (Davis and Zhu 2011).

The magnitudes of the exchange rate, the second most important determinant of domestic bank credit, differ significantly between the two country groups. However, the current study found that the exchange rate has a positive equilibrium long-run relationship with domestic bank credit in developed countries. The argument for this result is that a depreciation of the exchange rate, *ceteris paribus*, would increase exports and, thus, GDP. As shown in Table 2, GDP is positively related to bank credit, so a currency depreciation increased domestic bank credit.

In contrast, in Emerging Market Economies, the exchange rate is negatively related. This result can be attributed to the bank balance sheet argument. According to this argument, Emerging Market Economies' banks (and firms) are net foreign-currency borrowers. Furthermore, domestic banks borrow in foreign currency from the international market and use the funds to lend to domestic firms denominated in domestic currency. If not all of the foreign loans are hedged, a depreciation of the currency would have a negative impact on the balance sheets of domestic banks and firms. The depreciation would eventually reduce domestic bank credit. Bank credit is affected by changes in the exchange rate. This result is because the appreciation of the domestic exchange rate has been associated with changes in cross-country interest rate differentials and increases in domestic liquidity (Zanforlin 2011). In addition, exchange rates alter the relative values of domestic and foreign collateral goods and balance sheets, and thus, they affect the total financing available to a country. The argument is that when credit is denominated in foreign currency and the borrowing constraint in the economy is binding, an appreciation of the domestic currency strengthens the value of the assets and balance sheets of lenders and borrowers (Dawood et al. 2022). Moreover, an exchange rate appreciation reduces the purchasing power of any new debt denominated in foreign currency, ultimately increasing borrowers' net worth (Avdjiev and Takáts 2019). Furthermore, Hofmann, Ilhyock Shim, and Shin (2016) showed that an appreciation of the domestic currency is associated with greater risk-taking by both borrowers and lenders. Conversely, a stronger foreign currency (e.g., the US dollar appreciation) deteriorates the creditworthiness of Emerging Market Economies' borrowers as their liabilities increase relative to their assets. Even if assets generate dollar-denominated cash flows, a stronger dollar weakens the borrower's cash flows due to the rising debt service costs. From creditors' standpoint, the borrower's weaker credit position decreases the capacity for additional credit extension. This effect is more substantial the higher the share of foreign currency liability (Avdjiev et al. 2019).

This channel has long been cited as a significant contributor to the financial crises in Emerging Market Economies (see, for example, Barry Eichengreen and Ricardo Hausmann 1999; Woon Gyu Choi and David Cook 2004; Cook 2004; Isaac Marcelin and Ike Mathur 2016).

Table 2 Estimation Results

Variables	Developed countries coefficients	Emerging market economies coefficients	Differences between emerging market economies and developed
Long-run			
RDOM	−0.008884	−0.075323*	
FFR	0.091729***	0.353843***	286%
GDP	0.121847***	0.154516**	27%
Log(exchange)	0.229880*	−0.907280**	
CPI	−0.021324	−0.014429	
Log(houser)	1.919367***	2.765904***	44%
Short-run			
COINTEQ01	−0.011118***	−0.023697***	113%
DLOG(CREDIT(-1))	0.050233	−0.194743***	
DLOG(CREDIT(-2))	0.189507***	−0.050724	
DLOG(CREDIT(-3))	0.055078*		
D(RDOM)	0.001534**	0.005829	
D(RDOM(-1))		0.000605	
D(FFR)	-0.000139	0.011571	
D(FFR(-1))		−0.005964	
D(GDP)	−0.000479**	−0.006152*	
D(GDP(-1))		−0.002857	
DLOG(EXCHANGE)	0.023756*	0.103833	
DLOG(EXCHANGE(-1))		0.024841	
D(CPI)	0.000513	−0.005409*	
D(CPI(-1))		−0.0000228	
DLOG(HOUSER)	0.117446***	−0.111227	
DLOG(HOUSER(-1))		0.079957	
C	−0.00896	0.003291	

Notes: ***, **, and * denote levels of significance at 1%, 5%, and 10% correspondingly.

Source: Author's calculations.

Foreign interest rates are an important determinant of bank credit, but the results differ significantly between developed and Emerging Market Economies. We found that the magnitude of the relationship between foreign interest rates and domestic bank credit varies significantly between developed and Emerging Market Economies. As shown in Table 2, the magnitude of the relationship between foreign interest rates and domestic bank credit in Emerging Market Economies is nearly four times (286%) that of developed countries. The proportions were found by computing the percentage differences of the estimated coefficients. Moreover, we found a long-run positive equilibrium relationship between foreign and domestic interest rates. The argument for the positive relationship between foreign interest rates and bank credit is as follows. Monetary policy tightening by a major economy, such as of the United States (the Federal

Funds Rate), erodes the net worth and collateral value of the major economy's borrowers and induces multinational banks to increase lending in Small Open Economies (Luciana Barbosa et al. 2018; Ricardo Correa et al. 2018; Robert Hills et al. 2019). Conversely, lowering the Federal Funds rates improves the major economy's borrowers' creditworthiness, inducing banks to shift credit supply away from Small Open Economies to the US (Jin Cao et al. 2023). Furthermore, an increase in foreign interest rates makes foreign credit more expensive than domestic bank credit. As a result, domestic firms would seek fewer foreign and more domestic loans. The increase in foreign interest rates would eventually increase domestic bank credit (Dawood 2019). This argument contrasts with the Mundell-Fleming model, in which a freely floating exchange rate gives a central bank more freedom. According to the Mundell-Fleming model, once the exchange rate is freely floating, the domestic interest rate is all that is needed to achieve the internal policy target and output stabilization (Hélène Rey 2016).

GDP, another important determinant of bank credit, varies in magnitude between the two country groups. We found that the magnitude of the coefficients of the relationship between GDP growth and domestic bank credit is 27% greater in Emerging Market Economies than in developed countries. Furthermore, GDP and domestic bank credit have a significant long-run positive relationship. The proportions were found by computing the percentage differences of the estimated coefficients. These results are consistent with the findings of Imran and Nishat (2013) for Pakistan and Guerra (2017) for Mexico.

The argument for the positive relationship between economic growth and bank credit is the following. GDP growth measures the economy's overall health and can reflect the demand for credit. Therefore, higher GDP growth should translate into higher credit growth (Vahram Stepanyan and Kai Guo 2011). Banking credit is a means of payment for households and firms after production takes place. Therefore, the households' demand for credit reflects the consumption of newly produced goods and services, particularly dwellings, *via* mortgages. Furthermore, loans granted are a response to the banking expectations about the macroeconomic performance. Therefore GDP growth is a crucial variable that guides the credit banking policy according to the expectations of income earned by households and firms. Therefore, GDP growth influences the bank's willingness to lend (Guerra 2017). In addition, an increase in real GDP boosts the manufacturing sector's as well as the general people's earnings, which leads to higher domestic deposits, hence increasing the liquidity of banks, enabling them to lend more for investment needs, making the GDP have a positive association with private credit (Imran and Nishat 2013). While another argument is that credit expansions tend to be pro-cyclical (i.e., GDP growth rates tend to induce a high rate of credit growth). Usually, if in the "good times", banks relax their criteria and lend to both good and bad projects, then when the "bad times" arrive, most loans become non-performing, and the source of credit dries up, rationing out even good projects (P. K. Mishra, K. B. Das, and B. B. Pradhan 2009).

However, we found that domestic interest rates are only a significant long-run determinant of bank credit in Emerging Market Economies. Moreover, we found a negative relationship between domestic interest rates and bank credit, consistent with Bernanke and Blinder's (1992) findings. An increase in the monetary policy interest

rate significantly reduces bank loan growth. Relaxing the assumptions of perfect substitutability between credit instruments and imperfect information resulted in credit constraints for households and firms. The implication of relaxing these assumptions is that economic agents must provide collateral in order to obtain credit. Banks with weak balance sheets are more adversely affected by monetary policy restrictions because they have more substantial constraints for obtaining alternative sources of financing when they experience a shortage in core deposits. In general, small, less liquid, poorly capitalized, and high credit-risk banks experience a more significant decrease in lending after a restrictive monetary policy (Jose Eduardo Gomez-Gonzalez et al. 2021). In an alternative discussion, Disyatat (2011) argues that monetary policy is transmitted to the market through changes in the required rate of return (RRR) rather than the amount of deposits. Thus, when faced with contractive monetary policies, banks have a restriction on the side of capital. Those with a lower capital level suffer from a decline in financial health, which discourages investment, prevents banks from maintaining the level of credit, and thus reduces the supply of loans.

We also found that speed adjustments to long-run equilibrium differ significantly between developed and Emerging Market Economies. Table 2 shows that the coefficient for the error correction term is negative and significant at the 1% significance level for both developed and Emerging Market Economies using the error correction form. However, the magnitude of the speed of adjustment coefficient (COINTQ01) is more than twice that of developed countries. This magnitude means that the speed of adjustment to long-run equilibrium is twice as fast in Emerging Market Economies.

4.2 Granger Causality

The final stage of the analysis is to perform the panel Granger causality test to determine the direction of causality between house prices and other determinants of domestic bank credit. The results of the test are presented in Table 3.

The causality between real house prices, other determinants, and domestic bank credit varies between developed and Emerging Market Economies. Table 3 shows that the causality between foreign and domestic interest rates is unidirectional in Emerging Market Economies, running from foreign interest rates to credit. Meanwhile, in developed countries, the causal relationship between the two variables is bidirectional. This result is because bank credit financing in developed countries is substantial compared to the global financial market. Regarding GDP to domestic bank credit, the causality is unidirectional in developed countries and bidirectional in Emerging Market Economies.

Some of the determinants of domestic bank credit have unidirectional causality. For example, we found that the causality between the exchange rate and bank credit is unidirectional and runs from the exchange rate to bank credit. Moreover, such causality is uniform for developed and Emerging Market Economies.

Table 3 Granger Causality

	LNHOUSER does not Granger cause LNCREDIT	LNCREDIT does not Granger cause FFR	LNCREDIT does not Granger cause GDP
	LNCREDIT does not Granger cause LNHOUSER	FFR does not Granger cause LNCREDIT	GDP does not Granger cause LNCREDIT
Developed			
p-value	0.0000	0.0000	0.3116
p-value	0.0047	0.0000	0.0000
Developing			
p-value	0.0000	0.9324	0.0904
p-value	0.043	0.0000	0.0000
	LNEXCHANGE does not Granger cause LNCREDIT	RDOM does not Granger cause LNCREDIT	LNCREDIT does not Granger cause CPI
	LNCREDIT does not Granger cause LNEXCHANGE	LNCREDIT does not Granger cause RDOM	CPI does not Granger cause LNCREDIT
Developed			
p-value	0.0000	0.0000	0.0000
p-value	0.1558	0.0000	0.0000
Developing			
p-value	0.0000	0.2815	0.0868
p-value	0.2396	0.0016	0.511

Source: Author's calculations.

Causality differs slightly between developed and Emerging Market Economies. We found that the domestic interest rate is bidirectional in developed countries but unidirectional in Emerging Market Economies, with the causality running from bank credit to domestic interest rates. This result implies that the monetary policy channel on bank credit is less effective at influencing credit quantities. Other instruments, such as macroprudential policies, manage credit growth in these countries.

5. Conclusions and Policy Implications

Using quarterly data from 22 developed and six Emerging Market Economies, this study contributes to the academic discourse by providing empirical support for the equilibrium long-run relationship between credit from domestic banks channeled to the private sector, house prices, and other macroeconomic variables. This issue is significant because bank credits account for 76% and 49% of total private sector financing in emerging and advanced economies. Moreover, the high proportion of bank financing suggests that bank credit dynamics substantially impact the financial system's stability.

Using the panel autoregressive distributed lag method, the current study found that real house prices are the most influential factor in determining bank credit in developed and Emerging Market Economies *via* the wealth effects. This study also found that the magnitude of the long-term relationship between foreign interest and bank credit in Emerging Market Economies is nearly four times that of developed nations. In addition, we found that the magnitudes of the long-run equilibrium relationships between real house prices and GDP and domestic bank credit are significantly greater in Emerging Market Economies than in developed ones. Regarding direction and

causality, house prices have a positive, bidirectional, long- and short-run relationship with bank credit in both economies. Similarly, a positive, unidirectional, and statistically significant long-run equilibrium relationship exists between foreign interest rates and domestic bank credit in Emerging Market Economies.

Meanwhile, in developed nations, the relationship is also positive but is bidirectional. Moreover, the exchange rate has a significantly positive (*negative*) long-term relationship with credit for developed (*Emerging Market Economies*) countries. Additionally, this study found a positive, long-run, and statistically significant correlation between domestic bank credit and GDP. However, we found that the relationship between domestic interest rates and bank credit is only significant in Emerging Market Economies.

The limitation of this research is that, due to data availability, it considers only six Emerging Market Economies (Hungary, Indonesia, India, Mexico, Brazil, and South Africa). Since these countries are economically significant Emerging Market Economies in their continents, if data on additional countries are available, it would not significantly affect the conclusions in the article. In addition, this study does not consider episodes of a normal period, periods of booms, and periods of crises. Future research should add such periods to the analysis.

For policy suggestions, in performing macroprudential policy to manage the growth of credit to maintain the financial system's stability, the central bank or authorities responsible for macroprudential policy in both developed and Emerging Market Economies must pay close attention to the dynamics of house prices. In addition, Emerging Market Economies must pay particular attention to the dynamics of exchange rates and foreign interest rates to maintain the financial stability of their economy.

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Appendix

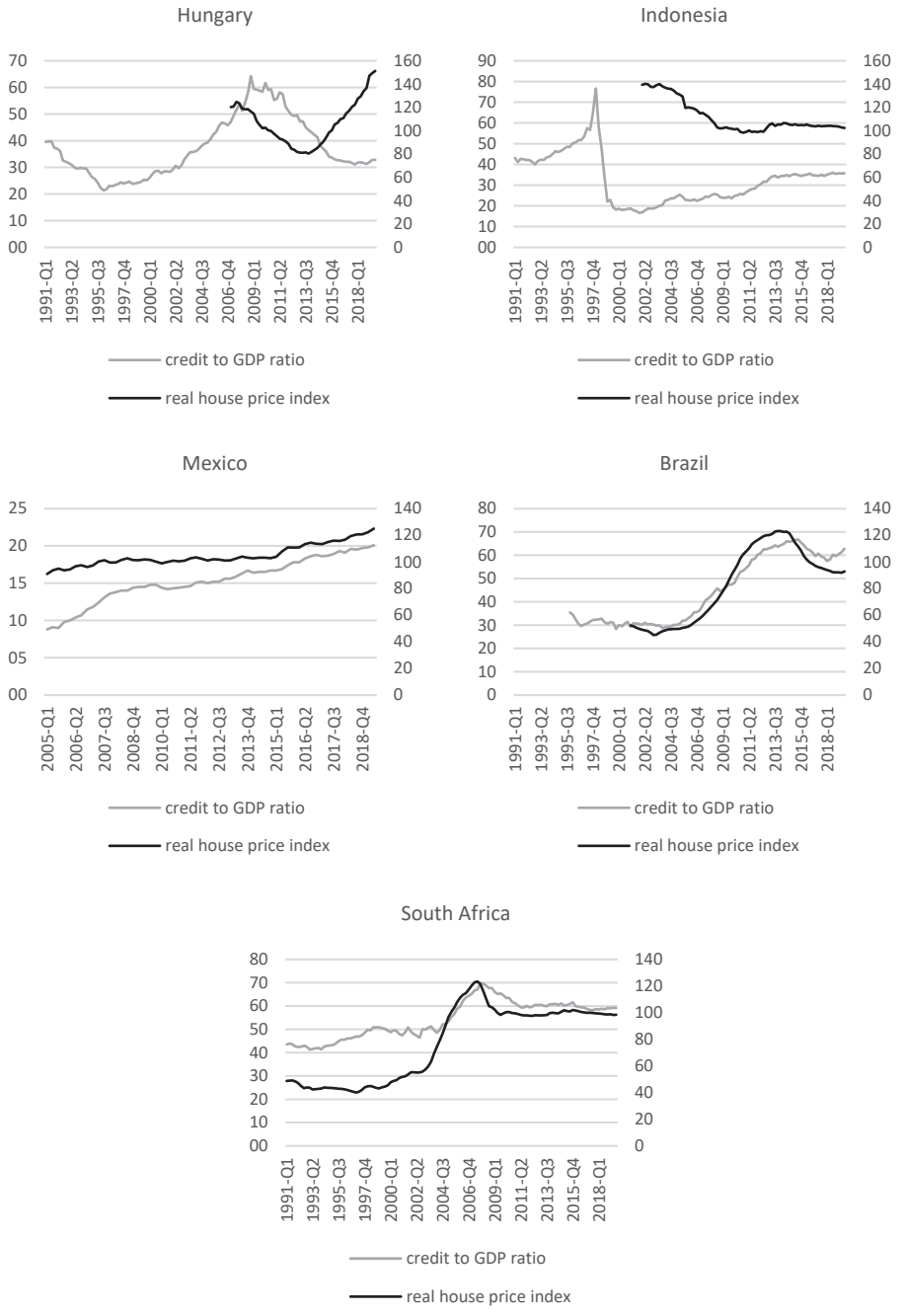
Table A1 Bank System Credit as a Percentage of Overall Financing

Country	Year/Quarter				
	Q1 17	Q2 17	Q3 17	Q4 17	Q1 18
Argentina	75.2%	75.2%	75.7%	75.9%	76.3%
Australia	69.1%	69.1%	69.3%	70.9%	71.8%
Austria	61.0%	59.9%	59.1%	58.0%	59.0%
Belgium	26.8%	28.3%	29.0%	28.5%	30.0%
Brazil	88.8%	92.3%	87.1%	87.1%	87.1%
Canada	54.6%	54.6%	52.5%	53.4%	52.0%
Chile	62.6%	58.8%	56.1%	56.4%	57.8%
China	77.1%	75.6%	75.8%	74.5%	74.8%
Colombia	73.8%	71.0%	70.8%	73.0%	72.7%
Czech Republic	52.2%	53.4%	55.8%	56.9%	58.4%
Denmark	74.5%	73.1%	71.2%	73.2%	74.5%
Finland	52.1%	50.4%	48.8%	51.4%	52.1%
France	53.1%	50.5%	50.5%	50.1%	50.5%
Germany	72.7%	72.8%	72.1%	71.8%	70.8%
Greece	89.5%	88.9%	87.3%	85.7%	83.8%
Hong Kong SAR	84.8%	82.7%	80.9%	81.1%	80.9%
Hungary	40.4%	38.5%	34.7%	35.7%	38.1%
India	92.4%	93.2%	93.3%	94.0%	94.8%
Indonesia	89.1%	88.1%	85.8%	87.9%	88.9%
Ireland	35.1%	26.8%	16.3%	15.9%	17.3%
Israel	57.6%	58.8%	60.2%	58.9%	59.2%
Italy	71.0%	70.9%	72.6%	72.4%	69.6%
Japan	67.3%	67.9%	68.6%	68.6%	69.9%
Korea	67.2%	67.0%	67.0%	68.4%	68.9%
Luxembourg	23.0%	23.2%	21.6%	23.4%	24.9%
Malaysia	99.5%	97.9%	97.0%	96.8%	96.0%
Mexico	47.6%	45.7%	44.8%	43.7%	45.1%
Advanced economies	**50.7%**	**49.6%**	**49.0%**	**48.9%**	**49.3%**
Emerging market economies	**77.3%**	**76.4%**	**75.9%**	**75.3%**	**75.5%**

Source: Bank for International Settlements (2022a, b).

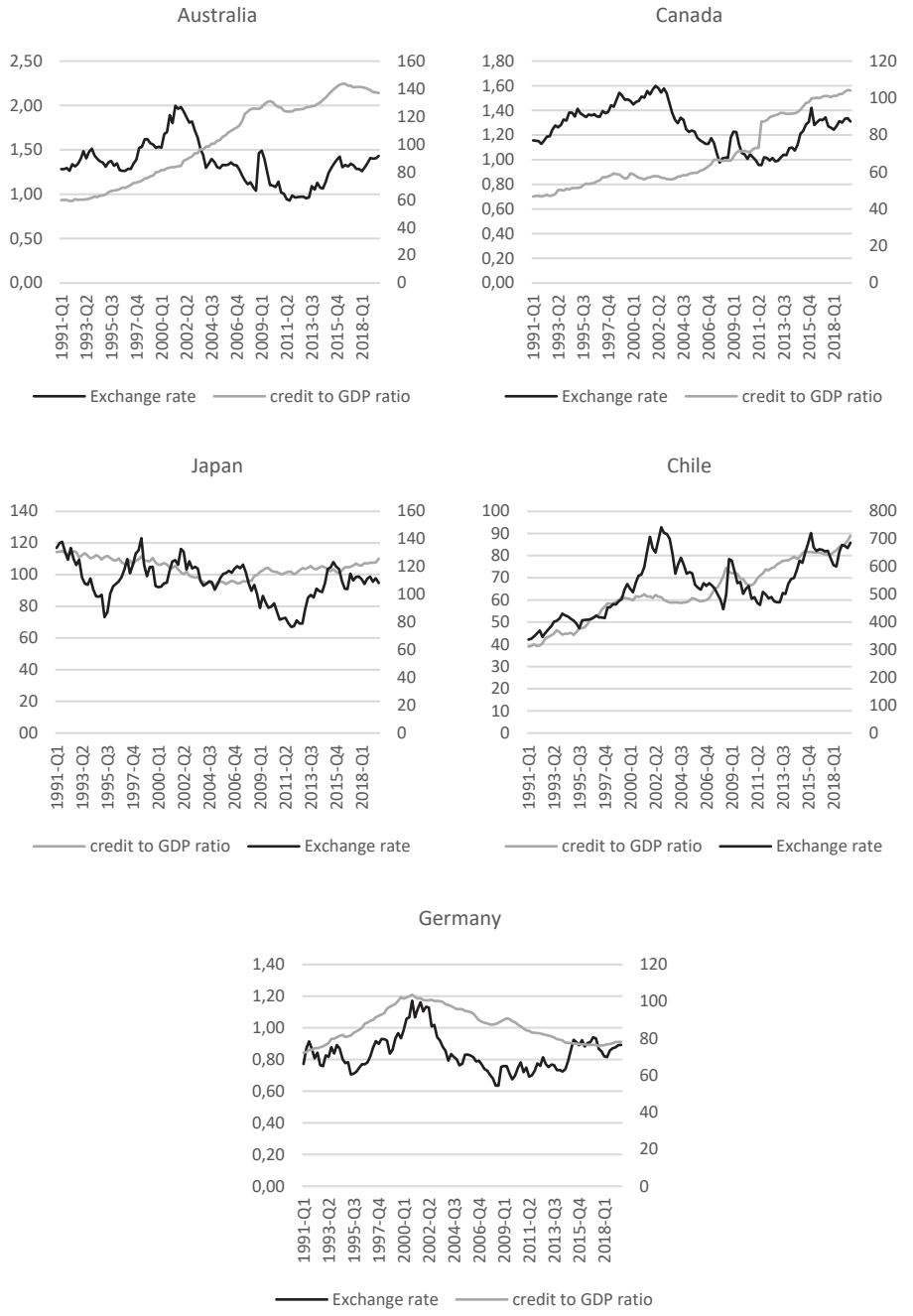
Source: Author's calculations.

Figure A1 The Credit-to-GDP Ratio and House Prices in Real Terms for Developed Countries



Source: Author's calculations.

Figure A2 The Credit-to-GDP Ratio and House Prices in Real Terms for Emerging Market Economies



Source: Author's calculations.

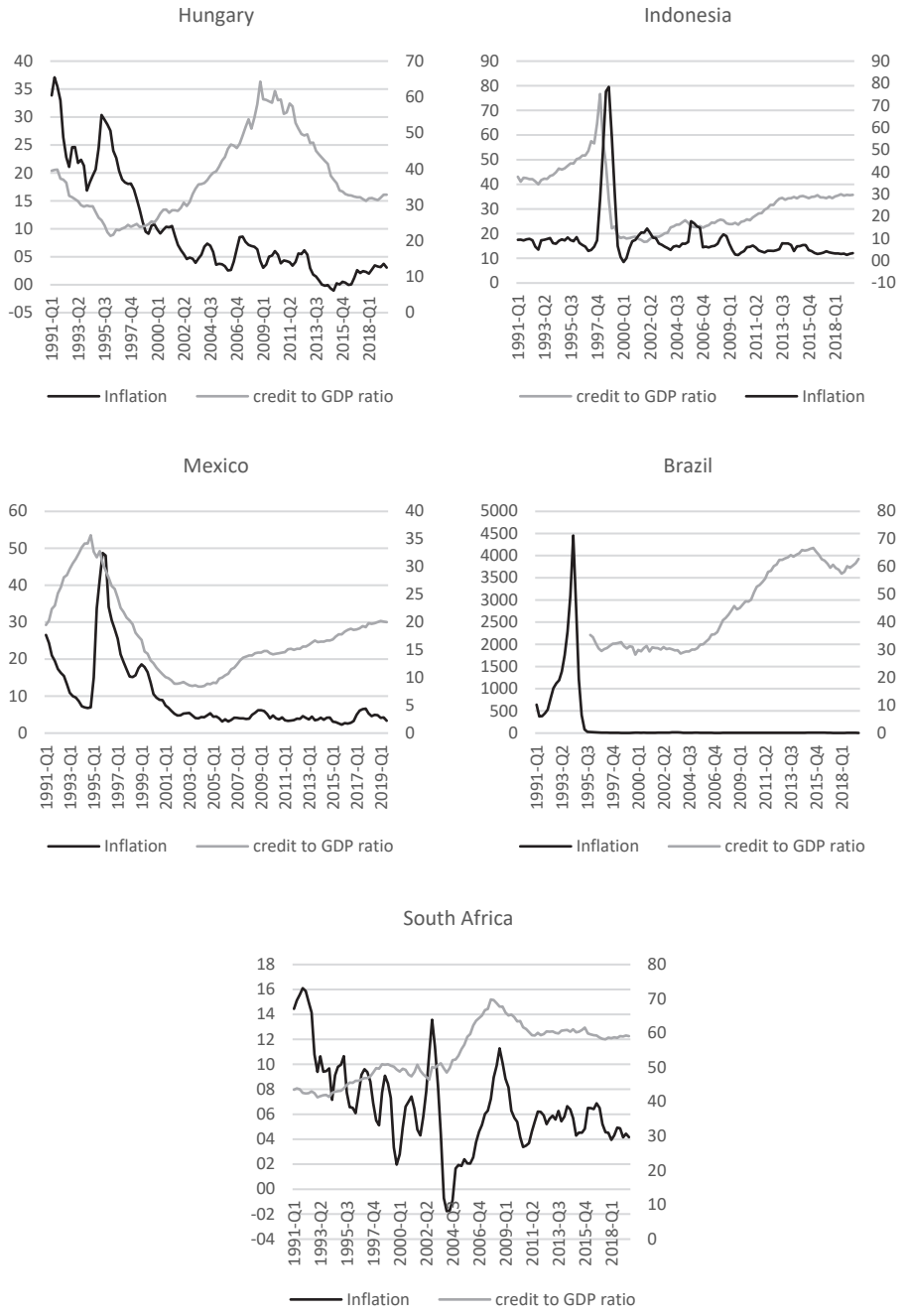
Figure A3 The Credit-to-GDP Ratio and Exchange Rate for Developed Countries

Source: Author's calculations.

Figure A4 The Credit-to-GDP Ratio and Exchange Rate for Emerging Market Economies

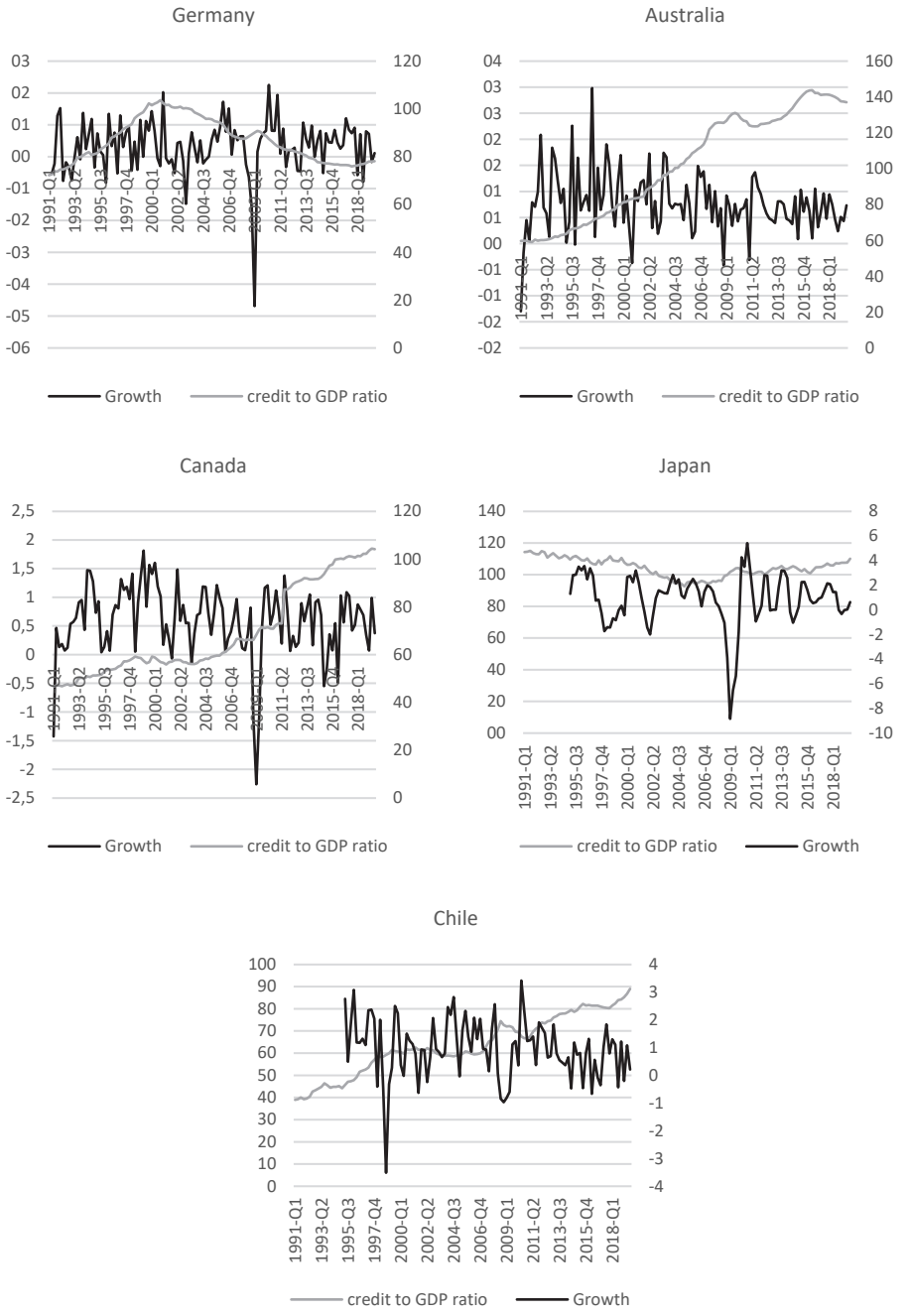
Source: Author's calculations.

Figure A5 The Credit-to-GDP Ratio and Inflation for Developed Countries



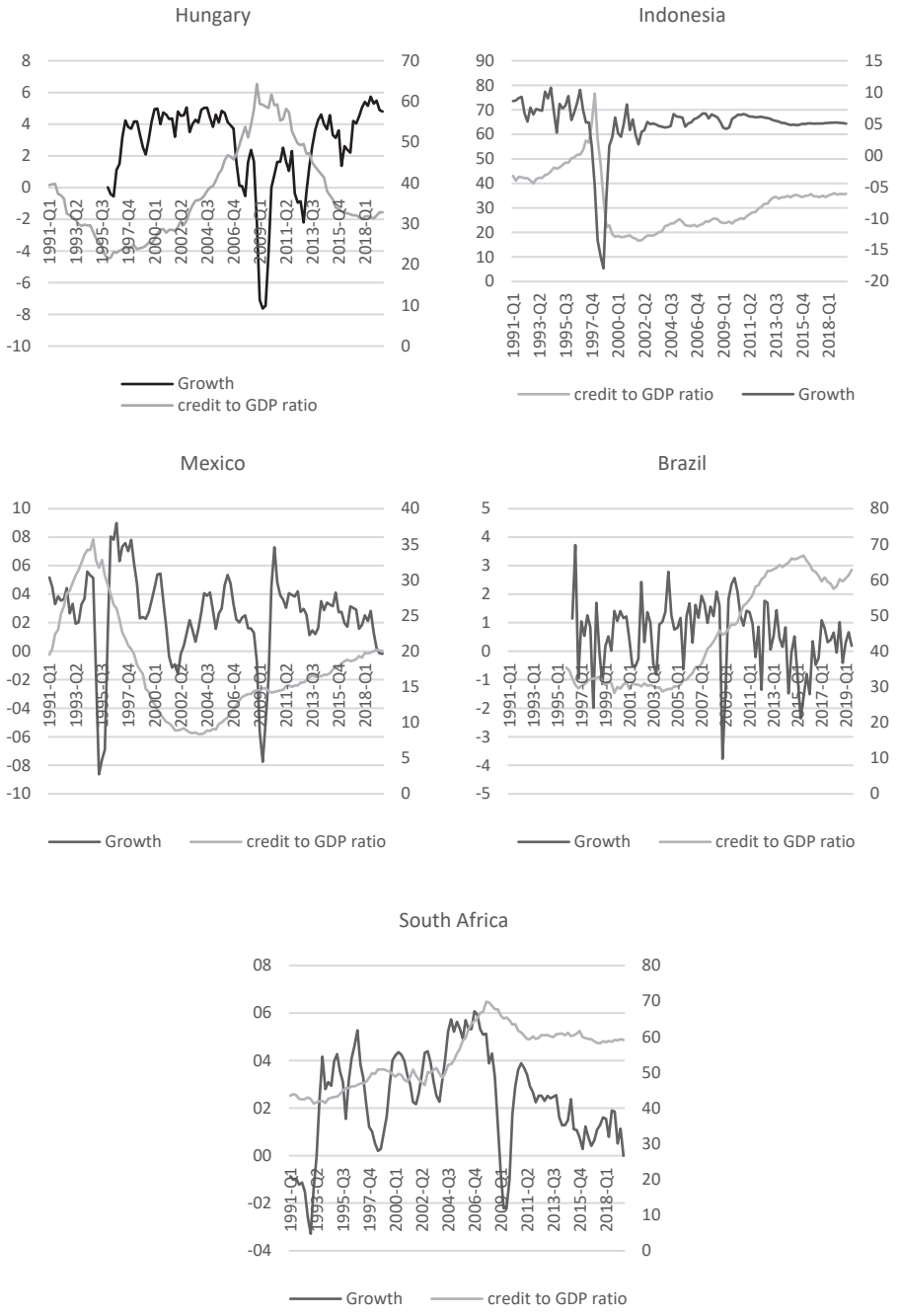
Source: Author's calculations.

Figure A6 The Credit-to-GDP Ratio and Inflation for Emerging Market Economies



Source: Author's calculations.

Figure A7 The Credit-to-GDP Ratio and Economic Growth for Developed Countries



Source: Author's calculations.

Figure A8 The Credit-to-GDP Ratio and Economic Growth for Emerging Market Economies

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