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Macroeconomic Determinants of Credit Growth in OECD Countries

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ABSTRACT

This paper investigates the determinants of credit growth in the private sector across some of the Organization for Economic Cooperation and Development (OECD) countries. The data set covers 24 countries and uses quarterly data over a period from the fourth quarter of 2001 to the fourth quarter of 2013. Panel unit root tests, indicate that the series used are stationary at their first difference form, and cointegration tests indicate that a long-term relationship exists among the series in the panel. Generalized impulse response functions and forecast variance decomposition are analyzed. The results indicate that, in the long-run, the main determinants of bank credit growth for OECD countries are exchange rates, foreign liabilities, money supply, interest rates, inflation, GDP, and fixed capital formation (FCF). The study shows that macroeconomic stability seems to be vital for the flow of credit to the private sector across OECD countries.

JEL Classifications: G21, O50, E44, E51

Keywords: credit growth; financial crisis; impulse response functions; variance decomposition; OECD

I. INTRODUCTION

The most recent financial crisis shows how serious could be the consequences of uncontrolled credit expansion to the private sector. The sub-prime housing market crisis in the USA quickly turned into an economic crisis, which spread worldwide, causing one of most severe economic crises since the Great Depression.

The importance of credit growth for policy makers has increased across countries in recent years, especially after the recent house price bust in USA. Since 1997, researchers have focused more on analyzing credit growth [see, for example, Calza and Sousa (2003); De Haas and Taci (2010), Guo and Stepanyan (2011), Hofmann (2004), Imran and Nishat (2013), Nieto (2007), Saito and Lazier (2014), and Shijaku and Kalluci (2013)]. The structure of credit growth shows significant patterns and differences among countries and country groups. The Asian crisis elucidated the influence of lending growth on the private sector. Since then, more attention has been paid to other regions, such as Latin America, Eastern Europe, and recently the Eurozone. Nevertheless, the expansion of credit during the recent global financial crisis has attracted more attention, especially in developed countries. This paper attempts to further investigate the credit growth phenomena in countries that are members of the Organization for Economic Cooperation and Development (OECD).

In this study, we investigate the main determinants of credit growth to the private sector. Studying such a case is important for several reasons. First, specifying credit growth determinants among OECD countries helps examine the spillover effect in this region as a result of the financial crisis. This is achieved by identifying the demand and supply factors that affect credit growth. In addition, the findings of this study may show the role that monetary policy plays in determining the credit growth in this region. Furthermore, by emphasizing the determinants of bank credit growth in OEDC countries, this study contributes to the existing literature by relating these determinants to the timing of the 2008 financial crisis.

This study provides an analysis of the determinants of domestic bank credit in the private sector in 24 OECD countries using quarterly data over the period from the fourth quarter of 2001 to the fourth quarter of 2013. The results indicate that, in the long run, the main determinants of bank credit growth in OECD countries are exchange rates, foreign liabilities, money supply, interest rates, inflation, GDP, and fixed capital formation (FCF).

This paper is organized as follows. Section II presents an overview of previous research on this subject. In Section III, the methodology and model specifications used in the study are explained. Data description is provided in Section IV. The empirical results are explained in Section V. Finally, the conclusion and policy implications are provided in Section VI.

II. LITERATURE REVIEW

A host of studies has investigated the factors determining the credit growth worldwide. The initial attempt is explored along with the Asian crisis.

The studies of Ghosh and Ghosh (1999), Corsetti, Pesenti, and Roubini (1998), and Agenor, Aizenman, and Hoffmaister (2004) focus on the influence of East Asian credit growth during the Asian crisis in 1997 and compared its influence during the pre-

crisis period. These studies find that foreign inflows influence credit growth. Krugman (1999) also investigates the influence of current accounts and outputs on the credit boom in East Asia and finds that credit booms increase as current accounts worsen and outputs decrease.

A study by Crowley (2008) investigates credit growth across different regions, such as the Middle East, North Africa, and Central Asia. The results show that credit growth in these regions is associated with stronger economic growth, financial deepening, banks' willingness to lend, and liberalization. However, the findings show no significant evidence that foreign deposits inflows and oil exports affecting credit growth. Gourinchas, Valdes, and Landerretche (2001) test the lending booms in Latin America. They find that credit growth increases with investment growth and interest rate rises.

A study by Saito, Savoia, and Lazier (2014) explains factors determining the private credit for OECD, BRICs, and Latin America and the Caribbean (LAC). They find that private consumption is considered the most influential factor affecting private credit in the OECD group, whereas the main determinant of private credit in the BRICs group and the LAC group is found to be the balance of the current account.

Another study by Imran and Nishat (2013) investigates the factors influencing private credit growth by the Pakistani banking sector. Their findings suggest that the most influential factors affecting private credit growth are domestic deposits, foreign liabilities, exchange rates, economic growth, and monetary conditions. However, they find that the inflation rate and the interest rate do not influence private credit growth in Pakistan.

Guo and Stepanyan (2011) investigate the determinants of bank credit growth for 38 emerging countries in Asia, Africa, Europe, and South America. They find that domestic and foreign funding and higher economic growth have a positive impact on credit growth. However, they find that inflation reduces credit growth. Interestingly, their study finds that a strong banking sector performance leads to higher credit growth.

A study by Aisen and Franken (2010) examines the factors influencing credit growth across 80 countries during the financial crisis in 2008. They find that countercyclical monetary policy reduces the reduction of bank credit in the post-crisis period. Specifically, they find that the main determinants of the credit slowdown after Lehman Brothers collapsed were high credit booms prior to the crisis, the lower economic growth of trading partners, and higher financial integration with respect to the rest of the world.

Egert, Backe, and Zumer (2007) investigate the factors determining the supply and demand sides of the domestic credit to the private sector in 11 countries in Central and Eastern Europe. They find that factors representing financial liberalization and competition in the banking sector, such as public sector credit, the nominal interest rates, and the spread rate, are the main determinants of credit growth in only five out of 11 countries.

A study by Oluitan (2013) examines the credit growth determinants in 33 African countries from 1970 to 2006. It is found that exports negatively affect private credit, whereas imports and capital inflows have positive relationships with private credit.

Another study by Shijaku and Kalluci (2013) examines the determinants of bank credit to the private sector in Albania. The findings show that bank credit is positively affected by economic growth, the degree of confidence among economic agents, and banking and financial intermediation. The results also show that there is a negative

relationship between bank credit and domestic borrowing by the government, the cost of lending, and the improvement of non-performing loans.

Hofmann (2004) tests the determinants of real bank credit for 16 industrialized countries. Although the study finds that real bank credit is positively related to real GDP and property prices, a negative relationship is found between real bank credit and the real interest rate.

Nieto (2007) investigates the factors affecting household credit in Spain and finds that household credit is positively related to real government spending, wealth, and outstanding credit repayments. However, loan costs and the rate of unemployment are found to have a negative impact on household credit. Gattin-Turkalj, Ljubaj, Martinis, and Mrkalj (2007) examine the credit demand in Croatia. The findings show that the main determinants of credit demand are the real GDP and real interest rates.

Several empirical studies support the finding of a bank credit effect on the efficiency of the financial sector and economic development. These studies include those of Schumpeter (1934), McKinnon (1973), Fry (1988), Odedokun (1998), Levine, Loayza, and Beck (2000), Calderón, and Liu (2003), King and Levine (1993), Johannes, Njong, and Cletus (2011) and Estrada, Park, and Ramayandi (2010). On the other hand, Robinson (1952) suggests economic growth causes financial development, empirical research by, e.g., Shan, Morris, and Sun (2001) support this argument. Finally, other researchers have found a bi-directional relationship between growth and financial development [e.g., Jung (1986) and Demetriades and Hussein (1996), Luintel and Khan (1999), Levine, Loayza, and Beck (2000), and Rousseau and Wachtel (2005)].

III. METHODOLOGY AND MODEL SPECIFICATION

A host of studies have investigated the determinants of credit growth across many countries and regions. According to previous literature, there is a long list of possible determinants of credit expansion to the private sector worldwide, which can be classified into three categories: economic performance indicators, structural indicators, and banking sector indicators.

This study consists of a panel of 24 OECD countries between the fourth quarter of 2001 to the fourth quarter of 2013. The estimated model includes factors driving the demand for credit to the private sector and those driving the supply of credit by the banking sector. Credit expansion is assumed to be determined by: the exchange rate, liabilities to non-residents, broad money, deposit rates, lending rates, the consumer price index (CPI), GDP, and fixed capital formation FCF. The general specification form of the model broadly follows the literature on determinants of credit supply to the private sector, which takes the following form:

$$\mathrm{Credit}_{it} = \mathrm{f}(\mathrm{exch}_{it}, \mathrm{Lnres}_{it}, \mathrm{Mbroad}_{it}, \mathrm{Deprate}_{it}, \mathrm{Lenrate}_{it}, \mathrm{cpi}_{it}, \mathrm{gdp}_{it}, \mathrm{fcf}_{it}) \quad (1)$$

where the expressions in the model above are used to denote country "i" in year "t" as a function of the credit growth determinants across OECD countries; "Credit" refers to claims on the private sector; "Exch" refers to the nominal exchange rate; "Lnres" denotes the liabilities to non-residents or foreign liabilities; "Mbroad" refers to broad money supply; "Deprate" denotes the deposit rate; "Lenrate" refers to the lending rate; "CPI" is the consumer price index; "GDP" is real gross domestic product; and "FCF" is fixed capital formation. The estimated model employed is as follows:

$$\begin{aligned}\text{Credit}_{it} = c_i + \alpha_{1i}(\text{exch}_i)_t + \alpha_{2i}(\text{Lnres}_i)_t + \alpha_{3i}(\text{Mbroad}_i)_t + \alpha_{4i}(\text{Deprate}_i)_t \\ +\alpha_{5i}(\text{Lenrate}_i)_t + \alpha_{6i}(\text{cpi}_i)_t + \alpha_{7i}(\text{gdp}_i)_t + \alpha_{8i}(\text{fcf}_i)_t + \varepsilon_{it}\end{aligned} \quad (2)$$

The coefficients α_{1i} to α_{8i} are the long-term coefficients to be estimated, while ε_{it} is a residual term. The variables are all measured in US dollars. Based on the above equation, the factors are expected to increase the supply of credit to the private sector from the supply side. Specifically, a rise in the exchange rate or an appreciation of any OECD currency is expected to result in an increase in the supply of credit to the private sector. Appreciation increases bank's net worth, thus leading to increasing the local currency denominated credit, leading banks to supply more credit to the private sector.

Additionally, a rise in foreign liabilities is assumed to lead to bank credit growth to the private sector, as banks obtain loans from foreign financial institutions. Their liquidity also increases, and they can thus lend more at home.

Broad money is considered an alternative gauge of a country's monetary conditions. An increase in broad money increases credit growth to the private sector. When central banks decide to follow an easy money policy, such as what the European Central Bank, or the Bank of Japan are doing these days, this would reduce the discount rate and the cost of borrowing in general, which stimulates expectations of future growth and private sector profitability. As a result, investment would grow and consumer demand. Under these conditions, the ability of borrowers to pay back their debts obligations increases, decreasing commercial banks credit risk exposure and the supply of credit to the private sector, would increase.

An increase in the deposit rate increases domestic deposits, thus enabling depository institutions to expand their credit to the private sector. Furthermore, an increase in the lending rate would enhance the supply of the credit to the private sector, as it would make it more profitable for banks to expand their credit. The lending rate also represents the funding costs to the private sector. Higher borrowing costs suggest that borrowing costs are associated with higher resource availability.

The inflation rate reflects a country's monetary instability. Monetary instability affects financial decisions in the private sector. Hence, we expect that if inflation has a negative impact on bank credit to the private sector, monetary instability will be associated with the reduced availability of bank resources, and inflation will be associated with lower bank credit to the private sector. However, if inflation is low or moderate, then we expect it to have a positive effect on bank lending to the private sector. Inflation reduces the rate of return on credit and also increases the cost of borrowing for the private sector as it is always leading to increase interest rates. For banks the impact of inflation of supply of credit depends on the ability of banks to accurately anticipate inflation and reflect that on the lending rate which depends on how inflation accelerates. When banks adjust lending rates to anticipated inflation, inflation risk would be less and banks supply more credit and vice versa.

Another significant factor influencing credit growth is the economy size; as the economy expands in terms of its GDP, it is expected to lead to more demand for credit. Finally, increasing FCF is expected to increase the demand for credit. Luporini and Alves (2010) state that FCF can create positive externalities for the private sector, which could increase the demand for credit.

The model is estimated first as a VAR to determine the optimum number of lags, based on different criteria. A panel unit root test is to be implemented on the levels of

data without a trend and with a trend. When using different panel unit root tests, if the results show that a unit root exists in the panel, the tests should be repeated using the first difference of the panel data with a trend and without a trend.

Having tested for the unit root, we check for panel cointegration using different cointegration tests to test for the long-term relationship between the variables in the model. Having tested for cointegration, we proceed by testing the generalized impulse-response functions. An impulse-response function traces the response to a one-time shock in the innovation. The accumulated response is the accumulated sum of the impulse responses. It can be interpreted as the response to a step impulse, where the same shock occurs in every period from the beginning. A shock to the i^{th} variable not only directly affects the i^{th} variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. An impulse-response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. For stationary VARs, the impulse responses should decrease to zero, and the accumulated responses should asymptote to some (non-zero) constant.

The study also tests for variance decomposition, which separates the variation in an endogenous variable into the component shocks of the VAR. Generalized impulse-response functions trace the effects of a shock to one endogenous variable and to the other variables in the VAR.

IV. DATA DESCRIPTION

The data used covers the period from the fourth quarter of 2001 to the fourth quarter of 2013 on a quarterly basis. The dataset in this study includes data from 24 OECD countries based on data availability. These countries include Australia, Austria, Belgium, the Czech Republic, Finland, France, Germany, Greece, Hungry, Iceland, Ireland, Italy, Japan, Korea, Luxemburg, Mexico, the Netherlands, Portugal, Slovakia Republic, Slovenia, Spain, Switzerland, the UK, and the USA.

The data are mainly obtained from the IMF database (*International Financial Statistics*) and OECD database. The analysis of credit growth to private sector depends on balanced data from selected OECD countries based on data availability. If there are any missing data in the IMF database (*International Financial Statistics*), the data for all variables are measured in million US dollars. The variable for private credit growth is measured by claims to the private sector/other sectors from the IMF database (*International Financial Statistics*). We use broad money as an indicator for the money supply variable. The nominal exchange rate is per US dollar and in the average period. The variable for foreign liabilities is measured by the liabilities of non-residents or foreign liabilities. The inflation variable is measured by the rate of change in CPI. The GDP is measured in real terms. The local investment variable is measured by gross FCF.

IV. EMPIRICAL RESULTS

A. Panel Unit Root Tests

First, a VAR system is estimated, and the optimum lag structure is tested. According to the results are presented in Table 1, all different criteria indicate that the optimum number of lags is three. Based on these results, we proceed to test the order of integration in the

panel using different panel unit root tests. In particular, we conduct panel unit root tests using two specifications—first, assuming no trend in the data and, second, using a trend, given an optimum lag length of three.

Table 1
Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Private Credit	1,184	823,569.6	2,523,974.0	7.4	14,690,900
Exchange Rate	1,184	91.6	245.3	0.5	1,383.5
CPI	1,184	103.5	13.0	68.6	171.1
Deposit Rate	1,184	2.8	1.8	0.0	11.2
FCF	1,184	203,553.2	591,927.3	293.6	3,234,800
Lending Rate	1,184	6.8	3.2	0.0	23.0
Foreign Liabilities	1,184	136,445.8	413,749.9	4.0	2,807,520
Money	1,184	753,345.3	2,335,616	42.5	14,841,000
GDP	1,184	954,191.2	2,901,593	1,956.1	17,089,600

Five different null hypotheses are tested. The first two belong to the Levin, Lin and Chu (LLC) and Breitung tests. The null hypothesis for these tests is the unit root, assuming the cross-sectional units share a common unit root process. The other three tests are: the Im, Pesaran and Shin (IPS) test, the ADF-Fisher chi-square test and the PP-Fisher chi-square test. The null hypothesis for these tests is the unit root, with the assumption that the cross-sectional units have an individual unit root process. The results of the five different tests conducted on the levels of the series that assume no trend in the data are displayed below in Table 2, while those with a trend appear in Table 3.

All the test results failed to reject the null hypothesis for claims on the private sector, the CPI, FCF, and the liabilities of non-residents; these series are all found to be non-stationary at their levels with no trend. While the LLC test rejects the null hypothesis for both the exchange rate and GDP, other tests failed to reject the null hypothesis. On the other hand, while the PP-Fisher chi-square test rejects the null hypothesis for broad money, other tests failed to reject the null hypothesis. For both deposit and lending rates, three of the five tests reject the null hypothesis, while the other two failed to reject the null hypothesis.

Table 2
VAR lag-order selection criteria

Lag	Log L	LR	AIC	SC	HQ
0	-66,501.8	NA	115.7	115.7	115.7
1	-57,098.8	18,642.4	99.4	99.9	99.7
2	-54,478.9	5,153.3	95.0	95.8	95.4
3	-49,145.7	10,406.7*	85.9*	87.0*	86.3*

* indicates the lag order selected by the criterion; Included observations: 1150; LR: sequential modified LR test statistic (each test at 5% level), FPE= final prediction error, AIC= Akaike information criterion, SC= Schwarz information criterion, and HQ= Hannan-Quinn information criterion.

Table 3
Panel unit root test results-series at levels with no trend

Method	Private Credit	Exchange Rate	CPI	Deposit Rate	FCF	Lending Rate	Foreign Liabilities	Money	GDP
Null: Unit root (assumes common unit root process)									
Levin, Lin, and Chu t-test*	5.94	-1.83	2.61	-9.65	2.51	-2.41	0.34	6.63	-2.79
	0.99	0.03	0.99	0.00	0.95	0.01	0.63	0.99	0.00
Null: Unit root (assumes individual unit root process)									
Im, Pesaran and Shin W-stat test	11.98	2.01	10.67	-17.21	9.28	-6.36	6.71	12.87	2.55
	0.99	0.98	0.99	0.00	0.99	0.00	0.99	0.99	0.99
ADF-Fisher chi-square test	0.64	19.45	1.12	374.33	1.93	120.30	4.61	0.43	15.54
	0.99	0.99	0.99	0.00	0.99	0.00	0.99	0.99	0.99
PP-Fisher chi-square test	0.17	16.37	0.11	128.58	0.19	44.69	2.04	0.00	10.65
	0.99	0.99	0.99	0.00	0.99	0.68	0.99	0.99	0.99

* Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality.

Table 3 shows the panel unit root tests for the series with a trend. While the null hypothesis could be rejected for both the deposit rate and FCF according to the results of the five tests, where they tend to be stationary, other test results for the other variables are mixed. According to both the results of the LLC t-test and the Breitung t-stat test, the null hypothesis is rejected for claims on to the private sector, but it could not be rejected for the results of the ADF-Fisher chi-square test and the PP-Fisher chi-square test. While the null hypothesis could not be rejected for the exchange rate according to the results of PP-Fisher chi-square test, it could be rejected according to the results of the other tests. The results of the Breitung t-stat test and the PP-Fisher chi-square test could not reject the null hypothesis for the CPI, but the other test results could. Only the results of the PP-Fisher chi-square test could not reject the null hypothesis, while the other test results show that this variable is stationary. The results of the Breitung t-stat test and the PP-Fisher chi-square test failed to reject the null hypothesis for the liabilities to non-residents, while the other test results could reject the null hypothesis. The null hypothesis for broad money could not be rejected using the results of the LLC t-test and the Im, Pesaran and Shin W-stat test, and the other test results could not reject the null hypothesis. Finally, GDP tends to be stationary according to the results of the Im, Pesaran and Shin W-stat test and the ADF-Fisher chi-square test for this series; however, other test results could not reject the null hypothesis for GDP.

Tables 4 and 5 clearly show that that the null hypothesis of the unit root can be firmly rejected at the 1% significance level using the two test specifications (trend and no trend). This finding indicates that all the tested series are stationary after first differencing. In summary, the unit root test results clearly indicate that all eight series are stationary after first differencing and are integrated of order 1 for the panel of 24 OECD countries. These criteria qualify them for the next step, which involves co-integration analysis.

Table 4
Panel unit root test Results—series at levels with trend

Method	Private Credit	Exchange Rate	CPI	Deposit Rate	FCF	Lending Rate	Foreign Liabilities	Money	GDP
Null: Unit root (assumes common unit root process)									
Levin, Lin and Chu t-test*	-7.55	-3.45	-13.91	-6.84	-14.49	-1.98	-2.31	-9.86	4.53
	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.98
Breitung t-stat test	-1.68	-7.97	-0.34	-12.97	-11.61	-14.10	0.83	-0.57	2.65
	0.04	0.00	0.37	0.00	0.00	0.00	0.79	0.28	0.99
Null: Unit root (assumes individual unit root process)									
Im, Pesaran and Shin W-stat test	-1.72	-4.20	-6.08	-15.32	-9.05	-7.75	-3.78	-2.25	-3.25
	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
ADF-Fisher chi-square test	0.64	84.86	113.77	300.48	166.43	142.33	78.80	58.36	69.53
	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.02
PP-Fisher chi-square test	43.92	51.19	38.83	87.96	80.83	31.52	50.66	49.29	42.27
	0.71	0.42	0.87	0.00	0.00	0.98	0.44	0.50	0.71

* Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality.

Table 5
Panel unit root test results—series at first difference with no trend

Method	Private Credit	Exchange Rate	CPI	Deposit Rate	FCF	Lending Rate	Foreign Liabilities	Money	GDP
Null: Unit root (assumes common unit root process)									
Levin, Lin and Chu t-test*	-30.50	-31.91	-24.01	-21.82	-28.10	-19.81	-23.01	-32.28	-20.45
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Null: Unit root (assumes individual unit root process)									
Im, Pesaran and Shin W-stat test	-25.07	-29.60	-23.97	-19.60	-23.91	-16.70	-18.88	-26.36	-18.26
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ADF-Fisher chi-square test	586.05	712.01	563.42	439.74	553.45	353.99	412.81	622.33	399.29
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PP-Fisher chi-square test	583.08	787.78	855.58	209.25	780.91	295.39	386.59	692.87	619.18
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality.

Following the identification of significant evidence that the series contain no unit root after differencing, the next step is to test for co-integration. In particular, the paper aims to identify whether a long-term co-integration relationship can be identified between the credit growth to the private sector and other variables.

B. Panel Co-integration Tests

Based on the approaches of the Kao residual co-integration test, the augmented Dickey-Fuller test and the Maddala and Johansen-Fisher panel co-integration tests, the null hypothesis of no co-integration is to be tested using the optimal lag length of 3. Tables 6, 7, and 8 report the results from the three-panel co-integration tests used. The results of all three tests provide evidence of co-integration in the panel. More precisely, the results of the Kao residual co-integration test and the augmented Dickey-Fuller test show that a long-term equilibrium relationship exists between the series, where the null hypothesis of no co-integration is rejected at the 1% level.

Similarly, the Johansen-Fisher panel co-integration test results indicate the presence of co-integration between the nine variables, where the null hypothesis of no co-integration ($r = 0$) can be firmly rejected at the 1% significance level. The test results suggest that the null hypothesis of the presence of, at most, 6 unique co-integrating vectors ($r \leq 6$) cannot be rejected. Therefore, some evidence supports the hypothesis about the existence of unique co-integrating vectors among the tested variables in the panel; and a long-term equilibrium relationship exists between claims on the private sector and the other eight variables in the panel.

Table 6
Panel unit root test results—series at first difference with trend

Method	Private Credit	Exchange Rate	CPI	Deposit Rate	FCF	Lending Rate	Foreign Liabilities	Money	GDP
Null: Unit root (assumes common unit root process)									
Levin, Lin and Chu t-test*	-30.86	-34.13	-22.3	-23.54	-27.17	-19.4	-23.43	-32.98	-22.99
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Breitung t-stat test	-19.02	-9.13	-21.99	-10.11	-18.97	-17.07	-14.38	-20.11	-12.14
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Null: Unit root (assumes individual unit root process)									
Im, Pesaran and Shin W-stat test	-23.72	-28.49	-21.97	-16.65	-21.71	-13.86	-16.17	-25.09	-15.87
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ADF-Fisher chi-square	495.24	619.37	461.36	331.15	460.52	260.66	312.49	530.32	308.61
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PP-Fisher chi-square	661.21	922.86	1225.16	122.81	838.79	205.01	286.05	1338.34	512.91
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Probabilities for Fisher tests are computed using an asymptotic chi-square distribution. All other tests assume asymptotic normality.

Table 7
Kao residual co-integration test

	t-Statistic	Prob.
ADF	-26.62	0.00

Table 8
Augmented Dickey-Fuller test equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID(-1)	-1.48	0.06	-26.61	0.00
D(RESID(-1))	0.46	0.04	10.56	0.00
D(RESID(-2))	0.20	0.03	5.97	0.00
D(RESID(-3))	0.10	0.03	3.80	0.00
R-squared	0.58	Mean dependent var.		-1,090.28
Adjusted R-squared	0.58	S.D. dependent var.		20,521.42
S.E. of regression	13,337.24	Akaike info criterion		21.84
Sum squared resid.	1.99E+11	Schwarz criterion		21.86
Log likelihood	-12,279.91	Hannan-Quinn criterion		21.85
Durbin-Watson stat	1.34			

Finally, the impact of different explanatory variable shocks on claims on the private sector is determined using the impulse-response functions and forecast variance decomposition. We do not report the VAR results due to space limitations. The VAR findings will be provided by the authors upon request.

C. Impulse Responses of Claims on the Private Sector to Various Shocks

The impulse response analysis helps to assess the direction, magnitude, timing and duration of a single shock to claims on the private sector, whereas the forecast variance decomposition decomposes the forecast error variances estimates the relative importance of various structural shocks. Next, we apply generalized variance decomposition to our nine -variable system. Because we focus on the fluctuations in the claims on the private sector, we only report the variance decomposition for credit growth and analyze the relative importance of different factors in the model in terms of influencing claims on private-sector movements. The results for different forecasting horizons are presented in Table 9.

Table 9
Johansen-Fisher panel co-integration test

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-Eigen test)	Prob.
None	3,859.0	0.000	1,078.0	0.000
At most 1	1,712.0	0.000	1,130.0	0.000
At most 2	1,465.0	0.000	595.9	0.000
At most 3	1,012.0	0.000	460.5	0.000
At most 4	663.7	0.000	410.1	0.000
At most 5	341.6	0.000	285.6	0.000
At most 6	122.5	0.000	140.3	0.000
At most 7	12.95	0.998	12.95	0.998

* Probabilities are computed using asymptotic Chi-square distribution

The figures in Appendix illustrate the generalized impulse-response functions of the claims on the private sector for the 24 countries with a positive one-unit standard deviation of various shocks after one quarter, two quarters, and up to a limit of 25 quarters. The dashed lines indicate the two standard error confidence intervals. As shown in the figures, the time paths have different shapes for different shocks.

The response of claims on the private sector to the exchange rate is positive until the tenth quarter, when it becomes to be negative and bottoms out at the twentieth quarter before turning back; however, in general, it remains positive in the long run.

As for the liabilities of non-residents or foreign liabilities, an immediate negative impact on the claims on the private sector exists for ten quarters, but the impact then becomes positive for the following ten quarters and negative thereafter. This impact is similar to the impact of the broad money supply shock. The shocks of both the lending rate and deposit rate tend to have a negative impact in the short run. Their impact turns positive for another four quarters, but there is generally slow positive impact on the claims on the private sector. The immediate impact of the CPI on the claims on the private sector is negative for three quarters and then positive for five quarters. At quarter eight, the impact of the CPI becomes negative for about ten quarters and then becomes positive thereafter. The response of credit in the private sector to GDP and FCF shocks appears similar. These shocks have a negative impact for ten quarters, followed by a positive impact for the next ten quarters.

The figures show that the impulse-response functions gradually decline in the long run, but they do not die out in the cases of exchange rate and CPI, as the effect of shocks in these cases persists in the long run.

D. Variance Decomposition Analysis

The relative contributions of the different explanatory variable shocks to the variations in the claims on the private sector are captured using the variance decomposition method. Variance decomposition measures each innovation's contribution, (%) to the forecast error variance of the claims on the private sector and provides a means to determine the relative importance of shocks in terms of explaining the variation in the claims on the private sector.

Table 10 displays the forecast error variance decomposition results for the structural VAR model. The numbers reported indicate the percentage of the forecast error of the different shocks at different time horizons from one quarter (short term) to 25 quarters (long term). A very interesting finding is that changes in the claims on the private sector are dominated by the explanatory variables. In the short run (one quarter), 100% of the forecast error variance of the changes in claims on the private sector are accounted for by their own innovations. None is accounted for by the other variables. However, the proportion explained by the claims on the private sector decreases dramatically as the time horizon increases. In the second quarter, approximately 93.7% of the forecast error variance is accounted for by its own innovations and approximately 7.3% by explanatory variables. This proportion decreases dramatically in the long run; after 25 quarters, only 28.1% of the forecast error variance is accounted for by changes in the claims on the private sector, while the rest (71.9%) is accounted for by explanatory variables.

Table 10
Generalized forecast error variance decompositions

	Private Credit	Exchange Rate	CPI	Deposit Rate	FCF	Lending Rate	Foreign Liabilities	Money	GDP
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	93.67	0.00	1.13	0.20	0.00	0.23	3.16	1.57	0.03
3	82.38	4.35	5.40	0.69	0.75	2.13	2.30	1.56	0.44
4	71.45	6.43	5.29	3.37	1.36	4.47	3.71	1.62	2.34
5	63.33	10.95	4.60	2.99	1.37	4.26	5.38	1.49	5.65
6	55.66	14.67	4.19	4.81	1.22	3.78	7.25	2.41	6.01
7	43.57	19.64	4.44	10.11	1.25	4.44	7.55	3.95	5.06
8	35.85	21.55	7.12	12.39	1.31	5.81	6.93	4.88	4.15
9	32.79	23.14	9.51	11.92	1.23	5.40	6.85	5.47	3.69
10	32.58	23.51	11.12	11.03	1.15	5.00	6.42	5.44	3.75
11	33.32	22.71	11.63	10.41	1.14	5.15	6.22	5.22	4.19
12	34.03	21.78	11.69	10.10	1.22	5.04	6.26	5.16	4.72
13	34.20	20.87	12.05	9.76	1.46	4.80	6.41	5.32	5.17
14	33.93	20.15	12.67	9.37	1.66	4.62	6.53	5.38	5.67
15	33.55	19.79	13.03	9.16	1.77	4.50	6.64	5.36	6.19
16	33.15	19.70	13.17	9.05	1.97	4.42	6.74	5.36	6.44
17	32.74	19.75	13.17	9.02	2.20	4.37	6.89	5.39	6.47
18	32.39	19.90	13.01	9.09	2.33	4.34	7.13	5.44	6.37
19	32.14	20.12	12.67	9.14	2.32	4.44	7.42	5.49	6.26
20	31.84	20.53	12.26	9.09	2.24	4.66	7.62	5.51	6.25
21	31.32	21.26	11.90	9.01	2.17	4.79	7.70	5.53	6.32
22	30.62	22.11	11.68	8.99	2.14	4.81	7.65	5.57	6.43
23	29.78	22.83	11.62	9.07	2.13	4.79	7.57	5.65	6.55
24	28.90	23.40	11.75	9.22	2.13	4.76	7.47	5.80	6.57
25	28.11	23.76	12.16	9.38	2.10	4.72	7.35	5.99	6.43

The impacts of explanatory variable shocks show some variation according to the source, with a general trend to increase over time. The changes in the exchange rate explain almost none of the forecast error variance in claims on the private sector through the second quarter; however, starting in the third quarter, the impact of the exchange rate shocks increases. The changes in the exchange rate accounts for approximately 4.3% of the forecast error variance in claims on the private sector in the third quarter, increasing to approximately 23.8% in quarter 25. This finding implies that exchange rate fluctuations tend to influence the claims on the private sector more than any other variable under investigation.

The CPI explains approximately 1.1% of the forecast error variance in the claims on the private sector in quarter 2. This proportion increases to 13.2% in quarter 16, thereafter decreasing to almost 12% in quarter 25. The changes in the deposit rate explain almost none of the forecast error variance in the claims on the private sector in quarter 2. This proportion increases to 12.4% in quarter 8 but generally starts to decrease thereafter, dropping to approximately 9.4% in quarter 25. On the other hand, the changes in the lending rate explain approximately 0.2% of the forecast error variance in the claims on the private sector in quarter 2, increasing to 5.8% in quarter 8 and then decreasing to 4.7% in quarter 25. This pattern is rather similar to that of the deposit rate.

The liabilities of non-residents explain approximately 3.2% of the forecast error variance in the claims on the private sector in the second quarter. In quarter 25, this proportion increases to approximately 7.3%. While GDP accounts for almost none of the forecast error variance in quarter 2, its proportion starts to increase thereafter, reaching 6.4% in quarter number 25. In addition, the money supply (broad money) explains 1.7% of the forecast error variance in the second quarter. In the long run, its proportion increases to almost 6% in quarter 25.

Finally, FCF is found to explain none of the forecast error variance in the second quarter and only 2.1% in quarter 25. In general, this finding suggests that the contribution of the FCF shock to variations in the claims on the private sector is negligible.

V. CONCLUDING REMARKS AND POLICY IMPLICATIONS

This study investigates the determinants of credit growth in the private sector using a panel of 24 countries. The list of explanatory variables includes exchange rates, liabilities of non-residents or foreign liabilities, broad money, lending and deposit rates, the CPI, GDP, and FCF.

Using a VAR system of credit to the private sector model, an optimum lag order of three quarters is found. Using this lag order, panel unit root tests show that the series of the panel at their levels with both trend and without a trend are mixed, with the series tending to be non-stationary. Panel test results also show that the null hypothesis of the unit root could be firmly rejected after taking the first difference of the time series in the panel.

Different panel co-integration tests results provide evidence of co-integration in the model. More precisely, the Kao residual co-integration test and the augmented Dickey-Fuller test results show that there is a long-term equilibrium relationship between the series, where the null hypothesis of no co-integration is rejected. Similarly, the Johansen-Fisher panel co-integration test results indicate the presence of co-integration between the nine series in the panel. The null hypothesis of the presence of, at most, 6 unique co-integrating vectors ($r \leq 6$) cannot be rejected.

The generalized impulse-response functions of the claims on the private sector for the 24 countries, with a positive one-unit standard deviation of various shocks, in the short and long run (after one quarter, two quarters, and up to a limit of 25 quarters) show that the response in the short run generally seems to be positive for the exchange rate shock; the response to other shocks in the short run is negative, though it may change direction in the long run.

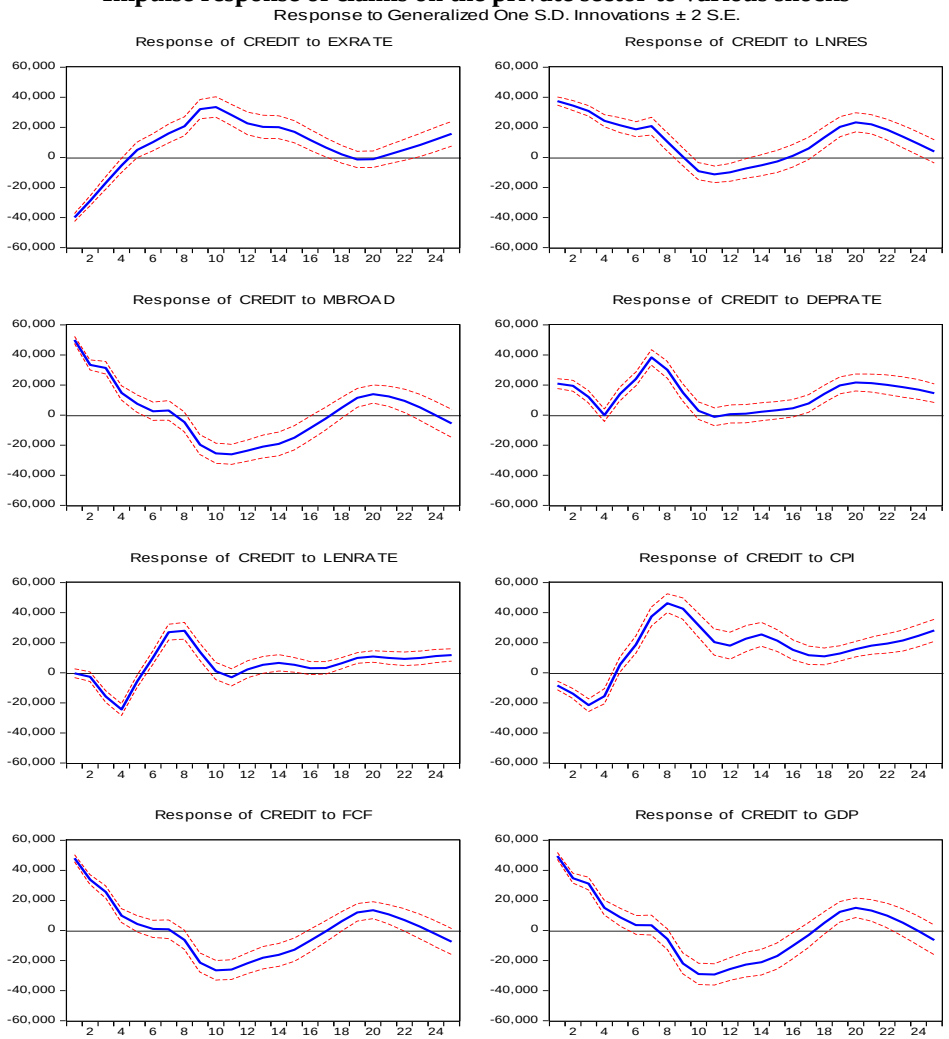
The impulse-response functions gradually decline in the long-run, but they do not die out in the cases of the exchange rate and the CPI; in these cases, the effect of shocks persists into the long run. In addition, a very interesting finding related to variance decomposition suggests that changes in the claims on the private sector are dominated by explanatory variables in the short run. However, the proportion explained by the claims on the private sector decreases dramatically as the time horizon increases. In the long run (after 25 quarters), only 28.1% of the forecast error variance is accounted for by changes in the claims on the private sector; the rest (71.9%) is accounted for by explanatory variables. In terms of importance, the exchange rate ranks first, explaining approximately 23.8% in the long run, followed by the CPI (13.2%), deposit rates (9.4%), the liabilities

of non-residents (7.3%), GDP (6.4%), broad money (6%), the lending rate (4.7%) and FCF (2.1%).

The main policy implications of these results are that policymakers should control variations in exchange rates, the growth of money supply and inflation to maintain the stability of credit flows to the private sector. Clearly, these variables are closely linked to monetary policy actions, and the results generally show that macroeconomic stability is vital for the flow of credit to the private sector in OECD countries.

APPENDIX

Impulse response of claims on the private sector to various shocks



CREDIT = Claims on the Private Sector; EXCH = Exchange Rate; LNRES = Liabilities of Non-Residents or Foreign Liabilities; MBROAD = Broad Money; DEPRATE = Deposit Rate; LENRATE = Lending Rate; CPI = Consumer Price Index; FCF = Fixed Capital Formation; and GDP = Gross Domestic Product.

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