BETA
Bureau
d'économie
théorique
et appliquée

Documents de travail

« Bank credit and economic growth: a dynamic threshold panel model for ASEAN countries»

Auteurs

Sy-Hoa Ho, Jamel Saadaoui

Document de Travail n° 2021 – 24
(Version révisée du WP2020-48)

Juin 2021

Bureau d'Économie Théorique et Appliquée
BETA

www.beta-umr7522.fr

@beta_economics

Contact :
jaoulgrammare@beta-cnrs.unistra.fr

Université de Strasbourg · cnrs · Université de Lorraine · INRAE · AgroParisTech

Bank credit and economic growth: a dynamic threshold panel model for ASEAN countries

Sy-Hoa Ho[a,*], Jamel Saadaoui[b,**]

[a]*Institute of Research and Development, Duy-Tan University, Da Nang, Vietnam*
[b]*University of Strasbourg, University of Lorraine, BETA, CNRS, 67000, Strasbourg, France*

Abstract

While it is widely recognized that the development of a sound financial system may contribute to foster economic growth, the relation between economic growth and financial activities is complex. In this perspective, our contribution investigates the existence of threshold effects in the relationship between economic growth and bank credit. Our sample of ASEAN countries is examined over the period spanning from 1993 to 2019. We use the approach of Kremer et al. (2013) to estimate threshold effects in a dynamic panel where a group of explanatory variables can be endogenous. Our results do not confirm the vanishing effect of finance on economic growth. We found a threshold of 96.5% (significant at the 5% level) for the credit-to-GDP ratio, the threshold variable. In the short run, for observations inferior or equal to the threshold, the positive effect of bank credit expansion on economic growth is around 0.08 (significant at the 1% level). Whereas, for observations superior to the threshold, the positive effect of bank credit expansion on economic growth is around 0.02 (significant at the 1% level). The role of exporting firms is essential in ASEAN countries as they are more export-oriented than other regions in the world economy. Our results may indicate that the beneficiary of the credit (firms versus households), the structural features (export-led growth), and the regional heterogeneity have to be considered in empirical investigations of threshold effects in the relation between economic growth and bank credit. This empirical evidence may help to formulate sound policy recommendations.

Keywords: Bank Credit, Economic Growth, Dynamic Threshold Estimation, ASEAN
JEL: C23, G21, O41

*Corresponding author
**Principal corresponding author
Email addresses: hosyhoa1@duytan.edu.vn (Sy-Hoa Ho), saadaoui@unistra.fr (Jamel Saadaoui)
URL: https://orcid.org/0000-0001-8936-8589 (Sy-Hoa Ho),
https://orcid.org/0000-0003-1143-4480 (Jamel Saadaoui)

1. Introduction

The end of the 1990s, after the East Asian crisis, witnessed a renewed interest in the impact of financial activities on the economic growth. While it is widely recognized that the development of a sound financial system may contribute to foster economic growth, the true nature of the relationship between finance and growth is complex. Indeed, the growth effect of finance may depend on several factors like the level of economic development, the depth of financial activities, and the quality of economic and political institutions. Indeed, to illustrate these complex links, we can describe one plausible causal mechanism in the following. On the one hand, we can reasonably argue that the development of financial activities may help to foster economic growth in low-to-medium income countries as the larger part of the bank credit is provided to finance firms' activities. On the other hand, the positive growth effect of finance may vanish in high-income countries as the further development of bank credit will mainly be offered to households.

We can observe that ASEAN countries have known an important economic development during the last twenty years. In the same time, financial and banking activities are less developed than in industrialized countries. Their growth model is more export-oriented than in other regions. Thus, the role of exporting firms seems to be essential in the economic dynamics of these countries. Indeed, these countries share several common features like good performances in terms of economic growth, a relatively limited development of financial and banking activities, and an export-oriented growth model. Besides, these economies managed to cope with the consequences of the great financial crisis of 2008 with a swift recovery. Consequently, we think that it is worthwhile to investigate the existence of thresholds effects in the relationship between bank credit and economic growth for a panel of ASEAN countries over the period spanning from 1993 to 2019.

In our empirical investigation, we seek to determine whether bank credit has different growth effect for observations (countries and periods) above a certain level for the credit-to-GDP ratio or not. To shed light upon this last point, we can detect the existence of true threshold effects only if the slopes of the relationship between bank credit and economic growth are statistically different before and after an estimated value for the threshold variable. If the slopes are not statistically different, we fail to identify threshold effects, and can revert to a linear model (i.e., without threshold). Our main empirical result confirms the existence of threshold effects in the relationship between bank credit and economic growth. Indeed, we find a statistically significant threshold of 96.5% for the credit-to-GDP ratio (i.e., the threshold variable). In the short run, when the credit-to-GDP ratio is inferior or equal to 96.5%, the positive effect of bank credit expansion on economic growth is around 0.08. Whereas, when the credit-to-GDP ratio is superior to 96.5%, the positive effect of bank credit expansion on economic growth is four times smaller. Thus, the growth effect of bank credit is weaker, but remains positive and statistically significant after the threshold.

In section 2, we first survey the literature on the search for thresholds in the finance-growth nexus, and then we discuss some contributions to the link between finance and growth in the short run. In section 3, we present the data and the methodology used to estimate the threshold in a dynamic panel data model with endogenous regressors. Then, we present the empirical results in section 4. Finally, we conclude in section 5.

2. Literature

2.1. Thresholds in the finance-growth nexus

The literature on the finance-growth nexus is too extensive to be comprehensively surveyed here[1]. One possible starting point could be the meta-analysis of Arestis et al. (2015). In their work, they include 69 empirical studies led after 1998. They show that, even this literature is not free from publication biases, there is a genuine positive relationship between financial development and economic growth[2]. This empirical result is especially interesting since this nexus has been subject to several debates. One potential important limitation of the meta-analysis of Arestis et al. (2015) is that it does not allow the possibility to explore the existence of threshold effects. Of course, this is because this meta-regression analysis was focused on establishing a genuine relationship between financial development and economic growth. Thus, it does not include studies allowing for threshold or nonlinear effects[3].

The same year Arcand et al. (2015) published an empirical investigation that puts the results of Arestis et al. (2015) in perspective. Indeed, they show that the financial development is not positively related to economic growth in countries with large financial sectors. They found, thanks to semi-parametric estimations, an interval for the threshold (between 80 and 120% of GDP for the credit to the private sector) before which the correlation between finance and growth is positive. This positive effect vanishes, and even becomes negative[4], at some point for several reasons: (i) the role of financial intermediation during the process of economic development, (ii) the instability and the higher probability of crashes induced by the deepening of the financial sector[5], and (iii) a brain drain effect from the productive sectors of the economy towards the financial sector.

In the following, we will survey the recent studies that explore the existence of threshold effects in the finance-growth nexus. As the no-threshold model is a special case of the threshold model, we believe that our survey of the empirical literature must focus on the studies that allow the existence of threshold effects. Indeed, in absence of threshold effects, we can revert to a model without threshold effect without difficulties. On the contrary, focusing on studies that do not allow for threshold effects or nonlinear effects could lead us to miss a part of the explanation without any means to check the robustness of the results, as we begin with a constrained model (without a threshold).

[1] Levine (2005) provides an authoritative survey on the question, with an extended review on the theoretical and empirical research on this nexus.

[2] The true existence of this relationship has been contested.

[3] In the literature, it seems that there is a semantical confusion. A threshold model does not imply necessarily nonlinear effects. The relationship may be linear before and after the threshold. For example, we can find a positive slope (linear) before a threshold and a flat slope after the threshold. Obviously, we can approximate this threshold effect with a nonlinear function, but the effect is linear before and after the threshold from a mathematical perspective. In many cases, the threshold model can be seen as a piecewise-linear approximation of a nonlinear function.

[4] We also talk about threshold effects when the effect disappears (i.e the slope of the curve becomes flat) after a certain value for the threshold variable (the credit to the private sector in this case).

[5] In this respect, the contribution of Wachtel (2018) aims at reconciling two independent branches of the literature. The first one is the literature on the finance-growth nexus and the second one is the literature on the impact of credit boom and credit deepening on financial crises.

A first wave of empirical studies was published at the beginning of the 2000s. In their works, (Rousseau and Wachtel, 2001, 2002) implement a series of panel econometric techniques (i.e., rolling regressions) for a panel of 84 countries over the period spanning from 1960 to 1995 to show that financial depth has a positive impact on economic growth when inflation falls below a threshold of about 6 to 8%. Here, the threshold variable is the consumer price inflation. The authors explained that, firstly, in high inflation regimes (above 6 to 8%), the information costs and the transactions costs are higher. Secondly, regimes of high inflation could lead to the inhibition of the financial sector and to financial repression in the sense that financial actors may be discouraged to finance long-term operations and, thus, affect the economy negatively. Besides, high inflation could lead the government to protect certain sectors of the economy, potentially leading to an inefficient allocation of resources. Thirdly, higher inflation will increase the opportunity cost of holding money and, thus, deteriorates the financial indicators which often are used to measure financial development.

Deidda and Fattouh (2002) introduce a OLG model with risk averse agents and costly financial transactions that explores the possibility of a different growth effect of financial activities for lower levels of economic development, comparatively to developed countries. To provide empirical evidence to confirm their theoretical intuitions, they use the database of King and Levine (1993) and implement the approach of Hansen (1999) to estimate the threshold at which the growth effect vanishes. The investigated sample includes 119 countries over the period spanning from 1960 to 1989. In this study, the threshold variable is the 1960 per capita GDP and the variable selected for measuring the financial activities is the ratio of liquid liabilities to GDP. They found an estimated threshold of 850 U.S. dollars for the 1960 per capita GDP. Before this threshold, the growth effect of finance is two times stronger[6]. Besides, it is interesting to note that in the linear OLS regression (i.e., without threshold), they simply capture a positive growth effect of financial activities, without any means to check the existence of threshold effects.

The idea that the growth effect of financial development can depend on the level of financial development is, then, explored by Rioja and Valev (2004). In their empirical investigation, the sample includes 74 countries with different levels of developments over the period spanning from 1960 to 1995. Three indicators of financial development are selected, namely, the ratio of private sector credit-to-GDP, the ratio of liquid liabilities-to-GDP and the ratio of commercial banks / central banks loans-to-GDP. In this study, the threshold for the three regimes of financial development are chosen in an *ad hoc* manner. Thus, the two thresholds of financial development for the three regimes of financial development (low region, middle region, high region) are not estimated. Even if the authors made robustness tests to ensure the stability of their estimates, it is quite difficult to determine whether the coefficients in the different regions are statistically different from each other. They found that the growth effect of financial development is uncertain in the low region, is stronger in the middle region, and in the high region the growth effect is positive, but smaller than in the middle region.

In the following years, Graff and Karmann (2006)[7] explore the interesting notion of "balanced financial development". Besides, they recall that the literature concerned with finance and growth

[6]The coefficient is around 0.05 before the threshold and around 0.025 after the threshold.

[7]This work circulated as a working paper in 2003.

can be split into four groups: (i) the first one considers that economic growth and financial development are unrelated, (ii) the second one views the financial sector as the by-product of real activities, (iii) the third one considers that financial activities are a determinant of economic growth and (iv) the last one admits that, under certain conditions, financial activities are harmful to growth. This last group of the literature implicitly admits the existence of thresholds effects in the finance-growth nexus. The meta-analysis of Arestis et al. (2015) shows quite convincingly that there is a genuine relationship between growth and finance. Consequently, we can safely consider that growth is affected by the evolution of financial activities. The question for Graff and Karmann (2006) is now to determine whether the fourth strand of the literature is right or not (i.e., threshold effects exist or not). They use a data sample of 90 countries over the period spanning from 1960 to 2000. Their empirical regression is based on a traditional production function augmented with human capital and, the variable of interest, the financial activities. Thanks to bootstrapping techniques, they found that 20% of their observations in their sample are in a "poverty trap", i.e., countries with a lower level of financial activities (than predicted by their level of development) benefit less from the same level of financial activities. In other words, the impact of financial activities on economic growth is lower for countries with a suboptimal level of financial activities[8].

Masten et al. (2008) use macro level data and industry level data[9] to consider the existence of threshold effects in the relationship between growth and finance with a particular attention to transitional economies. They use the methodology of Rajan and Zingales (1998) on industry level data and implement the methodology of Hansen (1999) to explicitly estimate threshold values of financial development in the finance-growth nexus. At the macroeconomic level, the sample includes 31 European countries over the period spanning from 1996 to 2004. At the industry level, the sample covers 30 European countries and 26 three-digit ISIC Rev. 2 manufacturing industries for the period spanning from 1996 to 2003. At the industry level, the results confirm that financial development affects growth positively, but only after controlling for alternative sources of financing and allowing for nonlinear effects. Interestingly, they found that transitional economies benefit more from financial development. In the threshold analysis, Masten et al. (2008) use the double threshold model of Hansen (1999) with the sum of stock market capitalization and domestic credit in GDP as threshold variable. They found two significant thresholds 53 % and 70% and that financial development has a positive impact on growth before the first threshold. This positive growth effect vanishes after the second threshold, but does not become negative. Finally, countries with high levels of financial development do not experience this positive growth effect of financial activities.

It is not very surprising to observe that the years following the financial crisis of 2008 have witnessed renewed interest in the quest for threshold(s) in the finance-growth nexus in the empirical literature. The work of Huang and Lin (2009) explores the finance-growth nexus through the lens of the level of economic development. They implemented the threshold model of Caner and Hansen (2004) to check whether the impact of financial activities is linearly dependent on the development

[8]In this case, the threshold variable is the difference between the level of financial activities and the "balanced" level of financial activities (i.e. predicted by the level of economic growth).

[9]Mainly to solve endogeneity problems at the macro level by using the information on external needs of financing at the industry level.

level or not. In other words, they try to test whether the financial activities have a stronger impact in low-income countries than in high-income countries or not. One of the great advantages of the approach of Caner and Hansen (2004) is the possibility to use the instrumental variables approach to control for endogeneity[10]. Indeed, in the relationship between finance and growth, it seems quite reasonable to think that financial development generates a faster economic growth, but also that economic growth will influence the development of financial activities (for example, a faster economic growth will generate more saving and, possibly, increase the total amount of new loans). Thus, in this relationship, we cannot expect that all the right hand side variables are exogenous and, especially, the variable representing the financial activities.

As mentioned before, Deidda and Fattouh (2002) use the approach of Hansen (1999) in their empirical investigation, where all the explanatory variables are exogenous. Huang and Lin (2009) relax this last hypothesis which seems to be too stringent in the case of the finance-growth nexus. Their sample includes 71 countries averaged over the period 1960-1995. They consider several indicators of financial activities. In their linear regressions, they confirm that financial activities have a positive impact on long-run economic growth. In the threshold regression, the logarithm of per capita income measure in 1960 is selected as the threshold variable. They found a value of 7.3 which corresponds to 1960 per capita income of 1480.30 U.S. dollars. The effect of the credit made by financial intermediary to the private sector on the long-run economic growth is positive and two times larger for countries with an 1960 income per capita inferior or equal to 1480.30 U.S. dollars comparatively to countries with a 1960 income per capita superior to the threshold[11]. As mentioned above, this interesting result can be explained by the role of financial intermediation at the beginning of the development process (Arcand et al., 2015).

In their graphical and econometric analysis, Rousseau and Yilmazkuday (2009) investigate the relationship between inflation, economic growth and financial development in a trilateral analysis. They build upon the study of Rousseau and Wachtel (2002) where the growth effect of finance vanishes in high inflation regimes. As mentioned above, the growth effect of financial depth becomes significantly positive below of an inflation threshold of 6 to 8% in Rousseau and Wachtel (2002). In the study of Rousseau and Yilmazkuday (2009), a sample of 84 countries is used over the period spanning from 1960 to 2004. The three variables of interest are: the economic growth (growth in real per capita output), the financial depth (the ratio of liquid assets-to-GDP and the ratio of M3 less M2-to-GDP) and inflation (consumer prices) averaged over periods of five years. They use a graphical approach to illustrate the evolution of the growth effect of finance in different regimes of inflation. Two observations can be made: (i) the two inflation thresholds (3.95% and 18.62%) for the three inflation regimes have been estimated as the pair of possible thresholds that minimize the sum of squares in the growth regressions; (ii) it is difficult to assess whether the difference between the coefficients in the different regimes is statistically significant or not. Finally, they found that high levels of financial development combined with low inflation are associated with higher growth. In the middle range inflation rates (between 3.95% and 18.62%), the relation between growth and finance is strong, meaning that higher inflation rates can have strong negative

[10]The work of Caner and Hansen (2004) develops the approach of Hansen (1999) with a model including endogenous regressors but an exogenous threshold variable.

[11]This results is robust to the addition of alternative instruments or alternative financial indicators.

effects. When inflation is very high (above 18.62%), the growth effect of finance vanishes.

The work of Yilmazkuday (2011) generalizes the empirical analysis of Rousseau and Wachtel (2002). He uses rolling regression techniques on a sample of 84 countries over the period spanning from 1965 to 2004 to estimate thresholds in the finance-growth nexus. In this work, several threshold variables are explored, namely, the inflation rate, the government size, the trade openness, the per capita income, and the initial per capita income. We mention several interesting results found in this empirical investigation. Briefly, the growth effect of finance vanishes after 8% of CPI inflation. The optimal government size lies between 11% and 19% for a significant growth effect of finance. When the trade openness is below 35% for low-income countries and below 75% for high-income countries the growth effect is positive. The catch-up effect of finance starts when a country passes a level of per capita income around 665 U.S. dollars and becomes the stronger when the per capita income is superior or equal to 1,636 U.S. dollars. He underlines the importance of the thresholds when the initial per capita income is used as the threshold variable. Finally, the main message of this work is that the finance-growth nexus cannot be analyzed with traditional cross-country linear regressions (i.e., without threshold effects).

Law et al. (2013) explore an interesting dimension of the finance-growth nexus, namely the role of the institutions. It is quite intuitive to think that the quality of the institutions will play an important role in the relationship between finance and growth. Better institutions will have a positive impact on the growth effect of finance, but it seems clear that there are threshold effects in this trivariate relationship. They use a sample of 85 countries over the period spanning from 1980 to 2008 and implemented the approach of Caner and Hansen (2004) to control the endogeneity of the right hand side variables. Several indicators of financial activity are chosen, namely private sector credit, liquid liabilities, and commercial bank assets. They capture three dimensions of the quality of institutions, namely the corruption, the rule of law, and the bureaucratic quality. Here, consequently, the threshold variable is the quality of institutions. To sum up their results, we can note that finance has a positive effect on growth only after a certain level of institutional quality. Indeed, the low quality of institutions may prevent the financial intermediaries from financing productive activities efficiently. Thus, before the threshold, the effect of finance is indiscernible from zero. Again, in the linear model, the growth effect of finance is positive regardless the quality of institutions, and we have any means to check the existence of threshold effect in this constrained model.

Law and Singh (2014) try to answer the following question: Does too much finance harm economic growth? This simple question is more complex than it appears because it hides two nested questions. Firstly, are there threshold effects in the finance-growth nexus? Secondly, in presence of threshold effects, do the positive growth effects of finance disappear or are they completely reversed after the threshold? To identify this optimal level of financial development, they use the approach of Kremer et al. (2013) which extends the cross-sectional approach of Caner and Hansen (2004) to a panel setting. As in Law et al. (2013), they use three alternative indicators of financial development. The data sample includes 87 countries over the period spanning from 1980 to 2010. In the vast majority of their regression, they found a threshold of around 90% for the financial development variable. Before the threshold, the effect of financial activities on economic growth is positive. After the threshold, the development of financial activities may hinder economic growth. We can note that this inverted U pattern in the finance-growth nexus is quite robust to

the level of economic development. For high-income countries and for low-income countries, they find that too much finance is harmful to growth[12], but the positive effect of finance is only significant at the 10% level in the high-income countries. This absence of a positive growth effect of finance in high-income countries can be explained by Beck et al. (2014). Indeed, the growth effect of finance comes from enterprise credit rather than household credit. As the major part of the financial development has been an increase in household credit in high-income countries, it is not surprising that the growth effect of finance is indiscernible.

In recent years, Slesman et al. (2019) examine the specific role of political institutions in the finance-growth nexus. Indeed, they argue that the political institutions have a crucial role in the institutional matrix. In this sense, they extend the work of Law et al. (2013) by implementing the approach of Kremer et al. (2013) to a sample of emerging and developing countries. The data sample includes 77 emerging and developing countries over the period spanning from 1976 to 2010[13]. In accordance with the literature, their main measure of financial development is the private sector credit and their measures of economic activities come from the Penn World Tables and the World Development Indicators of the World Bank. For the political institution variables, they use 14 indicators like the political rights, the civil liberty, for example, coming from the Freedom House database. Here, the threshold variables are the political institution variables. Briefly, their main results indicate the existence of significant thresholds for political institutions. The values of the thresholds are high and may reveal that emerging and developing countries must develop stable and relevant political institutions before reaping the growth benefits of financial development. Indeed, in the vast majority of their regressions, there is no growth effect of finance before the threshold[14], but there is a positive growth effect of finance after the threshold.

As mentioned before, the approach of Kremer et al. (2013) extends the approach of Caner and Hansen (2004) to a panel setting. Several of the regressors can be endogenous, but they assume that the threshold variable is exogenous as in Caner and Hansen (2004). However, this assumption can be seen as problematic in the finance-growth nexus. Indeed, when the threshold variable is the 1960 per capita income, we can safely assume that there is no problem of reverse causality. But, when the threshold variable is the current per capita income or the current level of financial development, it is quite difficult to think that this assumption of an exogenous threshold variable is still valid. In this perspective, the approach of Seo and Shin (2016) provide a framework to estimate dynamic panel with threshold effects and endogeneity. In their approach, both the regressors and the threshold effect can be endogenous.

To investigate the finance-growth nexus, Botev et al. (2019) implement static and dynamic panel models (Hansen, 1996, 1999; Seo and Shin, 2016). In their growth regressions, they include the following explanatory variables to explain the level (not the variation) of output[15]: physical capital, human capital, population growth, trade openness, an indicator of innovation intensity and a measure of financial development. Their sample includes around 100 countries over the period

[12]This positive growth effect of finance is significant only at the 10% level.

[13]In order to smooth business cycle fluctuations, they use 5 year averages of the variables.

[14]Sometimes, the growth effect of finance is even negative before the threshold.

[15]The adjustment between the long run and the short run is explored in an error-correction model framework in a second step.

spanning from the mid-1990s to 2012. They use several indicators of financial activity like the credit to the domestic economy (as a share of GDP), the credit to the private domestic economy (as a share of GDP), the stock market capitalization (as a share of GDP), the number of bank branches per capita and an index of financial liberalization[16]. The main result of this work can be summarized in the following way: the vanishing effect is not confirmed. Indeed, the authors cannot determine with certainty a threshold value from which the growth effect of growth becomes clearly negative.

2.2. Finance and growth in the short run

Despite extensive literature on the finance-growth nexus, few studies have explored this nexus in the short run. As noted by Wachtel (2018), this may be due to the parallel development of two relatively independent branches of the literature. Indeed, the first branch has tried to answer a set of questions related to the following research question: Does finance foster economic growth? The second branch of the literature was focused on financial crises and tries to determine whether the development of financial activities increases the occurrence and the economic consequences of financial crises and defaults. The link between these two research programs has became more obvious after the East Asian crisis at the end of the 1990s and after the financial crisis of 2008. Wachtel (2018) underlines that the development of financial activities (i.e., credit expansion) may foster economic growth[17], but credit expansions often lead to financial crises and deep contractions. In this perspective, the deepening of financial activities may have a negative impact on economic growth in the short run associated to a positive impact in the long run.

Kaminsky and Reinhart (1999) have inspected 102 episodes of currency crises and banking crises to determine the causal mechanisms that have led to these crises. For a series of 16 indicators, they tried to identify thresholds (thanks to a fine grid search) that signal the occurrence of a crisis episode. For example, the threshold values for the domestic credit-to-GDP ratio are equal to 90 percent for currency crisis episodes and equal to 95 percent for banking crisis. In other words, when the domestic credit increases rapidly and exceeds the thresholds[18], the authors can predict a business cycle turning point. Thus, too fast an expansion for the domestic credit-to-GDP ratio may negatively affect the economic growth in the short run by triggering a financial crisis.

Loayza and Ranciere (2006) aim at reconciling two pieces of apparently contradictory evidence. On the one hand, the development of financial activities may foster economic growth in the long run and, in the second hand, financial indicators like the domestic credit are the best predictor of financial crises as shown by Kaminsky and Reinhart (1999). Their sample includes 75 countries over the period spanning from 1960 to 2000. Thanks to panel econometric techniques that allow short run heterogeneity and a convergence towards a long-run relationship, they found that heterogeneous negative short-term effects of finance on growth may coexist with homogeneous positive long run

[16] A large part of the data comes form the Structural Policy Database for Economic Research (SPIDER) database built by the OECD.

[17] We can recall that the meta-analysis of Arestis et al. (2015) shows that there is genuine positive relationship between finance and growth, however the existence of thresholds is not explored.

[18] In a 48-months-window for the currency crises and 24-months-window for banking crises, the warning signals are considered as valid early warning of financial crises.

effects. Indeed, the process of financial development may lead to a better allocation of resources in the long run, but it may also increase the risk of financial crises in the short run when the financial systems or the political institutions (Slesman et al., 2019) are not sufficiently mature to supervise excessive risks[19].

Narayan and Narayan (2013) offer regional perspectives on the relationship between financial development and economic growth in the short run. Their sample includes 65 developing countries observed over the period spanning from 1995 to 2011. The domestic credit provided by the banking sector is selected to measure the impact of the banking system on economic growth in the short run[20]. To explore the regional heterogeneity, they split the panel into five regional panels namely Asian countries, Middle Eastern countries, European countries, Central and South American countries, and African countries. For the full sample, the development of bank credit has a negative and statistically significant impact on economic growth in the short run. While, the two other indicators, namely the market capitalization and the traded stock have a positive impact on economic growth in the short run. Their results indicate a large heterogeneity at the regional level. For example, finance-led growth effects are found in Asian countries for the stock market capitalization and for the traded stocks, but not for the bank credit where the coefficient is negative, but statistically insignificant. The strongest growth effects of finance are found in the Asian panel.

In a recent contribution, Lay (2020) explores the possibility of threshold effects in the relationship between bank credit and economic growth. In his empirical investigation, an inverted U-shaped relationship is identified, and a threshold of 135% of GDP is found after World War II in 17 industrialized countries. Simply put, when the credit-to-GDP ratio is above 135%, further bank credit expansion is detrimental to economic growth. Until this threshold, bank credit expansion has a positive effect on economic growth in the short run. The work of Beck et al. (2014) may help to explain this result. Indeed, the development of bank credit in industrialized countries has been mainly the development of household credit. Most of the growth effect of finance is fueled by enterprise credit rather than household credit. The beneficiary of the credit matters when we try to disentangle the complex links between financial activities and economic growth (Beck et al., 2012).

3. Data and methodology

3.1. Data

We use annual data for a sample of seven ASEAN countries (Malaysia, Brunei, Indonesia, Philippines, Thailand, Singapore, and Vietnam[21]) over the period spanning from 1993 to 2019[22]. These data are collected from various sources including the World Bank's World Development

[19]This dual effect of financial intermediation may imply that financial crises leave persistent, not permanent, scars on the economy.

[20]Other indicators of financial development are also used like the market capitalisation and the traded stocks. All the indicators are expressed in percent of GDP.

[21]As we want a balanced panel in our empirical investigation, Myanmar, Lao PDR and Cambodia are not included in the sample due to data availability. Besides, Myanmar and Lao PDR joined the ASEAN in 1997 and Cambodia joined in 1999.

[22]$N = n \times T = 7 \times 26 = 182$.

Table 1: Involved variables

Dependent variable	$YG_{i,t}$	Annual GDP per capita growth rate.
Threshold variable	$F_{i,t}$	Credit-to-GDP ratio.
Control variables	$X_{i,t}$	Government expenditure growth, Gross fixed capital formation, Consumer price inflation, Population growth, Terms of trade, Openness ratio, Dummy variables for financial crises (Laeven and Valencia, 2020).

Notes: the relationship between private credit and economic growth is examined in the short run. In the panel model, we explore the threshold effects for the involved variables in a dynamic setting. We are not investigating (absolute or conditional) growth convergence. Rather, we test the potential threshold effect of an expansion of private credit on the variation of the annual GDP per capita growth rate. Here, the threshold variable is also an explanatory variable.

Indicators, the Asian Development Bank, the International Monetary Fund and Laeven and Valencia (2020). In their work, Laeven and Valencia (2020) provide the crisis dates of 151 systemic bank crises. They also include the dates of sovereign debt crises and currency crises. The involved variables are presented in the Table 1.

In Figure 1 and 2, we plot the explained variable and the threshold variable for our sample of ASEAN countries. We can make several observations. On the one hand, in Figure 1, we can clearly see that these countries have known a V-shaped recovery after the East Asian crisis and after the financial crisis of 2008. We can note that the growth rate of the Vietnamese economy has always been positive over the examined period. On the other hand, in Figure 2, we can distinguish two sets of countries. The first one (Brunei Darussalam, Philippines, and Indonesia) fluctuates around 50% of GDP for the threshold variable and the second one (Singapore, Malaysia, and Thailand) fluctuates above 100% during the 2010s. Lastly, Vietnam moves from the first to the second group over the investigated period.

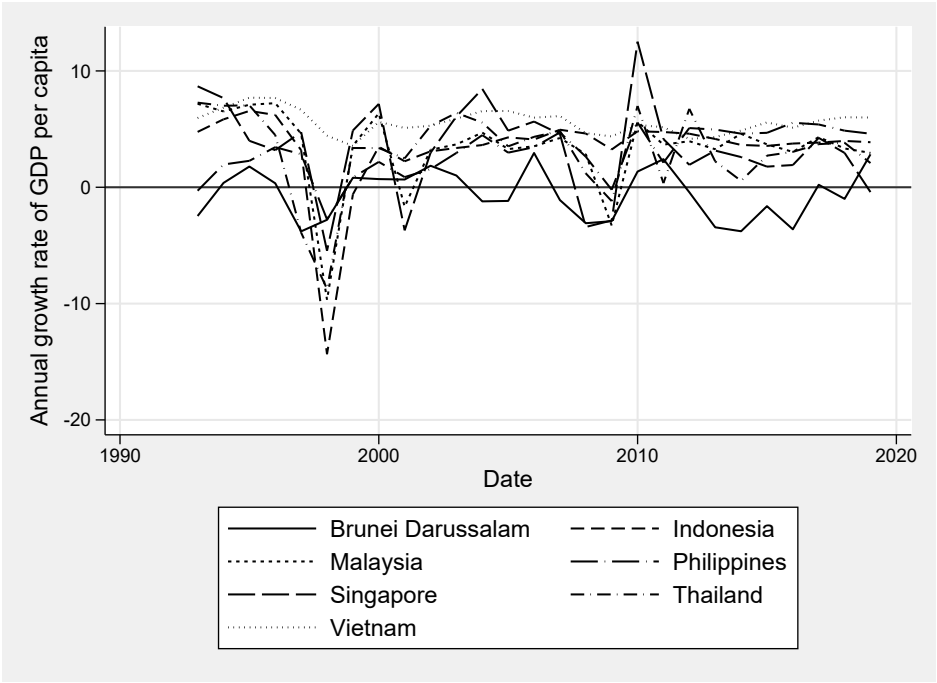
3.2. Methodology

We follow the approach of Kremer et al. (2013)[23]. In their approach, they combine the panel threshold model of Hansen (1999) and the instrumental variable estimation of the cross-sectional model introduced by Caner and Hansen (2004) thanks to the application of the forward orthogonal deviations' transformation suggested by Arellano and Bover (1995). This approach has several advantages, firstly, we can estimate threshold values rather than impose them as rightly underlined by Hansen (1999)[24], secondly, we can use a dynamic panel data model where endogeneity of

[23] We use the Stata program provided by Diallo (2020).

[24] One important advantage of this approach is to test the statistical significance of the threshold values. It is quite difficult to determine whether the threshold are statistically significant or not when thresholds are chosen in an *ad hoc* manner.

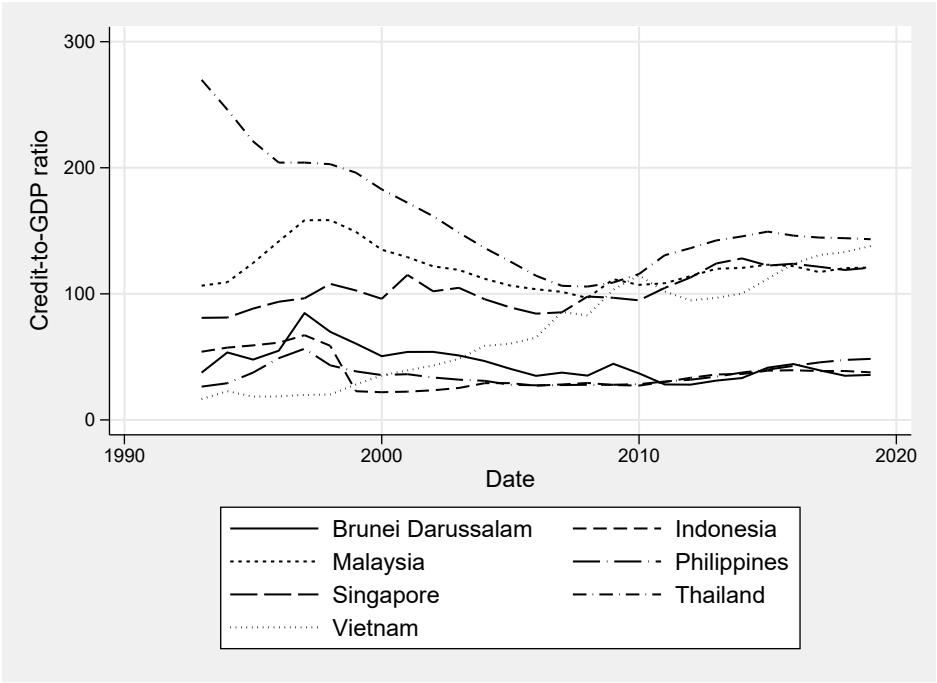
Figure 1: Annual GDP per capita growth rate



Notes: Myanmar, Lao PDR and Cambodia are not included in the sample due to data availability. Besides, Myanmar and Lao PDR joined the ASEAN in 1997 and Cambodia joined in 1999.

Source: see the text in section 3.

Figure 2: Credit-to-GDP ratio



Notes: Myanmar, Lao PDR and Cambodia are not included in the sample due to data availability. Besides, Myanmar and Lao PDR joined the ASEAN in 1997 and Cambodia joined in 1999.

Source: see the text in section 3.

important explanatory variables is controlled and, finally, by eliminating the fixed effects thanks to forward orthogonal deviations, this approach ensures that the error terms remain uncorrelated.

Thus, we follow Kremer et al. (2013), Baum et al. (2013), Narayan and Narayan (2013) and Lay (2020) to investigate the possibility of threshold effects in the relationship between bank credit and economic growth in the short run. To this aim, we consider the following dynamic panel threshold model:

$$YG_{i,t} = \mu_i + \chi YG_{i,t-1} + \beta_1 F_{i,t} I(F_{i,t} \leq \gamma) + \beta_2 F_{i,t} I(F_{i,t} > \gamma) + \alpha_1 X_{i,t} + \varepsilon_{i,t} \tag{1}$$

where subscripts $i = 1, ..., n$ represents the country and $t = 1, ..., T$ index the time. μ_i is the country-specific fixed effect, and the error term is ε_{it}. The involved variables are presented in Table 1. YG, is the annual GDP per capita growth rate and $I(.)$ is an indicator function indicating the regime defined by the threshold variable, F, the credit-to-GDP ratio. Here, the threshold variable and the regime dependent variable are the same, the credit-to-GDP ratio, as we can see in equation (1). The independent regime control variables, X include the investment, INV, the government expenditure, GOV, the consumer price index, INF, and the population, POP, all four measured in annual percentage growth, but also, the terms of trade, TOT, the openness ratio, $OPEN$, and dummy variables, $BANKING$, $CURRENCY$, $DEBT$ and $RESTRUCTURING$ for banking crises, currency crises, sovereign debt crises and debt restructuring, respectively.

The dynamic version of the model[25] in equation (1) is estimated in three steps:

1. In the first step, we estimate a reduced form of the endogenous variable, $YG_{i,t-1}$, as a function of the instruments on a set of regressors restricted to 1 lag since instruments[26] can overfit instrumented variables as shown by Roodman (2009). The endogenous variable, $YG_{i,t-1}$, is then replaced in the structural equation by the predicted values, $\widehat{YG}_{i,t-1}$.
2. In the second step, equation (1) is estimated through least squares for a fixed threshold γ where, $YG_{i,t-1}$, replaced by its predicted values from the first step regression. We can denote the resulting sum of squares as $S(\gamma)$. This step is repeated for a strict subset of the support of the threshold variable, F.
3. In the third step, the estimator of threshold value is selected as the one with the smallest sum of squared residuals, i.e., $\hat{\gamma} = \underset{\gamma}{\operatorname{argmin}}\, S_n(\gamma)$. In accordance with Hansen (1999) and Caner and Hansen (2004), the critical values for determining the 95% confidence interval of the threshold value is given by,

   $$\Gamma = \{\gamma \,:\, LR(\gamma) \geq C(\alpha)\}$$

   where $C(\alpha)$ is the 95% percentile of the asymptotic distribution of the likelihood ratio statistic $LR(\gamma)$. Once $\hat{\gamma}$ is determined, the slope of the coefficients can be estimated by the GMM for the previously used instruments and the previously estimated threshold $\hat{\gamma}$.

[25] Note that the differences are forward-orthogonal deviations.

[26] Which can be $YG_{i,t-2}$ to $YG_{i,t-p}$ with $p = T - 1$.

3.3. *Testing for a threshold*

For clarity purposes, it might be necessary to develop the third step about the estimation of the threshold value. We can start with a slightly more intuitive representation for equation (1) inspired by Hansen (1999):

$$YG_{i,t} = \begin{cases} \mu_i + \chi YG_{i,t-1} + \beta_1 F_{i,t} + \alpha_1 X_{i,t} + \varepsilon_{i,t}, & F_{i,t} \leq \gamma, \\ \mu_i + \chi YG_{i,t-1} + \beta_2 F_{i,t} + \alpha_1 X_{i,t} + \varepsilon_{i,t}, & F_{i,t} > \gamma. \end{cases} \tag{2}$$

To test the absence of a threshold with the following null hypothesis, $H_0 : \beta_1 = \beta_2$, Hansen (1996) uses a bootstrapped likelihood ratio test (asymptotically valid): $F_1 = (S_0 - S_1(\hat{\gamma}))/\hat{\sigma}^2$, where S_0 is the RSS for the model without threshold, S_1 is the RSS for the model with a specific threshold $\hat{\gamma}$, $\hat{\sigma}^2$ is the residual variance for a specific threshold.

When there is a threshold (the null is rejected in equation (2)), we test the true value of the threshold[27] with the following null hypothesis, (γ_0) $H_0 : \gamma = \gamma_0$, Hansen (1999) uses a likelihood ratio test[28]: $LR(\gamma) = (S_1(\gamma) - S_1(\hat{\gamma}))/\hat{\sigma}^2$. The critical values can be obtained with the asymptotic distribution of the $LR(\gamma)$ statistics: $c(\alpha) = -2\log(1 - \sqrt{1-\alpha})$. Finally, when the $LR(\gamma) \leq c(\alpha)$, we accept the null hypothesis for the threshold[29].

4. Empirical results

4.1. *Endogeneity of the threshold variable*

If we consider our studied sample, it seems clear that we have to consider the impact of these crises on economic growth to isolate the effects of banking credit in these countries. Thus, one potential limitation of the approach of Kremer et al. (2013) is that the threshold variable has to be exogenous. This approach has several merits as recalled above, but controls only the endogeneity bias for some important regressors like initial growth in panel growth regressions. One way to circumvent this potential problem of endogeneity for the threshold variable is to follow the approach of Seo and Shin (2016) and Seo et al. (2019). In particular, Seo and Shin (2016) develop a first-differenced estimator GMM, that allows both threshold variable and regressors to be endogenous. But before considering this solution, we run the Granger non-causality tests developed by Dumitrescu and Hurlin (2012) to investigate Granger causality between growth and bank credit in our sample[30]. As we can see in the Table 2, the economic growth does not Granger-cause the credit-to-GDP ratio in this sample. Thus, we can safely use the approach of Kremer et al. (2013).

4.2. *Panel threshold regressions with endogenous regressors*

The estimations of equation (1) are presented in Table 6. The threshold value for the credit-to-GDP ratio ($\hat{\gamma}$) is estimated by 96.5%[31] when the likelihood ratio reaches 0 as we can observe in

[27] The threshold effect may be detected only in the investigated sample and not in the statistical population.

[28] Where no further computations are requested since the sequence of the LR statistics is simply a re-normalization of the sequence of the F statistics.

[29] For example, the 5% critical value is 7.35.

[30] We use the `xtgcause` command developed by Lopez and Weber (2017).

[31] The results are robust to the inclusion of dummies for banking crises and to year dummies.

Table 2: Granger non-causality test results

Null hypothesis	$\overline{W}$	$\overline{Z}$	$\widetilde{\overline{Z}}$
$YG \nRightarrow F$	17.5818	7.4825 (0.107)	0.7936 (0.1660)

Notes: the null hypothesis indicates that growth per capita does not Granger-cause credit-to-GDP ratio. In the alternative, growth per capita does Granger-cause credit-to-GDP ratio for at least one country. The p-values in parentheses are obtained through bootstrapping where 1000 replications have been used. The optimal number of lags is equal to 7 according to the Akaike information criterion.
Source: authors' calculations.

Figure 3. The coefficients of the regime dependent variable, $(\hat{\beta}_1, \hat{\beta}_2)$ are positive and significant. The coefficients are fairly stable across specifications. Moreover, the the below-threshold coefficient is four times larger than the above one. These results mean that before the turning point of credit-to-GDP 96.5% bank credit stimulates economic growth, but positive effects of bank credit expansion are smaller after this threshold, but remain positive and statistically significant. Our results are consistent with previous empirical studies (Arcand et al., 2015; Cecchetti and Kharroubi, 2012; Law and Singh, 2014) that find a value for the credit-to-GDP ratio threshold which varies from 80% to 120% of GDP. However, after the threshold, bank credit still has a positive impact in our study, but this effect is substantially smaller than before the threshold[32]. Indeed, the vanishing growth effect of finance is not confirmed in our empirical investigation.

Once, the threshold is estimated, we can compute descriptive statistics for the whole sample (Table 3), below the estimated threshold (Table 4) and after the estimated threshold (Table 5). We find that overall the involved variables have the same characteristics below and above the threshold. To summarize, we can note that the mean economic growth is around 3 %, the government expenditures growth is around 5%, the population growth is around 1.5%, and the terms-of-trade index is around 110 (the standard deviation is lower for observations above the threshold). We can also note that investment and inflation are lower for observations above the threshold. Interestingly, we can note that above the threshold the trade openness ratio is higher (the mean is equal to 191% for observations superior to the threshold versus 110% for observations inferior or equal to the threshold). This result may reveal some key features in this sample of ASEAN countries as exporting firms have an essential role in the overall economic dynamics.

In this sample of ASEAN countries, the lagged value of GDP growth does not impact the current GDP growth rate. The coefficients for control variables have an expected sign when they are significant across specifications. The INV variable always has a positive impact on economic growth and the POP variable always has a negative one.

On the one hand, the dummies for the systemic bank, currency, and sovereign debt crises

[32]Our results are in line with those of Botev et al. (2019) in which they cannot confirm that financial developments have a negative impact on growth beyond a given level of development using a dynamic panel data threshold model which allows endogenous threshold variable and regressors (Seo and Shin, 2016; Seo et al., 2019).

Table 3: Without threshold

Variable	Count	Mean	SD	Min	Max
YG	189	3.047	3.453	-14.35	12.51
F	189	81.77	50.65	16.53	269.7
GOV	189	5.375	6.242	-15.37	58.81
INV	189	6.139	14.19	-44.03	86.22
INF	189	4.071	5.508	-2.315	58.45
POP	189	1.542	0.785	-1.475	5.322
TOT	189	114.2	34.78	70.38	284.4
$OPEN$	189	145.1	96.94	37.30	437.3

Notes: after the elimination of the individual fixed effects, one observation is lost.
Source: authors' calculations.

Table 4: Below threshold

Variable	Count	Mean	SD	Min	Max
YG	108	2.975	3.497	-14.35	12.51
F	108	44.78	20.53	16.53	96.05
GOV	108	5.322	7.591	-15.37	58.81
INV	108	7.998	16.16	-38.01	86.22
INF	108	5.045	6.732	-2.315	58.45
POP	108	1.677	0.615	0.921	4.166
TOT	108	116.6	45.00	70.38	284.4
$OPEN$	108	110.2	87.84	37.30	425.4

Notes: after the elimination of the individual fixed effects, one observation is lost.
Source: authors' calculations.

Table 5: Above threshold

Variable	Count	Mean	SD	Min	Max
YG	81	3.142	3.413	-9.671	7.274
F	81	131.1	33.95	96.47	269.7
GOV	81	5.446	3.806	-8.893	17.08
INV	81	3.660	10.64	-44.03	26.42
INF	81	2.773	2.775	-0.900	18.68
POP	81	1.363	0.941	-1.475	5.322
TOT	81	111.1	10.79	86.12	137.0
$OPEN$	81	191.6	89.08	77.75	437.3

Notes: after the elimination of the individual fixed effects, one observation is lost.
Source: authors' calculations.

provide some insight. Indeed, the currency crises have had a very negative impact on economic growth, and it is easy to infer that these results are driven by the influence of the 1997 East Asian Financial crisis. On the other hand, the time dummies[33] have been included to capture common shocks on economic growth. As we can see again in Table 6, the time dummy for the year 2009 reflects the negative effect of the 2008 crisis on growth. Besides, the time dummy for the year 2010 indicates that these ASEAN countries have known a V-shaped recovery.

Our conclusions can be seen as complementary to those of Lombardi et al. (2017) who find that credit to households tends to impede economic growth when household debt-to-GDP ratio is above 80%. Indeed, the expansion of bank credit in our sample is mainly provided to firms to develop their productive and exporting activities[34]. In our results, an expansion of banking credit still stimulates economic growth after this threshold of 96.5%. Nevertheless, the positive impact of bank credit expansion is four times smaller when the credit-to-GDP ratio is above 96.5%. Consequently, these differences with the empirical investigation of Lombardi et al. (2017) could be due to regional heterogeneity in emerging and developed countries, and to the beneficiary of the credit.

5. Conclusion

This empirical investigation aimed at determining whether threshold effects exist in the relationship between economic growth and bank credit for a sample of ASEAN countries over the period spanning from 1993 to 2019. We identify a statistically significant threshold for the credit-to-GDP ratio of 96.5%. This threshold effect cannot be captured with a linear model (i.e., without threshold). For observations (countries / periods) inferior or equal to a credit-to-GDP ratio of

[33]The non-significant time dummies have been removed with a general-to-specific approach.

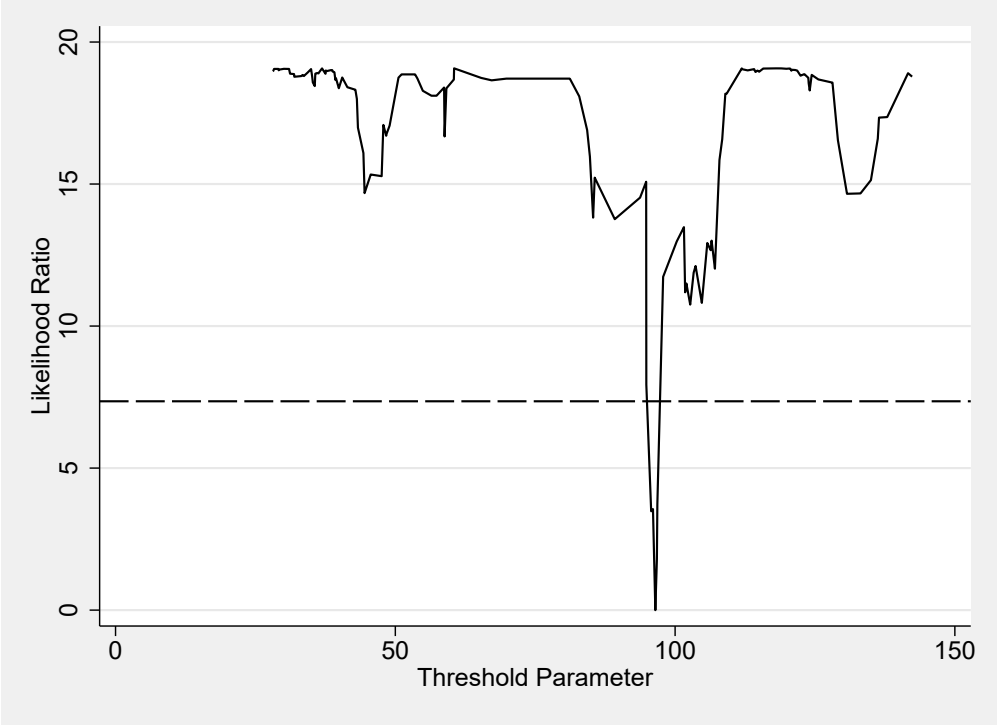
[34]Lim and Ho (2013) provide empirical evidence that support the export-led growth hypothesis thanks to nonlinear causality tests for a sample of 5 ASEAN countries, namely Malaysia, Thailand, Philippines, Indonesia and Singapore.

Table 6: Dynamic threshold panel regression estimation

Variables	**Baseline** $YG_{i,t}$	**Crisis dum.** $YG_{i,t}$	**Crisis and time dum.** $YG_{i,t}$
Estimated threshold	96.4703**	96.4703**	96.4703**
95% Confidence Interval	[95.7289; 96.8323]	[95.7289; 96.8323]	[95.7289; 96.8323]
Impact of credit			
$\beta_1 \quad (F_{i,t} \leq \gamma)$	0.0742***	0.1014***	0.0871***
	(0.0160)	(0.0207)	(0.0155)
$\beta_2 \quad (F_{i,t} > \gamma)$	0.0145*	0.0265***	0.0221***
	(0.0082)	(0.0046)	(0.0043)
Impact of covariates			
$YG_{i,t-1}$	-0.0108	0.0070	0.1164
	(0.0635)	(0.0916)	(0.0964)
INV	0.1276**	0.1003**	0.0819**
	(0.0600)	(0.0474)	(0.0389)
GOV	0.1406**	-0.0389	-0.0105
	(0.0547)	(0.0594)	(0.0427)
POP	-1.7708***	-1.8670***	-1.5593***
	(0.6640)	(0.5894)	(0.6045)
TOT	-0.0133	0.0003	-0.0025
	(0.0098)	(0.0070)	(0.0046)
$OPEN$	0.0056	0.0044	0.0050
	(0.0063)	(0.0060)	(0.0067)
INF	-0.1413	0.0526	-0.0173
	(0.1015)	(0.1165)	(0.0838)
$BANKING$		-0.8297	-1.1118
		(1.3528)	(1.2130)
$CURRENCY$		-10.2611***	-9.1433***
		(3.7410)	(2.9663)
$DEBT$		0.6585	4.8154
		(4.6309)	(5.9073)
$RESTRUCTURING$		0.3007	0.5283
		(1.2002)	(1.0238)
$DUMMY\_2009$			-1.6553**
			(0.7339)
$DUMMY\_2010$			3.0621***
			(0.6271)
Constant	2.8454	0.6935	0.8903
	(2.0637)	(1.6413)	(1.2073)
Observations	182	182	182
Observations above threshold	81	81	81
Number of countries	7	7	7

Notes: robust standard errors in parentheses. The symbols ***, ** correspond to statistical significance at 1 and 5 percent, respectively. The non-significant time dummies have been removed with a general-to-specific approach. All differences are forward-orthogonal deviations.
Source: authors' estimations.

Figure 3: Construction of the confidence interval in the threshold model



Notes: the estimation for the threshold value is the point where $LR(\gamma)$ is equal to zero. We obtain a value of 96.47 percent for the threshold. When the $LR(\gamma)$ curve crosses the horizontal line for the first time, the lower limit of the CI is obtained. When the $LR(\gamma)$ curve crosses the horizontal line for the second time, the upper limit of the CI is obtained. Source: authors' estimations.

96.5%, the bank credit has a positive impact on economic growth with a positive and statistically significant coefficient of around 0.08. Besides, for observations (countries / periods) superior to credit-to-GDP ratio of 96.5%, the growth effect of bank credit remains positive and statistically significant, but the coefficient is around 0.02. In the short run and for high level of bank credit, the growth effect of bank credit is lower, but remains positive and significant.

This empirical result may shed light on the regional heterogeneity in the finance-growth nexus. Indeed, ASEAN countries share several common features in terms of economic performances, a relatively limited financial development and export-oriented model of growth. In the economic dynamics of these countries, the role of exporting firms is essential. In our study, we do not confirm the existence of the vanishing effect of finance on growth for this sample of ASEAN countries, even the existence of multiple thresholds cannot be completely ruled out. Furthermore, we do not confirm that finance has a negative effect in the short run (by increasing financial instability and the occurrence of financial crises) associated with a positive effect in the long run (thanks to a better capital allocation). This result may be explained by the structural characteristics of these countries. Indeed, the beneficiary of the credit (firms versus households) plays a major role in the growth effect of bank credit.

To conclude, our empirical investigation may lead to explore the existence of threshold effects in the relation between economic growth and the different types of credit (firms, household) in different regions of the world economy. The exploration of regional heterogeneity in these threshold effects may help to formulate sound policy recommendations. Besides, the adjustment between the short run and the long run in the finance-growth nexus could also be an interesting avenue of research, especially when the existence of threshold effects is considered.

References

Arcand, J.-L., E. Berkes, and U. Panizza (2015). Too much finance? *Journal of Economic Growth 20*(2), 105–148.

Arellano, M. and O. Bover (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics 68*(1), 29–51.

Arestis, P., G. Chortareas, and G. Magkonis (2015). The financial development and growth nexus: a meta-analysis. *Journal of Economic Surveys 29*(3), 549–565.

Baum, A., C. Checherita-Westphal, and P. Rother (2013). Debt and growth: New evidence for the euro area. *Journal of International Money and Finance 32*(C), 809–821.

Beck, T., B. Büyükkarabacak, F. K. Rioja, and N. T. Valev (2012). Who gets the credit? and does it matter? household vs. firm lending across countries. *The B.E. Journal of Macroeconomics 12*(1).

Beck, T., H. Degryse, and C. Kneer (2014). Is more finance better? Disentangling intermediation and size effects of financial systems. *Journal of Financial Stability 10*(C), 50–64.

Botev, J., B. Égert, and F. Jawadi (2019). The nonlinear relationship between economic growth and financial development: Evidence from developing, emerging and advanced economies. *International Economics 160*, 3–13.

Caner, M. and B. E. Hansen (2004). Instrumental variable estimation of a threshold model. *Econometric Theory 20*(5), 813–843.

Cecchetti, S. and E. Kharroubi (2012). Reassessing the impact of finance on growth. BIS Working Papers 381, Bank for International Settlements.

Deidda, L. and B. Fattouh (2002). Non-linearity between finance and growth. *Economics Letters 74*(3), 339–345.

Diallo, I. A. (2020). XTENDOTHRESDPD: Stata module to estimate a Dynamic Panel Data Threshold Effects Model with Endogenous Regressors. Statistical Software Components, Boston College Department of Economics.

Dumitrescu, E.-I. and C. Hurlin (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling 29*(4), 1450–1460.

Graff, M. and A. Karmann (2006). What determines the finance-growth nexus? empirical evidence for threshold models. *Journal of Economics 87*(2), 127–157.

Hansen, B. E. (1996). Inference when a nuisance parameter is not identified under the null hypothesis. *Econometrica 64*(2), 413–430.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics 93*(2), 345–368.

Huang, H.-C. and S.-C. Lin (2009). Non-linear finance-growth nexus. *Economics of Transition 17*(3), 439–466.

Kaminsky, G. L. and C. M. Reinhart (1999). The twin crises: the causes of banking and balance-of-payments problems. *American Economic Review 89*(3), 473–500.

King, R. G. and R. Levine (1993). Finance and growth: Schumpeter might be right. *The Quarterly Journal of Economics 108*(3), 717–737.

Kremer, S., A. Bick, and D. Nautz (2013). Inflation and growth: new evidence from a dynamic panel threshold analysis. *Empirical Economics 44*(2), 861–878.

Laeven, L. and F. Valencia (2020). Systemic banking crises database II. *IMF Economic Review 68*(2), 307–361.

Law, S. H., W. N. W. Azman-Saini, and M. H. Ibrahim (2013). Institutional quality thresholds and the finance – growth nexus. *Journal of Banking & Finance 37*(12), 5373–5381.

Law, S. H. and N. Singh (2014). Does too much finance harm economic growth? *Journal of Banking & Finance 41*(C), 36–44.

Lay, S. H. (2020). Bank credit and economic growth: Short-run evidence from a dynamic threshold panel model. *Economics Letters 192*(C), 109231.

Levine, R. (2005). Finance and growth: theory and evidence. In P. Aghion and S. N. Durlauf (Eds.), *Handbook of Economic Growth*, Volume 1, pp. 865–934. Elsevier.

Lim, S. Y. and C. M. Ho (2013). Nonlinearity in ASEAN-5 export-led growth model: Empirical evidence from nonparametric approach. *Economic Modelling 32*, 136–145.

Loayza, N. and R. Ranciere (2006). Financial development, financial fragility, and growth. *Journal of Money, Credit, and Banking 38*(4), 1051–1076.

Lombardi, M. J., M. Mohanty, and I. Shim (2017). The real effects of household debt in the short and long run. BIS Working Papers 607, Bank for International Settlements.

Lopez, L. and S. Weber (2017). Testing for Granger causality in panel data. IRENE Working Papers 17-03, IRENE Institute of Economic Research.

Masten, A. B., F. Coricelli, and I. Masten (2008). Non-linear growth effects of financial development: Does financial integration matter? *Journal of International Money and Finance 27*(2), 295–313.

Narayan, P. K. and S. Narayan (2013). The short-run relationship between the financial system and economic growth: New evidence from regional panels. *International Review of Financial Analysis 29*, 70–78.

Rajan, R. and L. Zingales (1998). Financial dependence and growth. *American Economic Review 88*(3), 559–586.

Rioja, F. and N. Valev (2004). Does one size fit all?: a reexamination of the finance and growth relationship. *Journal of Development Economics 74*(2), 429–447.

Roodman, D. (2009). A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics 71*(1), 135–158.

Rousseau, P. L. and P. Wachtel (2001). Economic theory, dynamics and markets. In T. Negishi, R. V. Ramachandran, and K. Mino (Eds.), *Economic Theory, Dynamics and Markets*, pp. 309–324. Kluwer Academic Publishers.

Rousseau, P. L. and P. Wachtel (2002). Inflation thresholds and the finance–growth nexus. *Journal of International Money and Finance 21*(6), 777–793.

Rousseau, P. L. and H. Yilmazkuday (2009). Inflation, financial development, and growth: A trilateral analysis. *Economic Systems 33*(4), 310–324.

Seo, M. H., S. Kim, and Y.-J. Kim (2019). Estimation of dynamic panel threshold model using Stata. *The Stata Journal 19*(3), 685–697.

Seo, M. H. and Y. Shin (2016). Dynamic panels with threshold effect and endogeneity. *Journal of Econometrics 195*(2), 169–186.

Slesman, L., A. Z. Baharumshah, and W. N. W. Azman-Saini (2019). Political institutions and finance-growth nexus in emerging markets and developing countries: A tale of one threshold. *The Quarterly Review of Economics and Finance 72*, 80–100.

Wachtel, P. (2018). Credit deepening: precursor to growth or crisis? *Comparative Economic Studies 60*(1), 34–43.

Yilmazkuday, H. (2011). Thresholds in the finance-growth nexus: a cross-country analysis. *The World Bank Economic Review 25*(2), 278–295.

Acknowledgments

The authors are grateful to Ibrahima Amadou Diallo for making the STATA codes for estimating a dynamic panel data model with threshold effects and endogenous regressors publicly available, to Samuel Ligonnière for providing us with the banking crisis data, and to Katharina Priedl for proofreading. We thank all the participants of the ERMEES-BETA internal seminar which took place in February 2021. We are also grateful to Antonia Lopez-Villavicencio, Delphine Lahet, Juan Camilo Medellin Martinez for their relevant remarks during the 2nd EMME Workshop which took place on March 26th, 2021. We also thank Nicolas Poulin for his very valuable advice on the methodology and Francesco De Palma for stimulating discussions on mathematical aspects. All errors or omissions are ours.