Growth effect of foreign direct investment and financial development: new insights from a threshold approach

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Abstract

Purpose – The purpose of this study is to examine the effect of foreign direct investment (FDI) on economic growth contingent on the development level of the local financial system in emerging and developing Asia during the period 1996–2017.

Design/methodology/approach – The study adopts the threshold approach, namely the panel smooth transition regression (PSTR) model, for the annual data collection of 18 emerging and developing Asian countries in 22 years. The authors analyze the alternative PSTR models on different proxies of financial development (FD).

Findings – The results show new findings of two distinct thresholds of FD in the FDI–growth nexus. The growth-enhancing effect of FDI is realized only when the FD lies between the two threshold values. Notably, at very high levels of FD, the beneficial effect of FDI on growth is vanishing.

Originality/value – The authors provide new insights into the growth effect of FDI and the role of FD. The estimated nonlinear effect of FDI on growth and the thresholds of FD can be benchmarks for emerging and developing Asia in assessment of their situations. The results suggest important implications to the region in setting the long-run policies to boost the effect of FDI on economic growth.

Keywords Foreign direct investment, Financial development, Economic growth, Emerging and developing Asia, Panel smooth transition regression

Paper type Research paper

1. Introduction

Nowadays, the global policy for cross-border investment has become more and more restrictive and regulatory, yet the wish to attract foreign investment to enhance growth is as great as ever for developing countries. Most developing countries have made efforts to ease the restrictions and expand the investment incentives to encourage foreign direct investment (FDI), with the expectation that FDI stimulates economic growth. Indeed, FDI is generally seen not only to significantly contribute to capital accumulation but also generate transmission of knowledge and advanced technology, which potentially accelerates the long-run growth rate in developing world. But is it really?

This question has been addressed explicitly in both theories and empirical studies for years. In theories, the role of FDI is diversely postulated to explain the direct and indirect mechanisms of transmission of FDI to economic growth. However, the empirical evidence on the benefits of FDI in developing countries is inconclusive. Besides the common outcome of significant effects of FDI on growth in developing world, there are results of no impacts (Mahmoodi and Mahmoodi, 2016; Alvarado *et al.*, 2017; Carbonell and Werner, 2018) or even negative impacts of foreign investment on domestic outputs (Herzer, 2012; Agbloyor *et al.*, 2016; Baharumshah *et al.*, 2017).

This divergence in the empirical literature can be partly attributed to the heterogeneous samples of studies in different periods and, specifically, the different local conditions of the recipient countries. Recent studies show that the pivotal roles of some domestic factors are not fully considered when examining the benefits of FDI, leading to miss indirect channels of transmission of FDI to growth. Indeed, the growth effect of FDI is much dependent on local conditions in recipient countries that are called factors of absorptive capacity. There is a widespread belief that FDI will boost economic growth only when the factors of absorptive capacity exceed certain thresholds (Azman-Saini *et al.*, 2010a, b; Alguacil *et al.*, 2011; Chen and Quang, 2014; Rachdi and Brahim, 2014; Jude and Levieuge, 2017; Pradhan *et al.*, 2019).

An important factor of absorptive capacity commonly considered in the FDI–growth nexus is the development of local financial system. Several empirical studies at both the country level and regional level have reported the influential role of financial development (FD) on the growth-enhancing effect of FDI. Generally, the recent studies consistently suggest that the level of FD needs to be improved to enable the potential advantages of FDI to economic growth.

However, the current studies contain some limitations. In these studies, FDI is treated as an independent variable or considered in interaction terms with absorptive capacity factors. This implies the linear effect of FDI on growth with homogeneous and time invariant estimated coefficients, which blocks the heterogeneity of the growth effect of FDI. In addition, although nonlinear effect of FDI on economic growth is detected in several studies, the empirical results are limited in providing benchmarks of FD for follow-up policies. Some studies adopt a threshold approach to provide estimated threshold values (Chen and Quang, 2014; Baharumshah *et al.*, 2017; Yeboua, 2019). These studies similarly attain only one threshold value in a two-regime pattern. Meanwhile, there might exist more thresholds in some specific conditions. By and large, the extant literature shows inadequate evidence on the growth effect of FDI conditional on FD. Also, there is a lack of particular evidence from emerging and developing Asia while this region provides an interesting case study of the growth effect of FDI. Emerging and developing Asia is noted as the largest FDI recipient, occupying 39.4% of global inflows in 2018. This achievement might be attributed to the favorable macroeconomic conditions, the enhancement in investment policy-making, the stable economic-political environment and the improvement in institutional quality (An and Yeh, 2020). The real GDP growth rate of the region is the highest worldwide, at roughly 6.8% in the last five years [1]. It is thus worthy of a close examination on FDI–growth nexus in this region.

This study aims to fill these gaps with new insights into the nonlinear effect of FDI on economic growth conditional on FD in 18 emerging and developing Asian countries during the period 1996–2017. Specifically, we estimate the threshold value of the development level of the financial system and illustrate the patterns of regime-switching of growth-enhancing effect of FDI. This study has several original features compared to the extant literature.

This is the first study, to the best of our knowledge, to deal with the nonlinear growth effect of FDI for emerging and developing Asia. Previous empirical results for other regions or global samples might not fit the specific case of emerging and developing Asia. By such a particular investigation, our new findings are expected to fulfill or clarify earlier ambiguous

conclusions. Further, a plus of the PSTR method used in this study is it allows estimation of heterogeneous individual growth elasticity to FDI. Last but not least, since developing Asia has put a lot of resources to attract FDI, identifying the macroeconomic conditions that induce FDI to promote economic growth is of great importance for every host country. This study offers a reference of policy improvement for emerging and developing Asian countries.

The remainder is organized as follows. Section 2 is a literature review on the growth effect of FDI in developing countries and the role of FD. Section 3 is dedicated to methodology and model specifications. The information of data is given in Section 4. Section 5 reports the main results and discussion. The study concludes in Section 6 with remarks on policy implications for emerging and developing Asia.

2. Literature review

Regarding theories of the growth effect of FDI, there are generally two major streams: modernization theory and dependency theory. The modernization theory was a predominant paradigm between the 1950s and early 1960s and was developed largely in Africa and Asia. The modernization theory, involving both exogenous and endogenous growth models, argued that FDI promotes economic growth in developing countries (Adams, 2009). Accordingly, industrialization and economic growth, and the values associated with them, were the engines of social progress. Specially, in order to develop, developing economies needed to grasp values and techniques, develop a complex division of labor and improve social mobility and institutional quality (Smelser and Baltes, 2001). Then, FDI activities are highly desirable as they are believed to contribute to capital accumulation and positive spillovers, hence promote economic growth.

However, the failure of economic growth in Latin America and Western European between the late 1960s and 1970s challenged the underlying assumptions of modernization theory. The dependency approach, very soon later, protested the argument of a linear, evolutionary development continuum and the neglect of constraining factors exogenous to developing countries. According to the dependency school, exogenous factors such as trading and foreign investment in developing world might be the cause of "underdevelopment", social inequality and political instability because these countries only gained an inferior position in the international division of labor, occupying raw-material and cheap-labor intensive production. Thus, FDI in developing countries had a negative impact on economic development. The dependency theory gives general awareness of the important roles of external factors to the domestic economic and political systems (Moran, 1978; Cardoso and Faletto, 1979).

In the empirical literature, research studies also showed diverse conclusions on the growth effect of FDI. Iamsiraroj and Ulubaşoğlu (2015), doing a thorough review of 108 empirical studies on the growth effect of FDI, showed only 43% of the studies reporting positive and statistically significant effects and 26% showing positive but insignificant effects, while nearly one-third giving negative effects. These results are typical in developing countries, where external financing has been a crucial solution to the domestic lack of financial resources for growth, but their limitation in local conditions is a constraint for them from reaping benefits of external sources. Besides, there are foreign investments in developing countries that aim to exploit cheap labor, preferable promotions and other potentials rather than a long-term engagement and so making no contribution to growth of the receiving countries.

The recent literature shows that countries with better economic conditions are more capable to realize the benefits of foreign investments. Precisely, countries having higher degree of integration in the global business (Azman-Saini et al., 2010a, b; Pradhan et al., 2019), more advanced human capital resource (Makiela and Ouattara, 2018), strong domestic

financial markets (Azman-Saini *et al.*, 2010a, b; Chen and Quang, 2014; Yeboua, 2019), information and communication technology based investment (Gönel and Aksoy, 2016) and good institutions with supportive policies (Alguacil *et al.*, 2011; Rachdi and Brahim, 2014; Jude and Levieuge, 2017) will exploit the advantages of FDI.

The development of domestic financial system is recognized as one of the most important factors to enable FDI to accelerate economic growth (Azman-Saini *et al.*, 2010a, b; Iamsiraroj and Ulubaşoğlu, 2015). Several earlier studies have given investigations and explanations on the channels that FD influences the growth effect of FDI. Levine (2004), an influential research on financial system and growth, reviewed the theoretical functions of the financial system influencing savings and investment decisions and hence growth. FD involved improvements in easing information about possible investments and allocating capital, monitoring investment after providing finance and facilitating the trading, diversification and management of risk. Hermes and Lensink (2003) analyzed the role of financial system in the process of technological diffusion associated with FDI to domestic firms, which would contribute to economic growth. In a well-functioning financial system, external financing like FDI could be efficiently allocated, mobilized and monitored to ensure the efficiency of investment projects. Further, a developed financial system might help domestic firms to reduce risks to adopt new technologies and lower set-up costs for technology adaptation, hence raise the returns.

From the perspective of spillover effects of FDI, Alfaro *et al.* (2004, 2010) explained the different ways in which financial markets are mattered. The authors argued the spillovers for the host countries crucially depended on the level of FD. A well-developed financial market, easing access to loans and potential financing from stock markets, could facilitate FDI to create new firms through mergers and acquisitions. In other words, the development of local financial system played an important role in increasing financial sources for local economy, creating linkages between foreign and domestic investors and allowing positive spillovers to the host countries. Javorcik and Spatareanu (2005, 2009) revealed that one of the reasons for limited effects of FDI was the fact that local firms lacked funding for investment necessary to become suppliers. They indicated that in the absence of well-functioning credit markets, it was difficult for local firms to have business with foreign investors, and thus might not be able to reap the benefits of productivity spillovers in such business activities.

Several followers have provided rich evidence on the pivotal role of FD in the relationship between FDI and economic growth, either in groups of developed and developing countries or in global samples. Iamsiraroj and Ulubaşoğlu (2015), applying the meta-regression analysis with a global dataset of nearly 140 countries in 1970–2009, showed the nonlinearity in the interaction effect of FDI with financial markets in the growth model. As such, they proved the inverted-*U*-shaped effect, implying an increasing effect of FDI on growth at higher levels of FD but fading at very high levels of the condition. Contrarily, Abdul Bahri *et al.* (2019) examined the role of FD in the FDI–growth link for 65 developing countries during the period 2009–2013 by adopting a standard quadratic model of FD and considering the interaction terms between this absorptive capacity factor and FDI. They illustrated the *U*-shaped curve for the nonlinear relationship between FD and growth. Their contrasting results were explained due to possible structural changes in economic conditions after the global financial crisis.

The empirical results are diverse for different samples over different periods. The similarity, however, lies in interaction terms between the variable of FD and FDI in regressions, which generally demonstrate statistically significant effects. This means besides the linear direct effect, FDI has strong indirect effects on growth through the absorptive capacities. More recent studies attempt to examine the interaction effects, which particularly exhibit nonlinearity, when considering FD in the FDI–growth relationship.

The threshold approach has been recently preferred as a robust method to investigate the nonlinear relationship of FDI, FD and growth. Azman-Saini *et al.* (2010a, b) used the threshold

method to examine the role of financial market in the linkage between FDI and economic growth in 91 countries during the period 1975–2005. Chen and Quang (2014) employed the panel threshold regression for the sample of 80 countries over the period1984–2007 to examine the effects of international financial integration on growth. Specially, they estimated one threshold value of FD regulating the nonlinear effect of FDI and portfolio equity liabilities on economic growth. Similarly, Baharumshah *et al.* (2017) performed the panel threshold regression on 80 cross-sections of developed, emerging and developing countries in 1975–2007 and found a significant threshold effect of the development of local financial market on the links between FDI and growth. For a particular region, Yeboua (2019) applied the panel smooth transition regression (PSTR) on 26 African countries during the period 1990–2013 and showed a minimum threshold level of FD that unlocked the growth effect of FDI.

The rich and consistent results above give evidence for nonlinearity in the growth effect of FDI contingent on FD. The discrepancy in the estimated thresholds further suggests different conditions of local financial markets are required to realize the growth effect of FDI in different countries. Thus, the results for global samples or particular regions might not be perfect reference to a region, given their different levels of FD and economic conditions. Specially, the lack of empirical evidence for emerging and developing Asian countries will be filled in this study.

3. Methodology
3.1 Panel smooth transition regression framework
Our empirical model is built the same as the previous literature, assuming FDI contributes to economic growth in the form of Cobb–Douglas aggregate function as shown below:

$$\text{GROWTH}_{it} = \mu_i + \alpha' X_{it} + \beta' \text{FDI}_{it} + \varepsilon_{it} \tag{1}$$

where the subscripts $i(i = 1, 2, \ldots, N)$ and $t(t = 1, 2, \ldots, T)$ represent countries and years, respectively. GROWTH_{it} stands for economic growth. FDI_{it} is net inflow of FDI. X_{it} is a vector of time-varying explanatory variables that are widely acknowledged in the literature of economic growth model. μ_i denotes country fixed effects and ε_{it} is independent and identically distributed.

To examine the nonlinear effect of FDI on economic growth, we illustrate the growth model in Eqn. (1) of the PSTR framework developed by Gonzalez *et al.* (2005, 2017) with the basic form of two extreme regimes as follows:

$$\text{GROWTH}_{it} = \mu_i + \alpha_0' X_{it} + \beta_0' \text{FDI}_{it} + (\alpha_1' X_{it} + \beta_1' \text{FDI}_{it}) \, g(q_{it}; \gamma, c) + \varepsilon_{it} \tag{2}$$

in which the transition function $g(q_{it}; \gamma, c)$ is continuous and bounded between 0 and 1 as the threshold variable q_{it} increases. We follow Gonzalez *et al.* (2005, 2017) and Colletaz and Hurlin (2008) to use the logistic form for the transition function.

$$g(q_{it}; \gamma, c) = \frac{1}{1 + \exp(-\gamma(q_{it} - c))}$$

where $\gamma > 0$ is the slope of the transition function. The higher γ, the rougher the transition. When $\gamma \to \infty$, the transition function $g(q_{it}; \gamma, c)$ becomes indicator function $I[q_{it} > c]$ where $I[.] = 1$ when q_{it} exceeds the threshold value, 0 otherwise. This is the two-regime panel threshold regression (PTR) model by Hansen (1999). When $\gamma \to 0$, the transition function is constant, and the PSTR model turns into a linear panel model with fixed effects and homogeneous coefficients.

The location parameter c is the threshold value around which the effect of FDI_{it} on GROWTH_{it} is monotonically increasing between the two extreme regimes. The PSTR model can be expanded for $(r + 1)$ extreme regimes as follows:

$$\text{GROWTH}_{it} = \mu_i + \alpha_0^{'} X_{it} + \beta_0^{'} \text{FDI}_{it} + \sum_{j=1}^{r} (\alpha_j^{'} X_{it} + \beta_j^{'} \text{FDI}_{it})\, g_j(q_{it}; \gamma_j, c_j) + \varepsilon_{it} \qquad (3)$$

The PSTR method demonstrates several advantages over the standard linear model and the PTR model. On the one hand, the PSTR equation can be seen as a generalization of the PTR but with a smooth regime-switching mechanism. On the other hand, the PSTR model in case of zero slope in the transition function is a form of linear panel model with fixed effects.

Further, by considering the interaction between FDI and the threshold variable in a product with the transition function, the PSTR model shows changing impulse response over every change in the threshold variable. The interaction effect is thus nonlinear conditional on the threshold variable. This effect is apparently practical in economic sense. For example, influence of an absorptive capacity factor on the growth effect of FDI is not constant but intensified along with the improvement in that absorptive capacity.

Additionally, the PSTR model allows the cross-country heterogeneity and the time variability of the coefficients due to a smooth move across countries and over time in the transition function. The marginal effect of FDI on economic growth conditional on threshold variable q_{it} is given by [2]

$$e_{it} = \frac{\partial \text{GROWTH}_{it}}{\partial \text{FDI}_{it}} = \beta_0 + \beta_1 g(q_{it}; \gamma,\, c) \qquad (4)$$

This illustrates the nonlinear effect of FDI evolving as a continuum from β_0 (corresponding to low regime) to $\beta_0 + \beta_1$ (corresponding to high regime), driven by a monotonic transition at the slope γ and centered around the threshold value c.

3.2 Estimation procedure
Following Gonzalez *et al.* (2005, 2017), the procedure for the PSTR model has three steps.

(1) Linearity test

As the PSTR model is not identified in a homogeneous data generating process, it is necessary to test the specification in Eqn. (2) with the null hypothesis of homogeneity (linear model) $H_o: \gamma = 0$ or $H_0^{'}: \beta_1 = 0$ against the alternative PSTR model. However, due to the unidentified nuisance parameters c under either the null hypothesis, the tests are nonstandard. Gonzalez *et al.* (2005) conduct the replacement of the transition function $g(.)$ with its first-order Taylor expansion around $\gamma = 0$ and specify the auxiliary regression as follows:

$$\text{GROWTH}_{it} = \mu_i + \theta_0^{'*} Z_{it} + \theta_1^{'*} Z_{it} q_{it} + \varepsilon_{it}^{*} \qquad (5)$$

where $\theta = (\alpha,\, \beta)$; the parameters θ_1^{*} are proportional to γ; Z is the vector of X and FDI and the residual ε_{it}^{*} is the above residual plus the remainder of the Taylor expansion. Then, testing $H_o: \gamma = 0$ in Eqn. (2) is equivalent to testing $H_0^{*}: \theta_1^{*} = 0$ in Eqn. (5) without affecting the asymptotic inference. This null hypothesis is conveniently tested by a Wald LM test, pseudolikelihood ratio test and Fisher LM test, of which the statistics are following:

$$\text{Wald LM test}: \text{LM}_W = \frac{NT(\text{SSR}_0 - \text{SSR}_1)}{\text{SSR}_0} \sim \chi^2(K)$$

$$\text{Likelihood ratio test}: \text{LR} = -2[\log(\text{SSR}_1) - \log(\text{SSR}_0)] \sim \chi^2(K)$$

$$\text{Fisher LM test}: \text{LM}_F = \frac{(\text{SSR}_0 - \text{SSR}_1)}{\text{SSR}_1} \times \frac{NT - N - K}{K} \sim F(K, NT - N - K)$$

where SSR_0, SSR_1 are the sum of squared residuals under H_o (linear model) and H_1 (nonlinear model), respectively. N and T denote the number of crosssections and time dimensions, respectively. K represents the number of explicative variables. If the null hypothesis is rejected, the PSTR model is validated.

(2) PSTR estimation

The parameters are straightforward estimated by nonlinear least squares (NLS) that minimize the concentrated sum of squared errors. The main point is that we do a grid search for values of γ and c such that $\gamma > 0$, $c_{j,\min} > \min_{i,t}\{q_{it}\}$, $c_{j,\max} > \max_{i,t}\{q_{it}\}$. The values minimizing the concentrated sum of squared errors can be used as the starting values of the nonlinear optimization algorithm [3].

(3) Test of no remaining nonlinearity

We test the null hypothesis of one transition PSTR ($r = 1$, meaning two extreme regimes) against the alternative of two transitions ($r = 2$, meaning three extreme regimes). This is to test H_o: $\gamma_2 = 0$ in Eqn. (3) with $r = 2$, given the parameter (γ_1, c_1) estimated in the initial PSTR model. By the same token with the first linearity test, Eqn. (3) is rewritten using the first-order Taylor expansion of $g_2(.)$ around $\gamma_2 = 0$, then an LM test is applied [4]. If the null hypothesis is rejected, [5] meaning there are at least two transition locations, we estimate the additive PSTR using the NLS method like in step (2). This loop of linearity testing and estimating ends when the null hypothesis is not rejected. The sequential tests of linearity by this way can be seen as a tool to determine the optimal number of transitions in the model.

3.3 Empirical models

To investigate the growth effect of FDI conditional on FD, we estimate alternative empirical models upon the base model in Eqn. (2), utilizing different proxies of FD. Precisely, we use three alternative indicators for the threshold variable q_{it}. Domestic credit to private sector (CREPRI) measures the credit to the private sector from deposit money banks and other financial institutions over GDP. Credit by financial sector (CREFIN) represents the domestic credit provided by the financial sector, including all credits to various sectors on a gross basis, to GDP. Liquid liability (LIQUID) is the ratio of liquid liabilities, also known as broad money, to GDP. These indicators reflect the depth of FD and the degree of well-functioning structure of the financial market in the countries. In addition, the threshold variables of FD are also used as explanatory variables in the models as they are determinants of economic growth. With the three indicators of FD, we estimate three alternative empirical models. The $(r + 1)$ regime models are specified as follows:

$$\text{GROWTH}_{it} = \mu_i + \alpha_0' X_{it} + \beta_0' \text{FDI}_{it} + \sum_{j=1}^{r} (\alpha_j' X_{it} + \beta_j' \text{FDI}_{it})\, g_j(\text{CREPRI}_{it}; \gamma_j, c_j) + \varepsilon_{it} \quad (6)$$

$$\text{GROWTH}_{it} = \mu_i + \alpha_0' X_{it} + \beta_0' \text{FDI}_{it} + \sum_{j=1}^{r} (\alpha_j' X_{it} + \beta_j' \text{FDI}_{it})\, g_j(\text{CREFIN}_{it}; \gamma_j, c_j) + \varepsilon_{it} \quad (7)$$

$$\text{GROWTH}_{it} = \mu_i + \alpha_0' X_{it} + \beta_0' \text{FDI}_{it} + \sum_{j=1}^{r} (\alpha_j' X_{it} + \beta_j' \text{FDI}_{it})\, g_j(\text{LIQUID}_{it}; \gamma_j, c_j) + \varepsilon_{it} \quad (8)$$

in which the set of explanatory variables (X_{it}) includes government consumption (GC), domestic investment (DI), trade openness (OPEN), financial development (FD), initial income

(INC), population growth (POP), labor force (LABOR), inflation (INF) and institutional quality (INS).

Finally, the issue of endogeneity must be addressed in the estimation procedure. Theoretical and empirical literature studies have showed that growth and capital inflows, particularly FDI, have bidirectional causal relations, indicating that endogeneity may exist between these two variables in the growth model (Hsiao and Hsiao, 2006; Herzer *et al.*, 2008; Goh *et al.*, 2017 among others).

In terms of threshold approach, while previous methods restricted the independent variables to be exogenous (Hansen, 1999, 2000), the problem of endogeneity was first taken into account and resolved in the study of Caner and Hansen (2004). They developed a model that allowed endogeneity by using instrumental variable (IV) estimation, implementing the procedure of two-stage least squares and generalized method of moment estimations. However, finding the correct instrument is often difficult. According to the literature on FDI and growth, the widely used instruments are the lagged values of the independent variable (FDI) to reflect its self-reinforcing nature. Alfaro *et al.* (2009) and Baharumshah *et al.* (2017), in their examinations of endogeneity in the threshold model employing IVs, showed no major significant coefficient of growth, implying the endogeneity issue raised by the regressor FDI is of less concern.

In the same way, Fouquau *et al.* (2008) used IV regression technique to assess the robustness of the PSTR estimates to the potential endogeneity bias. They found that the estimated coefficients corrected for endogeneity were very close to the coefficients in the noncorrected model. This informally implies the PSTR framework can offset the presence of endogeneity bias. Precisely, the PSTR method allows heterogeneous parameters at each value of the threshold variable, which can mitigate the endogeneity issue. Similarly, Omay and Öznur Kan (2010), Delgado *et al.* (2014) and Jude and Levieuge (2017) among others, using IV estimation with different IV, showed that endogeneity can be addressed in the PSTR modeling.

Nonetheless, in this study, we follow previous authors, such as Delgado *et al.* (2014), Jude and Levieuge (2017) and Yeboua (2019), to use the first lagged value $FDI_{i,t-1}$ in the PSTR models to count for the possible delayed effects and to address the potential bias due to endogeneity and reverse causality issue risen from FDI in assessing the FDI–growth nexus.

4. Data
Based on the availability of data, to investigate the effect of FDI on economic growth in emerging and developing Asia, we consider the annual data of 18 countries from 1996 to 2017. We utilize the dataset from the World Development Indicators (WDIs), the Financial Structure Database (FSD) and the Worldwide Governance Indicators (WGI) by the World Bank. The dependent variable ($GROWTH_{it}$) is the log difference of real GDP per capita (in percentage, %), used as the proxy for economic growth. FDI_{it} is measured by net inflows of FDI in the reporting economy (% of GDP). The definition and measurement of the variables as well as the source of data are detailed in Table A1 in Appendix. We have a balanced panel except for some missing in the WGI data which are not available for three years, namely 1997, 1999 and 2001. Table A2 gives the descriptive statistics information.

5. Empirical results
5.1 Linearity tests
Linearity tests are first needed to verify the validation of the PSTR model. We test H_o: linear panel model against and H_1: nonlinear model (PSTR model). The results are reported in Table 1.

The null hypothesis of homogeneity is strongly rejected at 5% level of significance by three tests for all threshold variables. These variables are confirmed to exert nonlinear effects on the impact of FDI on growth. The PSTR model is thus appropriate with these factors as transition variables. We then perform PSTR regressions on the three alternative models.

Tests of no remaining nonlinearity are following to determine the optimal number of transition functions. The results of Fisher LM statistics (LMF) in Table 2 show the homogeneity hypothesis cannot be rejected for $r = 2$ in the three models, meaning there are two transition locations for the models 6–8. Here, the additional PSTR estimations will be applied.

5.2 Financial development threshold and regimes

The results of linearity tests confirm FD is an appropriate threshold variable in the nonlinear linkage of FDI and economic growth. The rejection in the sequential linearity tests suggests two distinct transition points of FD in our models, meaning three extreme regimes through which the nonlinear effect of FDI on growth evolves. Table 3 gives the PSTR estimates of three threshold factors of FD.

The PSTR estimation shows similar results of two transition functions with the three alternative thresholds of CREPRI, CREFIN and LIQUID. The slope parameters are all high at the first transition location but quite small at the second point, showing an abrupt change from the first low-extreme regime to the mid-regime before a smooth shift later to the third high-extreme regime. This means when the FD exceeds a certain threshold level, it will significantly influence the growth effects of growth determinants.

Regarding the thresholds, the estimated location parameters (c) show the first threshold values of the domestic credit to private sector and the liquid liabilities are 33% and 35.5% of GDP, respectively; the second threshold values are subsequently 99.4% and 102% of GDP.

Threshold variable	Wald (LM) test		Fisher (LMF) test		Likelihood-ratio (LR) test	
	Statistic	p-value	Statistic	p-value	Statistic	p-value
CREPRI	21.600	0.017	2.117	0.023	22.312	0.014
CREFIN	32.493	0.000	3.296	0.000	34.141	0.000
LIQUID	37.108	0.011	1.850	0.016	39.280	0.006

Note(s): This table reports the results of the tests of linearity for the models defined in Eqn. (6)–(8); H_0: linear model and H_1: nonlinear model (PSTR model with at least one transition function ($r = 1$)
Source(s): Author's computations

Table 1.
Test of linearity

Threshold variable	$r^* = 1$		$r^* = 2$		Optimal number of transition function (r)
	LMF stat	p-value	LMF stat	p-value	
CREPRI	3.786	0.000	1.634	0.097	$r = 2$
CREFIN	4.191	0.000	2.228	0.016	$r = 2$
LIQUID	2.539	0.006	1.798	0.061	$r = 2$

Note(s): This table reports the results of the tests of no remaining nonlinearity for the models defined in Eqn. (6)–(8). H_0: PSTR model with $r = r^*$ and H_1: PSTR model with $r = r^*+1$. At each step of the sequential testing procedure for the optimal r, the critical p-value is reduced by a constant factor ($tau = 0.5$) to avoid excessively large models
Source(s): Author's computations

Table 2.
Test of no remaining nonlinearity

Meanwhile, the threshold values of domestic credit by the financial sector are a bit higher at the first transition (48.2%) and lower at the second transition (63.4%). These results are consistent with previous studies. Hermes and Lensink (2003) found the threshold level of 14.6% for a group of 67 developing countries. Azman-Saini et al. (2010) gave the threshold of private sector credit at 49.7% of GDP and the threshold of liquid liabilities at 68.8% of GDP. Chen and Quang (2014) showed the threshold estimate of private credit at 18.5% of GDP. Yeboua (2019) reported a benchmark of 15.6% for African countries. Though being different in the estimates due to different samples and methodology, the current studies confirm the effect of FDI on growth is realized only when the domestic financial markets reach a certain level of development.

These PSTR thresholds thereby suggest different benchmarks in setting up the well-functioning structures of the financial markets in emerging and developing Asian countries.

5.3 Growth effect of FDI

The growth effects of FDI conditional on three threshold variables of FD are reported in Table 4. The estimates of FDI are statistically significant, confirming the nonlinear effect of FDI on economic growth conditional on FD.

Note, in the PSTR model, only the signs of the estimated coefficients are important, while the values of the coefficients are not directly interpretable (Fouquau et al., 2008). So, the

Threshold variable	Regime	Threshold value (c)	Slope parameter (γ)	AIC	SBC
CREPRI	$j = 1$	33.025	235.908	0.048	0.390
	$j = 2$	99.401	0.840		
CREFIN	$j = 1$	48.238	2976.2	−0.007	0.334
	$j = 2$	63.427	3.996		
LIQUID	$j = 1$	35.519	96.824	0.109	0.451
	$j = 2$	102.099	0.182		

Note(s): This table reports the PSTR estimation of transition functions in the models defined in Eqn. (6)–(8). There are two transition locations ($r = 2$) for each model. $j = [1, r]$ is the order of the transition locations. AIC and SBC are the Akaike Information Criterion and the Schwarz Bayesian Criterion, respectively
Source(s): Author's computations

Table 3.
PSTR estimates of financial development thresholds and regimes

Dep. var. Growth	CREPRI Eq. (6)	CREFIN Eq. (7)	LIQUID Eq. (8)
Low regime			
FDI	−0.112* (0.063)	0.059** (0.024)	−0.119 (0.095)
Mid-regime (first transition function)			
FDI×$g_1(q_{it}; \gamma_1, c_1)$	0.175*** (0.062)	0.068** (0.032)	0.175* (0.096)
High regime (second transition function)			
FDI×$g_2(q_{it}; \gamma_2, c_2)$	−0.255*** (0.088)	−0.121*** (0.029)	−0.334* (0.172)
Number of observation	342	342	342

Note(s): This table reports the effect of FDI on economic growth in different regimes of FD in the models defined in Eqn. (6)–(8). Standard errors corrected for heteroskedasticity in parentheses. *, ** and *** denote significance at the 10, 5 and 1% level, respectively
Source(s): Author's computations

Table 4.
Growth effect of FDI conditional on financial development

dynamics of the growth effect is interpreted from the signs of the parameters. In the three models, the signs of the estimates show the positive effect of FDI in the mid-regime. Precisely, the coefficient of FDI has a significant increase around the first transition point and has a positive effect on economic growth in the mid-regime. For example, when credit to the private sector (CREPRI) exceeds the threshold ratio of 33% of GDP, the coefficient of FDI increases from −0.112 in the lower regime of FD to 0.175 in the higher one. This means the beneficial effect of FDI on growth can be unlocked only when the credit to private sector attains 33% of GDP. This result is highly consistent with previous studies (Hermes and Lensink, 2003; Azman-Saini *et al.*, 2010a, b; Chen and Quang, 2014; Yeboua, 2019).

On the contrary, the estimated coefficient of FDI is significantly negative in the high regime, presenting a large decrease in the growth effect of FDI happening around the second transition point. In other words, the enhancing effect in the mid-regime will diminish and disappear at the higher levels of FD. For example, when the credit to private sector (CREPRI) gets over 99% of GDP, the coefficient of FDI reduces to −0.255. The marginal effects of FDI on growth conditional on FD are depicted in Figure 1.

This study is the first to show two distinct thresholds of FD in the dynamics of the growth effect of FDI. While previous works only show a positive association between the growth effect of FDI and FD, we complete the knowledge by additionally showing a negative effect that happens at a certain development level of the financial system. In other words, we propose a hypothesis of an inverted-U shaped relationship between FDI and growth depending on FD.

Notably, the PSTR estimates of the explanatory variables in Table 5 present the growth effects of the determinants and FD. Regarding the variables of FD, the coefficients are significantly negative at the second transition, presenting a sharp reduction in the direct effect of FD on growth. Together with the threshold effects through FDI, these results give an insight when the levels of the domestic credit and the liquid liabilities get so high; this will lead to a decline in economic growth both directly and indirectly. Generally, a high level of FD exerts a positive impulse in growth effect of FDI, but at a very high level of FD, the positive impulse vanishes, meaning more credit is associated with less economic growth.

In addition to all, besides the agreement with the current studies on the first threshold of FD, this study presents a new finding of the second threshold, where the fading effect happens. The consistency in the estimates of the variable FDI in three alternative models strongly confirms this finding. Indeed, our result is advocated by a vast of theoretical and empirical work. The possible explanation for the vanishing effect relates to theories on the evolving roles of banks and financial markets in the process of economic development. As countries become richer, the association between an increase in economic output and an increase in bank development becomes smaller (Azman-Saini *et al.*, 2010a, b). Other studies give the idea related to optimal structure of the financial system. In countries that have too much credit but inefficient financial service and ineffective allocation of resource, more credit does not necessarily enhance economic growth. Or high credit can lead to a risk of possible fragility of the financial system, which is harmful to growth. Iamsiraroj and Ulubaşoğlu (2015) report the growth effect of FDI attains the highest level when FD is 54% of GDP, and this effect remains positive and statistically significant providing FD below the level of 116% of GDP. Law and Singh (2014) and Arcand *et al.* (2015) in their investigations of "too much finance" conclude when credit to private sector reaches around 100% of GDP, the effect of FD on economic growth is turning negative.

5.4 Individual marginal effect of FDI on growth
As mentioned in section 3, the PSTR framework allows heterogeneous marginal effects for each country i at varying time t depending on threshold variable q_{it}, as defined in Eqn. (4).
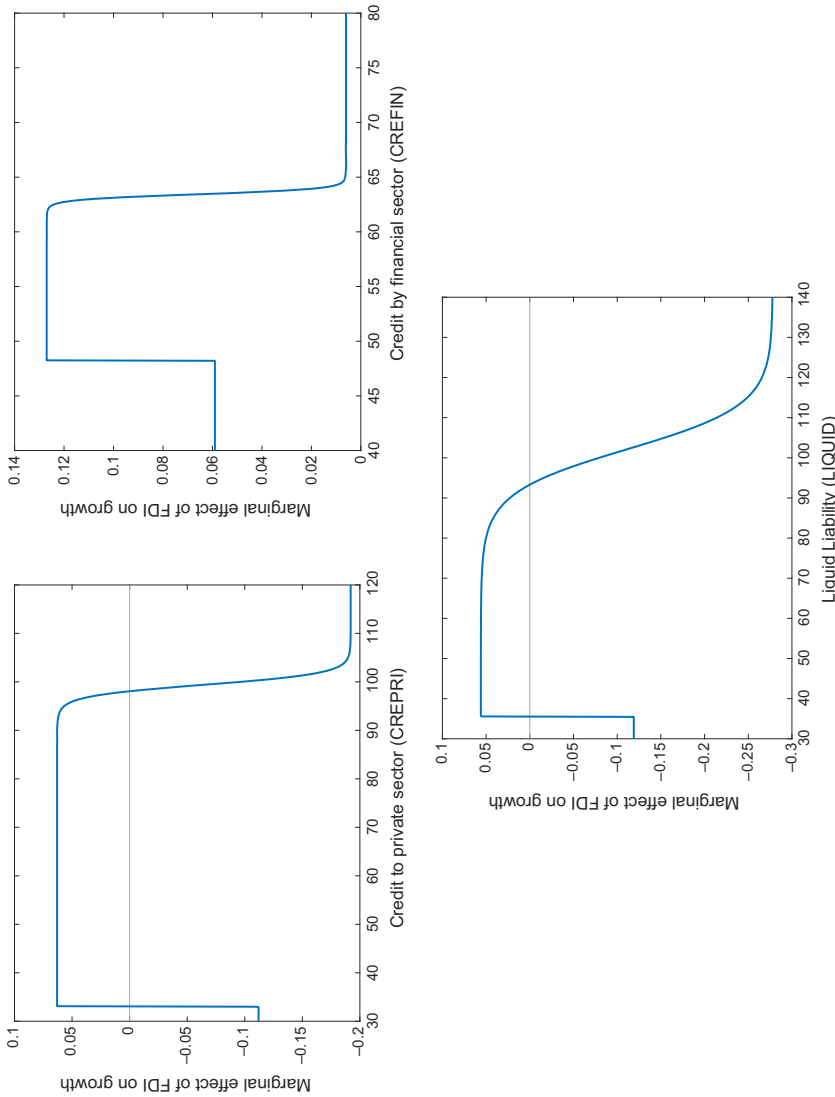
Note(s): Estimated transition functions of the threshold variables of *CREPRI, CREFIN, LIQUID* are reported in Table 3
Source(s): Author's computations

Dep. var. GROWTH	CREPRI Eq. (6)	CREFIN Eq. (7)	LIQUID Eq. (8)
Low regime			
FD	−0.025 (0.020)	0.002** (0.011)	−0.009 (0.039)
GC	−0.126** (0.054)	−0.091 (0.046)	−0.230*** (0.056)
DI	−0.011 (0.021)	0.002 (0.023)	−0.002 (0.031)
OPEN	0.024*** (0.006)	−0.375*** (0.138)	−0.173 (0.153)
INC	3.198*** (1.083)	−0.024 (0.036)	−0.047 (0.050)
POP	0.092 (0.245)	−0.002 (0.008)	−0.012 (0.008)
LABOR	0.041 (0.040)	−0.014 (1.009)	1.256 (1.058)
INF	−0.003 (0.009)	0.020*** (0.005)	0.029*** (0.008)
INS	0.240 (0.436)	0.065 (0.455)	−0.737 (0.813)
Mid-regime (first transition function)			
FD	−0.003 (0.023)	−0.057* (0.033)	0.023 (0.039)
GC	0.068 (0.060)	−0.332*** (0.107)	0.167*** (0.056)
DI	−0.031** (0.015)	0.094*** (0.027)	−0.042* (0.026)
OPEN	−0.033*** (0.007)	1.042 (0.653)	−0.107 (0.167)
INC	−0.044 (0.306)	0.032* (0.017)	0.058** (0.027)
POP	−0.434* (0.264)	−0.136*** (0.011)	−0.038 (0.026)
LABOR	0.056*** (0.017)	0.592 (0.506)	−0.918* (0.512)
INF	−0.051** (0.025)	−0.025*** (0.007)	−0.034*** (0.009)
INS	0.623 (0.758)	−0.216 (0.656)	0.652 (0.758)
High regime (second-transition function)			
FD	−0.058*** (0.020)	0.029 (0.033)	−0.019 (0.012)
GC	0.065 (0.095)	0.375*** (0.128)	0.103 (0.100)
DI	0.169*** (0.038)	−0.088** (0.041)	0.171*** (0.059)
OPEN	0.028*** (0.009)	−1.451* (0.759)	−6.344*** (1.523)
INC	−1.843** (0.864)	0.011 (0.022)	0.211*** (0.056)
POP	−1.029** (0.513)	0.108*** (0.029)	0.079 (0.061)
LABOR	0.097*** (0.037)	−0.467 (0.583)	−5.120*** (1.092)
INF	0.163*** (0.061)	0.015* (0.008)	0.045*** (0.013)
INS	2.373*** (0.868)	1.616* (0.939)	3.634*** (1.077)
Number of observations	342	342	342

Note(s): Standard errors corrected for heteroskedasticity in parentheses. *, ** and *** denote significance at the 10, 5 and 1% level, respectively
Source(s): Author's computations

Table 5.
PSTR estimates of explanatory variables

Figure 2 illustrates the individual growth elasticity to FDI conditional on domestic credit to private sector (CREPRI), as an example. It is well observed the shifting movement of the marginal effects occurs between regimes when the threshold variable attains certain value. Besides, the time (year) of the shifting points are varied among countries.

In general, the growth effects of FDI conditional on FD are negative in many emerging and developing Asian countries for most of the time. That is to say, the growth effects of FDI are limited due to the inadequate and undeveloped financial markets in the region. Pakistan has a stably negative marginal effect of FDI during the last 22 years. Meanwhile, in Bangladesh, Bhutan, Cambodia, Nepal, Mongolia, Sri Lanka, Turkey and India, the marginal growth effects of FDI have the same type of upward shift from negative (in the low regime) to positive (in the high regime) as the level of FD increases and surpasses the threshold value. This implies an appropriate improvement on FD reinforces the effect of FDI on growth. Contrarily, there is a type of switching from the high regime to the low one where credit to private sector decreases and less than the threshold value (in Indonesia) or "too much finance" issue like in Korea. The sensitivity of economic growth to FDI in other countries, such as China, Thailand
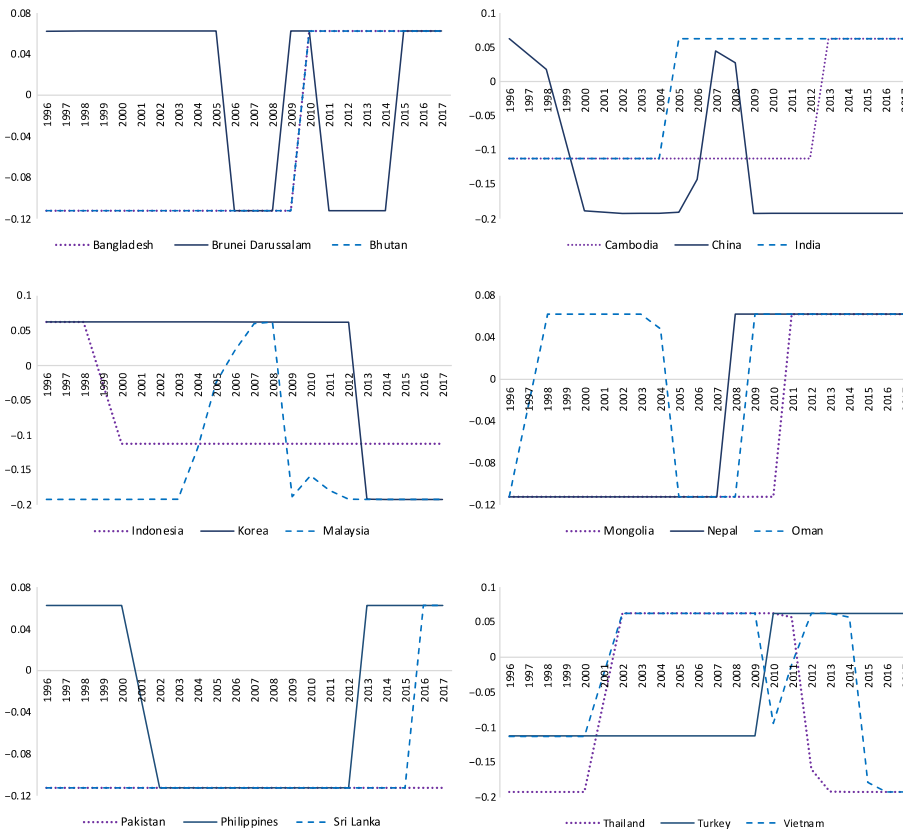
Source(s): Author's computations

and Vietnam, displays a fluctuation from low regime to high regime for some periods when the credit level is high and fluctuates around 100% of GDP.

6. Conclusions

This study investigates the effect of FDI on economic growth in 18 emerging and developing Asian countries during the period of 1996–2017. Specifically, we apply the PSTR framework to estimate the threshold value of FD and depict the switching movement of the growth effect of FDI. This study provides a significant addition to the extant inadequate empirics on the growth effect of FDI and the role of FD. Particularly, we implement an investigation in emerging and developing Asia to clarify the existing ambiguous conclusions in this region, hence fulfill the literature on this issue in general. The main conclusion is FDI has nonlinear effects on growth conditional on the level of FD. The results generally confirm that a sufficiently developed financial system will encourage FDI to enhance the growth effect in emerging and developing Asia. Otherwise, the effect of FDI on growth is negative or remains modest.

Beyond the consistency with the extant literature in the same line, this study reports new evidence of nonlinear effects of FDI on economic growth. First, this is the first study to prove

two distinct thresholds of FD in the dynamics of the growth effect of FDI. Or FD sets a three-regime scheme for the evolving movement of the growth effect of FDI. We complete the knowledge of the dynamics by a conclusive proof of vanishing effect that happens at very high levels of FD. Here, we contribute to the literature with the finding of an inverted-U shaped relationship between FDI and growth depending on FD, which is consistent with the confirmed nonlinear relationship between FD and economic growth.

Second, with the notable report of the second threshold of FD, the results remind emerging and developing Asian countries of the other side of "too much finance", which might do harm to economic growth if the financial system is not well functioning and efficient.

Third, this study is the first to estimate the individual marginal growth effect of FDI conditional on FD, making a specific reference for each developing Asian country to locate their levels as well as to analyze their dynamics of the effects across the time. Moreover, the results of the 18 countries in this study allow a comparative analysis among heterogeneous crosssections, which can further extend knowledge of FDI–financial system–growth nexus in the region.

Our new findings therefore would carry some policy implications for emerging and developing Asian countries. The empirical results make a remark for these countries to position themselves at particular levels of FD and so explain their current earning capability from FDI. Hence, this study has serious suggestions for countries that are just below the threshold level. Besides, the existence of the thresholds of local absorptive factors points out FDI promotion policies should be shadowed by strategies of improving the absorptive capacity, namely effective reforms in the financial system. Moreover, the hypotheses of "too much finance" and inverted-U shaped relationship shed light on coherent and effective policies for fostering growth effect of FDI that are crucial in emerging and developing Asia.

Needless to say, the selection of financial indicators suggests caution in interpreting the results. Due to availability of the data, this study considers only the conventional indicators reflecting the depth of finance but ignores the access and efficiency of the financial system. Notably, countries could have similar indicators of financial depth (proxied by ratio of credit to private sector over GDP) but differ in the access to and efficiency of the financial system. Then, the results emerging from the financial depth may not be representative for the whole financial system. Precisely, an inclusive set of FD indicators should be recruited when examining the growth effect of FDI. Moreover, models considering simultaneously several conditional factors are plainly needed, which would provide a more complete picture of the FDI–growth nexus as well as propose more constructive policy advice to boost the effect of FDI on economic growth. These gaps open up a room for future research.

Notes

1. Data from International Monetary Fund, World Economic Outlook Database, April 2020.

2. The marginal effect in the general case of r location parameters is straightforward as $e_{it} = \frac{\partial \mathrm{GROWTH}_{it}}{\partial \mathrm{FDI}_{it}} = \beta_0 + \sum_{j=1}^{r} \beta_j g_j (q_{it}; \gamma_j, c_j)$.

3. See Gonzalez *et al.* (2005, 2017) for details.

4. In a small sample, the F-version LM statistic has better size properties than the asymptotic chi-square statistic. The LM_F in the sequential tests of no remaining nonlinearity with r transitions has an asymptotic $F(K, NT - N - K - (r + 1)K)$ distribution under the null hypothesis.

5. As suggested in Gonzalez *et al.* (2005) and Fouquau *et al.* (2008), at each step of the testing procedure for no remaining nonlinearity, the significance level is reduced by a constant factor (*tau* = 0.5) to avoid excessively large models.

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Appendix
Details on the data
List of countries: Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, India, Indonesia, Republic of Korea, Malaysia, Mongolia, Nepal, Oman, Pakistan, Philippines, Sri Lanka, Thailand, Turkey and Vietnam.

Variable	Definition	Measurement	Source of data
GROWTH	Economic growth	Real GDP per capita in 2011 international dollar purchasing power parity-PPP (log difference) (%)	WDI
FDI	Foreign direct investment	Net inflows of FDI (% of GDP)	WDI
CREPRI	Credit to private sector	Domestic credit to private sector (% of GDP)	FSD
CREFIN	Credit by financial sector	Domestic credit by financial sector (% of GDP)	WDI
LIQUID	Liquid liability	Liquid liability or broad money (M3) (% of GDP)	FSD
GC	Government consumption	General government final consumption expenditure (% of GDP)	WDI
DI	Domestic investment	Difference between gross fixed capital formation and FDI (% of GDP)	WDI
OPEN	Trade openness	Sum of exports and imports of goods and services (% of GDP)	WDI
INC	Initial income	Real GDP per capita in 2011 international dollar PPP in the previous period (natural logarithm)	WDI
POP	Population growth	Country population growth rate (annual %)	WDI
LABOR	Labor force	Proportion of the population that is economically active (%)	WDI
INF	Inflation	Inflation and GDP deflator (annual %)	WDI
INS	Institutional quality	Composite index by simple average of six index components (control of corruption, government efficiency, political stability, regulation quality and rule of law)	WGI

Table A1.
Variable measurement and data sources

Note(s): WDI: the World Development Indicators, the World Bank. WGI: the Worldwide Governance Indicators, the World Bank. FSD: the Financial Structure Database, the World Bank
Source(s): Author's compilation

Variable	Obs	Mean	Std. Dev	Min	Max
GROWTH	396	1.544	1.504	−6.728	6.830
FDI	396	2.757	4.568	−37.155	43.912
CREPRI	396	49.070	35.794	3.933	163.211
CREFIN	396	65.390	43.489	2.599	216.908
LIQUID	396	61.266	36.012	8.442	197.997
GC	396	12.469	5.383	3.460	29.867
DI	396	24.415	10.060	3.216	68.234
OPEN	396	83.028	42.193	21.929	220.407
INC	396	3.873	0.467	3.041	4.937
POP	396	1.475	0.931	−0.267	7.350
LABOR	396	67.551	10.287	48.491	88.533
INF	396	7.522	12.132	−25.128	143.693
INS	342	−0.231	0.505	−1.178	0.840

Table A2.
Descriptive statistics

Note(s): Values reported are the statistics of the variables used in the models, as defined and measured in *Table A1*. Data for institutional quality stem from the WGI, getting the values by definition from −2.5 to 2.5. The WGI data are not available for three years 1997, 1999 and 2001
Source(s): Author's calculations