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The impact of currency crises on economic growth and foreign direct investment: The analysis of emerging and developing economies

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Abstract

In this paper, the discussion centers on the possible effects of currency crises on different economic indicators, with special attention to economic growth and foreign direct investment. There is insufficient research on this topic to draw any firm conclusions about the associations between currency crises and aforementioned variables. In fact, it appears that the impact of currency crises on economic growth and foreign direct investment is negative respectively. However, this study indicates that foreign direct investment can be positively correlated with currency crises as contrary to the common belief. The current study analyzes these relationships through dynamic panel models. The annual panel data for 71 emerging and developing countries are extracted from reliable databases for the time period of 2005–2014. Generalized method of moments estimators are used to obtain efficient and consistent results so as to reach necessary conclusions. The majority of estimated coefficients are significant and unbiased statistically, and also consistent with the economic theories proposed. The main results indicate that the presence of a currency crisis in a particular economy has a negative impact on economic growth, while its effect on foreign investment inflows is most likely positive. Robustness tests demonstrate that used models in the study are both economically and econometrically robust and valid.

Keywords: currency crises, economic growth, foreign direct investment, exchange market pressure index, generalized method of moments.
JEL classification: F3, F4, G0, O2.

1. Introduction

Recent decades have witnessed many severe economic and financial crises in different economies. Salient examples are the European crisis of 1992–1993,

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the Latin American crisis of 1994–1995, the Asian crisis of 1997–1998, and the global financial crisis which took place during 2007–2009. The currency crisis is deemed as the most dangerous component of that kind of economic collapse. Speculative attacks along with bad economic policies are fundamental factors in the initiation of currency crises. In fact, currency crises have become a very widespread topic of political and academic debate with a great deal of discussions and sessions and numerous publications in recent times.

In order to investigate a portion of this complex topic in depth, this research paper tries to examine the main effects of currency crises on economic growth and foreign direct investment (FDI). Indeed, the detrimental impact of currency crises on economies so affected may have generated a prevailing view that the effect of currency crises on growth and FDI is negative. However, after having reviewed sufficient amount of literature, one can conclude that the reverse is possible in terms of FDI. Therefore, this investigation focuses on the main characteristics of currency crises, economic growth, and FDI, and tests the relationship among them by applying several methodologies within the framework of economic theories. It includes the review of related literature to represent a good theoretical and empirical framework, the application of reliable and relevant research methods and a thorough analysis of the case followed by the interpretation and evaluation of results obtained.

Specifically, this paper is composed of 6 sections. The first section gives a brief introduction on the topic and research objectives. Then, the literature concerning currency crises is discussed thoroughly in the second part. The next two sections provide detailed data description and econometric methodology correspondingly, where necessary statistics on data, expectations, and different estimation methods are explained deeply. The fifth section concentrates on the interpretation and evaluation of results achieved using several econometric tests and diagnostics. Concluding remarks on the whole analysis are made in the last part, including policy implications and recommendations for further additional research.

2. Theoretical background and empirical evidence

There is no precise definition of currency crises in the existing terminology database and that limitation can create certain misapprehensions. This pertains not only to common policy debates but also to both theoretical and analytical works of several researchers. A brief overview of theoretical literature can induce a researcher to distinguish a currency crisis from a more general category of financial crisis, and some other similar concepts such as balance of payments crisis. The concept of a financial crisis appears to be the broadest, encompassing all kinds of instability associated with financial and monetary systems. A balance of payment crisis is a structural imbalance between a deficit in a current account, and a capital and financial account, that after depleting foreign reserves gives rise to a crisis in the national currency. Most literature indicates that these two notions are synonymous. Indeed, many theories have been proposed to investigate the phenomenon of a currency crisis. One can distinguish three generations of theoretical models of currency crises. The first-generation models were raised after balance-of-payment crises in Argentina, Chile, and Mexico occurred between the time period of 1970 and 1980. The Exchange Rate Mechanism (ERM) crisis in

1992 and the Mexican crisis of 1994–1995 acted as a stimulus for developing the second-generation models. Last but not least, first attempts to construct the third-generation models were initiated after the Asian crisis that took place between 1997 and 1998 (Dabrowski, 2002).

2.1. The models of currency crises

2.1.1. First-generation models

Salant and Henderson (1978) developed the first clear description of currency crises in terms of speculative attacks occurring in commodity markets. They maintained that government efforts to control the prices of gold spurred such attacks. Moreover, they propose that defensive strategies in which authorities use resource stockpiles in order to stabilize prices result in speculative attacks that deplete stocks ultimately. Correspondingly, they refer to the conventional theory of "Hotelling's model" and adjust that model to certain defining characteristics of the gold market, with agents expecting an auction of a supplementary reserve of gold at a specified time (Salant and Henderson, 1978). The main assumptions of the Salant–Henderson model are summarized in Table A1 in Appendix A.

In 1979, Krugman adjusted the Salant–Henderson model for the foreign exchange market so as to take into account the case of a government that utilizes its stock of foreign exchange reserves for exchange rate stabilization. His model applies to a small open economy whose citizens have rational expectations and consume a single tradable good of a fixed domestic supply. No private banks operate in a country and the sum of domestic credit issued by the central banks and the domestic-currency value of foreign reserves upheld by the central bank, which earn no interest, is equal to total money supply (Dabrowski, 2002). According to the Krugman model, an economy with a currency crisis problem undergoes three stages: initially, a period of gradually diminishing reserves; then, a sudden speculative attack; and finally, a post-crisis period during which the currency steadily depreciates. Krugman's analysis suggests that currency crises are an inevitable consequence of the maximizing behavior by investors which evolve from balance of payment problems under certain conditions and involve massive speculative attacks (Krugman, 1979). The assumptions of the Krugman model are represented in Table A2 in Appendix A.

The Krugman model further was simplified and extended by Flood and Garber. In 1984, they developed a log-linear generalization of Krugman's thoughts that allowed them to explicitly originate the timing of the balance of payment crisis under diverse assumptions relating to the driving forces of the post-collapse exchange rate regime. Flood and Garber present the idea of a shadow floating exchange rate and scrutinize whether the timing of the collapse is based totally on market fundamentals or based partly on arbitrary speculative behavior. They reach a conclusion that since arbitrary speculative behavior can also trigger the causal and uncertain timing of a fixed exchange rate regime collapse, the traditional pro-peg hypothesis that floating exchange rates may be conditional on arbitrary speculative variations, indeed, fails. Likewise, setting the fixed exchange rate simply masks but does not remove the economic impact of speculative behavior (Flood and Garber, 1984). This model, in fact, has become the standard model among the first generation models due to its simplified assumptions and convenient linearized form. The assumptions of the model are given in Table A3 in Appendix A.

2.1.2. Second-generation models

First-generation models assume that agents have rational expectations and perfect foresight, whereas governmental behavior is supposed to be purely static. These extreme assumptions with regard to agents' and government's behavior appear to be unrealistic in many cases. Thus, due to the insufficiency of first-generation models, it was required to have a new model that could explain currency crises adequately. That model was introduced by Obstfeld in 1994 as the second-generation model addressing the shortcomings of the first-generation models. The Obstfeld model requires three elements: a reason for governments to abandon its exchange rate peg, a reason to defend it, and the increasing cost of defending the current regime when its collapse is predicted or self-fulfilled. In order for speculators to attack the exchange rate regime, there should be something dangerously fixed in the domestic economy. A speculative attack may be successful even if the position of fiscal and monetary policy does not contradict the level of the exchange rate. Therefore, there must be an inducement for the government to devalue its currency so as to seek a more expansionary domestic policy in spite of high political costs. Once speculators recognize that inducement and identify a moment that is likely to cause a shift in monetary policy, they will start attacking the reserves. Hence, the logic of the second-generation model stems from the fact that as the market believes that it will eventually fail, defending exchange rate parity can be relatively costly (by means of higher interest rates). Consequently, either an anticipated future deterioration in fundamentals or purely self-fulfilling foresight acts as a trigger for a speculative attack on domestic currency to develop (Obstfeld, 1994). The main assumptions of the model are summarized in Table A4 in Appendix A.

2.1.3. Third-generation models

The Asian crisis of 1997–1998 aroused renewed interest in the origins and repercussions of currency crises. Even the first- and second-generation models failed to explain them accurately and in detail. In such a manner, the third-generation modeling was developed by Corsetti, Pesenti and Roubini in 1998. In fact, the third-generation model mainly concentrates on microeconomic weaknesses such as moral hazard and subsequent over-borrowing, which may cause speculative attacks against the current exchange rate regimes. In general, moral hazards create a series of events beginning with a credit expansion and ending in unsustainable current account deficits. The dynamics of the crisis indicate that there is a significant association between a currency crisis and a financial crisis, as the government is ready to defend the peg only if this policy is consistent with the solvency constraint, emphasizing that the amount of reserves devoted to the defense is limited. Thus, if reserves hit the threshold that causes a financial crisis, the government requires mobilizing resources to finance its financial assistance plans. Overall, this model tries to take into consideration both multiple equilibriums and fundamental factors in market behavior (Corsetti et al., 1998a, 1998b). The assumptions of this model are represented in Table A5 in Appendix A.

2.2. Empirical findings

Over the decades, a large number of researchers have investigated currency crises by looking at their major causes and consequences, or analyzed these downfalls on the basis of diverse theoretical models. However, there is limited literature specifically examining the impact of currency crises on economic growth and FDI. Therefore, relevant works related to currency crises are discussed in this section to reach necessary theoretical conclusions eventually.

Bernd Schnatz (2000) examines the role of macroeconomic fundamentals on the occurrence of speculative attacks along with currency crises. He focuses on a wide-ranging sample of 26 emerging market economies and analyzes different macroeconomic variables in tranquil pre-crisis periods. His findings support the view that several macroeconomic fundamentals can increase the vulnerability of a specific country's currency to speculative attacks and then lead to a currency crisis in the end.

Alves et al. (2004) represent a critical review of theoretical models of currency crises and introduce a post-Keynesian approach to speculators' behavior and instability of the financial system. They analyze the Brazilian currency crisis of 1998–1999 within the framework of their new approach. They conclude that the entire range of disruptive outcomes stemming from the speculative behavior in these global financial markets will be only eradicated if there is an institution able to stimulate efficient economic growth and prevent capital volatility along with market price instability.

Similarly, the neo-Keynesian framework is used by Pourshahabi and Dahmardeh (2015) to analyze the impact of economic sanctions and speculative attacks on the development of currency crises in the case of the Iranian economy. Researchers introduce a new model of currency crises within the framework of neo-Keynesian perspectives and estimate this model using the Canonical co-integration regression approach. The results show that both speculative attacks and sanctions have a positive and highly significant impact on currency crises.

In fact, there are several methods to withstand speculative attacks and currency crises. In this manner, monetary authorities play a fundamental role with their crisis management strategies. Central banks have two choices to fulfill: either influence exchange rates by intervening in the foreign exchange market or just refrain from taking defensive actions. If central banks decide to intervene, this may lead to both positive and negative consequences. The empirical analysis of Erler et al. (2014) reveals that central banks can reduce the costs of currency crises by taking two countermeasures: a successful defense and an immediate depreciation. In this case, it is highly likely that central banks will be able to offset the effects of speculative attacks without any negative repercussions. However, this intervention may result in an unsuccessful defense too, which is associated with high economic costs such as output loss of at least 5% (Erler et al., 2014).

According to conservative beliefs, high interest rates are a key to defend currencies under speculative attacks. This posits that monetary authorities can make it too costly for speculators to take short positions in the attacked currency by raising interest rates high enough. This method also helps to maintain a fixed exchange rate. By contrast, it might be convincingly argued that these hypotheses lack systematic empirical evidence. Kraay (2003), in his research paper, examines the role of high interest rates during the currency crisis period. Based on evidence derived from a large sample of speculative attacks in both developing and developed countries, he concludes that high interest rates do not defend currencies during speculative attacks. The results indicate that there is not sufficient evidence to show the systematic relationship between interest rates and the outcomes of speculative attacks (Kraay, 2003). If monetary authorities decide not to raise the interest rates too high, the exchange rate must be devalued by a certain amount. Thus, they face a tradeoff between the costs of devaluation and the costs of fixed exchange rate defense. Devaluations have negative effects on the government's political strength and monetary credibility. Meanwhile, defending the exchange rate peg is also costly, since the required monetary contraction depresses economic growth and investment (Walter, 2007).

One of the main assumptions of the third-generation model is the possibility of currency crises to pass from one country to another contagiously. In fact, very little theoretical literature has scrutinized the contagion effect of a currency crisis across countries. Eichengreen et al. (1996) provide one of the first tests for the existence of contagious currency crises in the real world. They analyze 20 industrial economies using a panel of quarterly political and macroeconomic data from 1959 to 1993. Due to complexity in identifying currency crises just by considering devaluations or revaluations, the authors construct a model including a measure of currency crises (exchange market pressure) which is obtained by a weighted average of interest rate changes, exchange rate changes, and changes in international reserves. Their empirical estimation indicates that the spread of a currency crisis across countries raises the likelihood of a speculative attack on the domestic currency by 8%, even considering diverse economic and political factors (Eichengreen et al., 1996).

Gunsel et al. (2010) also use an index of exchange market pressure as proxy for currency crises in their empirical analysis to study the association between currency crises and economic fundamentals. They analyze four different groups of economies for the period of 1991–2006. The results show that increases in real interest rates, growth rate of GDP and inflation rates are positively and significantly related with the possibility of currency crises (Gunsel et al., 2010).

Generally, a deeper insight into the crisis literature could incorporate the following categories of crisis costs: (1) fiscal costs resulting from devaluation and high interest rates; (2) the need to restructure monetary organizations and some big companies; (3) costs regarding lost economic growth; (4) social costs related to a drop in real incomes, unemployment, poor health and living conditions, poverty and so forth; (5) political costs (Blaszkiewicz and Paczynski, 2001). Indeed, it is too difficult to measure these issues empirically and compare the consequences with other countries. However, Blaszkiewicz and Paczynski (2001) try to make comparative analyses of different crisis effects by investigating a sample of 41 countries, paying special attention to the transition economies of the former Soviet Union and Eastern Europe. These researchers examine the behavior of several macroeconomic indicators in the pre- and post-crisis periods and describe their positive and negative consequences overall. Specifically, all the countries sampled suffer from continuous imbalances in their current accounts prior to the crises. The effect of currency crises on trade balance turns to be positive in some countries after the crisis periods. The net capital inflows, portfolio and foreign direct investments remain repressed during and after the crises periods, remaining below the pre-crises levels. The study indicates that social and economic costs of currency crises are manifested in terms of higher inflation, high output loss, lower real wages, higher unemployment, and higher debt burden (cited in Dabrowski, 2002).

Mete Feridun (2007) analyzes the Mexican Peso crisis of 1994–1995 and identifies the factors behind this collapse. His empirical analysis is based on a probit model including 20 monthly macroeconomic, financial, and political indicators for the period of 1970–1995. The results show that foreign exchange reserves, political instability, national savings, ratio of FDI to GDP, ratio of domestic credit to GDP, lending and deposit rate spread are statistically significant, even though most of them do not indicate the expected signs. Estimated signs of real exchange rate, import growth, stock prices, political instability, real interest rate, GDP per capita, and foreign exchange reserves are in line with the expected ones. Overall, he concludes that the Mexican Peso crisis of 1994–1995 stemmed from incorporated microeconomic and macroeconomic factors.

Another empirical analysis on currency crises is conducted by Frankel and Rose (1996). They use a panel data of numerous economic variables from 1971 to 1992 for a sample of more than 100 developing countries. The prime objective of their research is to identify the variables that can help to predict currency crises much more accurately. In their paper, the authors define a crisis as a marked change of the nominal exchange rate (no less than 25%) and also as a considerable acceleration in the rate of change of the nominal depreciation rate (surpassing the previous year's change by at least 10%). Statistically significant variables in their test were output growth, the total debt burden, foreign interest rates, and the rate of change of credit. Investigation results show that the mixture of high indebtedness with a rise in foreign interest rates appears to be a road to currency crises. Nearly all composition variables in the test indicate the expected signs and are statistically significant when considered one by one (Frankel and Rose, 1996).

Hutchison and Noy (2002) investigate the effects of currency crises on output growth in emerging market economies using panel data for the period of 1975–1997. Their findings support the idea that currency crises in emerging economies are commonly related to a sharp decline in economic growth. Severe pressure on the currency as a result of considerable losses in foreign reserves or a sharp devaluation does not allow the economy to progress. Results show that a currency crisis depresses output in the region of 5%–8% over the course of two years following the crisis and growth begins to recover in the third year thereafter (Hutchison and Noy, 2002). Growth performance after a currency crisis and current account reversals appears to be better in more open economies and in nations whose real exchange rate was less overvalued before the collapse. In fact, median growth after the current account imbalances and currency crises will be roughly the same as prior to the slowdown (Milesi-Ferretti and Razin, 1998).

Despite the detrimental impact of currency crises on diverse economic and financial variables, a sufficient amount of literature indicates that certain variables could be unaffected or even positive. Based on their research, Fernandez-Arias and Hausmann (2001) suggest that FDI is not vulnerable to currency crises. They analyze the impact of the composition of capital flows on the possibility of crises in a sample of 170 economies. The study reaches a conclusion that non-FDI flows are exposed to currency crises, whereas FDI is neutral (Soliman, 2005).

Furthermore, Mohamed Soliman (2005) tests the effects of a currency crisis on FDI in 21 emerging economies using data from 1983 to 2000. His findings show that there appears to be a nonnegative relationship between currency crises and FDI, contrary to common belief. The results show that a currency crisis may in fact increase FDI activity in the affected economy since it results in an expansion in the number of associates and a lagged increase in associate sales. His investigation emphasizes the steady nature of FDI in relation to other types of international capital flows and as a safe means of financing for emerging market economies.

In 1997, there was a breakdown in the financial markets of certain East Asian economies. Portfolio equity investment and net private foreign bank lending were estimated to be negative in 1997 for the group of countries most affected by the crisis: Malaysia, Republic of Korea, Thailand, Philippines and Indonesia. Nevertheless, whereas large quantities of short-term capital left these countries, FDI inflows kept on being positive and continued to add to the existing FDI stock. In fact, FDI inflows in 1997 to the five most affected countries remained at a level similar to that of 1996 (UNCTAD, 1998). In the report of United Nations Conference on Trade and Development 1998, the implications of the crises for inward FDI into the affected economies are examined by means of changes resulting from the crises. It then addresses the consequences of the crises for outward FDI from the countries of the region and inward FDI to developing economies not directly affected by the crises. The findings underline that crises actually create opportunities for FDI activity, particularly for asset- and efficiency-seeking FDI activities in terms of devaluation-driven cost gains and cheaper assets (UNCTAD, 1998).

To summarize the literature review, a priori, one should expect a negative association between currency crises and economic growth, while the impact of currency crises on FDI is most likely positive, ceteris paribus.

3. Data

This paper uses annual panel data of different economic and financial variables to explore the effects of currency crises on economic growth and FDI. The data are obtained from reliable databases such as World Bank Development Indicators[1] (WDI), Penn World Tables 9.0[2] (PWT) and International Monetary Fund[3] (IMF). The study period comprises the span of 10 years, from 2005 to 2014 inclusively. The sample in the analysis consists of 71 emerging and developing economies. Countries are identified based on IMF (2012) and are selected according to the data availability and also detected cases of currency crises and speculative attacks in the previous periods. Table B1 in Appendix B provides the list of countries in this sample. The following variables are used in this analysis (Table 1).

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1 https://datacatalog.worldbank.org/dataset/world-development-indicators
2 https://www.rug.nl/ggdc/productivity/pwt/
3 https://www.imf.org/en/Data

Table 1
Economic variables and their proxies.

Variables	Measurement	Abbreviation
Economic growth	GDP per capita growth (annual %)	EconGrowth
FDI	FDI, net inflows (% of GDP)	FDI
Currency crisis	Exchange market pressure index	CCrisis
Labor productivity	Human capital index	LaborPro
Physical capital	Gross capital formation (% of GDP)	PhysCap
Population growth	Population growth (annual %)	PopGrowth
Trade openness	Trade (% of GDP)	TradeOp
Life expectancy	Life expectancy at birth, total (years)	LifeExp
Infrastructure	Mobile cellular subscriptions (per 100 people)	Infrastr
Household final consumption expenditure	Household final consumption expenditure (% of GDP)	HouseFCE
Economic stability	Inflation (GDP deflator %)	EconStab
Labor force	Labor force participation rate (% of total population ages 15+)	LaborForce

Descriptive statistics for the aforementioned variables are given in Table B2 in Appendix B. In fact, the panel data are balanced and include only a small number of missing observations for certain countries.

3.1. Dependent variables

Economic growth is a crucial variable in this investigation. It is measured by the growth rate of GDP per capita. This indicator is available on the WDI database.

FDI is another important variable that should be analyzed. It is directly observable at the WDI and IMF databases.

In fact, this analysis estimates two separate models to examine the impact of currency crises on economic growth and FDI. They can be expressed as follows:

Model 1:

$$EconGrowth = f(LaborPro, PhysCap, PopGrowth, TradeOp, LifeExp, FDI, CCrisis), \quad (1)$$

Model 2:

$$FDI = f(EconGrowth, TradeOp, Infrastr, HouseFCE, EconStab, LaborForce, CCrisis). \quad (2)$$

In the first model, economic growth is used as a dependent variable while FDI is explanatory, respectively. The reverse is then applied in the second model. This technique is realistic, since there is a clear positive association between economic growth and FDI. Indeed, rapidly growing economies attract more foreign investors and afford them better opportunities to make higher profits. Besides, the higher the FDI, the higher the GDP and thus economic growth.

Tables B3–B4 in Appendix B demonstrate the correlation matrices for both models separately. It is evident that there is almost no multicollinearity among explanatory variables and that feature enhances the consistency of the ongoing study.

3.2. Control variables

This study examines the impact of currency crises on economic growth by estimating a model which is based on neoclassical growth theories. In fact, the classic Solow growth model is applied and extended using the research paper of Upreti (2015) in this analysis. In addition, the academic papers of Demirhan and Masca (2008), Phung (2017), and O'Meara (2015) are used to construct a model to test the impact of currency crises on FDI.

As proxy for labor productivity, human capital index is used in the study. Lucas (1988) highlights that human capital is a key determinant of economic growth and it can be defined as knowledge, skills and competencies embodied in individuals that promote economic and social well-being. He states that a positive relationship exists between GDP per capita and human capital and they enable each other to decrease or increase correspondingly under the steady state equilibrium. Thereby, the expected sign for this control variable is positive.

Gross capital formation is a good proxy for physical capital indeed. As Mankiw (2009) emphasized, increases in capital formation result in higher economic growth and, in turn, the higher the economic growth, the higher the gross capital formation too. Thus, it is likely that the relationship between economic growth and gross capital formation is positive.

Actually, most academic works reveal that low rates of population growth are beneficial for economies. This is because rapid population growth reduces the magnitudes of both physical and human capital per worker, and it raises investment rates too. This ultimately depresses GDP per capita or economic growth overall (Eicher et al., 2009). Apparently, population growth is negatively linked to economic growth.

When the economy is more open to international trade rather than being closed, this can accelerate the growth rate of the economy substantially (Eicher et al., 2009). Moreover, a range of surveys propound the perception that open economies encourage more foreign investments too. Thus, the rate of trade openness is used in the current investigation. It is measured by the sum of exports and imports as shares of GDP. Undeniably, the expected sign is positive with regard to both economic growth and FDI.

Higher life expectancy rates indicate that the country concerned has provided good living conditions for its citizens by means of a better healthcare system, ease of access to medical assistance, promoting a healthy lifestyle and so forth. These facilities and living environments are the main indicators of economic growth (Upreti, 2015). However, according to Acemoglu and Johnson (2007), the increase in life expectancy results in marginal growth in aggregate incomes, but principally initiates faster population growth, and thus has a negative impact on GDP per capita overall. Therefore, there is either positive or negative association between economic growth and life expectancy.

As Jordaan (2004) stated, in cases where basic structures and facilities necessary for a society to operate smoothly are well-developed and of high quality, then there is an increase in the productivity potential of investments in a country and consequently it stimulates FDI flows into the economy. Therefore, the predicted sign for infrastructure is positive in relation to FDI. As proxy for infrastructure capability, mobile cellular subscriptions variable is used in this analysis.

Foreign investors may think about aggregate demand as an essential precondition for founding an enterprise in a different country. Household final consumption expenditure could be a good proxy for aggregate demand. It measures the market value of all goods and services purchased by households at a particular time. As long as consumption of households is high, it is highly likely that invested money to establish a company in that country will bring high returns eventually (O'Meara, 2015). Thereby, there is a clear positive relationship between household final consumption expenditure and FDI.

Also, investors are attracted to countries that can provide them with a cheaper labor force and other immobile production factors. This can be measured by labor force participation rate in a country. Thereby, the possible correlation between FDI and labor force is positive (Phung, 2017).

In fact, the inflation rate is an ideal indicator of economic stability in a particular country. Low rates of inflation are effective in attracting FDI inflows to the country and therefore, the predicted sign for inflation rate is negative with reference to FDI (Demirhan and Masca, 2008).

The data for labor productivity is obtained from the PWT database, while all the necessary statistics for population growth, gross capital formation, trade openness, life expectancy, infrastructure, household final consumption expenditure, labor force, and inflation rate are extracted from the WDI database.

3.3. Measuring the currency crisis

Currency crises cannot be easily identified with actual devaluations, revaluations and cases in which the domestic currency is floated, since speculative attacks are not always successful. Besides, governments continuously adopt remedial strategies to prevent any kind of attacks and collapses. Eichengreen et al. (1995, 1996) conducted one of the first tests to determine speculative attacks and currency crises. They used the index of speculative pressure to identify currency crises in a particular country. As a measure of speculative pressure, they calculated a weighted average of foreign reserve changes, exchange rate changes, and interest rate changes.

$$EMPI_{c,t} = (\alpha \times \%\Delta e_{c,t}) + (\beta \times \Delta(i_{c,t} - i_{d,t})) - (\gamma \times (\%\Delta r_{c,t} - \%\Delta r_{d,t})), \quad (3)$$

where e denotes the nominal exchange rate; i denotes short-term interest rates; r denotes foreign exchange reserves; c and d refer to country under investigation and different anchor country; and α, β and γ are weights. Weights are calculated as the inverses of standard deviations of the corresponding variables.

There are several other methods of constructing an exchange market pressure index. For instance, the index of Kaminsky et al. (1998, 1999) can be expressed as follows:

$$EMPI_{c,t} = \frac{\Delta e_{c,t}}{e_{c,t}} - \frac{\delta_e}{\delta_r} \times \frac{\Delta r_{c,t}}{r_{c,t}} + \frac{\delta_e}{\delta_i} \times \Delta i_{c,t}, \quad (4)$$

where e is the units of country c's currency per US dollars at time t; r refers to international reserves; i is the nominal interest rate for country c in period t; and δs are corresponding standard deviations.

Bird and Mandilaras (2006) proposed one of the simplified versions of calculating EMPI:

$$EMPI_{c,t} = \alpha \times \Delta e_{c,t} - \beta \times \Delta r_{c,t} + \gamma \times \Delta i_{c,t}, \tag{5}$$

where e is the exchange rate; r is the level of reserve assets; and i is the short-term interest rate. However, there is no consensus on the weights α, β, γ of each component.

This study uses the modern approach of calculating EMPI which is a modified version of Eichengreen et al. (1995, 1996) formula. It is extracted from the work of Pontines and Siregar (2008) and can be expressed as follows:

$$EMPI_{c,t} = \frac{1}{\delta_e} \times \frac{\Delta e_{c,t}}{e_{c,t}} - \frac{1}{\delta_r} \times \left(\frac{\Delta rm_{c,t}}{rm_{c,t}} - \frac{\Delta rm_{0,t}}{rm_{0,t}} \right) + \frac{1}{\delta_i} \times [\Delta(i_{c,t} - i_{0,t})], \tag{6}$$

where $e_{c,t}$ is the units of country c's currency per anchor country's currency at time t; $rm_{c,t}$ and $rm_{0,t}$ are the ratios of international reserves to monetary base in a particular country and in its counterpart in period t respectively; $i_{c,t}$ and $i_{0,t}$ are nominal interest rates of an economy under scrutiny and an anchor country; δ_r, δ_i, δ_e are standard deviations of the corresponding differentials and a relative change. In this analysis, US is considered to be an anchor country to all the countries sampled.

Currency crises are defined as the extreme values of this index. They are identified only once EMPI exceeds with its overall mean value by 1.5 times the pooled standard deviation of the calculated index:

$$CC_{i,t} = 1 \text{ if } EMPI_{i,t} > 1.5 \times \delta_{EMPI} + \mu_{EMPI},$$
$$CC_{i,t} = 0 \text{ otherwise}, \tag{7}$$

where δ_{EMPI} and μ_{EMPI} are the sample mean and standard deviation of EMPI, respectively (Eichengreen et al., 1996).

Data for the variables are obtained from the IMF database and EMPI is calculated manually using the MS Excel software. The results could detect 13 cases of currency crises in several economies. In fact, there were no true currency crises after the turn of the century as stated by Calvo et al. (2006a). They emphasize that currency crises, or even severe financial crises in emerging markets are usually followed by rapid recoveries. This happens because exports become extremely competitive after currency depreciation, and consequently, there is a large positive shift in the terms of trade (Calvo et al., 2006b). It is likely that that trend could have been continued in the period under scrutiny too. Thereby, the detected cases appear to be less in magnitude.

4. Methodology

To conduct an empirical analysis, panel data approach is adopted in this paper. This method enables one to analyze the associations between variables considering both the variability among countries and the development of those associations over time. This technique also allows examining the country-specific effects too, thereby reducing the possibility of facing biased coefficients. Nevertheless, the use of panel model can integrate an endogeneity problem among independent variables. Thus, it is undeniably correct to apply the dynamic panel model here to eliminate that bias.

It takes the following form:

$$Y_{i,t} = \alpha + \beta_1 \times Y_{i,t-1} + \beta_2 \times X_{1i,t} + \beta_3 \times X_{2i,t} + \ldots + \beta_{Ji,t} \times X_{Ji,t} + U_i + \varepsilon_{i,t}. \quad (8)$$

This model suggests that the current value of Y depends on its prior state, and future states of Y depend on current ones. Y is also a function of the stable unit-level unobservable and an idiosyncratic error term. Yet, this model has some imperfections too. If one estimates this model using traditional techniques such as Ordinary-least-squares (OLS) regression, he/she will get biased coefficients in the end.

As Beck and Katz (1995) mentioned, the fixed effects transformation with lagged dependent variable is the most appropriate technique for panel data with large time period and smaller number of observations. However, there is a bias in the fixed effects estimation of panel data with small time span and large number of observations. Therefore, several methodologies have been proposed by scientists to eliminate the bias in the estimated results of short period panels.

Adapting the first difference model might be one solution to the preceding problem:

$$\begin{aligned} Y_{i,t} - Y_{i,t-1} = {} & \beta_1 \times (Y_{i,t-1} - \mathrm{Y}_{i,t-2}) + \beta_2 \times (X_{1i,t} - X_{i,t-1}) + \ldots + \\ & + \beta_j \times (X_{ji,t} - X_{ji,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}). \end{aligned} \quad (9)$$

There is a new error term of $(\varepsilon_{i,t} - \varepsilon_{i,t-1})$, which is still correlated with the lagged difference term and indeed, there is a possibility of getting biased results. At this point, Anderson and Hsiao (1981) suggest finding an instrumental variable or variables related to the difference term but not correlated with the error term. They recommend to use the twice lagged difference term $(Y_{i,t-2} - \mathrm{Y}_{i,t-3})$ as an instrument for the lagged difference term $(Y_{i,t-1} - \mathrm{Y}_{i,t-2})$ and then estimate the model. This method is defined as the Anderson–Hsiao estimation of dynamic panel models. Since $(Y_{i,t-2} - \mathrm{Y}_{i,t-3})$ is not correlated with the error term, one can estimate the model without bias. However, there is one big problem associated with this estimation method. To implement the aforementioned procedure, basically, one can lose three waves of data. Thus, even though the estimated results are unbiased, they are not effective overall.

Arellano and Bond (1991) show that there are, in fact, several possible instruments for the lagged difference term in panel datasets. They claim that the Anderson–Hsiao estimation, while consistent, fails to take all of the potential orthogonal conditions into consideration. Their solution rests on the idea that deeper lags of Y may be used as instruments for the lagged difference term, with more and more lags being available as one moves forward in time in the panel. Thereby, while moving through the panel one picks up more and more instruments to get better precision of the estimates. Besides, there is a possibility of using both lagged levels and lagged differences of the exogenous X variables as other instrumental variables. Thus, the Arellano–Bond estimator is commonly said to be superior to Anderson–Hsiao, as it uses far more information and is thus more efficient. This method is defined as the Generalized method of moments (GMM) estimation of dynamic panel models.

The estimation of dynamic panels with GMM method allows eliminating the bias of simultaneity, the omission variable bias and reverse causality.

A likely fault in the Arellano–Bond estimator is considered in later works by Arellano and Bover (1995), and Blundell and Bond (1998). The lagged levels are, in fact, rather poor instruments for first-differenced variables, particularly as the variables are close to a random walk. Their alteration of the estimation method comprises lagged differences along with lagged levels overall.

The original estimator is often entitled Difference GMM, while the expanded estimator is commonly termed System GMM. The cost of the System GMM estimator involves a set of additional restrictions on the initial conditions of the process generating *Y*. In fact, System GMM is much more efficient than Difference GMM due to the validity of instruments and non-autocorrelation of error terms. However, it is necessary to be ensured for the absence of autocorrelation in first and second orders of first difference residuals. Consequently, the error terms are uncorrelated if we reject the null hypothesis of no autocorrelation of second order. The only drawback of System GMM is its exclusion of individual fixed and temporal effects (Baum, 2006).

Stata software is used in this analysis to estimate the models under consideration. The Difference and System GMM can be easily employed using the commands *xtabond* and *xtdpdsys* respectively. Indeed, both these GMM methods are complicated and can generate invalid and inefficient estimates if one uses them improperly.

Roodman (2006) introduced a new command that can solve any problems related with *xtabond* and *xtdpdsys*, and termed it as *xtabond2*. This command can do everything that the abovementioned two do and has numerous additional features. Using this command one can eliminate the problem of endogeneity among independent variables and avoid the collinearity of specific effects and lagged dependent variables. Moreover, *xtabond2* reports the Arellano—Bond test for autocorrelation and the tests of over-identifying restrictions in the regression output. Both Difference and System GMM can be performed by *xtabond2* command, even with the options of one and two step standard errors. Once the two-step variant is implemented, *xtabond2* compensates the regression using Windmeijer (2005) correction method. Baum (2006) specifies *xtabond2* as the best dynamic panel data estimator superior to other estimators. Therefore, this analysis refers to *xtabond2* command of David Roodman to estimate the effect of currency crises on economic growth and FDI. Conclusions are fully based on the *xtabond2* results with corrected standard errors.

5. Results and discussion

This section analyzes all the regression results obtained for both models under study and discusses them thoroughly. Primarily, the original Difference and System GMM methods are implemented to get the initial impression on the analysis. Further, after complicated procedure, the required *xtabond2* results are achieved. The econometric robustness check is performed to all these estimators. Then, using the available information and statistics, relevant comparisons and explanations are provided. As the results obtained from these estimation methods are significant and unbiased, this indicates that the conducted test and used models are appropriate and strong. To check for the robustness of the economic models used in this study, necessary robustness tests are applied to represent the validity of the current investigation.

5.1. The impact of currency crises on economic growth

The econometric form of Model 1 can be written as follows:

$$EconGrowth_{i,t} = \alpha_0 + \alpha_1 \times EconGrowth_{i,t-1} + \alpha_2 \times LaborPro_{i,t} + \\ + \alpha_3 \times PhysCap_{i,t} + \alpha_4 \times PopGrowth_{i,t} + \alpha_5 \times TradeOp_{i,t} + \\ + \alpha_6 \times LifeExp_{i,t} + \alpha_7 \times FDI_{i,t} + \alpha_8 \times CCrisis_{i,t} + \varepsilon_{i,t}. \quad (10)$$

Due to unreliability and inconsistency of simple *xtabond*, *xtdpdsys*, and *xtabond2* GMM outputs with one-step default estimation, the two-step estimations with robust standard errors are used in the analysis to get final consistent results for evaluation of the current study.

The reliable and unbiased results with a robustness feature are summarized in Table 2. From Difference and System GMM results, it can be inferred that there is a negligible difference in the estimated coefficients. Wald chi2(8) = 48.78 and Wald chi2(8) = 35.18 accordingly indicate that one can reject the hypothesis of at least one of the estimated coefficients being equal to zero and conclude that the goodness of fit of both models is significant overall. Arellano–Bond test for autocorrelation reports the results of first- and second-order autoregression in first differences with a null hypothesis of no serial correlation. Difference GMM provides results with the existence of serious autocorrelation in both orders, whereas from the System GMM output it is evident that there is almost no autocorrelation ($\Pr > z = 0.0509$) in first differences of AR(2). This is a good sign as Elitza Mileva (2007) states, since the test for AR(2) in first differences detects serial correlation in levels which is an imperative attribute of the results obtained. Hansen's J test of over-identifying restrictions is not available for both estimation methods. The dynamic panel bias analysis of Nickell (1981) warns that the number of instruments used in the regression must be less than or equal to the number of groups. In both estimators, the number of instruments is less than the number of groups, and thus estimated coefficients are said to be unbiased and consistent. All the coefficients match with the proposed expectations. However, the results for FDI, population growth, and human capital are statistically insignificant in *xtabond* output, while these series are complemented with gross capital formation in *xtdpdsys* results. In essence, both estimators prove that the relationship between EMPI (as proxy for currency crises) and GDP per capita growth (as proxy for economic growth) is negative.

Two-step robust option of *xtabond2* implements two-step System GMM with robust standard errors and enables one to get the finite-sample corrected two-step covariance matrix based on Windmeijer (2005). So as not to make it confusing for the reader, the results obtained from the abovementioned method are regarded as the output of "*xtabond2* GMM". Certainly, panel-specific heteroscedasticity and serial correlation are removed too while using this method. Thus, the results are slightly different from the original Difference and System GMM output. In fact, from Wald chi2(7) = 221.72, it is evident that the overall significance of

Table 2
Obtained results from Model 1.

Variables	GDP per capita growth (annual %)		
	Difference GMM two-step robust	System GMM two-step robust	*xtabond2* two-step robust
Human capital	$1.09e^{-05}$	$4.27e^{-05}$	$1.37e^{-05***}$
	($2.84e^{-05}$)	($8.84e^{-05}$)	($3.70e^{-06}$)
Gross capital formation (% of GDP)	0.139^{*}	0.105	0.101^{**}
	(0.0710)	(0.0673)	(0.0422)
Trade (% of GDP)	0.0526^{**}	0.0729^{***}	–0.00681
	(0.0266)	(0.0262)	(0.00531)
Life expectancy at birth, total (years)	-0.404^{**}	-0.265^{**}	-0.0563^{**}
	(0.157)	(0.115)	(0.0280)
Population growth (annual %)	–0.545	–0.674	-0.410^{***}
	(0.375)	(0.579)	(0.105)
FDI (% of GDP)	0.0363	0.0304	0.0272
	(0.0264)	(0.0257)	(0.0193)
EMPI	-0.598^{***}	-0.655^{**}	-1.240^{***}
	(0.215)	(0.261)	(0.324)
Constant	23.30^{**}	13.23	5.388^{***}
	(11.27)	(8.258)	(2.042)
Observations	554	627	696
Number of groups	71	71	71
Number of instruments	44	52	51
Wald Chi2	Wald chi2(8) = 48.78 Prob > chi2 = 0.0000	Wald chi2(8) = 35.18 Prob > chi2 = 0.0000	Wald chi2(7) = 221.7 Prob > chi2 = 0.0000
Arellano–Bond test for autocorrelation in first differences	AR(1): $z = -3.5689$ Pr > z = 0.0004 AR(2): $z = -2.0252$ Pr > z = 0.0428	AR(1): $z = -3.5962$ Pr > z = 0.0003 AR(2): $z = -1.9527$ Pr > z = 0.0509	AR(1): $z = -3.39$ Pr > z = 0.001 AR(2): $z = -1.68$ Pr > z = 0.092
Hansen *J*-test	–	–	Chi2(43) = 47.94 Prob > chi2 = 0.279

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

Model 1 is highly acceptable. Nickell bias is not present in this case, since 51 instruments along with 71 groups are used in the regression. Arellano–Bond autocorrelation test specifies that there is no serial correlation in levels, while the test for AR(1) process in first differences rejects the null hypothesis unsurprisingly. The Hansen's J statistic tests the validity of over-identifying restrictions in the context of *xtabond2* GMM. It checks whether the instruments in the regression as a group are exogenous (null hypothesis) or not (alternative hypothesis) (Hansen, 1982). The results show that the instruments used in the estimation are valid and exogenous on the whole.

All the estimated coefficients except that of trade are in conformity with the predicted signs. However, the results for trade and FDI are not statistically different from zero, whereas the coefficients of remaining variables are statistically significant at 5% significance level.

As predicted earlier, the association between labor productivity and economic growth is positive. The estimated coefficient of human capital is 1.37. It means that if human capital increases by one unit, GDP per capita growth should rise by that percentage point, holding everything constant. Thereby, one can state that increased labor productivity positively impacts on the growth of the economy.

One of the highest significant positive associations exists between gross capital formation and GDP per capita. Undeniably, capital formation has either direct or indirect positive effect on GDP of a particular economy through increasing the physical capital stock or promoting the technology correspondingly (Mankiw, 2009). The significant coefficient of 0.1011 validates that theoretical consideration. The predicted positive impact of physical capital on growth has, thus, been confirmed by these results.

The estimated coefficients for both life expectancy and population growth variables are negative and statistically significant at the same time. According to the literature reviewed, an increase in the life expectancy rate has either positive or negative impact on economic growth. The higher the life expectancy, the better are the living conditions of citizens, and the outcome is a growth in the amount of human and physical capital accordingly. However, this indicator has a considerable direct effect on population growth which is a negative factor for economic growth. From the results, it appears that the impact of life expectancy rate on GDP per capita growth is negative, meaning that this variable contributes to the growth of population substantially rather than increasing labor productivity and the volume of physical capital. Indeed, the size effect of population growth is –0.41 which is eight times lower than that of life expectancy rate, with –0.05625. This is the proof of negative association between population growth together with life expectancy and economic growth of the country.

Exchange market pressure index is used as proxy for currency crises. As predicted before, the results indicate a negative relationship between EMPI and GDP per capita growth. The estimated coefficient is –1.24, which means that if EMPI increases by one unit, the growth rate of GDP per capita should decrease by that proportion, holding all else constant. Thereby, one can conclude that the impact of currency crises on economic growth is negative.

To summarize, the results of *xtabond*, *xtdpdsys*, and *xtabond2* with robust standard errors are all unbiased and consistent within the econometric framework. In fact, all the estimated coefficients obtained from these three regressions are really similar to each other. This is the remarkable evidence for the unbiasedness of *xtabond2* results. If one gets absolutely different estimates of *xtabond2* as compared to that of other two estimators, this will indicate that there is a bias in the results and it will give misleading conclusions eventually. The superiority of *xtabond2* GMM is that it has specific remedial measures to several problems and inefficiencies that one can confront while using *xtabond* and *xtdpdsys*. Indeed, the coefficients of human capital and population growth are statistically insignificant in terms of the Difference and System GMM results; meanwhile *xtabond2* command gives significant estimates that match with the expected ones comparatively. The default in the above two may be due to the existence of autocorrelation in first-differenced residuals or lost waves of observations. Basically, the focal point is that the research interest of this study concerning the relationship between currency crises and economic growth can be confidently proved to be negative based on the significant results of all the three estimators.

5.2. The impact of currency crises on FDI

The following is the econometric form of Model 2:

$$FDI_{i,t} = \alpha_0 + \alpha 1 \times FDI_{i,t-1} + \alpha_2 \times EconGrowth_{i,t} + \alpha_3 \times TradeOp_{i,t} + \\ + \alpha_4 \times Infrastr_{i,t} + \alpha_5 \times HouseholdFCE_{i,t} + \alpha_6 \times EconStab_{i,t} + \\ + \alpha_7 \times LaborForce_{i,t} + \alpha_8 \times CCrisis_{i,t} + \varepsilon_{i,t}. \quad (11)$$

The same methodology is applied in order to test the effect of currency crises on FDI. The results of two-step *xtabond*, *xtdpdsys*, and *xtabond2* GMMs with the robustness properties are summarized in Table 3.

The estimated coefficients of the Difference GMM are all simultaneously statistically insignificant even at 10% significance level. However, Wald chi2(8)

Table 3
Obtained results from Model 2.

Variables	FDI (% of GDP)		
	Difference GMM two-step robust	System GMM two-step robust	*xtabond2* two-step robust
GDP per capita growth (annual %)	0.0913 (0.0671)	0.205 (0.153)	0.381^{***} (0.147)
Trade (% of GDP)	0.0564 (0.0548)	0.0268 (0.0832)	0.0672^{***} (0.0158)
Inflation	–0.0106 (0.0201)	0.0250 (0.0271)	–0.0372 (0.0383)
Mobile cellular subscriptions (per 100 people)	–0.00691 (0.0176)	0.00442 (0.0245)	–0.000940 (0.00924)
Household final consumption expenditure	–0.00488 (0.0471)	0.198 (0.159)	0.0672^{**} (0.0320)
Labor force participation rate	–0.0310 (0.167)	0.240 (0.200)	–0.0268 (0.0501)
EMPI	–0.0674 (0.0446)	-0.124^{*} (0.0677)	1.231^{**} (0.537)
Constant	1.467 (12.32)	-29.17^{***} (10.94)	–4.195 (3.612)
Observations	553	625	693
Number of groups	71	71	71
Number of instruments	44	52	51
Wald Chi2	Wald chi2(8) = 37.11 Prob > chi2 = 0.0000	Wald chi2(8) = 287.6 Prob > chi2 = 0.0000	Wald chi2(7) = 41.79 Prob > chi2 = 0.0000
Arellano–Bond test for autocorrelation in first differences	AR(1): $z = -1.1125$ Pr > z = 0.2659 AR(2): $z = -1.455$ Pr > z = 0.1457	AR(1): $z = -1.3809$ Pr > z = 0.1673 AR(2): $z = -1.4245$ Pr > z = 0.1543	AR(1): $z = -1.60$ Pr > z = 0.109 AR(2): $z = -1.56$ Pr > z = 0.120
Hansen *J*-test	–	–	Chi2(43) = 51.77 Prob > chi2 = 0.169

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

= 37.11 indicates that the overall goodness of fit of the model is highly significant. Arellano–Bond test for autocorrelation evidences that there is no serial correlation in first-differenced errors in both AR(1) and AR(2). Likewise, the results of the System GMM show also insignificant estimates for all variables except that for EMPI (significant at 10% significance level). Nevertheless, this significant coefficient does not match with the proposed expectations. The overall significance of the model can be expressed to be fitting based on Wald chi2(8) = 287.6. AR(1) and AR(2) results of Arellano–Bond test fail to reject the null hypothesis of no autocorrelation in first-differenced residuals. In fact, the output obtained from both estimators is unbiased and consistent, since the number of instruments is relatively less than the number of groups in the sample. However, these results are inefficient in many ways and do not allow one to reach relevant conclusions in the study. Thus, one can use Roodman's *xtabond2* GMM to get corrected, efficient, and unbiased results.

Xtabond2 estimation with two-step robust standard errors provides much more accurate and significant results overall. Estimated coefficients of four variables out of seven are statistically different from zero and all of them are in conformity with the expected correlation signs. The results for inflation (as proxy for economic stability), mobile cellular subscriptions (as proxy for infrastructure), and labor force participation rate (as proxy for labor force) are appeared to be statistically insignificant altogether. The regression model is significant overall, since Wald chi2(7) = 41.79 rejects the null hypothesis of one of the estimated coefficients being equal to zero. Autocorrelation is not present in first-differenced errors of both AR(1) and AR(2), and that can be confirmed by insignificant *p*-values of *Z*-statistic of the Arellano–Bond test. Hansen's J-statistic with Chi2(43) = 51.77 indicates that all the instruments used in the regression are, as a group, exogenous and valid. The number of instruments used in *xtabond2* GMM is less than the number of groups sampled, and thus the regression results implicitly avoid the warning of Nickell (1981).

One of the exogenous variables with significant estimates is GDP per capita growth as proxy for economic growth. As anticipated, the relationship between that variable and FDI is positive. The higher the economic growth in a country, the higher will be foreign investment inflows. Schneider and Frey (1985) and Gastanaga et al. (1998) find a significantly positive impact of economic growth on FDI, while Nigh (1985) obtains a weak positive association for developing countries and weak negative relationship for highly developed economies. Since the ongoing study takes emerging or developing economies as a sample on the whole, the extracted results from the regression concerning the effect of GDP per capita growth and FDI totally complete other previous works.

From the findings of Culem (1988) and Edwards (1990), one can expect a strong positive relationship between trade openness and FDI. Indeed, the *xtabond2* output indicates that the estimated coefficient of trade is equal to 0.0672 and it is statistically different from zero at 1% significance level. It can be concluded that there is a weak positive correlation between trade openness and FDI for emerging market economies.

As predicted earlier, the size effect of household final consumption expenditure is positive and statistically significant at 5% significance level. The more households consume in a country, the greater the opportunities to establish a new business, and thus, this factor will attract foreign investors considerably.

This study is mainly interested in exploring the possible association between currency crises and FDI. The estimated coefficient of EMPI is 1.231 and statistically significant at 5% significance level. It appears that if exchange market pressure index increases by one unit, FDI's share on GDP should increase by the achieved percentage point correspondingly. The results are in conformity with the findings of Mohamed Soliman (2005) discussed in the literature review section. Thereby, one can conclude that, in fact, the impact of currency crises on FDI might be positive, contrary to common belief. This is proof of the fact that FDI is indeed the most stable indicator of a particular economy.

From the findings on Model 2, it can be summarized that *xtabond2* GMM has provided efficient estimates matching with the predicted ones overall, while *xtabond* and *xtdpdsys* commands have failed to give significant results. Thus David Roodman's *xtabond2* maintains its superiority in comparison with other GMM estimators. The estimated coefficients of four variables in the model are statistically significant and provide necessary information to make relevant conclusions. For instance, the growth rate of GDP per capita appears to be the most important factor in increasing FDI. Overall, the results are both unbiased and consistent. It is of prime importance that the association between currency crises and FDI has turned to be positive and is in compliance with other researchers' findings.

5.3. Robustness testing

Robustness tests examine the stability of the baseline model's estimated coefficients to any kind of systematic model specification changes. One can refer to the robustness of results as a situation in which estimates from the robustness tests do not deviate considerably from the size effects of the baseline model. The number and variety of possible robustness tests is large and, if tiny details and small differences matter, potentially infinite. The research project and its design as well as the degree of uncertainty about specific modeling assumptions determine the choice of robustness tests. Not every possible robustness test is relevant for each research project. Specifically, five types of robustness tests can be distinguished: model variation tests, randomized permutation tests, structured permutation tests, robustness limit tests, and placebo tests. The most extensively used robustness tests in numerous academic works are model variation tests. They are flexible and can be applied to all dimensions of model uncertainty. Examples of model variation tests in the literature abound: the inclusion of additional control variables, changes in the sample, alternative measures of the regress and or main regressors, and alternative measurement scales or functional forms, dynamics, spatial dependence, and so on (Neumayer and Plümper, 2017).

This study performs the robustness check for both models under scrutiny using the methods of the inclusion of extra control variables and alternative measures of main explanatory variables correspondingly. The estimates achieved using *xtabond2* GMM, are used as baseline results. Robustness test-1 explores the influence of adding an extra control variable in the central economic model. Whereas, robustness tests 2 and 3 analyze the changes in the estimates while using alternative set of independent variables instead of the core ones. The following table performs the robustness check for Model 1 (Table 4).

Table 4
Robustness testing for Model 1.

Variables	GDP per capita growth (annual %)			
	Baseline results	Robustness test-1	Robustness test-2	Robustness test-3
Human capital	$1.37e^{-05***}$ ($3.70e^{-06}$)	$1.32e^{-05***}$ ($3.49e^{-06}$)	$1.41e^{-05***}$ ($3.28e^{-06}$)	$1.17e^{-05***}$ ($4.10e^{-06}$)
Gross capital formation (% of GDP)	0.101^{**} (0.0422)	0.105^{***} (0.0372)	0.0994^{**} (0.0396)	0.0836^{**} (0.0391)
Trade (% of GDP)	–0.00681 (0.00531)	–0.00750 (0.00550)	–	–
Life expectancy at birth, total (years)	-0.0563^{**} (0.0280)	-0.0755^{**} (0.0341)	-0.0769^{**} (0.0350)	–
Population growth (annual %)	-0.410^{***} (0.105)	-0.589^{***} (0.152)	-0.608^{***} (0.153)	-0.494^{***} (0.186)
FDI (% of GDP)	0.0272 (0.0193)	0.0380^{*} (0.0205)	0.0588^{*} (0.0308)	0.0740^{**} (0.0309)
EMPI	-1.240^{***} (0.324)	-1.161^{***} (0.350)	-1.189^{***} (0.354)	-1.177^{***} (0.362)
Gross savings (% of GDP)	–	0.00492 (0.0244)	–	–
Trade in services (% of GDP)	–	–	–0.0214 (0.0154)	–0.0220 (0.0174)
Health expenditure (% of GDP)	–	–	–	–0.0594 (0.104)
Constant	5.388^{***} (2.042)	6.802^{**} (2.655)	6.889^{***} (2.670)	2.113^{*} (1.172)
Observations	696	677	677	676
Number of groups	71	71	71	71

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

From the results, it is clear that changes in the specifications of Model 1 are not significantly differing from the baseline estimates, and thus, the economic model under consideration is said to be robust. In detail, all the statistically significant variables in the baseline model remained significant, even with relatively low *p*-values, after the change in specification. The estimated coefficients of EMPI in robustness tests, which is of prime importance in this investigation, are really similar to those of the baseline ones and statistically significant at 1% significance level.

The next table demonstrates the robustness check for Model 2 (Table 5). It is obvious that the estimates in robustness tests do not deviate much from the baseline results. The size effect of EMPI in the base model is significant at 5% significance level, and it has turned out to be statistically significant at 1% after the change in the economic model. However, the use of alternative measures of explanatory variables has caused household final consumption expenditure to be insignificant after all. Other estimates maintained the same in significance accordingly. Overall, one can conclude from the table that the economic model used in this analysis is robust and any changes in the model specification do not considerably change the estimated coefficients.

Table 5
Robustness testing for Model 2.

Variables	FDI (% of GDP)			
	Baseline results	Robustness test-1	Robustness test-2	Robustness test-3
GDP per capita growth (annual %)	0.381*** (0.147)	0.410*** (0.155)	0.443*** (0.139)	0.399*** (0.109)
Trade (% of GDP)	0.0672*** (0.0158)	0.0667*** (0.0164)	–	–
Inflation	–0.0372 (0.0383)	0.00518 (0.0315)	–0.0360 (0.0459)	–0.0226 (0.0372)
Mobile cellular subscriptions	–0.000940 (0.00924)	–0.00450 (0.00936)	0.00374 (0.00798)	0.0126 (0.0101)
Household final consumption expenditure	0.0672** (0.0320)	0.0780** (0.0354)	0.0119 (0.0197)	0.00255 (0.0260)
Labor force participation rate	–0.0268 (0.0501)	–0.0173 (0.0589)	–0.0375 (0.0538)	–
EMPI	1.231** (0.537)	1.320*** (0.507)	1.158*** (0.404)	0.929*** (0.313)
Profit taxes	–	–0.0673 (0.0665)	–	–
Trade in services (% of GDP)	–	–	0.160*** (0.0226)	0.169*** (0.0224)
Wage and salaried workers (% of total employment)	–	–	–	–0.0218 (0.0344)
Constant	–4.195 (3.612)	–4.494 (4.399)	2.107 (4.019)	0.709 (3.026)
Observations	693	607	674	674
Number of groups	71	71	71	71

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

6. Concluding remarks

The aim of this research is to analyze the impact of currency crises on economic growth and FDI. There exist three generation models of currency crises which are proposing speculative attacks, bad macroeconomic policies, and microeconomic weaknesses in an economy as the main sources of currency crises. Economies in currency crisis tend to run continuous current account deficits, undergo trade deficits, or borrow large amounts of capital from foreign investors. Due to the sources mentioned earlier, these capital inflows can become inconstant after some period and then, these may drive down exchange rates, exhaust foreign reserves, make interest rates rise, and sometimes may even generate temporary recessions (Dabrowski, 2002). These are all typical characteristics of a currency crisis, and thus there is no specific definition for this economic term.

In fact, there is limited literature specifically focusing on the relationship between currency crises and variables under consideration. Thus, a sufficient number of empirical findings concerning currency crises have been reviewed. Having analyzed the papers, one can realize that the possible impact of currency crises on economic growth is negative, whereas FDI is more likely stable or positively correlated with currency crises.

The annual panel data for the sample of 71 emerging economies have been extracted from the reliable sources for the time period 2005–2014. The data are balanced and contain only a negligible number of missing observations. Two separate models are used to analyze the effect of currency crises on economic growth and FDI. Overall, 12 variables are used for the econometric analysis. The correlation matrices for both models indicate that there is no multicollinearity problem among independent variables. As proxy for currency crisis, exchange market pressure index is employed. It can be calculated by means of several methods. The contemporary measure of currency crises by Pontines and Siregar (2008) has appeared to be the most operative option. It has detected 13 cases of currency crises in different economies over the span of a decade.

The empirical analysis has been conducted on the basis of the results of Generalized Method of Moments (GMM) estimators. Even though the Difference and System GMM results are inefficient and contain certain drawbacks, they are implemented to get the preliminary impression on the analysis. Efficient and unbiased estimates are achieved by applying the *xtabond2* command of David Roodman (2006). All the instruments used are valid and exogenous as a group (Hansen J-statistic). Autocorrelation is not present in first-differenced residuals of both AR(1) and AR(2). The validity of the current investigation has been checked using the model variation robustness tests. Overall, the estimated coefficients are significant in most cases and in conformity with the expected signs, and changes in the model specification do not considerably change the estimated coefficients.

To conclude, it can be affirmed that the effect of currency crises on economic growth and FDI is consistent with the proposed theories. This evidences the significance of used models and econometric tests altogether.

6.1. Policy implications and recommendations for further research

As mentioned before, currency crises negatively affect the whole economy in many ways, such as by raising interest rates, exhausting international reserves, devaluing the currency, and generating certain kinds of economic deficits. Therefore, possible root causes of currency crises mentioned in the literature review part must be analyzed vigorously and authorities should, in advance, plan several remedial actions and economic strategies to overcome these extreme collapses. Based on the results obtained from this study, several important policy implications can be suggested now. Due to the fact that FDI is considered as the most stable economic variable, even during crisis periods, governments should find ways to attract foreign investors to their countries, and thereby reduce the possibility of being affected adversely by severe external shocks. An increase in capital inflows significantly accelerates the growth rate of any economy, and after that, the negative impact of currency crises on economic growth can be offset eventually. Sound macroeconomic management should be carried out to attract foreign inflows indeed. Low rates of inflation, advanced infrastructure, balanced budget, and cheap labor force in a country are the prime factors affecting FDI positively and the elements maintaining investor expectations at stable levels. Besides, the choice of exchange rate regimes is an important element too. This is because applying pegs to an exchange rate can lead to a currency crisis ultimately. Therefore, the advantages of exchange rate flexibility should be also taken into account while making policy decisions. In addition, increases in human and physical capital can definitely improve the economy overall, and reduce the severity of currency crises. These require the allocation of large amounts of money by government for the purpose of enhancing the educational sector in a country and increasing wages so as to promote labor force. Once the determinants likely to influence economic growth positively achieve desired levels or rates of growth, then the negative effects of currency crises can be neutralized in any country.

In future research, one can use other measures of calculating exchange market pressure index which may give much more accurate results overall. In fact, due to unavailability of monthly data for all countries sampled, annual panel data are used in this study to calculate that index. If there were sufficient amount of data on a monthly basis for all selected economies, the results would be more accurate and efficient in many respects. Moreover, one can modify the methodology of this study in order to use different econometric estimators, such as instrumental variables regression or maximum likelihood estimation methods. Advanced robustness tests can be employed, so that the results obtained demonstrate the validity of both economic and econometric modeling. Besides, in addition to the exchange market pressure index, one can use the exchange market regime as a control variable in econometric models. This might provide much deeper analysis and new approaches into the issue under consideration.

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Appendix A

Table A1
The assumptions of the Salant–Henderson model.

No.	Assumptions
1	Mine owners have an initial gold stock $\overline{I}$ of unknown size which they extract without cost and sell in a competitive market.
2	The government possesses an initial stockpile of gold $\overline{G}$ that may be sold in a single auction in the next period with constant probability α, assessed by both mine owners and speculators.
3	Speculators have neither inventories nor storage cost and are free to buy and resell gold.
4	Consumers' demand for gold $D(.)$ is downward sloping with a choke price P_C above which demand is zero.
5	Agents are risk-neutral and act to maximize discounted expected profits.
6	P_t represents the price of gold which will emerge at time t in the absence of an auction while f_t is the real price resulting in case of a sale.
7	The stock of gold owned by the private sector at the beginning of period t in the absence of an auction is denoted S_t.
8	The timing of the auction is an exogenous random process.

Source: Zenker (2014).

Table A2
The assumptions of the Krugman model.

No.	Assumptions
1	The domestic country is a small economy and produces a single composite tradable good whose price is set on world markets. Hence, the *Purchasing Power Parity* (PPP) holds, that is $P = SP^*$, stating that the domestic price level P is determined by the exogenously given foreign price level P^* and the spot exchange rate S. Since it is also assumed that $P^* = 1$, the PPP simplifies to $P = S$.
2	Prices and wages are assumed to be fully flexible, whereby output is always at the full-employment level Y.
3	The balance of trade B which here is also the BOP is determined by the difference between output and spending, i.e. $B = Y - G - C(Y - T, W)$, with G being government expenditure, C being private consumption, and W being private wealth (all expressed in real terms). $C(.)$ is assumed to be increasing both in net income $Y - T$ and wealth W, that is $\frac{\partial C}{\partial Y}, \frac{\partial C}{\partial W} > 0$ and $\frac{\partial C}{\partial T} < 0$.
4	In the asset market, investors can choose between the two assets domestic and foreign currency which both yield zero interest. Hence, the real private wealth W of domestic residents is defined as the sum of the real value of their holdings of domestic money M and their holdings of foreign money F: $W = \frac{M}{P} + F$.
5	Since foreigners do not hold domestic money, M is also the outstanding stock of domestic money and the stock that domestic residents must be willing to hold in equilibrium.
6	With desired holdings of domestic money being proportional to wealth, the portfolio equilibrium condition is $\frac{M}{P} = L(\pi)W$ where π denotes the exogenous expected rate of inflation and, at the same time, of depreciation and $L(.)$ indicates the demand for domestic money which is assumed to be decreasing in π, i.e. $\frac{\partial L}{\partial \pi} < 0$.

Source: Zenker (2014).

Table A3
The assumptions of the Flood–Garber model.

No.	Assumptions
1	The domestic country is a small economy where the PPP $P(t) = S(t)P^*(t)$ holds, with $P(t)$ denoting the domestic and foreign price level and $S(t)$ the spot exchange rate at time t. The exogenous foreign price level $P^*(t)$ is set at a constant level P^*.
2	Agents are assumed to have perfect foresight. Therefore, the *Uncovered Interest Parity* (*UIP*) of the form $i(t) = i^*(t) + \frac{\dot{S}(t)}{S(t)}$ holds which states that the domestic interest rate $i(t)$ is determined by the exogenous foreign interest rate $i^*(t)$ plus the actual rate of depreciation of the exchange rate $\frac{\dot{S}(t)}{S(t)}$. For convenience, $i^*(t)$ is held constant at i^*.
3	Four assets are available to domestic residents: domestic money, domestic bonds, foreign currency, and foreign bonds. Whereas domestic money yields a monetary service to domestic residents, foreign money does not. Hence, domestic citizens will not hold foreign money, implying that foreign money is denominated in return by domestic money and by domestic and foreign bonds which are assumed to be perfect substitutes.
4	The government possesses a stock of foreign currency which is used to peg the value of the exchange rate at value $\overline{S}$.
5	The money market equilibrium condition is given by $\frac{M(t)}{P(t)} = \alpha_0 - \alpha_1 i(t)$ where $M(t)$ is the domestic money stock, and α_0 and α_1 denote parameters of the money demand with $\alpha_0, \alpha_1 > 0$.
6	The domestic money stock $M(t)$ must equal the book value of international reserves $R(t)$ plus domestic credit $D(t)$, that is $M(t) = R(t) + D(t)$.

Source: Zenker (2014).

Table A4
The assumptions of the Obstfeld model.

No.	Assumptions
1	Domestic output y is given by $y_t = \alpha(e_t - w_t) - u_t$ where e is the exchange rate, w is the money wage, and u is a mean-zero, serially independent employment shock affected also by foreign interest rates, demand shifts, etc.
2	Workers and firms are assumed to agree to set period t wages w_t on date $t-1$ in order to maintain a constant real wage, that is $w_t = E_{t-1}(e_t)$ where $E_{t-1}(.)$ indicates a conditional expectation based on date $t-1$ information. Since this information cannot include the unanticipated shock u_t, i.e. $E_{t-1}(u_t) = 0$, wages cannot adjust to period t demand shocks.
3	Again, the PPP $e = p - p^*$ holds, with p and p^* denoting the domestic and foreign price level. For convenience, the foreign price level p^* is constant and normalized to zero, so that $e_t = p_t$. This implies that the actual depreciation rate $e_t - e_{t-1}$ is equal to the actual inflation rate $p_t - p_{t-1}$.
4	The government is able to respond to demand shocks occurring in period t through a change in the contemporaneous exchange rate. Hence, it will attempt to follow stabilization policies. The government is assumed to temporarily manage its exchange rate freely with the objective of minimizing a loss function of the form $L_t = \sum_{s=t}^{\infty} \beta^{s-t}[\theta(p_s - p_{s-1})^2 + (y_s - y^*)^2]$, where the β is the government's discount factor and θ is the weight given to the inflation target, with $0 < \beta, \theta < 1$. The loss function penalizes deviations of inflation rates from a zero target and deviations of output from a constant target y^* which is assumed to be $y^* > 0$.
5	The model implicitly assumes perfect capital mobility, with the UIP condition holding, and perfect asset sustainability, so realignment represents the only form of monetary policy.

Source: Zenker (2014).

Table A5
The assumptions of Corsetti–Presenti–Roubini model.

No.	Assumptions
1	The domestic country is a small open economy specialized in the production of a traded good Y according to the aggregate Cobb–Douglas production function $Y = \tilde{A}_t K^{\alpha t} L^{1-\alpha}$ where K is physical capital, L is labor and $\tilde{A}_t$ is a stochastic technology parameter which is $\tilde{A}_t = A + \sigma$ or $\tilde{A}_t = A - \sigma$ with a probability of 0.5 each and $A > \sigma > 0$. Labor is inelastically supplied, and normalized to 1.
2	The asset market is assumed to be incomplete and segmented, with a fraction β of domestic agents who is called the *Elite* (*ELI*) benefiting from full access to capital markets while the remaining $1 - \beta$ agents, called *the Rest of the Country* (*ROC*), do not hold any assets. In contrast, the labor market is competitive for both ELI and ROC. Since ELI agents hold the entire stock of domestic real money balances which provide liquidity services, their expected utility is given by $E_t \sum_{s=t}^{\infty} \frac{1}{(1+\delta)^{s-t}} [C_s^{ELI} + \chi \ln\left(\frac{M_s}{P_s}\right)]$ where δ is the rate of time preference, C^{ELI} is the consumption by ELI, and $\frac{M}{P}$ is real money holdings.
3	ELI agents borrow funds from abroad and lend capital to domestic firms which are owned by the ELI itself. Furthermore, we assume the capital stock of the economy at some initial date t_0 to be entirely financed through external borrowing. The resulting aggregate budget constraint of ELI agents is given by $K_{t+1} - K_t - (D_{t+1} - D_t)\frac{\varepsilon_t}{P_t} = \beta W_t - \rho_t \frac{\varepsilon_t}{P_t} D_t - C_t^{ELI} - T_t^{ELI} - \frac{M_t - M_{t-1}}{P_t}$, where D denotes gross foreign debt, ρ—the cost of borrowing in real terms, T^{ELI}—net taxes paid by the ELI, ε is the nominal exchange rate, and W indicates the gross labor income in real terms which is defined as $W_t = (1 - \alpha)Y_t$.
4	Because ROC agents do not have access to the capital market, labor income represents the only source of wealth to them. Hence, the aggregate budget constraint of ROC agents is given by $(1 - \beta)W_t = C_t^{ROC} + T_t^{ROC}$ where C^{ROC} is consumption and T^{ROC} are net taxes of ROC.
5	Labor income of both ELI and ROC agents is assumed to be taxed at rate η_t such that $T_t^{ELI} + T_t^{ROC} = \eta_t W_t$.
6	A financial crisis is defined as an event occurring at time t_c where the conditions $\varepsilon_{t_c} \frac{D_{t_c}}{P_{t_c}} > K_{t_c}$ and $\varepsilon_{t_c+\tau} \frac{D_{t_c+\tau}}{P_{t_c+\tau}} = K_{t_c+\tau}$ for all $\tau \geq 1$ are satisfied, indicating that a financial crisis occurs when foreign creditors are unwilling to provide further credit so that the ELI firms would be forced to declare insolvency unless the government intervenes by absorbing the difference between foreign private liabilities and domestic capital.
7	The government implements tax and transfer policies and manages the stock of foreign reserves, under the hypothesis that it never defaults on its domestic or external liabilities. It is further assumed to borrow and lend in international financial markets at the market rate r which is constant and equal to the rate of time preference δ according to the assumption of a small open economy. The consolidated public sector budget identity is therefore $\frac{\varepsilon_t}{P_t}[(R_{t+1} - L_{t+1}) - (R_t - L_t)] = T_t^{ELI} + T_t^{ROC} + \frac{M_t - M_{t-1}}{P_t} + r\frac{\varepsilon_t}{P_t}(R_t - L_t)$, where R and L denote the assets and liabilities vis-à-vis the Rest of the world (ROW), both denominated in foreign currency.

Source: Zenker (2014).

Appendix B

Table B1
List of countries.

Albania	Bolivia	Costa Rica	Hungary	Lesotho	Mozambique	Philippines	Tajikistan
Algeria	Botswana	Croatia	India	Liberia	Myanmar	Qatar	Tanzania
Angola	Brazil	Dominican Republic	Indonesia	Malawi	Namibia	Romania	Thailand
Argentina	Brunei Darussalam	Egypt	Iraq	Malaysia	Nicaragua	Russia	Trinidad & Tobago
Armenia	Bulgaria	Fiji	Jamaica	Mauritania	Nigeria	Rwanda	Uganda
Bahrain	Burundi	Gambia	Jordan	Mauritius	Pakistan	Sierra Leone	Ukraine
Bangladesh	Chile	Guatemala	Kenya	Mexico	Panama	South Africa	Uruguay
Barbados	China	Haiti	Kuwait	Moldova	Paraguay	Sri Lanka	Venezuela
Belize	Colombia	Honduras	Kyrgyzstan	Mongolia	Peru	Swaziland	

Source: IMF (2012).

Table B2
Descriptive statistics.

	count	mean	sd	min	max	skewness	kurtosis
GDP per capita growth (annual %)	710	3.03	3.85	–14.42	18.30	–0.06	5.42
Human capital	710	1,815.6	15,662.5	1.16	178,992.77	8.99	85.57
Gross capital formation (% of GDP)	697	24.57	8.59	5.47	61.47	1.08	4.73
Trade openness	703	83.41	38.28	0.17	311.36	0.99	5.70
Life expectancy at birth. total (years)	710	68.18	8.07	43.60	79.42	–0.95	2.92
Inflation (annual %)	710	8.07	8.27	–27.63	103.82	2.73	30.17
Mobile cellular subscriptions (per 100 people)	708	78.33	41.26	0.26	218.43	0.10	2.38
Household final consumption expenditure (% of GDP)	695	67.40	21.74	13.07	228.36	1.40	12.72
Labor force participation rate (% of total population ages 15+)	710	62.82	9.71	39.20	86.90	0.18	3.09
Population growth (annual %)	709	1.73	1.81	–1.67	16.33	3.35	23.33
FDI (as % of GDP)	710	5.11	7.00	–15.99	84.95	4.60	36.76
EMPI	710	–0.04	1.86	–12.44	26.63	3.59	66.93

Source: Stata auto database.

Table B3
Correlation matrix for Model 1.

	GDP per capita growth	Human capital	Gross capital formation	Trade	Life expectancy rate	Population growth	FDI	EMPI
GDP per capita growth	1							
Human capital	0.0754^{*}	1						
Gross capital formation	0.228^{***}	0.0886^{*}	1					
Trade	–0.0597	$–0.0840^{*}$	0.105^{**}	1				
Life expectancy rate	$–0.0833^{*}$	0.0894^{*}	0.165^{***}	0.0780^{*}	1			
Population growth	$–0.166^{***}$	–0.0608	0.0347	0.0436	$–0.180^{***}$	1		
FDI	0.103^{**}	–0.0627	0.284^{***}	0.319^{***}	–0.0323	0.0132	1	
EMPI	$–0.228^{***}$	–0.00083	0.0248	$–0.121^{**}$	0.0249	–0.0275	–0.0220	1

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Stata auto database.

Table B4
Correlation matrix for Model 2.

	FDI	GDP per capita growth	Trade	Inflation	Mobile cellular subscriptions	Household final consumption expenditure	Labor force participation rate	EMPI
FDI	1							
GDP per capita growth	0.103^{**}	1						
Trade	0.319^{***}	–0.0597	1					
Inflation	–0.0344	0.132^{***}	$–0.155^{***}$	1				
Mobile cellular subscription	–0.0103	$–0.248^{***}$	0.201^{***}	$–0.180^{***}$	1			
Household final consumption expenditure	0.265^{***}	0.00961	0.0977^{**}	0.0294	$–0.332^{***}$	1		
Labor force participation rate	$–0.125^{***}$	0.0517	$–0.159^{***}$	–0.00812	$–0.164^{***}$	$–0.142^{***}$	1	
EMPI	–0.0220	$–0.228^{***}$	$–0.121^{**}$	0.0563	0.122^{**}	0.0143	–0.0052	1

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Stata auto database.