Economics Bulletin

Volume 30, Issue 1

Does exchange rate policy matter for economic growth? Vietnam evidence from a co-integration approach

Thi hong hanh Pham
University of Rouen

Duc thinh Nguyen
Ministry of Planning and Investment of Vietnam

Abstract

Both economic growth and exchange rate theories suggest that the exchange rate regime could have consequences for the medium-term growth of a country, directly, through its effects on the adjustment to shocks, and indirectly, through its impact on the important determinants of growth. It is, however, surprising that there was little empirical work investigating the indirect relationship between the exchange rate policy and economics growth in the case of a specific country. In a co-integration framework, our research attempts to fill the gap by econometrically investigating the possible impacts of exchange rate regime on economic growth through two main channels - Foreign direct investment (FDI) and Exports - in the case of Vietnam - a successful example of a transitional economy.

Citation: Thi hong hanh Pham and Duc thinh Nguyen, (2010) "Does exchange rate policy matter for economic growth? Vietnam evidence from a co-integration approach ", *Economics Bulletin*, Vol. 30 no.1 pp. 169-181.
Submitted: Dec 17 2009. **Published:** January 11, 2010.

1. Introduction

An important question of ongoing debate in international economics is whether the exchange rate policy influences economic growth. Both economic growth and exchange rate theories suggest that the exchange rate policy could have consequences for the medium-term growth of a country, directly, through its effects on the adjustment to shocks, and indirectly, via its impact on other important determinants of growth, such as foreign investment, international trade. Ghosh et al. (1997) tested for this relationship in a sample of 136 countries over the period 1960 – 1989. They find no systematic differences in growth rates across exchange rate regimes. This result was confirmed over the extending period from 1960 to the mid-1990s by the International Monetary Fund (IMF) (1997). Bailliu et al. (2001), in a study of 25 emerging market economies over the period 1973-1998, report a positive linkage between the degree of exchange rate flexibility and economic growth. Levy Yeyati and Sturzenegger (1999) find that less flexible exchange rate regimes are associated with slower growth in developing countries. They suggest, however, that the exchange rate regime has no significant impact on growth in the case of industrialized countries.

A further problem relating to this literature is that it focuses on the nominal exchange rate rather than the real exchange rate (RER). Moreover, it is surprising that there was little empirical work investigating indirect relationship between the exchange rate policy and economics growth in the case of a specific country. We, therefore, attempt to fill the gap by econometrically testing for the indirect linkages between RER and economic growth in a co-integration framework through the RER impacts on two important determinants of growth, foreign direct investment (FDI) and Exports in the case of Vietnam, which is a successful example of a transitional economy, over the period 1990-2007.

We begin our empirical research with a test for the possible linkages among RER, Exports and FDI, which is performed in three steps. The first one is to test for the presence of unit root in each variable. The second one, having established the order of integration, employs the heterogeneous panel co-integration technique developed by Pedroni (1999) to investigate the long run co-integrated relationships between the variables in question. In the last step, the Fixed-effects model will be used to assess explicitly the channels through which the variables studied can affect each other. In order to reinforce our suggestion that RER policy may indirectly influence economic growth via exports and FDI channels, we also perform an additional Granger causality test among three variables: Exports, FDI and growth.

The paper's remainder is organised as follows. Section 2 provides a brief data description. Section 3 specifies the methodology employed and analyses the empirical results. Section 4 discusses Vietnam's exchange rate reform and its impacts on economic growth. Section 5 concludes the paper.

2. Data

As stated above, our paper provides two separate analyses. The first one investigates the linkages among RER, FDI and Exports. In order to affirm that RER can indirectly influence Vietnam economic growth through FDI and exports channels, the second one will test for the possible relationships among FDI, exports and Vietnam economic growth.

Firstly, to evaluate the impacts of RER on FDI and exports, we use the panel annual data from 1990 to 2007 covering FDI inflows, exports and bilateral RER between Vietnam and its ten partner countries: Japan; The U.S.; France; Thailand; Singapore; Australia; Malaysia; Hong Kong SA; Taiwan; Korea. All variables are transformed into logarithms and identified as follows:

- EX_t^i: Exports from Vietnam to country i at year t in million constant US dollars 1995 (source: Vietnam Ministry of Industry and Trade);
- FDI_t^i: Foreign direct investment flows into Vietnam from country i at year t in million constant US dollars 1995 (source: Vietnam Ministry of Planning and Investment). In this

work, we use the implemented FDI inflows data. The reason is that many foreign investors that invested in Vietnam during the period failed to register their projects with the Ministry of Planning and Investment in advance. They registered their investment projects in the following years after they started the projects. This reason explains why the officially registered FDI cannot be used as a consistent and accurate measurement for FDI activities in Vietnam for our work and also for other rigorous researches.

- RER_t^i: Bilateral real exchange rate between Vietnam and country *i* at year *t*, which is calculated as the product of the nominal exchange rate and relative price levels in each country. The real exchange rate between foreign country *i* and Vietnam at time *t* is thus:

$$RER_t^i = e_{i,t} \times \frac{p_{i,t}^*}{p_t^{VN}} \qquad \textbf{(1)}$$

where p_t^{VN} is the price level of Vietnam, $p_{i,t}^*$ is the price level in foreign country *i*, and e_i is the nominal exchange rate (IMF, International Financial Statistics, line 00rf) between the VN dong and the currency of foreign country *i*. e_i is expressed as the number of VN dong units per foreign currency unit, so that e_i rises with an depreciation of Vietnam currency. *Equation 1* suggests that we should expect to find a positive coefficient on the real exchange rate in all estimated regressions, where an increase in the bilateral real exchange rate represents a real depreciation of the VN dong. To construct bilateral RER between Vietnam and foreign country, we use the most commonly used price series that are consumer price indices (CPI) (IMF, International Financial Statistics, line 64, base year 1995). These have the advantage of being timely, similarly constructed across countries and available for a wide range of countries over a long time span.

- GDP_t^i: GDP of country *i* at year *t* in million constant US dollars (source: United Nations Division Statistics).

Secondly, to explore the relationships among economic growth, FDI, and exports, our analysis is based on the aggregate quarterly data covering FDI flow into Vietnam, exports and real GDP Vietnam from 1990 to 2007. Three variables are identified as follows:

- EX_t : Vietnam total exports of goods and services at the time *t*;
- GDP_t : Vietnam GDP at the time *t*,
- FDI_t : FDI flow into Vietnam at the time *t*.

All of these three variables are also transformed into logarithms and measured at constant price. Aggregate data on FDI are obtained from the Foreign Investment Agency, Ministry of Planning and Investment (FIA – MPI). Aggregate data on GDP and exports are collected from the annual reports of General Statistics Office (GSO).

3. Methodology and empirical results

3.1. Relationship among RER, FDI and Exports

Firstly, we examine the presence of unit root in our panel data. Secondly, having established the order of integration, we use the heterogeneous panel co-integration technique developed by Pedroni (1999) to investigate the possible long-run co-integrated relationships among the variables in question. In the last step, the Fixed – effects model will be performed.

3.1.1. Panel unit root tests

Unit root tests are traditionally used to test for the order of integration or to verify the stationarity of the variables. Among many recent methods, the panel unit root tests of Levin, Lin and Chu (2002) (LLC test) and Im, Pesaran and Shin (1997) (IPS test) are the most popular. Both of these tests are based on the ADF principle. The LLC test assumes homogeneity in the dynamics of the autoregressive (AR) coefficients for all panel members. In detail, the LLC test assumes that each individual unit in the panel shares the same AR(1) coefficient, but allows for individual effects, time effects and possibly a time trend. Lags of dependent variable may be introduced to allow for serial correlation in the errors. This test may be viewed as a pooled Dickey-Fuller test, or an Augmented Dickey-Fuller (ADF) test when lags are included, with the null hypothesis that of non-stationarity (I(1) behavior). After transformation, the t-star statistic is distributed standard normal under the null hypothesis of non-stationarity. The IPS test is more general than the LLC test because of allowing for heterogeneity in dynamic panel. Therefore, it is called as a "Heterogeneous Panel Unit Root Test". It is particularly reasonable to allow for such heterogeneity in choosing the lag length in the ADF test when imposing uniform lag length is not appropriate. In addition, the IPS test allows for individual effects, time trends, and common time effects. Based on the mean of the individual Dickey-Fuller t-statistics of each unit in the panel, the IPS test assumes that all series are non-stationary under the null hypothesis. Lags of the dependent variable may be introduced to allow for serial correlation in the errors. The exact critical values of the t-bar statistic are given in IPS test. The IPS test has thus considered a technique, which has higher power than other tests, including the LLC test. Statistic results of LLC test and IPS test are reported in *Table 1*.

In the LLC test for the levels of FDI and exports, the small negative statistics values for each variable do not exceed the critical values (in absolute terms). However, when we take the first difference of each variable, the large negative LLC statistics indicate rejection of the null of non-stationarity at least 5% level of significance for all variables. Given the short span of the individual series, we are more confident to accept the more powerful IPS panel test results, which also support that all variables are only stationary after being differenced. According to the LLC and the IPS results, we conclude that all variables are non-stationary and integrated of order one in level but integrated in order zero in their first difference at least 5% significance level. Having established that FDI, GDP, RER and Exports series are integrated of the first order, the panel co-integration approach is employed to determine the nature of the long-run relationship.

3.1.2. Panel co-integration

Dealing with panel co-integration test, most of the recent researches utilised the heterogeneous panel co-integration technique developed by Pedroni (1999). This technique allows different individual cross-section effects by allowing for heterogeneity in the intercepts and slopes of the co-integrating equation, and makes use of a residual-based ADF test. The Pedroni test for the co-integrated relationship, for example among FDI, bilateral RER and Vietnam exports, is based on the estimated residuals from the following long-run model:

$$\Delta FDI_t^i = \beta_{0i} + \beta_{1i}\Delta EX_t^i + \Delta GDP_t^i + \Delta RER_t^i + \varepsilon_{1it} \qquad \textbf{(2)}$$

where $i = 1,...,10$ countries and $t = 1,...,18$ period observations. The term Δ is the difference operator. The term $\varepsilon_{1it} = \rho_{1i}\varepsilon_{i(t-1)} + \xi_{1it}$ is the deviations from the modeled long-run relationship. If the series are co-integrated, ε_{1it} should be a stationary variable. The null hypothesis of Pedroni procedure is whether ρ_i is unity. In addition, the Pedroni technique permits to test for the possible co-integrated relationship in four different models: Model with heterogeneous trend and ignoring common time effect (**M1**); Model without heterogeneous trend ignoring common time effect (**M2**); Model with heterogeneous trend allowing common time effect (**M3**); Model without heterogeneous trend allowing common time effect (**M4**). All of the Pedroni's statistics under different model specifications are reported in *Table 2*.

The Pedroni results include seven different statistics in two groups. The first group is termed "within dimension" including: the "panel v-stat" and the "panel rho-stat" are similar to the Phillips and Perron (1988) test; the panel pp-stat (panel non-parametric) and the "panel adf-stat" (panel parametric) are analogous to the single-equation ADF-test. The second group calling "between dimensions" is comparable to the group mean panel tests of Im et al. (1997). This group includes three tests: group rho-stat; group pp-stat; and group adf-stat. The test statistics reject the null hypothesis of absence of co-integration at 1% of significance level for both FDI and Exports regressions. We can, therefore, conclude the long-run co-integrated relationship among the variables studied. Moreover, we notice substantially larger panel co-integration statistics in the FDI regression, meaning that more perceptible and strong correlation between FDI flows into Vietnam and bilateral RER.

3.1.3. Fixed – effects estimation

The previous section concluded a long-run co-integrating relationship among the variables, but did not indicate the channels through which these variables may interact. Applying the Fixed – effects estimation, this section discusses our empirical findings on the linkages among bilateral RER, FDI and exports of Vietnam. In the FDI regression, the dependent variable is value of FDI flows into Vietnam. Independent variables include GDP and lagged GDP of the FDI home country, exports and lagged exports from Vietnam to the FDI home country, bilateral RER and lagged bilateral RER between Vietnam and the FDI source country. In the exports regression, the dependent variable is exports from Vietnam to its FDI source countries. Independent variables include both contemporaneous and lagged values of bilateral RER, FDI flows into Vietnam and GDP of the FDI source country. In each of two regressions, we add a dummy variable *DU* accounting for the appearance of Asia financial crisis, which obviously affected Vietnamese economy and its trade partners. This dummy takes the value of 1 from 1997 to 1999, and 0 in all other period. The Fixed – effects estimations over the full panel is presented in Table 3.

Beginning with discussion on the FDI regression's results, we find that when Vietnam currency depreciate with respect to the foreign currency (for example, when RER_{t-1}^{i} increases), there is a corresponding increase in FDI. In detail, 1% depreciation in the VN dong causes an increase in FDI into Vietnam of 0.92%. There are several possible channels through which bilateral RER may affect FDI. In Vietnam, the most important channel is that a depreciation of the bilateral real exchange rate reduces the cost of domestic labour (and other productive inputs) relative to foreign production costs. The depreciation increases labour demand and employment, thereby raising the return on capital. Thus, an increase in FDI in to response to a money depreciation. This issue is consistent with a positive value of the bilateral RER's coefficient in the FDI regression, meaning that an increase in the bilateral RER represents a real depreciation of the VN dong. Moreover, the bilateral RER may also affect FDI into Vietnam through an imperfect capital markets channel. In this case, a real depreciation of Vietnam currency raises the wealth of foreign investors relative to that of domestic investors and thereby increases FDI. This channel also has the prediction that a real depreciation increases FDI. The imperfect capital markets channel for RER effects may be more relevant in merger and acquisition bids than in the green-field investments which prevail in Vietnam. Turning to the exports regression, our results also show that a RER depreciation has the positive expected effect on Vietnam exports: 1% depreciation of lagged RER (RER_{t-1}^{i}) or contemporaneous RER (RER_{t}^{i}) with respect to the foreign currency causes an increase in exports from Vietnam of 0.58% or 0.27%, respectively.

Additionally, the Fixed-Effects estimation provide other important findings. Firstly, a rise of 1% in lagged GDP of the FDI home country may cause 0.18% increase of FDI into Vietnam and 0.22% increase of exports from Vietnam. Secondly, our result suggests that during the Asian financial crisis period, FDI into Vietnam and Vietnam exports decrease 15% and 29%, respectively. Finally, we find out a weakly causal linkage between FDI flows into Vietnam and exports from Vietnam to the FDI home country. This result suggests an open question whether FDI into Vietnam plays an important role in promoting the exports from Vietnam to other countries and does not aim at increasing the exports from Vietnam to the FDI home country. We leave this issue for our future research.

3.2. Relationship between economic growth, FDI and exports

In this section, we investigate the Granger causality among GDP, FDI and exports. Similar to the previous section, our investigation is performed in three steps: Unit root test; Co-integration test and Granger causality test for three time series variables: EX_t, FDI_t, GDP_t.

3.2.1. Time series unit root test

The Augmented Dickey-Fuller test (ADF) (1979), the Phillips-Perron test (PP) (1988), the Kwiatkowski–Phillips–Schmidt–Shin test (1992) (KPSS), and the Zivot and Andrews test (1992) (ZA) are used to verify the stationarity of GDP, FDI and EXP variables. The ADF and the PP tests consider the existence of a unit root as the null hypothesis against the alternative that the series has no unit roots. The KPSS test differs from ADF test and PP test by having a null hypothesis of stationarity. In the literature, the KPSS test is sometimes used to verify the results of ADF and PP because their probability of rejecting the false hypothesis is low. To capture the effect of any possible structural break over the estimation period, the ZA endogenous structural break test is used, which is a sequential test which utilizes the full sample and uses a different dummy variable for each possible break date. The null hypothesis of the ZA test is that the variables contain a unit root with a drift that excludes any structural break, while its alternative hypothesis is that the series is a trend-stationary process in which a one-time break in the trend variable occurs at an unknown point in time. The ADF, PP and KPSS results are reported in *Table 4* and the minimum t-statistics of the ZA test are reported in *Table 5*.

The ADF, PP and KPSS statistics allow us to conclude that all variables are non-stationary and integrated of order one in level but integrated of order zero in first difference at 1 % level of significance. In the other hand, following the ZA results, we observe that the estimated breakpoint for EXP series is in December, 1996, for GDP series is in April, 1997 and for FDI series is in January, 1998. These results coincide with the appearance of Asian financial crisis in 1997, which obviously affected the exports, FDI and then economic growth of Vietnam.

3.2.2. Johansen Co-integration test

Since the variables under consideration are non-stationary, we apply the Johansen (1988) maximum likelihood method within a vector autoregressive (VAR) framework determine the nature of the long-run relationship among the variables of interest. Before testing for the Johansen co-integration, we choose the lag length or order of the VAR framework by using the Akaike Information Criterion (AIC) and Schwarz Bayesian Information Criterion (SBIC)[1]. The AIC and SBIC tests (see *Table 6*) have both chosen a VAR model with two lags (p = 2). After choosing the optimal lag, the Johansen co-integration procedure is employed to determine the number of co-integration equations *r* in a vector error correction model (VECM).

We begin with discussion on results from the model ignoring deterministic trend. Because the trace statistic at r = 0 of 55.08 exceed their critical values 29.68, we reject the null hypothesis of no co-integrating equations. In contrast, since the trace statistics at r = 1of 6.00 is less than its critical value 18.17 we cannot reject the null hypothesis that there are one or fewer co-integrating equations. Since Johansen's method for estimating *r* is to accept as $\hat{r}$ the first *r* for which the null hypothesis is not rejected, we accept *r* = 1 as our estimate of the number of co-integrating vectors among GDP, EXP and FDI variables. Irrespective of the choice of deterministic trend, there is also strong support for one co-integrating vector, since the trace statistics at r = 0 of 59.92 exceed their critical value 34.55. In sum, the presence of deterministic trend did not change the nature of at least one long-term relationships between the variables studies.

[1] A brief outline of the AIC, the SBIC and the Johansen procedure is presented in Appendix A and Appendix B.

3.2.3. Granger causality test

Having established a long-run co-integrating relationship, the Granger causality tests will be performed with all variables transformed into first differences and including an error correction mechanism (ECM). To investigate the causal relationship between three variables, the test involves specifying a multivariate k^{th} order VECM as follows:

$$(1-L)\begin{bmatrix}\ln FDI_t \\ \ln EXP_t \\ \ln GDP_t\end{bmatrix} = \begin{bmatrix}\alpha_1 \\ \alpha_2 \\ \alpha_3\end{bmatrix} + \sum_{i=1}^{k}(1-L)\begin{bmatrix}\beta_{11i} & \beta_{12i} & \beta_{13i} \\ \beta_{21i} & \beta_{22i} & \beta_{23i} \\ \beta_{31i} & \beta_{32i} & \beta_{33i}\end{bmatrix}\begin{bmatrix}\ln FDI_{t-i} \\ \ln EXP_{t-i} \\ \ln GDP_{t-i}\end{bmatrix} + \begin{bmatrix}\delta_1 \\ \delta_2 \\ \delta_3\end{bmatrix}\left[ECT_{t-1}\right] + \begin{bmatrix}\varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t}\end{bmatrix} \quad \textbf{(3)}$$

In addition to the variables defined above, *(1-L)* is the lag operator, ECT_{t-1} is the lagged error-correction term derived from the long-run co-integrating relationship between the variables studied (this term is not included if the variables are not co-integrated) and $\varepsilon_{1t}, \varepsilon_{2t}$ and ε_{3t} are serially independent random errors with mean zero and finite covariance matrix. In this model, the dependent variable is regressed against past values of itself and other variables. The significance of the vector of coefficients β, which ca be tested by Wald test, implies the short-run Granger causality. Long-run causality, on the other hand, can be investigated by testing for the significance of coefficients δ by t-test value. We use the same lag length found in the Johansen co-integration test ($p = 2$) in testing for Granger causality in order to maintain consistency with the co-integration rank estimation. The *F*-statistics in each model indicates the statistical significance of the short-run causal effect. The *t*-statistics indicates the statistical significance of the long-run causal effect. *Table 8* reports results of Granger causality tests.

In the model studied, the null hypothesis that the exogenous variables do not “Granger cause” the endogenous variable in the short-run is rejected since the *F* statistics on the explanatory variables exceed its critical value at the 5% level or better. We can thus conclude that there is bidirectional Granger causality between three variables in question. For the long-run, the *t*-statistics values show that there is also a bidirectional causality between GDP, FDI and EXP variables. This result suggests that FDI inflows and exports are two important determinants of the Vietnamese economic growth. Moreover, we can argue that FDI into Vietnam is oriented to exports or in the other words, FDI inflow encourages Vietnamese exports. This finding is consistent with the theory by Helpman (1984) that the headquarters tend to export capital equipment and factors services, such as R&D, to the host country, and in return, the host country exports input resources to the home country. In sum, our major finding is that the RER regime has positive effects on attracting FDI and promoting exports, which, in turn, encourage Vietnam’s economic growth. Hence, in the next section, we briefly present some ideas which may be relevant to evaluating Vietnam’s exchange rate reforms.

4. Vietnam Exchange rate regime: Reform and Current Problems

Before the “Doi Moi” Reform, Vietnam had triple-digit inflation (774 % per annum in 1986), multiple exchange rates, and a rapidly depreciating currency in the parallel market. In the early 1990s, Vietnam began to overcome these problems by containing inflation and stabilizing its currency. In the final stage of disinflation, the State Bank of Vietnam (SBV) kept the VND/USD exchange rate at around 11,000 from late 1991 to early 1997. The exchange rate was, moreover, virtually fixed at that level from early 1994 to late 1996. This “11,000 VND policy” can be interpreted as an attempt to secure lasting price stability by the discipline of a dollar peg. This reform in the exchange rate finally succeeded in reducing inflation to a very low level. However, the side effect of this policy was gradual overvaluation. From the 1996 summer, the SBV began to effectively depreciate VND by broadening the bandwidth around the official central rate. During the 1997 Asian financial crisis, VND became overvalued relative to the regional currencies which fell sharply, while Vietnam was not directly attacked by speculators. The exchange rate band was further broadened to ±5% in February 1997 and to ±10% in October 1997. In February 1998, the official central rate itself was devalued from 11,175 to 11,800 VND/USD. These adjustments brought the actual exchange rate to 12,980, at the most depreciated end of the revised band. In February 1999, the SBV introduced a new exchange rate mechanism. The central rate was now set daily at the average of interbank exchange rates on the previous transaction day with a very narrow band of ±0.1%. With this mechanism, VND started to crawl (depreciate) very slowly towards the present level of around 15,600 (December 2003) and around 16,073 in 2007.

Reforms in exchange rate regime have significantly positive consequences for Vietnam's economic growth through its impacts on FDI and exports. More precisely, from *Figure 1*, we can observe that economic growth, exports and FDI into Vietnam have been stimulated by a RER depreciation. This indicates the success of Vietnam in improving the efficiency of exchange rate regime in a way that contributes to significant or consistent economic growth.

Although of success in improving the efficiency of exchange rate regime, the current exchange rate mechanism of Vietnam based on averaging of the previous day's interbank exchange rates is imperfect since it is merely a technical procedure without analytical linkage with economic fundamentals. Since exchange rate policy is not defined in terms of economic fundamentals, it is hard to evaluate whether or not the current level of VN Dong is appropriate. Vietnam, therefore, needs to reformulate its exchange rate policy in a way that clarifies its economics objectives, which may be include the following: (*i*) Competitiveness; (*ii*) Price Stability; (*iii*) Domestic financial stability; (*iv*) Minimizing the impact of various external shocks; (*v*) Stimulating growth, capital accumulation particularly FDI.

Basing these economic objectives, Vietnam must adapt its policy goals to initial conditions and changing circumstances but cannot pursue all these goals simultaneously. Just becoming 150th member of WTO, mixing the two most fundamental goals of competitiveness and price stability should actually the most basic strategy for Vietnam. Hence, these two goals are achieved, Vietnam may orient to the fifth goal of stimulating growth and FDI. However, competitiveness and price stability goals are conflicting requirement. Because competitiveness requires flexible adjustment of the exchange rate to eliminate overvaluation, but price stability requires using the nominal exchange rate. In order to achieve simultaneously competitiveness and price stability, the budget and money must be under control, the domestic economy is healthy, and no serious external shocks exist. In other word, the current issue for Vietnamese policy makers is to choose an exchange rate mechanism, which Vietnam should adopt to achieve the best mix of exchange rate flexibility and stability.

5. Closing remarks

Several conclusions can be drawn from our research. Firstly, our research provides a number of statistically significant linkages among FDI, RER and exports of Vietnam. On one hand, a real depreciation of Vietnam dong with respect to the foreign currency increases both FDI into Vietnam and exports from Vietnam. On the other hand, we also find an evidence of a causal relationship between FDI and Vietnam exports. This linkage puts evidence on the export-oriented FDI policy of the Vietnamese government and the role of Vietnam exports growth in attracting FDI in Vietnam. Our second major finding supports a strong causal link running from exports and FDI to economic growth, and vice versa. This means that the Vietnamese government has succeeded in the export-oriented development strategy and in attracting FDI inflows to promote economic growth. Thirdly, this set of relationships allows us to conclude the determinant role of exchange rate policy in encouraging Vietnam economic growths through two main channels – FDI and Exports. For conclusion, our paper can be seen as a complement to the recent empirical studies since it investigates the relationships among economic growth, bilateral real exchange rate, foreign direct investment and exports at once.

References

Akaike, H. (1973) “Information theory and an extension of the maximum likelihood principle” in *Second International Symposium on Information Theory* by B.N. Petrov and F. Csaki, Eds., Akademiai Kiado: Budapest, 267–281

Bailliu, J., Lafrance, R. and Perrault, J.F. (2001) “Exchange Rate Regimes and Economic Growth in Emerging Markets.” In *Revisiting the Case for Flexible Exchange Rates*, 317–45. Proceedings of a conference held by the Bank of Canada, November 2000. Ottawa: Bank of Canada

Dickey, D.A. and Fuller, W.A. (1979) “Distribution of the estimators for autoregressive time series with a unit root” *Journal of the American Statistical Association*, 74(366), 427-431.

Ghosh, A-M.G. and Wolf, H. (1997) “Does the Nominal Exchange Rate Regime Matter?” NBER working paper number 5874

Granger, C.W.J. (1969) “Investigating Causal Relations by Econometric Models and CrossSpectral Methods” *Econometrica* **35**, 424-438.

Helpman, E. (1984) “A Simple Theory of International Trade with Multinational Corporations” *Journal of Political Economy* **92**, 451 - 471.

Im, K., Pesaran, M. H. and Shin, Y. (2003) “Testing for unit roots in heterogeneous panels” *Journal of Econometrics* **115(1**), 53–74.

International Monetary Fund (1997) “Exchange Rate Arrangements and Economic Performance in Developing Countries.” In *World Economic Outlook*, October, Chapter 4. Washington, D.C.: International Monetary Fund

Johansen, S. (1988) “Statistical analysis of co-integration vectors” *Journal of Economic Dynamics and Control* **2**, 231 - 254.

Kwiatkowski D., Phillips P.C.B., Schmidt P. and Shin Y. (1992) “Testing the Null Hypothesis of Stationary against the Alternative of a Unit Root. How Sure Are We that Economic Time Series Have a Unit Root?” *Journal of Econometrics* **54**, 159-178.

Levine, A., Lin, C. F. and Chu, C. S. (2002) “Unit root tests in panel data: asymptotic and finite-sample properties” *Journal of Econometrics* **108**, 1-24.

Levy Yeyati, E.L. and Sturzenegger, F. (1999) “Classifying Exchange Rate Regimes: Deeds vs. Words.” (available at: http://www.utdt.edu/~ely/Regimes_final.pdf)

MacKinnon, J.G. (1996) “Numerical Distribution Functions for Unit Root and Cointegration Tests” *Journal of Applied Econometrics* **11**, 601–618.

Pedroni, P. (1999) “Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors” *Oxford Bulletin of Economics and Statistics* 61 (Special Issue), 653–678.

Phillips, P.C.B. and Perron, P. (1988) “Testing for a unit root in time series regression”. *Biometrika* **75/2**, 335 - 346.

Schwarz, G. (1978) “Estimating the dimension of a model”. *Annals of Statistics* 6, pp. 461 - 464.

Zivot, E. and Andrews, D. (1992) “Further Evidence of the Great Crash, the Oil-Price Shock and the Unit Root Hypothesis” *Journal of Business and Economic Statistics* **10**, 251–270.

APPENDIX

APPENDIX A: Akaike Information Criterion (AIC) & Schwarz Bayesian Information Criterion (SBIC)

$$AIC = -2\left(\frac{LL}{T}\right) + \frac{2t_p}{T} \qquad \textbf{\textit{(A1)}}$$

$$SBIC = -2\left(\frac{LL}{T}\right) + \frac{\ln(T)}{T}t_p \qquad \textbf{\textit{(A2)}}$$

where T is the number of observations, t_p is the total number of parameters in the model, *ln* is the natural log, and *LL* is log likelihood for a VAR(*p*) (see further Hamilton, 1994) calculated as following:

$$LL = \left(\frac{T}{2}\right)\left[\ln\left(\left|\hat{\Omega}^{-1}\right|\right) - K\ln(2\pi) - K\right] \qquad \textbf{\textit{(A3)}}$$

In *Equation (A2)*, K is the number of equations, and $\hat{\Omega}$ is the maximum likelihood estimate of $E[u_t u_t']$, where u_t is the $K \times 1$ vector of disturbances.

APPENDIX B: Brief outline of the Johansen procedure

Let y_t denote a $p \times 1$ vector of variables which are not integrated of an order higher than one, then y_t will be formulated as a VAR model of order *k*:

$$y_t = \Pi_1 y_{t-1} + \Pi_2 y_{t-2} + \Lambda + \Pi_k y_{t-k} + \textit{Deterministic components} + \varepsilon_{1t} \qquad \textbf{\textit{(B1)}}$$

where ε_{1t} is independently and normally distributed, and $\Pi_1, \Pi_2, \Lambda, \Pi_{t-k}$ are coefficient matrices. The VAR model can be rewritten to yield a basic VECM following:

$$\Delta y_t = \Gamma_1 \Delta y_{t-1} + \Lambda + \Gamma_{k-1}\Delta y_{t-(k-1)} + \Gamma y_{t-1} + \textit{Deterministic components} + \varepsilon_t \qquad \textbf{\textit{(B2)}}$$

where ε_t is a $(K \times 1)$ vector of normally distributed errors that is serially uncorrelated but has contemporaneous covariance matrix Ω, and $\Gamma_1, \Gamma, \Gamma_{t-(k-1)}$, and Γ are coefficient matrices. Let $r = rank(\Gamma)$, then if $0 < r < p$, the matrix Γ can be portioned into $p \times r$ matrices α and β is such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is I(0) (Johansen and Juselius, 1990). The number of co-integrating relationships is *r* and each column of β is the co-integrating vector. The null hypothesis of Johansen's method is that there are no more than *r* co-integrating relations. This method starts testing at *r* = 0 and accepts as $\hat{r}$ the first value of *r* for which the null hypothesis will be rejected.

Table 1: Panel unit root tests

Panel A: LLC unit root test

Model	Variables							
	Level				First difference			
	EX	FDI	GDP	RER	EX	FDI	GDP	RER
1	-1.57	-1.02	-1.24	-2.18	-5.45**	-5.53**	-4.33**	-5.88**
2	-1.77	-1.15	-1.44	-2.26	-4.84***	-5.62**	-4.71**	-5.42**
3	-2.03	-2.31	-1.29	2.32	-6.65***	-5.71***	-4.96***	-5.62***

*(1): Model with heterogeneous intercepts and heterogeneous trend. (2): Model with heterogeneous intercepts. (3): Model without heterogeneous intercepts. *** (**): Rejection of the null hypothesis at the 1% and 5% significance level respectively.*

Panel B: IPS unit root test

Model	Variables							
	Level				First difference			
A	**EX**	**FDI**	**GDP**	**RER**	**EX**	**FDI**	**GDP**	**RER**
$(1)^a$	-2.08	-1.77	-2.06	-1.52	-2.95***	-3.55***	-2.91***	-2.75**
$(2)^b$	-0.81	-0.99	-0.73	0.01	-2.45***	-2.47***	-2.04**	-2.24***
B	**EX**	**FDI**	**GDP**	**RER**	**EX**	**FDI**	**GDP**	**RER**
$(1)^a$	-2.27	-2.41	-2.19	-1.72	-2.83**	-2.92***	-2.91***	-2.81**
$(2)^b$	-1.16	-1.25	-1.75	-1.88	-2.41***	-2.31***	-2.17**	-2.08**

*(A): Model with common time effect. B: Model without common time effect. [a]: The critical value at 1%, 5% and 10% is -2.84, -2.63 and -2.52 respectively. [b]: The critical value at 1%, 5% and 10% is -1.89, -1.99 and -2.21 respectively. (1): Model with heterogeneous intercepts and heterogeneous trend. (2): Model with heterogeneous intercepts only. *** (**): Rejection of the null hypothesis at the 1% and 5% significance level respectively.*

Table 2: Pedroni panel co-integration test

Test statistics	**FDI regression**				**Exports regression**			
	M1	**M2**	**M3**	**M4**	**M1**	**M2**	**M3**	**M4**
panel v-stat	-0.34	-2.21	0.29	-1.69	-0.98	-2.83	-0.72	-2.19
panel rho-stat	-4.84	-6.74	-5.79	-4.28	-3.24	-3.21	-3.78	-3.04
panel pp-stat	-11.57	-12.85	-14.19	-18.69	-6.70	-7.88	-6.47	-6.43
panel adf-stat	-6.60	-5.65	-5.22	-11.53	-4.96	-3.91	-4.48	-4.84
group rho-stat	-5.57	-5.29	-4.26	-4.83	-4.14	-3.50	-4.39	-5.20
group pp-stat	-14.94	-14.32	-17.73	-18.88	-7.36	-8.04	-8.21	-8.69
group adf-stat	-9.01	-5.97	-5.19	-6.60	-4.54	-3.32	-5.33	-5.71

Table 3: Fixed – effects Model Estimations

Dependent variables	**FDI regression**		**Exports regression**	
	Coefficient estimated	Standard error	Coefficient estimated	Standard error
RER_t^i	1.28	0.89	0.27**	0.024
RER_{t-1}^i	0.92**	0.32	0.58***	0.044
FDI_t^i	-	-	-0.05	0.02
FDI_{t-1}^i	-	-	0.001**	0.0003
EX_t^i	-0.49	0.31	-	-
EX_{t-1}^i	0.003**	0.0009	-	-
GDP_t^i	-3.13	2.30	1.38**	0.63
GDP_{t-1}^i	0.18***	0.002	0.22**	0.0016
DU	-0.15***	0.022	-0.29**	0.059
constant	0.96**	0.17	0.73***	0.24

*The adjusted R-squared of FDI regression is 0.953. The adjusted R-squared of Exports regression is 0.961. *** (**): Significance at the 1% and 5% level, respectively.*

Table 4: Unit root tests to individual series

Variables	Models	ADF		PP		KPSS	
		Level	First Difference	Level	First Difference	Level	First Difference
EXP	(1)	-1.29	-13.74***	-1.18	-19.46***	1.84***	0.19
	(2)	-2.51	-13.68***	-2.57	-19.81***	0.74***	0.02
	(3)	1.29	-12.60***	1.23	-13.35***	-	-
GDP	(1)	-0.18	-11.11***	-0.51	-13.37***	1.89***	0.05
	(2)	-3.08	-11.03***	-1.19	-11.28***	0.48***	0.02
	(3)	1.51	-8.20***	-0.63	-8.20***	-	-
FDI	(1)	-1.73	-9.83***	-1.66	-9.88***	1.54***	0.18
	(2)	-2.27	-9.79***	-2.13	-9.85***	0.52***	0.28
	(3)	1.12	-9.18***	1.33	-9.16***	-	-

*ADF: Augmented Dickey – Fuller. PP: Phillips – Perront. KPSS: Kwiatkowski–Phillips–Schmidt–Shin. (1): Model with constant only. (2): Model with constant and deterministic trend. (3): Model without constant. ADF and PP critical values are taken from MacKinnon (1991). KPSS critical values are sourced from Kwiatkowski, Phillips, Schmidt and Shin (1992). *** (**): Rejection of the null hypothesis at the 1% and 5% significance level..*

Table 5: Zivot - Andrews minimum t-statistics

Variables	t-statistics	Periods
EXP	-2.64***	28
GDP	-2.59***	30
FDI	-3.79***	33

T-statistics values are estimated from a break in intercept and trend model. Critical values are those reported in Zivot and Andrews (1992). Results show no rejection of unit root hypothesis.

Table 6: AIC and SBIC results

	Lags				
	p = 0	p = 1	p = 2	p = 3	p = 4
AIC	-5.22	-5.78	-6.85*	-5.81	-5.07
SBIC	-5.12	-5.38	-6.17*	-5.44	-5.26

*AIC: Akaike Information Criterion. SBIC: Schwarz Bayesian Information Criterion. *: The optimal lag*

Table 7: Johansen tests for existence of co-integration vectors

		(1)		(2)	
Null hypothesis	Alternative hypothesis	Trace test statistics	5% critical value	Trace test statistics	5% critical value
$r = 0^a$	$r \geq 1$	59.92	34.55	55.08	29.68
$r \leq 1^b$	$r \geq 2$	11.99	18.17	6.00	15.41
$r \leq 2^c$	$r \geq 3$	0.67	3.74	0.41	3.76

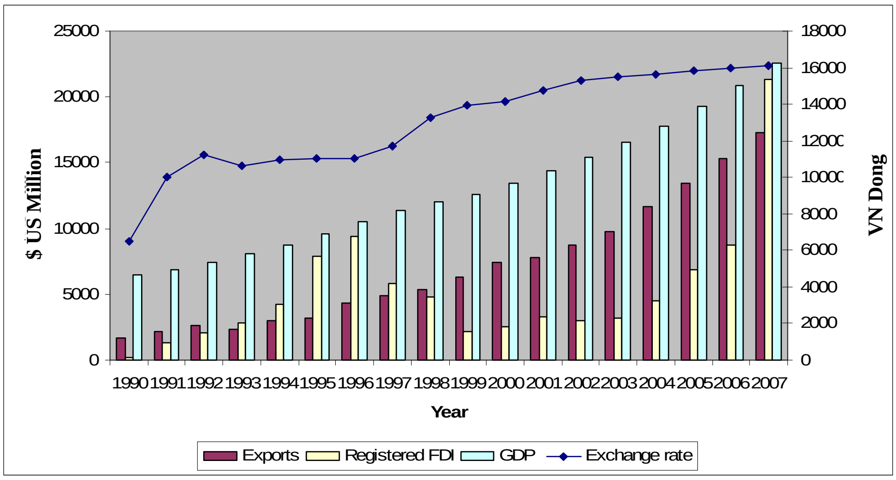
(1) Model with deterministic trend. (2) Model without deterministic trend. Critical values are those reported in Johansen (1995).

Table 8: Granger Causality Tests[a]

	Granger causality Wald test (F statistics)			t-statistics
Ind.var / Dep.var	$\Delta \ln FDI_t$	$\Delta \ln EXP_t$	$\Delta \ln GDP_t$	ECT_{t-1}
$\Delta \ln FDI_t$	-	19.11*** (0.00)	28.99*** (0.00)	-0.71** [0.28]
$\Delta \ln EXP_t$	11.37** (0.02)	-	16.29*** (0.00)	-0.52*** [-3.32]
$\Delta \ln GDP_t$	12.59*** (0.00)	13.94*** (0.00)	-	-1.11*** [-3.55]

*[a]: A shift dummy, DU (which takes the value of 1 from 1998, January to 2001, December, and 0 in all other periods), was included in each of the VECM. Dep.var: Dependent variable. Ind.var: Independent variable. Values in brackets are t-statistics. Values in parentheses are p-values associated with Wald test statistics. ** (***) denotes statistical significance at the 5% and 1% levels respectively.*

Figure 1: Exchange rate, FDI and Exports movements in Vietnam



Source: Created from UNSD database; Vietnam Ministry of Industry and Trade; Vietnam Ministry of Planning and Investment