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Revisiting the nexus between exchange rate, exports and economic growth: further evidence from Asia

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ABSTRACT

The economic growth of developing countries has been associated with their exports, and the existing research suggests that exchange rates significantly influence the exports. This study used panel data to investigate the potential nexus of gross domestic product (GDP), exports and exchange rates in Asian countries over the period of 1981–2016. The results portray that nexus between exchange rate and exports holds true for Export-led Growth (ELG) and Growth-led Exports (GLE) hypotheses. This study used the Wald test under Vector Error Correction Model (VECM) with all necessary specifications tests to identify the possible nexus of variables, and applied the fixed effects model along with control variables. The results imply that an undervalued currency enhances exports and has a significant impact on economic growth. Additionally, the results of Fully Modified Ordinary Least Squares (FMOLS) model with financial crises dummy suggested that the estimations are robust. Keeping in view the aforementioned findings, a timely and balanced policy can play a pivotal role in improving the long term nexus of exchange rates, exports and economic growth.

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1. Introduction

Recent decades have seen major developments in the economic structure of developing countries due to liberalization and economic reforms. Several developing countries have been focusing on more outward oriented policies of external trade, which increase the level of exports from emerging markets (Razmi, 2007). Emerging markets are crucial for the international market due to supply-chains and technological exports. As Cheung and Sengupta (2013) noted, the share of trade in global output

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has tripled since the Second World War and it denotes expansion in trade and growing eminence of the developing countries. Additionally, despite steady economic growth, exchange rate movements are also important in terms of their impact on international trade; the collapse of the Bretton Woods system triggered a hot debate on the consequences of exchange rate variability and external trade. More recently, the global and Asian financial crises have reopened this Pandora box. Therefore, it is worthwhile to investigate the nexus of exchange rate, international trade and economic growth.

With the increasing participation of Asia's emerging markets in global activities, this region has emerged with offshore production and economic growth. Supportive domestic policies have liberalized many Asian economies, and with the industrialization of China and India, the majority of Asian countries are now becoming competitive in international trading activities. These trade links have been building a strong connection between Asia and rest of the world, stimulating international financial flows and associated investment. The International Monetary Fund (IMF) reported that the share of emerging Asian economies (EAEs) in global trade climbed up to a third in 2006, and the average annual regional trade flows have increased more than 10% per annum since 1990 (IMF, 2014). In addition, the economic growth of Asian countries has been an attractive prospect for the developed world.

EAEs adequately weathered the global financial crisis of 2008 and many of the Asian countries even experienced double digit growth after the turmoil. Lee and Hong (2012) cited that the real gross domestic product (GDP) of the region, in terms of purchasing power parity (PPP), climbed from 3.3 trillion United States Dollars (USD) to 24.5 trillion USD during 1980 to 2009. An interesting fact is that the world economy increased only three-fold over this period, while Asia's economy increased seven-fold. Furthermore, during the same period, Asia's real per capita GDP increased more than four times, while the average global income posted less than a two-fold increase. Such robust and persistent growth has clearly raised income levels, lifted millions out of poverty, and expanded the global economic influence of EAEs.

This increasing influence of Asia in the world economy, combined with increased regional integration among Asian countries, indicates the growing importance of exchange rates and the corresponding policies within the region (Dumrongrittikul & Anderson, 2016). Furthermore, a stable exchange rate is a key factor for a successful outward-oriented and exports-focused development strategy. Conversely, the misalignment of exchange rates with economic fundamentals can also lead to macro-economic and financial instability in developing countries. This instability can have a direct negative impact on exports and on the economic growth of developing economies (Edwards, 1988). Therefore, exchange rates and their impact on international trade are very important for the rapidly changing and growing Asian economies.

Figure 1 shows the exports of five Asian countries. Since 1980, China's exports have increased the most, followed by Japan and Korea. Interestingly, all these economies had steady growth in exports during the Asian Financial Crisis of 1997, but the global crisis of 2008 significantly reduced their exports. However, despite this significant drop in exports, all five Asian economies recovered sharply and were back on a growth track by the end of the decade. This paper seeks to examine the exchange

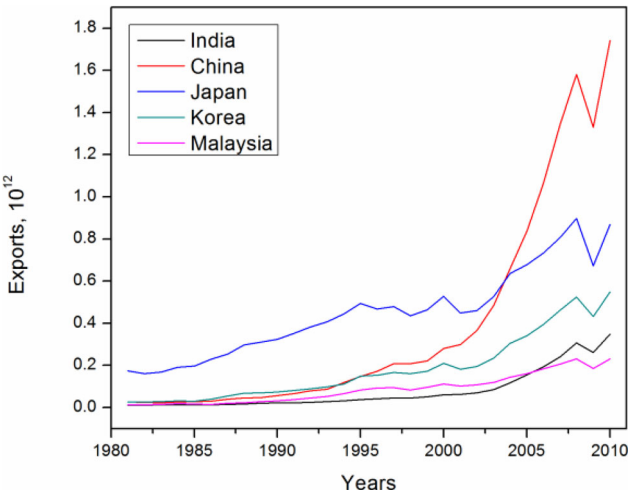

Figure 1. Exports of five prominent Asian countries.
Source: Authors' analyses.

rate, exports and growth nexus. By having a comparison of the Granger Causality and the panel Generalized Method of Moments (GMM) analysis, the findings are based on the three variables and several other important factors. Identifying the relationship between the exchange rate, exports and economic growth may have important policy ramifications for developing countries, including providing insights on how countries might best prioritize their exchange rate fluctuations in order to maximize long-run growth.

The main motivation behind this work is that the existing studies have investigated the growth effects of export composition. To the best of our knowledge, the studies exploring this nexus using the exchange rate, exports and economic growth for countries in Asia are lacking. This paper aims to fill that gap by using regression analysis to endogenously identify the potential relationship between these factors. Taking the balanced panel data of developing Asian counties into account, this study provides fresh and robust evidence based on several econometric techniques and supported by corresponding theoretical arguments. Therefore, it is an important addition in existing literature and useful for academia and policy makers of developing regions.

The rest of this paper is organized as follows: Section 2 describes the background exploring the inter-linkages between exchange rates, exports and GDP, in addition to discussing previous literature on the subject. The empirical methods, data and variables are explained in Section 3. The results are reported in Section 4. Last but not the least, concluding remarks and policy implications are documented in Section 5.

2. Literature review

2.1. Export-led growth and Growth-led exports theories

The relationship between exports and economic growth has long been a field of research in international and development economics, and it has received the attention of policy makers around the globe. The findings of Stolper (1947) suggest that

exports contribute to economic growth through the foreign trade multiplier effect, which asserts that, given the spending function, the magnitude of the expansionary effect of the exports surplus depends on the marginal propensity of imports. The transfer of available resources from low to high productivity domestic export industries increases the overall production and results in accelerating output growth. In addition, a high level of exports might contribute to growth, since export revenues are an important source of earning foreign exchange. When domestic savings are inadequate for the import of capital goods, foreign exchange is a crucial source for bridging the gap. Furthermore, exports can also trigger economic growth through increase in market efficiency (Tekin, 2012). This is one of the four propositions, and is known as Export-Led Growth (ELG).

The second proposition, Growth-Led Exports (GLE), postulates a reverse logical scenario, i.e., economic growth induces trade flows by creating competitive advantage leading to specialization, and eventually facilitating exports. In the first two cases, both factors are included, thus the third notion is the feedback relationship. Finally, it is also possible that there is no simple contemporaneous relation between the two variables (Kónya, 2006). In general, a causal review of the relationship between exports and economic growth would lead us to conclude a positive correlation between the two variables (Feder, 1983; Michaely, 1977). Instinctively, increasing exports necessarily increases economic growth because exports are a component of GDP. Along with a direct increase in GDP, exports' growth may also lead to positive externalities in the domestic economy in the form of knowledge spillovers, including management and production efficiency (Edwards, 1993; Grossman & Helpman, 1990). This, in turn, increases the expansion and production of both the export and non-export sectors, resulting in a further increase in GDP.

Although vast amount of literature is available regarding exports and economic growth for individual economies, regional studies are relatively few in number. For example, Lam (2013) examined the linkage effect between exports and growth for developing countries. For a given growth rate and level of exports, the higher the linkage effect of exports, the faster the output growth. Furthermore, economies tend to grow more rapidly through exporting specialized, high-technology goods compared with more traditional or low-technology products (Lee, 2011); for example, Chang et al. (2013) found that high energy exports and globalization expanded economic growth in the South Caucasus. Also, higher economic, political and social integration was associated with faster growth, and exports led to higher growth rates during periods of increasing economic as well as political integration.

The study of four Asian Little Dragons by Tang et al. (2015) concluded that exports and GDP are co-integrated because there is a long term relationship between variables, but the ELG hypothesis is not established for all countries. The findings of Ahmad et al. (2018) confirmed the ELG hypothesis in the long run and short run; the authors found that ELG and foreign direct investment (FDI)-led growth are crucial for the Association of Southeast Asian Nations (ASEAN) economies. However, their study had a shorter data set and did not focus on the exchange rate of developing Asian nations. In another study, Ahmad et al. (2019) emphasized on China's exchange rate policy and its impact on the economic development; the findings

showed that a lower exchange rate proved to be very useful for China and it had a positive impact on the economic growth. This study was focused on China only and due to its uniqueness, the results can be hardly generalized for other developing Asian economies.

2.2. Exchange rate and exports

It is generally argued that exchange rate movements have important implications for international trade, resource allocation and the choice of financial system. Theoretically, the effect of exchange rate uncertainty on international trade is ambiguous. The impact of exchange rate variability depends on the degree of risk aversion (Du & Zhu, 2001). However, Viaene and de Vries (1992) argue that the straightforward assumption of a negative relation may not be appropriate because the existence of forwards markets enable exporters to hedge against exchange rate risk. In the absence of a forwards market, a higher exchange rate risk or volatility may lead to a decrease in international trade. A well-developed market can turn this effect positive, depending on the current position of a country.

On the other hand, the effect of exchange rate depreciation lowers the price of domestically produced goods, leading to an increase in exports and a reduction in imports; this, in turn, improves the current account balance. Although this makes the exports of the domestic economy more competitive, foreign consumers may not adjust their purchasing power immediately (Pattichis, 2012). The effect of exchange rates on international trade is clearly an empirical issue; however the evidence is mixed. Verheyen's (2013) study of trade between the United States of America (USA) and the European Economic and Monetary Union (EMU) countries pointed to the fact that exports responded more strongly to depreciation than they did to appreciation of the exchange rate. Broadly speaking, the financial and debt crises in Europe have led to substantial swings in the dollar-euro exchange rate; covering the effects of exchange rate volatility on exports from eleven euro-zone countries to the USA, Verheyen (2012) showed that the influence of exchange rate volatility is typically negative.

A proactive exchange rate policy is also important for developing countries in terms of price competitiveness. Recent surveys of developing countries show that a number of them have used undervaluation to foster the competitiveness of manufacturing exports (Nouira et al., 2011). Further, plenty of literature is available on an individual national level about the relationship between exports and the exchange rate. The panel data set of Japanese exports indicated that large swings in the value of the yen caused corresponding swings in the level of Japan's exports during the last decade (Thorbecke & Kato, 2012). With regards to developing countries, volatile exchange rates and financial instability may have significant effects on exports, but, for example, the results of Demez and Ustaoğlu (2012) reveal that Turkey's exports are not sensitive to structural breaks and currency fluctuations. With regards to China, there is strong evidence to suggest that the response of exports to a change in the value of Yuan is small.

However, empirical evidence on the effects of Yuan appreciation on Chinese exports has been mixed for processed exports, because parts and components for

these goods come from other Southeast Asian countries. Therefore, exchange rate changes in supply chain countries may have a much larger effect on exports than the unilateral movement of domestic currency. Furthermore, the relationship between the appreciation of Yuan and the exports of ASEAN, the main supply chain of China, is also positive for disaggregated exports (Hooy et al., 2015; Li et al., 2015; Thorbecke, 2011). Trade is a crucial component of the small Asian economies as well. For example, 60 to 70% of Pakistan's exports are textiles, and exchange rate fluctuations may affect the export level. As Chaudhry and Bukhari (2013) concluded, depreciation in Pakistan's currency leads to a sustained increase in exports of finished goods. Conversely, Wong and Tang (2008) supported the view that exchange rate variability has an adverse impact on Malaysia's export of electrical goods, inferring that the relationship between the two variables varies from country to country.

2.3. Exchange rate and growth

The micro and macroeconomic effects of exchange rate volatility has been a topic of interest among policy makers for a long time. However, after the collapse of the Bretton Woods, increased financial liberalization and capital market integration exposed both developed and developing countries to large swing in exchange rates. Exchange rate fluctuations necessarily affect the output and employment levels in a country. Through the initial increase in the price of foreign goods, depreciation may stimulate economic activity producing excess demand for home products. Subsequently, domestic growth and the price level increase. Conversely, appreciation may have an adverse effect on the economy. The empirical findings of several studies suggest a robust correlation between competitive exchange rates and the economic growth of developing countries. It is also evident that macroeconomic variables such as the investment ratio, openness to trade and stock market development have influenced the economic growth of emerging markets (Naik & Padhi, 2015; Razmi et al., 2012).

An overvalued euro has caused a significant drop in the economic growth rate of Greece, while exchange rate volatility has had a negative impact on the manufacturing firms of Turkey (Demir, 2013; Papanikos, 2015). In an earlier study, Kandil and Dincer (2008) conclude that anticipated appreciation has had significant adverse effects on the manufacturing sector in Turkey. Furthermore, anticipated exchange rate appreciation decreases growth in exports. Studies have also shown that the net effect of unanticipated exchange rate fluctuations decreases real output and consumption growth, and increases export growth in Egypt. For Malaysia, an increase in exchange rate misalignment leads to a decrease in economic growth; more precisely, devaluation promotes economic growth and appreciation hurts growth (Wong, 2013). The evidence regarding US sectorial output indicates that expansionary and contractionary effects cancel each other out in determining industrial real output growth in response to the dollar appreciation (Kandil & Mirzaie, 2002).

However, in contrast to established assumptions, the Chinese economy has not benefited from a lower exchange rate of the Yuan, and no direct correlation exists between the real exchange rate (RER) and growth in the long run. According to the empirical evidence, the expansion of exports and inflow of foreign capital significantly

stimulated the Chinese economy. After the 2008 financial crisis, the Yuan exchange rates were largely dependent on the enhancement of national strength and inflows of foreign capital, rather than the slow increase in foreign trade (Tang, 2015). Using a tri-variate model, Elbadawi et al. (2012) investigated the nexus between foreign aid, exchange rate misalignment, and economic growth in Sub-Saharan Africa (SSA). Contrary to conventional wisdom, they found that aid is not a major contributor to exchange rate overvaluation.

In addition to the abovementioned findings, Elbadawi et al. (2012) suggested that aid fosters growth but its impact is weaker in countries with overvalued exchange rates; although overvaluation reduces growth, financial development ameliorates its negative effect. The study of Draz et al. (2019) focused on the determinants of exchange rates for South Asian economies; the findings indicated that macroeconomic variables had significant impact on the exchange rates of the sample nations; however, this study lacks in terms of relationship between exports and economic growth. Another study conducted by Ullah and Ozturk (2020) showed significant relationship between exchange rate volatility and carbon emissions; however, this paper was focused on a single economy and did not focus on exports and economic growth. The work of Azam et al. (2021) looked into the economic growth and international trade of Central Asian economies and found long run co-integration among the selected variables; however, this study did not include exhange rates and was focused on five Central Asian nations only.

The present literature shows that exchange rates can play an important role in economic growth. However, many empirical studies only consider the growth of total exports and its impact on economic growth, as well as the effect of exchange rates on growth, and they are mostly concerned with individual developed countries. In contrast, our work uses a comprehensive approach to investigate the exchange rate, exports and economic growth nexus for Asian countries.

3. Data, variables and empirical methods

To explore the relationship between exports, exchange rate and economic growth, empirically as well as possible long-run associations in that relationship, This study used the panel data of 9 Asian countries[1] over the period 1981–2016. The variables employed in the estimations are as follows: gross domestic product (GDP) growth, exports of merchandise and services (EXP) and the nominal bilateral exchange rate (EXR). The data for economic growth is taken from the World Bank, the International Financial Statistics of the IMF are used for the exchange rate data, and the data for exports is taken from the UNCTAD statistical database, available on http://unctadstat.unctad.org. The potential threshold variables of this study are: human capital (HC), physical capital investment (INV) and external debts (EXD).

Human capital was measured as the percentage of secondary school enrollment, and the capital stock was measured as the investment to GDP ratio. The data for all additional variables is taken from the World Bank's World Development Indicators database. The amount of government investment is one of the key factors to develop an economy as a whole. Investment boosts the various economic sectors and

enhances the production as well exports of the country. Similarly, the production, sales, distribution and other technical skills are as important as the physical capital for overall development. The major source of many intellectual skills is the human capital. On the same note, the scarcity of funds is a common problem in developing countries and to bridge the investment gap they often relay on the external source of funds. The appropriate use of funds accelerates the production, exports and economic development, this, in turn affects the exchange rate.

Additionally, this study has included a dummy variable D to account for the financial impact and possible structural break in data. The dummy variable D takes the value of 0 from 1981 to 1995 and 1 for the remaining sample period, thus takes into account both the Asian financial crisis of 1997 and global financial crisis of 2008.

In order to investigate the stationary properties of the data, this study applied a series of panel unit root tests. Unit root tests include both tests with a common unit root process and tests with an individual process. The generalized form of the Levin, Lin and Chu method under the common unit root process can be described in the form of the following equation:

$$\Delta X_{it} = \alpha X_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta X_{it-j} + Y'_{it}\delta + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots \quad (1)$$

ΔX_{it} represents the endogenous variables in the model and Y'_{it} the exogenous variables. This study assumed a common $\alpha = p-1$ as well as ε_{it} are assumed to be mutually independent and extracted $\Delta\bar{X}_{it}$ with the following equation:

$$\Delta\bar{X}_{it} = \Delta X_{it} - \sum_{j=1}^{p_i} \beta_{ij} \Delta X_{it-j} - Y'_{it}\delta \ldots\ldots\ldots\ldots\ldots \quad (2)$$

Likewise, $\bar{X}_{it-1}$ can be extracted using the second set of coefficients:

$$\bar{X}_{it-1} = \bar{X}_{it-1} - \sum_{j=1}^{p_i} \beta_{ij} \Delta X_{it-j} - Y'_{it}\delta \ldots\ldots\ldots\ldots\ldots \quad (3)$$

On the other hand, the Im, Pesaran, and Shin, as well as the Fisher's Augmented Dickey-Fuller test (Fisher-ADF) and Phillips-Perron (PP) tests are categorized as individual unit root process tests. A separate ADF regression for each cross section for the Im, Pesaran, and Shin tests can be explained in the following form:

$$\Delta X_{it} = \alpha X_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta X_{it-j} + Y'_{it}\delta + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots \quad (4)$$

Secondly, if π_i is defined as the *p-value* from any individual unit root test for cross-section i then under the null of the unit root for all N cross-sections, the results under the Fisher-ADF and PP tests can be elaborated in equation form as follows:

$$-2\sum_{i=1}^{N}\log(\pi_i) \rightarrow x_{2N}^2 \ldots\ldots\ldots\ldots\ldots \quad (5)$$

The next step is testing whether our data are co-integrated in the long run. Using the concept of a stochastic trend, one may ask whether our series are driven by common trends or, in other words, are cointegrated (Engle & Granger, 1987). This leads to testing for the existence of linear independent, so-called co-integrating relationships (Ramos, 2001)

This study applied the panel co-integration approach for testing the long-run relationships between the variables. The Engle and Granger (1987) test states that cointegration among variables indicates that the residuals are I(0); in case of no integration the residuals are I(1). Extending this work Pedroni (1999) explained that the panel co-integration techniques are intended to allow the selection of the pool information regarding common long-run relationships from across the panel, while allowing the associated short-run dynamics and fixed effects to be heterogeneous across different variables of the panel. These tests allow the dynamic and fixed effects to differ across members of the panel, and also allow the co-integrating vector to differ across members under the alternative hypothesis. These tests are one way residual based, taken from Engle and Granger (1987). In contrast, Johansen Fisher's test is a system based test for the whole panel set. Fisher (1932) uses the results of the individual independent tests for co-integration by combining tests from individual cross-sections to obtain a test statistic for the full panel (Tekin, 2012).

After the confirmation of a long run association, this study applied the panel data fixed effects approach to discover the potential link between GDP growth, exchange rates and exports. This approach is chosen due to different reasons. It is a suitable approach to estimate the impact and relationship of data varies over the time. It controls the biasness between predictors and dependent variables and measures the net impact of variables. Thus, provides reliable results. Another feature of this approach is it assumes that individual data features are distinctive and are different for each entity. As, each entity is unique therefore error terms and constant are also not correlated for each data. In the case of correlation among different entities, the obtained results might not reliable under fixed effects and the random effects should be used instead. Contrary to this, the random effects assume the variations among different entities are random.

This study used the Hausman test to decide the best fit approach between two in this paper. Additionally, the panel data best describes the association between endogenous and exogenous variables making use of time series as well as cross-sectional characteristics of data. Thus, helps to enhance variability, proficiency and eliminate the adverse effects of correlation among different variables. Furthermore, an additional feature of panel data is to focus on changes in countries than between them, which provides more reliable and adequate results. Furthermore, this study applied the Fully Modified Ordinary Least Squared (FMOLS) for robustness check.

4. Empirical results and discussion

The primary step is to test the integration order of the variables to ensure that no variable is integrated at I(2) before applying the Johansen testing approach of co-

Table 1. Unit root summary.

Variables	Levin, Lin & Chu	Im Pesaran	ADF	PP
Exports	8.47	13.22	0.22	0.089
1st	−2.41	−2.28	94.22	169.10
GDP	−9.71	−9.46	115.66	120.76
EXR	−0.48	1.44	15.69	17.49
1st	−8.85	−12.23	158.24	181.09
EXD	8.36	10.53	9.69	5.37
1st	−2.45	−2.33	70.01	69.99
HK	0.76	3.70	4.05	3.17
1st	−7.62	−8.40	102.80	104.92
KINV	1.10	0.28	19.52	18.01
1st	−12.56	−12.16	152.27	169.82

Notes: 1. Given values are the test statistics.
2. The level of significance is 5%.
Source: Authors' analyses

integration. The assumption states that the variables are non-stationary at order but become stationary at 1st difference. This study has applied a set of the panel unit root tests to deal with the stationary properties. The battery of tests includes the Levin, Lin & Chu (LLC), the Im Pesaran, and the panel ADF and PP tests. The results are presented in Table 1.

The results reveal that all series are non-stationary at levels but the condition of stationary is fulfilled at the 1st difference. Therefore, the next step is to identify the long-term relationship among the variables. This study applied the different co-integration tests, both residual and individual cross section based, for the whole panel. The results of all the tests are reported in Table 2. The results of the Pedroni tests reject the null hypothesis of no co-integration because the majority of both the panel and the group test statistics are significant at a given level of significance. In addition, the ADF value under the Kao test is also significant.

4.1. Fixed effects model

The Johansen Fisher combined test for all panel values also rejected the null hypothesis of no association. Both the trace and max values indicate that variables are associated in the long run. The confirmation of a long run relationship provides base to investigate the actual impact of these factors on economy. Therefore, this study used the fixed effects panel model to examine the significance of our three variables for economy. The results for our first tri-variate model, where EXR is the dependent variable, and EXP and GDP are the independent variables, are provided in Table 3. Our first observation is that the coefficients of the exchange rate and GDP are significant. Considering additional variables in the model as auxiliary and focusing solely on the relationship between EXR, GDP and exports, our results show that economic growth affects the exchange rate: higher growth rate strengthens the value of a nation's currency.

On the other hand, the relationship between exports and the exchange rate is negative. The increasing value of exports accumulates foreign reserves for the country as well as strengthening the balance of trade position, but this relationship is complicated because of the feedback loop between both variables. Exchange rates have an

Table 2. Panel tests of co-integration.

Model	Statistic	Probability	Weighted statistics	Probability
Pedroni				
Panel v-Statistic	−0.87	(0.80)	−1.42	(0.92)
Panel rho-Statistic	0.41	(0.66)	−1.84	(0.032)
Panel PP-Statistic	−1.42	(0.077)	−2.59	(0.004)
Panel ADF-Statistic	−2.65	(0.004)	−2.59	(0.004)
Group rho-Statistic	−0.627	(0.26)		
Group PP-Statistic	−3.45	(0.003)		
Group ADF-Statistic	−2.90	(0.018)		
Kao Residual Co-integration Test				
ADF	7.45	(0.009)		
Johansen Fisher Panel Co-integration Test				

Hypothesized Co-integrating (H_0)	No. of Relationships (H_1)	Trace	Prob.	Max. Eigenvalue	Prob.
$r = 0$	$r>0$	156.04	(0.00)	128.07	(0.00)
$r \leq 1$	$r>1$	68.43	(0.018)	60.84	(0.010)
$r \leq 2$	$r = 3$	54.33	(0.041)	54.33	(0.041)

Notes: 1. The numbers in parentheses are probabilities.
2. All of the panel tests under the Johansen co-integration test identified the presence of long-run associations among variables.
Source: Authors' analyses

Table 3. Fixed effects (1st Model).

Dependent Variable EXR			
Variables	Coefficients	t-Statistic	Prob.
C	−7.12	−0.96	(0.33)
GDP	−8.6	−1.77	(0.07)
EXD	2.45	8.22	(0.00)
EXP	−8.42	−7.86	(0.00)
HC	9.88	0.95	(0.34)
INV	19.60	0.95	(0.34)
D	−4.79	−1.66	(0.09)
$R^2$0.67			
DW1.51			

Notes: 1. The values in parenthesis are the corresponding probabilities.
2. DW is the Durbin Watson stat.
3. The level of significance is 5 %.
Source: Authors' analyses

important impact on the trade balance in both surplus and deficit situations, which in turn affect the value of the currency itself. Likewise, a high economic growth rate is most likely accompanied by a high investment rate and high export growth.

Ito et al. (1999) explain that unless the central bank intervenes in the foreign exchange market and accumulates foreign reserves; successfully increasing exports produces a current account surplus which results in nominal appreciation pressure on the currency. Although interventions maintain fixed exchange rates, unsterilized intervention results in inflation and an appreciation of the exchange rate. Furthermore, in the presence of free capital mobility, fast growth often invites foreign capital inflows, due to the high expectations of investors regarding the returns. Capital inflows appreciate the nominal exchange rate because of the increased demand for local currency. Put simply, successful economic development results in a currency appreciation which improves the standard of living. In contrast, failure in economic development often results in sharp currency depreciation.

Table 4. Fixed Effects (2nd model).

Dependent variable EXP

Variables	Coefficients	t-Statistic	Prob.
C	−1.81	−4.91	(0.00)
EXR	7.86	2.28	(0.00)
GDP	2.45	1.20	(0.23)
EXD	2.51	32.62	(0.00)
HC	7.60	1.40	(0.16)
INV	3.69	3.50	(0.005)
D	−3.44	−0.98	(0.40)
$R^2$0.91			
DW1.72			

Notes: 1. The values in parenthesis are the corresponding probabilities.
2. DW is the Durbin Watson stat.
3. The level of significance is 5 %.
Source: Authors' analyses

The results of our second tri-variate model are given in Table 4. In this model exports is the dependent variable, while the exchange rate and economic growth are the independent variables. First, considering the exchange rate as the auxiliary variable in the system, and focusing solely on the GDP-EXP relationship, this study can now test the null hypothesis that GDP does not have a significant impact on EXP. The estimated regression coefficients are positive, as required for claiming support for the growth-led export hypothesis. Therefore, the null hypothesis of no significant relationship can be rejected. Often countries may experience ELG, but economic growth can increase exports as well.

Theoretically, enterprises have more funds for investment during an economic boom; this investment could help boost exports through an increase in long-term productivity in an economy. Conversely, investment activity slows down during a recession, eventually affecting the growth of exports. Another potential factor in this reciprocal relationship is productivity gains: higher levels of domestic skills and technology increase productivity, which causes exports to expand (Bhagwati, 1988).

On the other hand, the correlation between exports and the exchange rate suggests that devaluation of currency promotes exports. Our results support the general idea that the appreciation of a currency decreases the export competitiveness of a country. Generally speaking, an undervalued currency reduces the price of domestic goods, which promotes exports and discourages imports because of increased exports competitiveness in the international market.

China is the perfect Asian example of using currency devaluation to offset tough competition from rival economies; cheaper currency has been providing support for the production of less expensive and more competitive exports than its competitors, which in turn, has boosted overseas trade. This has been driving the growth of the economy for last couple of decades. Additionally, China is a large economy with respect to its development strategies and export-oriented growth because of its undervalued exchange rates. Furthermore, policy instruments have helped China to attract more investment than other developing countries in Asia.

China became the so-called "Factory of the world" in international markets for a variety of manufacturing exports, and experienced a large amount of trade surpluses

Table 5. Fixed Effects (3rd model).

Dependent Variable GDP			
Variables	Coefficients	t-Statistic	Prob.
C	0.47	0.36	(0.71)
EXR	4.65	7.33	(0.04)
EXP	0.82	1.92	(0.01)
EXD	−7.54	−1.05	(0.29)
HC	0.03	1.98	(0.04)
INV	0.25	6.82	(0.00)
D	−0.23	−0.34	(0.72)
$R^2$0.93			
DW1.84			

Notes: 1. The values in parenthesis are the corresponding probabilities.
2. DW is the Durbin Watson stat.
3. The level of significance is 5 %.
Source: Authors' analyses

from its major trading partners Wang et al. (2012). At an early stage, many developing countries adopt an overvalued exchange rate policy to obtain cheaper imports of technological instruments, but overvaluation decreases exports and growth (Sekkat, 2016). Another common feature of developing countries is a weak institutional framework, which boosts exports growth under a weak exchange rate. Nunn (2007) argues that generally the exports of sophisticated goods are contract or relationship intensive, and the tax framework for these exports is weaker than the primary goods. Therefore, in general, an undervalued currency boosts the exports of developing economies.

Table 5 shows the results of our last model with GDP as a dependent variable. Here exports and exchange rates are considered as independent with additional control variables. The first test is for the ELG hypothesis. The coefficients are significant at the given level of significance; therefore, this study found no evidence against a relationship between exports and GDP for the sample data. An important issue to note is that the signs of the regression coefficients involved in the GMM tests are crucial for claiming support for the ELG hypothesis. As Tekin (2012) argues, this study can not claim support for the ELG or the growth-led export hypothesis unless the regression coefficients involved in the tests are positive, because both hypotheses imply positive parameters.

The coefficients of both our models are significant and the signs are positive. Therefore, there is evidence of ELG for our analysis of Asian countries. The ELG term has been closely associated with developing countries in Asia. In fact, export promotion has particularly distinguished East Asian countries from the rest of developing world. Following the Asian financial crisis and the global recession, relatively rapid growth and current account surpluses in Asian developing countries has justified the role of exports in the economic development of the region. The rapid growth of China and its accumulation of foreign reserves has been a good example of this. However, as Jimenez and Razmi (2013) argue, for a country to export more, at least one other country has to import more. In other words, this strategy requires continuous trade deficits in developed countries, which at the some point may become unsustainable. Thus, the ELG strategy may yield diminishing returns in the long-run.

On the other hand, the coefficients of exchange rate indicate a positive relationship between economic growth and currency depreciation. Appreciation enables

Table 6. Hausman and diagnostic tests.

Tests	Model 1	Model 2	Model 3
Hausman Test			
Chi-square values	12.33*	22.62*	23.03*
Probabilities	(0.031)	(0.0004)	(0.0003)
Correlation Tests			
Breusch-Pagan LM	0.86	0.66	0.87
	(0.20)	(0.54)	(0.19)
Pesaran scaled LM	0.42	0.35	0.56
	(0.56)	(0.67)	(0.42)
Pesaran CD	0.59	0.27	0.41
	(0.55)	(0.78)	(0.72)

Notes: 1. The corresponding probabilities are given in the parenthesis.
2. '*' represents the Chi-square values of the Hausman test.
Source: Authors' analyses

consumers to buy cheaper goods, boosting low cost imports, which improves the living standard of the population. In general, currency appreciation is a sign of competitiveness, lifting the economic development of a country. In the long-run, a strong exchange rate may lower inflation, resulting in a strong economic performance. In the short run, exchange rate fluctuations may not necessarily be a sign of economic prosperity. The main driving force could be speculation on the continuing economic boom of developing countries rather than long-term economic improvement.

Conversely, in times of recession an appreciated currency could also depress economic growth. Generally, a currency appreciation reduces exports and increases the level of imports due to their low price, which reduces the demand for domestically produced goods. Overall, this will reduce aggregate demand; furthermore, the government will then need to increase interest rates to strengthen the value of the currency, and this may affect the growth rate in the long-run. Hence, an undervalued currency promotes aggregate demand and exports that significantly stimulates economic growth. It should be noticed that undervaluation increases inflationary pressure. Furthermore, the coefficients of our dummy variable are not very significant. This shows that the association between crises and our variables is not strong but still the impact is negative.

To estimate the accuracy of our estimations, this study also applied the Hausman test of fixed and random effects. The numerical values of our estimation are presented in first part of Table 6. The chi-square values and the corresponding probabilities clearly reject the null hypothesis. Therefore, this study used fixed effects in three models. Finally, to check the accuracy of our fixed effects estimations, a battery of specification tests has been performed. This includes; the Breusch Pagan's Lagrange Multiplier (LM), Pesaran scaled LM and the Pesaran's Cross-Sectional Dependence (CD) test for the correlation and cross-section dependence. The results are presented in Table 6. The estimated test values and the assigned probabilities of all tests indicate that the present study cannot reject the null hypothesis of no correlation among residuals. Therefore, the estimated coefficients are accurate and our results are reliable.

4.2. Robustness check

This study applied the fully modified ordinary least squared (FMOLS) method to confirm the robustness of our estimations. It is an advanced version of OLS to

Table 7. The panel FMOLS models.

Variables	EXR		EXP		GDP	
EXR	–	–	3.35	(2.06)[a]	1.81	(2.35)[a]
GDP	−4.57	(−0.32)[c]	7.47	(0.27)[c]	–	–
EXP	−6.62	(−4.02)[a]	–	–	4.14	(2.14)[a]
EXD	2.29	(4.55)[a]	2.80	(21.38)[a]	−6.09	(−2.92)[a]
HC	7.25	(0.51)[c]	9.69	(1.16)[c]	3.43	(2.52)[a]
INV	5.60	(1.84)[b]	1.46	(0.79)[c]	1.24	(7.04)[a]
D	−4.80	(−0.96)[c]	−3.54	(−1.19)[c]	−0.58	(−0.92)[c]
R^2	0.63		0.91		0.74	
Adjusted R^2	0.62		0.89		0.71	

Notes: 1. The 'a', 'b' and 'c' represent the level of significance at 5, 10 and 1% respectively.
2. The values in parentheses are the t-statistic of coefficients.
Source: Authors' analyses

provide more specific results and efficiency in several aspects. The corrections in original OLS can be used to determine the important empirical effects of this new version. The FMOLS uses standard Wald test based on asymptotic Chi-square statistical interpretation. Generally, this method takes endogeneity and serial correlation into consideration. It provides more options for investigators to find out the differences between both techniques as it offers impartial estimators of co-integrating regressions in a single equation. Furthermore, this method is asymptotically balanced and suitable in the existence of mix normal asymptotic.

The FMOLS results are presented in Table 7. The first column represents the 1st model taking exchange rate as a dependent variable. The third column shows the exports model with other control variables. Finally, the last column offers the results for GDP as the dependent variables. The overall findings of three models confirm that the direction of the link among EXR, EXP and GDP remains the same. Furthermore, the significance level among the coefficients also remains unchanged at large. The crises dummy is also negative and shows the adverse impact of financial turmoil. Therefore, the FMOLS results confirm the robustness of our findings.

5. Conclusion

The existing literature pertaining to the relationship of exports and economic growth has either focused on developed countries or the analysis were performed for an individual economy. Using co-integration approach and fixed effect model, this study selected panel data for Asian countries to examine the relationship of exchange rate, exports and economic growth. To verify the robustness of the association, this study applied the FMOLS model with control variables. Contrary to the available literature, this study used a tri-variate model to focus on the developing Asian economies. Various panel co-integration techniques were used in this study to explore the long term association between the selected variables, and necessary tests were employed for the results' accuracy.

The results of fixed effects model depict that the ELG and the GLE hypotheses hold true for the selected economies in this study. The economic structure of the Asian countries is a vital factor for these findings because the Asian economies are exporting both manufactured goods and services. The second nexus examined in this

paper is the exchange rate's impact on growth and exports of the countries in our sample. The major finding is that an undervalued exchange rate significantly affects the exports. Also, economic development has a positive impact on the exchange rate and a strong exchange rate contributes to the development of an economy. Likewise, the financial crises exert a negative impact on the overall economy. Additionally, the cross check through the FMOLS specifies that the results are robust.

The findings of this study have important policy implications. Since exports play a crucial role in the economic growth of the selected Asian economies, internationalization of the exporting enterprises is needed to enhance their competitiveness. To reduce the inflationary pressures and enhance exports' competitiveness, a timely and balanced exchange rate policy can be effective for the developing Asian economies. Based on the results of this study, overvalued exchange rates and lack of exports can be detrimental for the economic growth in Asia. Since this study focuses on tri-variate analysis for the developing Asian economies overall, the future research can be conducted on Asian economies by taking into consideration the regional differences and levels of economic development.

Note

1. Bangladesh, China, India, Indonesia, Iran, Malaysia, Nepal, the Philippines and Thailand

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