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EXCHANGE RATE VOLATILITY AND PRODUCTIVITY GROWTH NEXUS IN SELECTED ASIAN COUNTRIES

RUKHSANA KAUSAR AND KALSOOM ZULFIQAR*

Abstract. Present study investigates the impact of real exchange rate volatility on long-run productivity growth for a set of selected Asian countries by applying panel ARDL approach for the time period 1985 to 2015. The exchange rate volatility is found to have a significant negative bearing on productivity growth. However, the sway of real exchange rate volatility mainly hinges on a country's financial sector development. The countries with relatively low levels of financial sector development, experience a productivity growth sinking effect of exchange rate volatility, but countries having developed financial sector are not significantly influenced by exchange rate volatility. Similarly, government burden has significant negative implications for productivity growth. On the basis of findings, it is recommended that there is a need to overhaul and develop the financial sector of a country to counter the negative implications of exchange rate volatility for productivity growth.

Keywords: Exchange rate volatility, Productivity growth, Panel ARDL approach, Human capital, Financial development

JEL classification: F31, O40, C23, O15, O16

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*The authors are respectively Lecturer of Economics at Govt. Fatima Jinnah College for Women Chuna Mandi Lahore and Assistant Professor/In-charge at Department of Economics, University of the Punjab, Lahore-Pakistan.

Corresponding author e-mail: sakoang@yahoo.ca

I. INTRODUCTION

Exchange rate volatility increases uncertainty which adversely affects economic growth. It is also described in terms of the risks regarding unexpected and unanticipated fluctuations in the exchange-rate. This is predominantly applicable for developing economies due to their brittle financial systems and high liability to external shocks. Moreover, it can also cause changes in the share and portion of industrialized products, balance of payments, imports as well as exports and reserve money. Exchange rate volatility provides opportunities to local investors who can utilize their foreign currency to obtain higher profits. Sengupta and Sfeir (1996) highlighted as to how exchange rate volatility can impact imports, exports, balance of payments and economic growth of a country.

In 1973, the productivity and exchange-rate volatility interconnection became very important due to the adoption of floating and flexible exchange rates by different countries. During the period of 1980 to 1990, we find a more impulsive behavior of inflation, balance of payments, stock prices and interest rates primarily due to changes in exchange-rate regimes. Similarly, globalization, technological progression, currency speculation and capital account liberalization have led to a sharp rise in cross-country flows in recent years (Hook & Boon, 2000). The volatile and unpredictable exchange-rates depict instability in the worldwide exchange and transaction both in terms of financial assets and goods. The decision of exchange rate scale administration is the most confrontational part of monetary arrangement and economic policy nowadays. For instance, China's rigid system of exchange-rate is confronting effective global feedback in term of bitter criticism; in the meantime, the policymakers of South Africa are censured for not doing what is needed to balance out the nation's exceedingly volatile and unstable currency.

For developing world, the concerns regarding international trade are escalated when, alongside inflationary weights, outer components show up as "shocks" or perturb the international costs and prices of stocks and commodities. Such factors disturb smooth stream of exchange-rate and most of the time become the very reason of stock market downfalls as well as currency disasters. Now and then, such turns are wrongly perceived as "hypothesis." Exchange rates mostly show extremely

lopsided patterns in response to these very shocks, and the subsequent patterns are alluded to as "volatility", i.e. instability. If a shock prolongs and places a passing effect that leads to fluctuation in exchange-rates and trade, and moreover if these fluctuations defer the development of exchange-rate cogently back to their original state, the subsequent trade and exchange patterns will exasperate the normal returns by increasing the prospect of misfortunes.

Over the last few decades, it can be seen that exchange-rate variations have turned into a significant subject of macroeconomic analysis and have attracted the attention of researchers, economists as well as policy makers, especially after the disruption of the agreement namely Bretton Woods regarding exchange-rates mainly among the states which were heavily industrialized. Nilsson and Nilsson (2000) analyzed the influence of exchange-rate regime on the exports of emerging and developing economies. For the developing economies, they asserted that the export-led growth is essential for development but exports of the developing nations are strongly influenced by exchange-rate volatility.

There are many studies in existing literature which explore various dimensions of the interconnection between exchange rate volatility and economic growth. However, there are very few studies which particularly focus the association between exchange rate volatility and productivity growth for Asian region. Current study aims at filling this gap in existing literature by using latest data set and employing more updated methodology. It will be a significant contribution to the existing literature as most of the developing countries face internal shocks in form of inflation and external shocks in terms of exchange rate volatility which negatively impact their productivity growth and hence long-term economic growth. The study also explores the impact of financial development, human capital, government burden and inflation on productivity growth.

II. LITERATURE REVIEW

Friedman (1953) analyzed the capability of different exchange rate regimes in insulating the economy against real shocks and found very erratic results. It also examined how shocks in terms of trade lead to variation in price and output in developing countries. Kenen and Dani (1984) concluded a significant negative impact of short term exchange

rate volatility on the volume of imports. Cushman (1986) described that a country might have indirect implications of exchange rate risks faced by some third-country through some trade partner. Chowdhury (1993) found significant impact of exchange rate volatility on volume of exports in G-7 countries by estimating multivariate ECM (Error Correction Model). Michael and David (2001) concluded that unpredictability of terms of trade and real exchange rate has negative consequences for economic growth and investment. Rose (2000) found a significant negative relationship between exchange rate volatility and trade. The study concluded that 1% rise in volatility will lead to a loss of about 13% in trade. In another study Clark *et al* (2004) however concluded 7% loss in trade due to 1% increase in volatility by using the same dataset and by estimating fixed effects model.

Baak *et al* (2002) investigated consequences of exchange rate volatility for exports in four East Asian countries (Hong Kong, South Korea, Singapore, and Thailand). The results suggested that erratic exchange rate has negative implications for exports both in short run and long run. Calderon (2004) resolved that in developing countries the changes in real exchange-rate are about four times more unpredictable and volatile as compared to industrial economies. Similarly developing nations with flexible and adaptable regimes are 3 times more unpredictable and volatile as compared to the developing nations with settled regimes or hard pegs. Mustafa and Nishat (2004) based on the data for the time period between 1991 and 2004 suggested that in case of Pakistan exchange-rate volatility has significant negative influence on trade relations with partners such as UK and US, Australia and Singapore. Goldstein (2004) concluded that countries which adopt disciplined macroeconomic policies to cope with the challenges arising from globalization get the benefit from foreign direct investment in form of reduction in exchange rate volatility.

Ozturk (2006) resolved that foreign trade growth is inhibited by the increased exchange rate volatility. Tenreyro (2007) established that if volatility is entirely removed volume of trade will increase by 2%. Philippe and Romain (2006) submitted that exchange rate volatility usually reduces growth in countries having relatively low level of financial development whereas in financially advanced countries no such impact exists. Rasaq (2013) concluded a positive impact of exchange

rate volatility on trade Openness, gross domestic product and FDI (Foreign Direct Investment) and an adverse effect on inflation rate. Amor and Sarkar (2008) examined the implications of exchange-rate volatility for exports and imports with reference to trading partners of Pakistan. The findings of study suggest that exchange rate volatility has depressed both exports and imports. Sehar *et al* (2015) have explored whether volatility of real exchange rate has been reduced by greater foreign investment in emerging Asian economies. The results suggested that major shocks in foreign liabilities result in the reduction of volatility of real rate of exchange especially for countries like Malaysia China, Singapore, South Korea and India.

III. THEORETICAL BACKGROUND AND ANALYTICAL FRAMEWORK

Aghion *et al*. (2005) suggested that investment, employment and growth rates are adversely affected by exchange rate volatility. The study theoretically linked exchange rate volatility to aggregate productivity growth and concluded a negative relationship among exchange rate volatility and aggregate productivity growth, especially in the countries where the financial market is under-developed. Arize (1998) also supported the same argument. Aghion (2005) in the option-pricing model advocated that a rise in the exchange rate volatility impedes firms' foreign investment and afterward their growth.

Arize *et al*. (2003) concluded that exchange rate volatility in emerging economies reduces foreign firm's employability due to the fact that they shift their production to less unstable markets. Findings of Caglayan and Demir (2014), however, do not support the connection between labour productivity and exchange rate volatility. Contrariwise, exchange rate improbability might upturn foreign firms' entrance and growth as risk-averse firms' supernumerary foreign production for exports (Goldfajn & Valdes, 1999). De Grauwe (1994), Azid *et al* (2005), Andersen *et al*. (1998), Engel and Devereux (2002) and Bacchetta and Eric (2006) have described various straits through which economic variables influence the level of exchange rate volatility and hence may impact productivity growth. Hence, there are various channels through which exchange rate volatility can impact productivity growth. Keeping in view these linkages

we can use the following model to describe the relationship among productivity growth and exchange rate volatility

$$\mathbf{PG = f\ (HC, GCF, VOL, FD, GB, INF)} \qquad (1)$$

Where;

PG = Productivity Growth

HC = Human Capital

GCF= Gross Fixed Capital Formation

VOL = Exchange Rate volatility

FD = Financial development

GB = Government burden

INF= Inflation

IV. ECONOMETRIC METHODOLOGY

An important limitation of the typical methods used for panel data analysis is that they do not take into account long-term influences of the variables with similar coefficients. As data on macroeconomic time series is mostly non-stationary, usage of simple OLS method might provide spurious results (Asteriou and Hall, 2007). Blackburne and Frank (2007) have pointed out that in fixed effect (FE) and mean group (MG) estimation for dissimilar panel data analysis, where intercepts and slope coefficients vary across the groups and are greater than the number of time periods the postulation of homogeneity of gradient coefficient becomes inconsistent. In mean group approach, a distinct model is estimated for each group and average of slope coefficients is considered. Resultantly, the error variances, slope gradients and intercepts are invariant across the groups. ARDL panel modelling or pooled mean group (PMG) estimator overcome these problems where slope coefficients can vary in short-run but consistent in the long-run

The structure of the Pooled Mean Group (PMG) model utilized by current study is described as under.

$$Y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \delta_{ij} X_{i,t-j} + \mu_i + \varepsilon_{it} \qquad (2)$$

In the above equation (2) Xi, t-j is the vector of explanatory variables for group i. Here, μi denote the fixed effects. Furthermore, p and q are lags which may vary through the countries because of unbalanced panels. When the macroeconomic variables are integrated at I (1) and co-integrated, the error term is processed at I (0). Therefore, it is common to re-parameterize error-correction equation as If variables are I (1) and co-integrated then the error term is integrated at I (0). For VECM system, above model can be re-parameterized as

$$\Delta Y_{it} = \theta i\left(y_{i,t-1} - \psi i X_{i,t-1}\right) + \sum_{j=1}^{p-1} \lambda_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (3)$$

In the above equation ψ represents the long-run and, θi are error correction parameters. In present analysis, Y represents productivity growth, and X is a set of various explanatory variables including exchange rate volatility, financial development, government burden, human capital and inflation. The parameters on left side in parenthesis are the long run and term on right hand side is short run dynamics. It can be anticipated that θi has significant negative value under the pre-assumption that variables direct a convergence to long-term equilibrium.

MEASUREMENT OF EXCHANGE RATE VOLATILITY

Various methods have been used to measure exchange rate volatility in existing literature. Some studies have constructed a systematic variance of the series. However, it is just an ingenuous derivation of improbability. It completely rules out the possibility that economic agents may have information about exchange rate patterns and it only explains systematic fluctuations but not the uncertainty in this regard (Dorantes & Pozo, 2001). ARCH models were presented by Engle (1982) and generalized as GARCH by Bollerslev (1986) which offer a more parsimonious model which is easier to estimate. GARCH model can be a better option as it predicts exchange rate movements and measures improbability around that prediction. Autoregressive Conditional Heteroscedasticity (ARCH) methodology is based on response mechanism that integrates previous observations into the present. Current study has utilized GARCH model to estimate exchange rate volatility. In current study GARCH model conditional variance is determined that is the average weighted of past square-residuals. The weights gradually

decrease but always positive. In the specification GARCH (p, q) p presents past conditional-variances while q stands for past squared-innovations. In this study, the simple specification of GARCH (1, 1) is used to measure exchange rate volatility.

DATA DESCRIPTION

Current study is based on a panel data set for 12 Asian countries including Bangladesh, China, India, Japan, Philippines Indonesia, Sri Lanka, Singapore South Korea, Malaysia, Pakistan, and Thailand from 1985 to 2015. Labor productivity is used as a proxy for productivity growth (PG) and is measured as the proportion of aggregate outcome to the quantity of laborers used to create the output.i.e. Labor productivity = GDP / Employed person. GCF is gross fixed capital formation, Human capital (HC) is assessed through government expenditure on health and education as percentage of GDP. Both a rise in gross fixed capital formation (GCF) and human capital (HC) promote economic growth by enhancing labor productivity. Government Burden (GB) measured by government consumption/GDP ratio crowds out private investment hence it can have negative implications for productivity growth. Financial development (FD) is measured by regional credit to private sector as % of GDP. A higher level of financial development stimulates efficient resource allocation and thus likely to impact productivity growth positively. Inflation is measured by Consumer price index (CPI). An increase in uncertainty resulting from Inflation obstructs investment levels in an economy which impedes productivity growth. The data for current study is taken from World Development Indicators (WDI), IMF (International Monetary Fund), IFS (International Financial Statistics) and Penn world tables. All the variables are used in log form.

V. EMPIRICAL RESULTS

First step in estimating the panel ARDL model is to determine the order of integration of data. Present study has used Im, Pesaran and Shin (IPS) panel unit root test in this regard. The null hypothesis states that there is unit root. The hypothesis is rejected if the estimated value (tau) is greater than the critical value. The rejection of null hypothesis means that the data is stationary. If otherwise differencing procedure is utilized to ensure stationarity.

RESULTS OF PANEL UNIT ROOT TEST

The results of unit root test conducted at level and first differenced data are summarized in Table 1. The results suggest that all variables except inflation are stationary at first difference i.e. Integrated of order 1.

TABLE 1

Panel Unit Root Test Results

Variable	At Level		At First difference	
	With Intercept	With intercept &trend	With Intercept	With intercept &trend
Productivity (PG)	4.6639 (1.0000)	-3.1172 (0.9437)	-7.1173* (0.0000)	-5.2297* (0.0000)
Inflation (INF)	-4.1529** (0.0072)	-2.6691** (0.0055)	-6.7312* (0.0000)	-5.2297* (0.0000)
Gross Fixed Capital Formation (GCF)	9.3274 (1.0000)	6.4532 (1.0000)	-4.3321* (0.0000)	-3.6887* (0.0000)
Government Burden (GB)	-0.5112 (0.3046)	-0.1987 (0.4326)	-8.7113* (0.0000)	-7.0365* (0.0000)
Financial Development (FD)	2.5493 (0.7924)	1.3112 (0.3796)	-9.8547* (0.0000)	-8.0657* (0.0000)
Exchange rate volatility (VOL)	1.2395 (0.7932)	1.0054 (0.3385)	-8.3251* (0.0000)	-7.7741* (0.0000)
Human Capital (HC)	5.7921 (1.0000)	3.6658 (0.8957)	-3.4231* (0.0000)	-2.6958* (0.0000)

Note: * and ** indicate significance at 5% and 10% level, respectively. In parenthesis are p-values. Source: Calculated by the authors

In Panel ARDL approach we apply unit root test to exclude the possibility that none of the variables is integrated of order 2 (Pesaran *et al*. 1999). The study has utilized E-views to estimate the model which automatically determines the number of optimal lags by utilizing Akaik information criterion (AIC) and Schwartz information criterion (SIC).

LONG-RUN RESULTS (POOLED MEAN GROUP ESTIMATION)

The results show that for both models (Model II is an augmented version of Model I by adding the interaction term FD*VOL) human capital, Gross fixed capital formation, inflation, govt. burden, financial development and exchange rate volatility are all significantly related to productivity growth. The findings of both models are similar with respect to the direction of relationship. The coefficient on inflation is -0.0793 in Model I. It suggests that a 1% increase in inflation will lead to a decrease in productivity by 0.07 %. Similarly, Model II predicts an even larger decline in productivity by about 0.09 % in response to 1% increase in inflation. It implies that productivity growth is hindered by inflation in these Asian economies. These results are in line with the findings of Gylfason and Herbertsson (2001), Schnabl (2008), Gillman and Harris (2010) and Eriș and Ulașan (2013).

TABLE 2

Exchange Rate Volatility and Productivity Growth

Variable	Model I	Model II
Inflation	-0.0793** [-1.8473]	-0.0914* [-2.5412]
Gross fixed Capital formation	0.1971* [3.2586]	0.1335* [2.4750]
Financial Development	0.2458 [4.0214]	
Exchange rate volatility	-0.4412* [-2.3841]	-0.5412 [-2.9975]
Human Capital	0.80145* [3.2581]	0.6443 (2.0221)
Government burden	-0.0658* [-5.0241]	-0.0559* [-2.9591]
Exchange rate volatility* Financial Development		0.1320* [3.3429]

Note: *and **Represent significance at 1% and 10% respectively. t-values are provided in brackets. Source: Calculations by the authors

Gross fixed capital formation (GCF) has a significant positive impact on productivity growth as indicated by the coefficients in both models. This positive correlation among productivity growth and gross fixed capital formation is confirmed by many previous studies. (See DeLong & summers; 1993, Borensztein *et al*.1995). A higher level of GCF results in higher levels of capital accumulation and hence leads to productivity growth. The level of financial development has a significant positive impact on productivity growth in Model 1 implying the fact that a well-developed financial market promotes productivity growth. It suggests that development of financial sector aids in optimal use of scarce financial resources and hence boosts productivity. These results are parallel to the findings of AyhanKose, *et al* (2008)[1] and Levine, *et al*. (2000). Rapid and unanticipated changes in exchange rate can result in macroeconomic instability, financial crisis and business cycles in an economy. This uncertainty has not only negative implications for investors but it has adverse impact on trade as well. Resultantly, the exchange rate-volatility leads to decrease in productivity.

In specification II (column 3) the interaction term EX*FD captures the effect of exchange rate volatility on productivity growth in presence of financial development. The positive and significant coefficient suggests that well-developed financial sector helps to neutralize rather overcome the negative impact of exchange rate volatility on productivity growth. The results suggest that there is a significant negative impact of government burden on productivity growth. Labor productivity augments when businesses use latest methods of production, improved technology, increase capital per worker, and provide training and development opportunities to their workers. A market with least government intervention encourages the profit maximizing individuals to optimize their output. However, these market forces will be unreceptive in an environment where government is playing the main role. Similarly, government consumption crowds out private investment which leads to very little incentive for producers to adopt new technologies and hence productivity growth slows down. Pattillo *et al*. (2002) and Schclarek (2004) support the same conclusion as any type of financial burden halts

[1]Does Openness to International Financial Flows Raise Productivity Growth? By *M. AyhanKose, Eswar S. Prasad, andMarco E. Terrones(2008).*

the productivity growth due to inefficient resource utilization and increased cost of capital. The results also support the debt over-hang hypothesis presented by Krugman (1987).

Human capital has a significant positive impact on productivity growth. It plays a crucial role in productivity enhancement through increased investments in health and education. Many previous studies confirm this positive impact of human capital on labour productivity including Landau (1983) Baumol *et al* (1989) and Barro (1991).

SHORT RUN DYNAMICS

The short term dynamics of the models are presented in table below:

TABLE 3

Short - Run Dynamics

Variables	Model 1	Model 2
ECM (-1)	-0.5934 (-2.712)*	-0.7221 (-3.139)*
D(LP(-1))	-0.1472(1.4739)	0.4157(1.5432)
D(INF)	-0.3219(-0.6973)	-1.0025*(-1.3035)
D(INF(-1))	-0.1723(-0.8317)	-0.2011(-0.9547)
D(GF)	0.1397(1.9897)**	0.2741(1.8247)***
D(GF(-1))	0.2311(1.8412)	0.3347(0.6587)
D(FD)	0.6923(2.0397)	-
D(FD(-1))	0.4137(1.3972)	-
D(VOL)	0.7832(0.5725)	0.2772(0.4711)
D(VOL(-1))	-0.4474(-0.7293)	-0.5541(-1.0358)
D(VOL*FD)	-	0.1236(0.6992)
D(VOL(-1)*FD(-1))	-	0.0839(1.0691)
D(HC)	0.6843(1.9711)*	0.4741 (2.008)*
D(HC(-1))	0.7118(1.5661)	0.1147(1.4415)
D(GB)	-0.0368(0.7541)	-0.0548(-0.6654)
D(GB(-1))	-0.1647(0.8563)	-0.2324(-1.1241)
C	2.0312 (0.3984)	3.2217(0.8847)

*, **, ***Represent 1,5and10 percent level of significance respectively. In parenthesis [] are t-statistics. Source: Calculations by the authors.

The short-run dynamics of the models are summarized in Table 3. The adjustment coefficient ECM (-1) in both cases is negative and significant suggesting that the models are stable and the systems are converging toward equilibrium after any shock. The magnitude of the adjustment coefficient represents speed of adjustment. The error correction coefficients reflect that 59% to 72% adjustment takes place per period.

CAUSALITY ANALYSIS

The results of Panel Homogeneous Causality Test are summarized in Table 4. The results suggest the existence of uni-directional causality running from exchange rate volatility to productivity growth. The results also support bi-directional causality between financial development and productivity growth. Many previous studies like Hooper and Kohlhagen (1978), Gotur (1985), Bailey *et al* (1987), Asseery and Peel (1991) Aghion (2005) also support this finding. The findings also suggest that human capital (HC), Government burden (GB) and inflation have uni-directional causality with productivity growth (PG). The causality is running from inflation, human capital, and government burden to productivity growth.

TABLE 4

Panel Homogeneous Causality

Variable	PG	INF	GCF	FD	VOL	HC	GB
PG	-	0.5581	0.0322*	0.0083*	0.0001*	0.3555	0.5598
INF	0.0652***	-	0.5541	0.2511	0.0000*	0.783	0.4069
GCF	0.3547*	0.6547	-	0.3985	0.7114	0.2957	0.0054*
FD	0.0431**	0.0067*	0.4451	-	0.0000*	0.0001*	0.0003*
VOL	0.6377	0.0615*	0.8756	0.0000*	-	0.9489	0.3617
HC	0.0157*	0.7830	0.9741	0.0069*	0.0000*	-	0.0672*
GB	0.0000*	0.1852	0.7412	0.0483*	0.0000*	0.9489	-

*, **, *** represent 1, 5 and 10 percent level of significance respectively

VI. CONCLUSION AND POLICY IMPLICATIONS

Current study has explored the impact of exchange rate volatility on productivity growth for a set of 12 Asian countries using panel ARDL approach. The results conclude that countries with relatively low levels of financial sector development, experience a productivity growth reducing effect of exchange rate volatility. However, the countries having a developed financial sector not only overcome these negative implications rather benefit from exchange rate volatility in the form of increase in productivity growth. The findings also suggest that human capital and gross fixed capital formation lead to increase in long-term productivity growth while inflation and government burden has an adverse impact on productivity growth. On the basis of these findings it is suggested that there is a need to control exchange rate volatility for better productivity growth. The negative implications of exchange rate volatility can be countered by taking effective policy measures to develop financial markets. Government should adopt policies to increase the capacity building of human resource and increase gross fixed capital formation to enhance productivity growth. Similarly, public sector should rationalize its expenditures and ensure macroeconomic stability to boost productivity growth.

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