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Predicting Stock Indices Trends using Neuro-fuzzy Systems in COVID-19

Muhammad Zubair Mumtaz
Associate Professor of Finance
School of Social Sciences and Humanities,
National University of Sciences and Technology,
Islamabad, Pakistan.
zubair@s3h.nust.edu.pk

College of Business Administration,
University of Bahrain,
The Kingdom of Bahrain.
mmumtaz@uob.edu.bh

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Abstract:
Predicting the ebb and flow of stock markets is a complex and challenging exercise owing to the disruptive and uncertain behavior of stock prices. The COVID-19 pandemic is an example of an event that, had a drastic impact on global stock markets, due to business activities and trading being severely affected. It is important, therefore, to be able to predict how stock markets behave in a crisis period. We find that stock markets obtain the worst returns in countries where there are higher reported positive cases of coronavirus. This study employs adaptive neuro-fuzzy inference systems (ANFIS), comprising of a controller and the stock market process, to predict the behavior of selected stock indices. After training ANFIS and evaluating the resultant data, we estimate statistical errors and found that 100 training epochs provide marginally better results. To test the accuracy of our results, we used hit rate success and report that the neuro-fuzzy system predicts stock market trends with an average accuracy of 65.84%, an improvement over earlier techniques reported in the literature. Finally, we compute the rate of return using a buy-and-hold strategy and a neuro-fuzzy system, and identify that market indices outperform by employing the proposed method.

Keywords: Stock market index, COVID-19, Neuro-fuzzy, forecasting.

JEL Classification: C53, E17, G11, G12.

Predicting Stock Indices Trends using Neuro-fuzzy Systems in COVID-19

1. Introduction

Stock markets are sensitive and volatility can be caused by global or local events can affect stock market trading activities. Over the past two decades, we have observed the impact of various crises - the Asian financial crisis, dotcom bubble, global financial crisis - that have adversely influenced stock markets. Given that on the eve of the financial crisis, the decrease in stock prices was significantly associated with a decline in real economic output (Atsalakis, et al., 2016), it is essential to more accurately predict how stock prices may behave in the future.

The coronavirus (COVID-19) pandemic started in early 2020 and has affected millions of people across the globe. As of September 2020, approximately thirty-five million people were infected, with over a million succumbing to COVID-19. The total number of countries that has been drastically impacted in this manner is, at the time of this study, approximately 215. Owing to this crisis, business activities have halted, which eventually affects both economic and stock market activities. As every crisis negatively influences the stock markets, the behavior of the market is based on uncertainty, ambiguity, and a high frequency of data. Hybrid intelligence networks provide different options for the unconventional management of complex issues. These networks have been extensively employed in numerous functions. Bahrammirzaee (2010) used artificial neural networks (ANNs) along with other methods, such as neuro-fuzzy systems that integrate the human-like cognitive form of fuzzy sets. The benefit of this network is to act as a general approximator for performing the strengths of translating power. Guillaume and Charnomordic (2011) incorporated a fuzzy-logic inference system (FIS) with an ANN by combining it with derivative-free optimization methods, which provide appropriate results for neuro-fuzzy controllers utilized for the prediction of stock markets. Similarly, Rajab and Sharma (2019) suggested a proficient and interpretable neuro-fuzzy system to forecast stock prices by applying various technical parameters that emphasize accuracy trade-offs. Their simulation findings show that a neuro-fuzzy system provides a better balance between accuracy and interpretability.

To estimate impacts on stock markets, an ANFIS technique is generally used (Makridou et al., 2013; Guillaume and Charnomordic, 2011), as it measures the complex trends of stock markets appropriately under stipulated procedures. Atsalakis and Valavanis (2009) argued that various models provide better results in a stable state of economic conditions and the absence of complex behavior of stock markets (Belke and Gokus, 2011), but they are unable to make predictions in a crisis period. This study applies a neuro-fuzzy system to forecast how the stock indices behave during the pandemic period. We choose our sample based on the highest and lowest deaths as of August 2020 and consider 19 stock indices to predict their behavior using a neuro-fuzzy system. We report that stock markets obtain lower returns in countries where the reported cases of COVID-19 are higher. This study uses the ANFIS technique based on the controller and stock market process. To estimate the accuracy of the results, we compute the mean square error (MSE), mean absolute error (MAE), hit rate success, and RoR using the B&H strategy and trading simulations. We report that 100 training epochs marginally estimate better results. We also find that a neuro-fuzzy system, on average, predicts the trends of stock indices with an average accuracy of 65.84%. Furthermore, we report that market indices outperform using a neuro-fuzzy system over the B&H strategy.

2. Literature Review

Predicting stock market trends is important from the viewpoint of investors, as it helps to explore growth opportunities, determine investment potential and identify risk-return patterns. Generally, the purpose of investment in the stock market is to earn profits. However, the forecasting behavior of the stock market provides a cushion for investors to decide whether they invest in stock or withdraw their funds. The forecasting behavior of the stock market assists investors in identifying the possible risks that could affect various geographical destinations, and subsequently diversifying their asset portfolio.

Previous studies (Apostolakis et al., 2021; Mahmud and Meesad, 2016; Atsalakis and Valavanis, 2009) have used various techniques to examine the movement of stock markets and predict their behaviors. Atsalakis and Valavanis (2009) used a neuro-fuzzy adaptive control system to estimate trends of stock prices. They considered the data of both the Athens and New York Stock Exchanges to trade and assess the ANFIS and reported that this technique has been executed well in trading simulations and its results are better than the buy-and-hold strategy. In contrast, they

employed thirteen other computing techniques to predict the accuracy of stock market trends and found that ANIFS is a supervisory approach. Lin et al. (2002) argued that the neuro-fuzzy system had originally evolved to model large datasets in a manner stimulated by human minds. It recreates the biological nervous system for analyzing the data. The objective of artificial intelligence is to simulate the decision-making competence and capabilities of human minds (Kumar et al., 2012). A neuro-fuzzy system is a consolidation of neural networks and fuzzy logic. Hence, this technique is applied to predict the behavior of stock markets, economic policy, pattern recognition, and medicines.

Trinkle (2006) applied ANFIS and neural networks to estimate the abnormal returns of three public firms. He compared the results of ANFIS and neural network techniques with the ARMA model and reported that both techniques are superior in terms of their predictive ability. Abbasi and Abouec (2008) examined the pattern of stock prices using ANFIS and found that the behavior of stock prices could be determined with a low level of errors. Yunos, Shamsuddin and Sallehuddin (2008) proposed a hybrid neuro-fuzzy with ANFIS to forecast the daily trend of the stock market, and their findings suggest that ANFIS has more predictive ability than artificial neural networks (ANN). In another study, Boyacioglu and Avci (2010) investigated the pattern of the Istanbul Stock Exchange by employing ANFIS. They accounted for six macroeconomic factors and three indices as inputs. They found that ANFIS predicted monthly returns with an accuracy of 98.3%. Mahmud and Meesad (2016) used ANFIS to forecast stock price movements of four top stocks listed on the Dhaka stock exchange. They compared their findings with other traditional methods and reported that neural networks provide superior results in terms of predicting stock market behavior.

Earlier studies have widely documented that neuro-fuzzy is a superior method to examine the predictability of stock market returns. Esfahanipour and Aghamiri (2010) employed four different models to examine thirty Taiwanese stocks and found the superiority of the neuro-fuzzy system in measuring future stock returns. Atsalakis and Valavanis (2009) employed different soft computing techniques (e.g., regression model, GARCH-M, neural networks, radial basis function (RBF) network, multilayer perceptron (MLP), and neuro-fuzzy) to contrast results and reported that among others, the neuro-fuzzy system shows the highest hit rate percentage and proved itself as a superior method. Likewise, Kumar et al. (2012) examined the stocks listed on the Bombay stock exchange and

reported that the ANFIS technique has the ability to forecast stock returns 10-15 days in advance.

Ly (2021) used ANFIS to predict the number of COVID-19 cases in the UK by considering artificial neural networks and fuzzy logic structures to train the model. They evaluated different dynamics of ANFIS and proved it to be a real-time series prediction model. Moreover, they suggested that data relating to Spain and Italy can intensify the predictive power of COVID-19 cases in the UK.

In a recent study, Apostolakis et al. (2021) argue that a worldwide contagious effect in terms of economic parameters enhances volatility in financing markets. They document that during the COVID-19 pandemic, a higher level of volatility is spread by mid-cap firms to large-cap firms. In light of the superiority of ANFIS, the aim of this study is to predict the behavior of selected stock indices during COVID-19. Though the behavior of stock markets varied on the eve of the crisis, ANFIS on average accurately predicts how stock markets respond and provides an opportunity for investors to take appropriate measures to avoid losses.

3. The Model

Researchers have widely documented that most financial analysts, stockbrokers, and individual investors rely on historical information to predict the behavior of stock markets because the occurrence of an event is adjusted by an increase or decrease in stock prices. The stock market comprises many firms; therefore, the occurrence of an event can subsequently influence the stock market index. This study uses stock market indices as inputs (predictors) to develop a predicting schema that measures the fundamental principle of stock market movement, which eventually forecasts a trend of the stock market index for the next day. To examine the behavior of stock indices, this study follows the methodology of ANFIS. Earlier studies (Rajab and Sharma, 2019; Atsalakis and Valavanis, 2009; Abraham et al., 2005; Jang et al., 1997) document that ANFIS is a better technique, as it can capture the movements of stock markets. We divide the process of a neuro-fuzzy system into training and evaluation phases.

A diagram of the neuro-fuzzy system during the training and application–evaluation phases is shown in Figs. 1a and 1b (Atsalakis and Valavanis, 2009).

Figure 1a: Control system during the training phase.

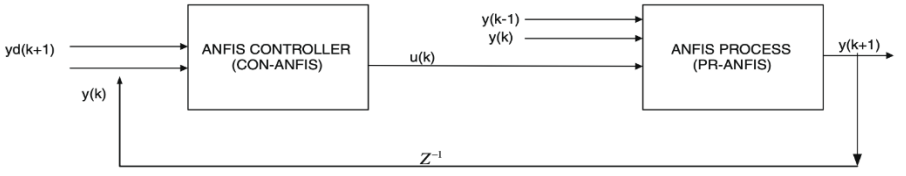
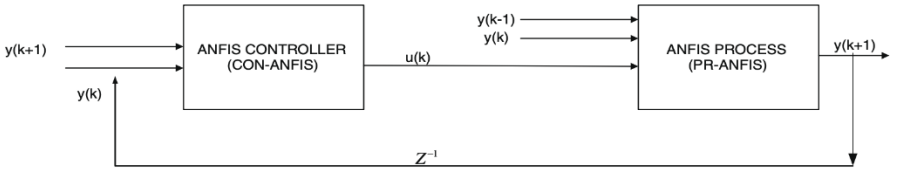


Figure 1b: Control system during the application-evaluation



The controller (CON-ANFIS) regulates the framework of the stock market process (PR-ANFIS) and subsequently predicts the trend of stock indices (i.e., next day). The process and controller can be managed by a neuro-fuzzy system that is applied to both phases and expressed as:

$$y(k+1) = f\big(y(k), u(k)\big) \tag{1}$$

$$u(k) = g \tag{2}$$

where $y(k+1)$ and $y(k)$ refer to the stock market index at time $k+1$ and k, respectively, and $u(k)$ is the control signal at time k. The issue of control is to determine the mapping $\varphi(\cdot)$ for the controller, which identifies certain anticipated performance through the overall system.

3.1. Controller – Training Phase

The controller (CON-ANFIS) is trained on the inverse learning method, also as general learning. However, an offline system is applied to construct the converse dynamics of the process in the learning phase. In terms of the application phase, the neuro-fuzzy system is applied in order to create control actions to model the process of the market index. Both phases may operate concurrently, which suggests that this technique adjusts well with classical adaptive control structures. The general form of equation (1) can be written as (Kumaran, Ravi, & Mugilan, 2013):

$$y(k+n) = F(y(k), U) \tag{3}$$

where n refers to the order of the process. F denotes multiple composite functions, and U is the control actions from k to $k+n-1$. This equation shows that in control input *u*, time moves from k to $k+n-1$ in precisely *n* time phases. Considering the inverse dynamics process of a market index, U becomes a specific function of $y(k)$ and $y(k+n)$:

$$U = G\big(y(k), y(k+n)\big) \tag{4}$$

where the existence of exceptional input classifications U quantified through mapping G can be obtained from stock market index $y(k)$ to $y(k+n)$ in *n* time phases. In this system, an inverse mapping G must be obtained. To estimate the inverse mapping G, the ANFIS method is a Sugeno first-order model with *2n* inputs and *n* outputs per broad training datasets $[y(k)^T, y(k+n)^T; U^T]$. where $y(k+1)$ refers to the output of the stock market index, which is a function of earlier stock market index $y(k)$, and the input $u(k)$. Thereafter, the ANFIS controller reproduces the inverse dynamics of mapping G. Based on $y(k)$ and the predicted stock market index $y_d(k+n)$, the ANFIS controller produces a projected $\hat{U}$:

$$\hat{U} = \hat{G}\big(y(k), y_d(k+n)\big) \tag{5}$$

Subsequently, by computing *n* phases, this method will take $y(k)$ close to the anticipated $y_d(k+n)$ as the representative of $\hat{G}$, which is accurately the same as the inverse mapping G. If $\hat{G} \neq G$, then $y(k)$ are far from $y_d(k+n)$. To circumvent this issue, an additional dataset may be employed to improve the process, where $\hat{G}$ will become closer to G, indicating the precision of the training process. In the application phase, the predicted $y_d(k+n)$ is not accessible beforehand. To measure $y_d(k+n)$ as the next day's trend, this study uses the rate of change of the three-day moving average of the stock market index.

To train the controller, this study uses the dataset $[y(k), y(k+1); u(k)]$. where $y(k)$ and $y(k+1)$ indicate the change in the stock market index at time k and $k+1$, respectively. $u(k)$ is always positive and measured as $u(k) = \sqrt{\big(y(k) - y(k+1)\big)^2}$.

3.2. Stock Market Process – Training Phase

In this process, the current index of the stock market is used to predict the variation in the next day's index. Using the present inputs and prior outputs of the model, the changes in the actual stock market index are obtained from the controller:

$$y(k+1) = f\big(y(k), y(k-1), u(k)\big) \tag{6}$$

This study presumes that the underlying forces of the process of the market index are unknown. The training phase is emphasized on a first-order ANFIS that estimates $[y(k-1), y(k), u(k)]$ the change in the predicted stock market index at $y(k+1)$. The PR-ANFIS model is a Sugeno first-order technique with *3n* inputs and one output. This method employs a hybrid learning algorithm that clubs the back-propagation gradient descent and the least square method, in order to produce a fuzzy intrusion network where membership functions are regulated as per the inputs and output trading dataset.

3.3. Measuring stock indices on the eve of COVID-19

This study forecasts the stock indices on the eve of COVID-19 that can adversely influence the stock markets on the one hand and the entire economy on the other. The trend of stock indices is represented by the rate of change, indicating a parameter of market momentum. Rate of change (RoC) is a central measure that moves above and below zero. This indicator gauges the percentage change in the index over a certain period and is measured as:

$$RoC_{(x)} = \frac{I_{(x,t)} - I_{(x,t-n)}}{I_{(x,t)}} \tag{7}$$

Where $I_{(x,t)}$ shows the closing market index of country x at time t, which indicates that the percentage change in the market index can be positive or negative.

3.4. Estimation by Statistical Performance Measures

To examine the accuracy of the results, statistical errors assess the sum of the difference between actual and forecasted indices. Atsalakis et al. (2016) used MAE and MSE to measure the accuracy of these estimations as:

$$MSE = \frac{1}{N}\sum_{t=1}^{N} e_t^2 \quad (8)$$

$$MAE = \frac{1}{N}\sum_{t=1}^{N} e_t \vee \quad (9)$$

3.5. Hit Rate Success – Trend Evaluation

In general, stock indices are affected by market reactions. During the trading session, if the market index increases in the following session, investors will participate to acquire more shares to dispose of them tomorrow. For instance, if there is a probability of a lower closing market index in the next day, investors will sell or hold their stocks. The pattern of the stock index is significantly based on trend forecasting and is calculated as follows:

$$Hitrate = \frac{h}{n} \quad (10)$$

Where h is the number of accurate estimations of the trend of stock indices and n is the number of tests (60 sessions in the analysis).

4. Sample and Data

This study used the daily data between the date of the first reported case of coronavirus in the country and 31st August 2020. We selected 19 countries to forecast the behavior of stock indices. To examine the effect of coronavirus on the stock indices, we split our sample into the highest and lowest deaths. Table 1 exhibits the position of the highest deaths of COVID-19 as of 31 August 2020, stock market indices, analysis period, and training data.

Table 1: The first reported case of COVID-19, total death, indices, analysis period, and training data

Country	Deaths	Index	The day when the first case of COVID was confirmed	Period	Training data (daily prices)
USA	5,997,163	S&P 500	20/1/2020	21/11/2019–31/8/2020	196
Brazil	3,862,311	Bovespa	26/2/2020	26/12/2019–31/8/2020	171
India	3,621,245	BSE Sensex 30	30/1/2020	26/11/2019–31/8/2020	192
Russia	995,319	MOEX	21/2/2020	16/12/2019–31/8/2020	175
Peru	647,166	SPBLPGPT	6/3/2020	2/1/2020–31/8/2020	168
South Africa	625,056	JTOPI	5/3/2020	3/1/2020–31/8/2020	166
Colombia	607,938	COLCAP	6/3/2020	2/1/2020–31/8/2020	161
Mexico	595,841	IPC	28/2/2020	24/12/2019–31/8/2020	173
Spain	439,286	IBEX 35	31/1/2020	25/11/2019–31/8/2020	195
Chile	409,974	IPSA	8/3/2020	6/1/2020–31/8/2020	166
Argentina	401,226	MERVAL	3/3/2020	2/1/2020–31/8/2020	160
UK	334,467	FTSE 100	29/1/2020	25/11/2019–28/8/2020	193
France	277,943	CAC 40	24/1/2020	20/11/2019–31/8/2020	198
Canada	127,940	TSX	27/1/2020	25/11/2019–31/8/2020	193
China	89,895	Shanghai composite	31/12/2019	27/09/2019–31/8/2020	224
Sweden	85,958	OMX Stockholm 30	4/2/2020	2/12/2019–31/8/2020	185
Japan	67,865	Nikkei 225	24/1/2020	25/11/2019–31/8/2020	186
Australia	25,746	ASX	25/1/2020	22/11/2019–31/8/2020	195
Hong Kong	4,802	Hang Seng	23/1/2020	22/11/2019–31/8/2020	191

5. Results

5.1. Summary statistics

Table 2 shows the summary statistics of selected stock indices based on daily training data reported in Table 1. Among the sample countries, on average, the Colombian stock index (COLCAP) performed worst (-0.194%), followed by the Chilean stock index – IPSA (-0.157%) and FTSE-100 (-0.112%). The results show that on average, the Russian stock index (MOEX) obtained the highest return of 0.135%, followed by the Argentinian stock index – MERVAL (0.082%) and Shanghai composite (0.066%). When we divide our sample into the highest and lowest COVID-19 cases to examine their returns and volatility, we find that stock indices obtained the lowest returns (-0.047%), where the cases of COVID-19 were higher, and they have higher volatility of returns. Similarly, the position of returns and volatility is better in those stock indices where the reported cases of coronavirus are lower. The median returns of the majority of stock indices are positive, which indicates the positive returns of stock indices over the sample period. When we analyze the standard deviation, the results report that Brazilian and Argentinian stock indices are more volatile than other sample indices. Likewise, the returns of all stock indices are negatively skewed except MOEX, Nikkei 225, and ASX.

Table 2: Summary Statistics of Selected Stock Indices

	Mean	Median	Min.	Max.	Std. Dev.	Skewness	Kurtosis
S&P 500	0.061%	0.271%	-12.765%	8.968%	2.372%	-0.851	7.913
Bovespa	-0.098%	-0.019%	-15.993%	13.022%	3.331%	-1.232	7.584
BSE Sensex 30	-0.029%	0.104%	-14.102%	8.595%	2.247%	-1.540	10.678
MOEX	0.135%	-0.005%	-8.884%	8.835%	1.990%	0.039	3.999
SPBLPGPT	-0.063%	0.078%	-11.009%	4.064%	1.753%	-1.859	9.856
JTOPI	-0.004%	0.122%	-10.450%	7.907%	2.251%	-0.875	4.858
COLCAP	-0.194%	0.024%	-13.281%	12.470%	2.677%	-0.843	11.210
IPC	-0.105%	-0.137%	-6.638%	4.744%	1.698%	-0.471	1.875
IBEX 35	-0.142%	-0.052%	-15.151%	7.528%	2.273%	-1.690	11.039
IPSA	-0.157%	0.271%	-12.765%	8.968%	2.525%	-0.850	7.913
MERVAL	0.082%	0.175%	-15.629%	9.773%	3.783%	-0.702	3.099
Highest COVID cases	*-0.047%*	*0.076%*	*-12.242%*	*8.625%*	*2.445%*	*-0.986*	*7.275*
FTSE 100	-0.112%	0.067%	-11.512%	8.667%	2.003%	-1.042	7.522
CAC 40	-0.083%	0.044%	-13.098%	8.056%	2.184%	-1.346	8.100
TSX	-0.016%	0.141%	-13.176%	11.294%	2.350%	-1.273	12.488
Shanghai composite	0.066%	0.125%	-8.039%	5.554%	1.308%	-1.178	8.310
OMX Stockholm 30	0.019%	0.080%	-11.173%	6.849%	1.994%	-1.072	5.748
Nikkei 225	-0.004%	-0.061%	-6.274%	7.731%	1.791%	0.262	3.567
ASX	0.050%	0.039%	-9.157%	11.881%	2.039%	0.550	8.229
Hang Seng	-0.029%	0.024%	-5.720%	4.925%	1.597%	-0.412	1.667
Lowest COVID cases	*-0.014%*	*0.057%*	*-9.769%*	*8.120%*	*1.908%*	*-0.689*	*6.954*

5.2. A Neuro-fuzzy System

The purpose of this study is to predict the stock indices because stock markets act as a barometer representing the position of the bench of stocks and providing a direction for existing and potential investors whether they should or should not invest. We used the ongoing coronavirus pandemic as a crisis period to forecast the behavior of stock indices. The datasets formulated for both controller $[y(k), y(k+1); u(k)]$ and process $[y(k-1), y(k), u(k); y(k-1)]$. where $y(k)$ = the difference of closing stock index between k and $k-1$, $u(k) = \sqrt{\left(y(k) - y(k+1)\right)^2}$ and $y(k+1)$ = a 3-day moving average is used in the evaluation phase as the closing stock index for the next day is not available.

This study uses MATLAB to estimate the result of the controller model in the training phase. The formation of the control model is similar for all stock indices selected for analysis due to the mix of the same number of membership functions. $y(k)$ and $y(k+1)$ are two inputs along with three membership functions (3^2=9) that produce a single output $u(k)$; this shows the variation in the stock market index and is used as input in the process model. The membership functions assist in transforming inputs to linguistic groups. After the training, membership functions will also change. The selected stock indices are sensitive on the eve of COVID-19. In the case of a small change in the next-day stock index, volatility is also lower, as reflected by $u(k)$, which represents the lower sensitivity of the stock market index.

Employing the ANFIS, the data were trained to forecast the next day's stock market return in the process model comprising three inputs $y(k)$, $y(k+1)$, and $u(k)$. where $u(k)$ is extracted from the controller model. Three inputs generate $y_d(k+1)$, which shows the next day change in the stock index. Similar to the controller model, three membership functions are used (3^3=27). The process model has a higher number of rules due to a greater number of inputs relative to the controller model. Upon the completion of training data, ANFIS generates forecasted values for the next-day market return, which determines the behavior of stock markets on the eve of COVID-19.

5.3. Estimation by Statistical Performance Measures

Table 3 exhibits the estimation of MSE (Panel A) and MAE (Panel B) using 100 and 300 training epochs. The results report that the estimation of MSE and MAE for 100 training epochs is somewhat better in terms of overall performance. The estimation of errors indicates the accuracy of the prediction, but they cannot predict the movement of stock indices. As such, investors' decisions rely on the increase or decrease in the stock index. To estimate the accuracy of the results, we employ the hit rate success and rate of return (RoR) on the market index.

Table 3: Empirical estimation of MSE, MAE, and hit rate performance of selected stock indices

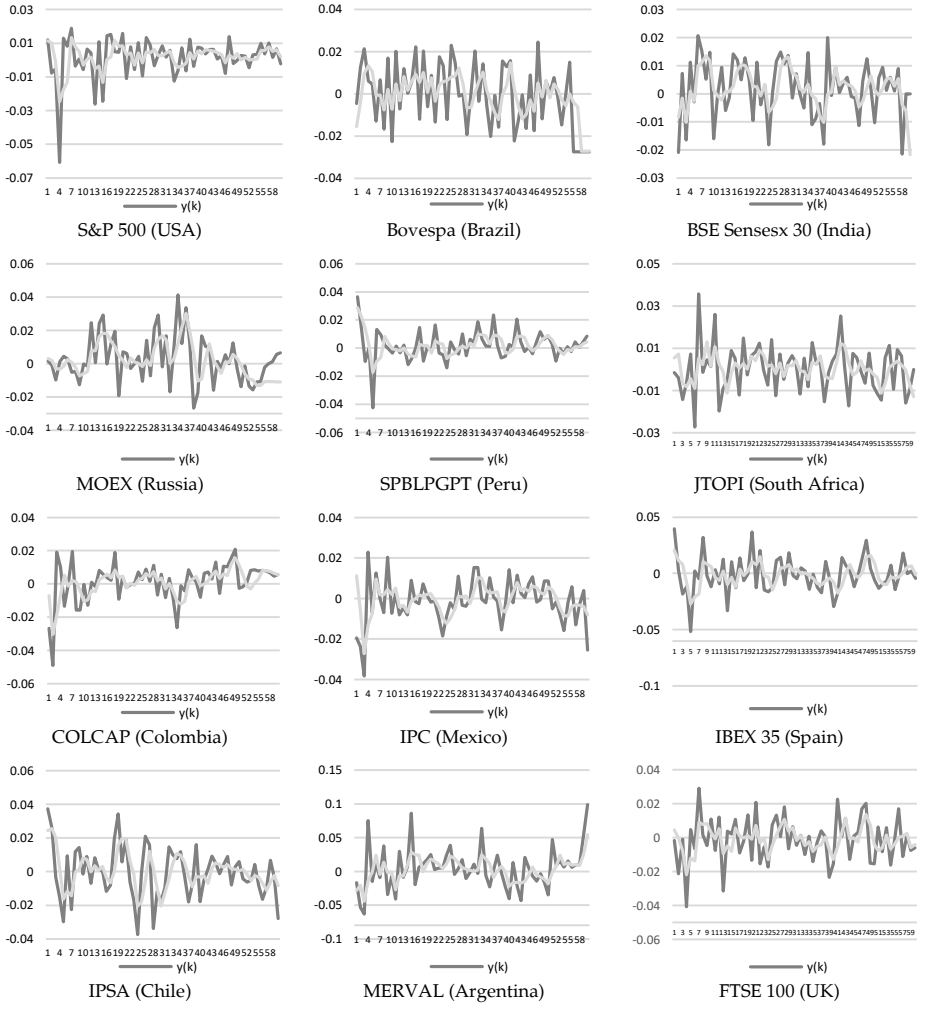
Index	Panel A: MSE (%)		Panel B: MAE (%)		Panel C: Hit rate (%)	
	Training epochs		Training epochs		Training epochs	
	100	300	100	300	100	300
S&P 500	0.00010	0.00010	0.00685	0.00681	66.63	67.60
Bovespa	0.00013	0.00012	0.00958	0.00961	57.31	55.11
BSE Sensex 30	0.00007	0.00007	0.00654	0.00650	64.13	66.70
MOEX	0.00012	0.00013	0.00850	0.00871	67.24	68.12
SPBLPGPT	0.00007	0.00007	0.00611	0.00613	68.56	69.43
JTOPI	0.00010	0.00009	0.00806	0.00861	74.21	73.22
COLCAP	0.00009	0.00009	0.00677	0.00663	67.31	67.11
IPC	0.00009	0.00008	0.00688	0.00673	61.43	62.43
IBEX 35	0.00017	0.00016	0.01053	0.01089	65.74	64.11
IPSA	0.00014	0.00015	0.00913	0.00926	63.35	62.75
MERVAL	0.00054	0.00057	0.01672	0.01764	62.44	62.98
FTSE 100	0.00013	0.00012	0.00801	0.00862	64.78	65.66
CAC 40	0.00014	0.00014	0.00834	0.00884	65.32	65.01
TSX	0.00006	0.00006	0.00576	0.00569	66.25	67.17
Shanghai composite	0.00016	0.00017	0.00968	0.00947	67.33	66.87
OMX Stockholm 30	0.00001	0.00001	0.00754	0.00781	66.88	66.11
Nikkei 225	0.00011	0.00010	0.00843	0.00802	70.24	68.98
ASX	0.00009	0.00011	0.00835	0.00807	66.39	65.93
Hang Seng	0.00011	0.00011	0.00813	0.00837	65.35	64.98
Sample average	0.00013	0.00013	0.00777	0.00813	65.84	65.80

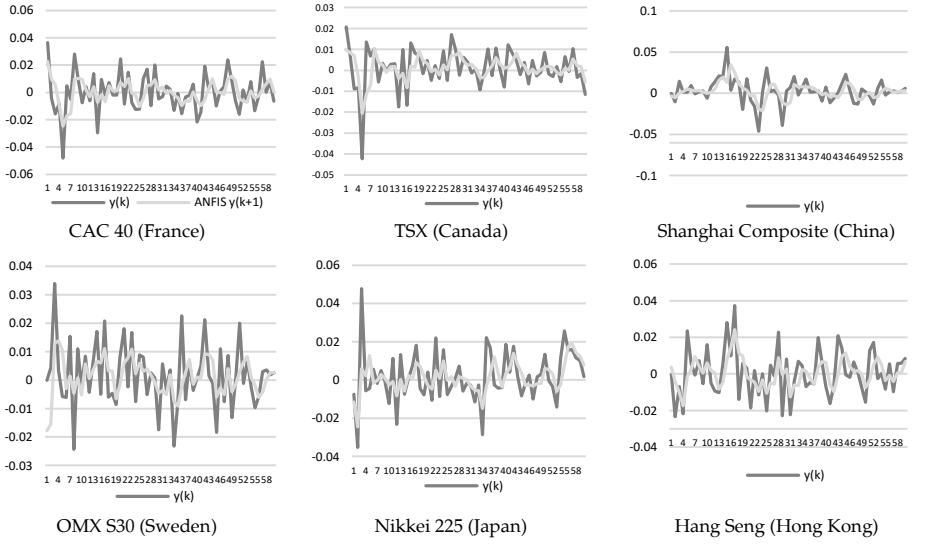
5.4. Hit Rate Success

Table 2 (Panel C) presents the forecasting accuracy per number of epochs for the selected stock indices. Using 100 and 300 training epochs, the forecasting accuracy falls between 55.11% and 74.21%. On average, the hit rate performance is 65.84% and 65.80% for 100 and 300 training epochs,

respectively. This evidence suggests that the neuro-fuzzy system, on average, predicts accurately 65.84% of stock market index movements. Atsalakis and Valavanis (2009) compared the results of different techniques used to estimate the hit rate reported by earlier studies and documented that neuro-fuzzy predictions of stock market activities had an accuracy of 68.33%, which is higher than other methods. Fig. 2 illustrates the position of actual and predicted stock index change of the selected indices.

Fig. 2: Actual and predicted stock index change





CAC 40 (France) TSX (Canada) Shanghai Composite (China)

OMX S30 (Sweden) Nikkei 225 (Japan) Hang Seng (Hong Kong)

5.5. Comparing RoR of stock indices

This section compares the rate of return using the buy-and-hold (B&H) strategy and a neuro-fuzzy system. B&H refers to the participation in investment based on the market index and holds it until the end of the simulation horizon for the portion of the coronavirus period studied here. The RoR is computed as:

$$ROR = \frac{netgain \in stockindex}{initialinvestment} \tag{11}$$

A neuro-fuzzy system envisages that an investor increases participation in the stock market when there is a forecast showing an upward trend for the next day and reduces participation if the market is predicting a downward trend. While participating in the stock market, an investor may take a short or long position; however, in this study, we assume that an investor takes a long position. We suppose that an investor has $10,000 to participate in the stock market and measure the RoR of the trading simulation and RoR of the B&H strategy. Table 4 compares the RoR using both methods. The results show that RoR employing the neuro-fuzzy system outperforms the B&H strategy. During the early coronavirus outbreak, all stock indices outperformed, which illustrates that investors who intend to participate in stock markets/stocks may use a neuro-fuzzy system to predict the stock markets and earn abnormal returns. We further argue that prediction using the proposed method is more accurate without considering the volatility of the stock market.

It is important to note that investors may yield positive returns by investing in risk-free government securities when the forecast of stock indices is trending downward. In this regard, a comparison can be made by calculating returns on investment. We can argue that on the eve of loss when predicting an upward trend as a downward trend is not the same, similar to the loss when measuring a downward trend as an upward trend. In the case of the Spanish stock index (IBEX-35), the overall returns of the market are negative, whereas in the case of the FTSE-100, we suppose that if an investor distributes assets to risk-free government bonds, it may yield some positive returns. In addition, the accurate prediction of the trend of the stock index does not identify the intensity of the movement of the stock index. This suggests that income from precision estimation and losses from improper prediction may be different. On a practical note, investment policies are clubbed with more complex trading measures along with hedging strategies to overcome the volatility of the investment.

Table 4: Comparison of the RoR between a neuro-fuzzy system and the B&H strategy

Index	B&H strategy	RoR
S&P 500	14.45	18.21
Bovespa	12.12	21.68
BSE Sensex 30	14.19	23.15
MOEX	19.48	27.61
SPBLPGPT	19.22	22.67
JTOPI	10.05	18.31
COLCAP	14.92	26.31
IPC	-1.66	18.31
IBEX 35	-5.93	19.67
IPSA	3.28	21.14
MERVAL	15.83	31.62
FTSE 100	-3.29	18.98
CAC 40	1.81	14.53
TSX	8.70	11.05
Shanghai composite	19.04	24.37
OMX Stockholm 30	7.09	7.68
Nikkei 225	5.58	8.90
ASX	-0.01	10.55
Hang Seng	9.65	14.45

6. Conclusion

This study uses a neuro-fuzzy adaptive control system to predict the trend of the next day's stock indices in the early COVID-19 period. A

neuro-fuzzy system can predict the patterns of stock markets. This technique is based on the ANN adaptive capacity, which is based on fuzzy logic qualitative estimation. A neuro-fuzzy system conducts training and evaluation phases, which refine the output of the system.

This study employs nineteen stock indices to predict their behavior on the eve of the coronavirus. To assess the prediction results, we estimate MSE, MAE, hit rate success, and the RoR of the B&H strategy and trading simulations. Based on the historical information and the suggested controller, this technique precisely predicts the patterns of stock indices. This technique outperforms in the context of trading simulations, which shows that the rate of returns is higher relative to the B&H strategy. This evidence illustrates that the proposed technique provides robust and accurate predictions of stock market trends during a crisis period.

In summary, we may infer that a neuro-fuzzy-based controller is appropriate to predict stock indices during a crisis period where investors can earn positive returns. For future research, it is proposed that researchers consider macroeconomic factors using ANFIS that can influence the prediction of stock markets during the crisis period.

References

Abbasi, E., & Abouec, A. (2008). Stock price forecast by using neuro-fuzzy inference system. Proceedings of World Academy of Science, Engineering and Technology, 36, 320–323.

Abraham, A. (2005). Adaptation of fuzzy inference system using neural learning fuzzy system engineering: Theory and practice. In Nadia Nedjah et al. (Eds.), Studies in fuzziness and soft computing (53-83). Germany: Springer-Verlag.

Apostolakis, G. N., Floros, C., Gkillas, K., & Wohar, M. (2021). Political uncertainty, COVID-19 pandemic and stock market volatility transmission. *Journal of International Financial Markets, Institutions & Money*, 74, 101383.

Atsalakis, G. S., Protopapadakis, E. F., Valavanis, K. P. (2016). Stock trend forecasting in turbulent market periods using neuro-fuzzy systems. *Operational Research: An International Journal*, 16, 245–269.

Atsalakis, G. S., Valavanis, K. P. (2009). Forecasting stock market short-term trends using a neuro-fuzzy based methodology. *Expert Systems with Applications*, 36 (7), 10696–10707.

Bahrammirzaee, A. (2010). A comparative survey of artificial intelligence applications in finance: Artificial neural networks, expert system and hybrid intelligent systems. *Neural Computing and Applications*, 19, 1165-1195.

Belke A.H., Gokus, C. (2011). Volatility patterns of CDs, bonds, and stock markets before and during the financial crisis: Evidence from major financial institutions. Social Science Research Network, Rochester, NY, SSRN Scholarly Paper ID 1793135.

Boyacioglu, M. A., & Avci, D. (2010). An Adaptive Network-based Fuzzy Inference System (ANFIS) for the prediction of stock market return: The case of the Istanbul Stock Exchange. *Expert Systems with Applications*, 37(12), 7908-7912.

Esfahanipour, A., & Aghamiri, W. (2010). Adapted Neuro-Fuzzy Inference System on indirect approach TSK fuzzy rule base for stock market analysis. *Expert Systems with Applications*, 37(7), 4742-4748.

Guillaume, S., Charnomordic, B. (2011). Learning interpretable fuzzy inference system with FisPro. Information Sciences, 181(20), 4409–4427.

Jang, J-S. R., Sun, C-T. E., & Miizutani, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. NJ: Prentice-Hall.

Kumar, H. P., Prashanth, K. B., Nirmala, T. V., & Patil, S. B. (2012). Neuro fuzzy based techniques for predicting stock trends. *International Journal of Computer Science Issues*, 9(4), 385.

Kumaran, J., Ravi, G., & Mugilan, T. (2013). Hybrid network of neuro-fuzzy based decision tool for stock market analysis. *International Journal of Computer Applications*, 70(17), 29-33.

Lin, C. S., Khan, H. A., & Huang, C. C. (2002). Can the neuro fuzzy model predict stock indices better than its rivals? Discussion Papers of University of Tokyo CIRJE-F-165.

Ly, K. T. (2021). A COVID-19 forecasting system using adaptive neuro-fuzzy inference. *Finance Research Letters*, 41, 101844.

Mahmud, M. S., & Meesad, P. (2016). An innovative recurrent error-based neuro-fuzzy system with momentum for stock price prediction. *Soft Computing*, 20, 4173-4191.

Makridou, G., Atsalakis, GS, Zopounidis, C., & Andriosopoulos, K. (2013). Gold price forecasting with a neuro-fuzzy-based inference system. *International Journal of Financial Engineering Risk Management*, 1(1), 35–54.

Rajab, S., & Sharma, V. (2019). An interpretable neuro-fuzzy approach to stock price forecasting. *Soft Computing*, 23, 921-936.

Trinkle, B. S. (2006). Forecasting annual excess stock returns via an adaptive network-based fuzzy inference system. *Intelligent Systems in Accounting, Finance, and Management*, 13(3), 165–177.

Yunos, Z. M., Shamsuddin, S. M., & Sallehuddin, R. (2008). Data modeling for Kuala Lumpur Composite Index with ANFIS. In Second Asia international conference on modeling and simulation, AICMS 08, Kuala Lumpur (pp. 609–614).

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The Impact of Economic Policy Uncertainty on Consumer Confidence in Pakistan

Syed Ateeb Akhter Shah
Deputy Director, Research Department,
State Bank of Pakistan, Karachi, Pakistan.
syed.ateeb@wmich.edu
(Corresponding Author)

Fatima Kaneez
Associate Professor,
Institute of Management Sciences,
University of Balochistan, Quetta, Pakistan.

Riffat Arshad
Chairperson, Department of Economics,
University of Balochistan, Quetta, Pakistan.

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Abstract:
This study examines the impact of Economic Policy Uncertainty (EPU) on the consumer confidence index (CCI) in Pakistan. Using a sample from the start of 2012 up to February 2020, a vector error-correction model is used to gauge the impact of EPU on CCI. Our results show that a shock to EPU in Pakistan affects CCI negatively and significantly. The shock persists for a span of more than 20 forecast horizons, informing economic policy makers in Pakistan that sudden changes in the stance without proper communication can deteriorate consumer confidence. This is important as consumer confidence in Pakistan accounts for not only the current economic situation, but expected changes in key macroeconomic variables which is usually a key consideration when forward-looking policies are devised. Our results remain robust to alternate Choleski specifications and lag lengths in the model.

Keywords: Pakistan, economic policy, uncertainty, consumer confidence, VECM, IRFs, VDCs.

JEL Classification: E32, H00, H31.

The Impact of Economic Policy Uncertainty on Consumer Confidence in Pakistan

1. Introduction

The use of alternative economic indicators for the measurement of economic conditions for policymaking has grown more important in economics. Consumer confidence, which is one such indicator, is defined in the economic literature as the perceptions formed by the agents in an economy from the quantitative evaluations of the given state of economy. Given that the agents are rational and utilize all readily available information to formulate expectations about the state of the economy, they are able to make positive – as well as negative – judgments about the state of the economy, in additional to their own well-being (Mirza, 2020).

Measurement of consumer confidence can be difficult as it is a latent variable depicting human behavior. However, attempts to formulate a measure that can identify the level of consumer confidence in an economy have been made since 1940. The first known consumer confidence index is the University of Michigan Consumer Sentiment Index, developed by George Katona at the University of Michigan in the late 1940s, and which remains in use. Initially, this index was computed annually transitioning to quarterly in 1952 and then monthly since 1978. Since its inception, the University of Michigan's consumer survey has been one of the widely followed indicators in the United States of America (Ludvigson, 2004).

This index was followed by the creation of a number of consumer confidence indices for the U.S. and other economies. The Organisation for Economic Co-operation and Development (OECD) (2021) provides detailed data on a large number of CCI indices across many countries. The State Bank of Pakistan (SBP), in collaboration with the Institute of Business Administration (IBA), began to measure consumer confidence for the Pakistani economy in January 2012. This index telephonically surveys 1,600 randomly selected households across Pakistan. This sample consists of a rotating panel with 33 percent of respondent households who have been surveyed six months earlier and are surveyed once again, while the remaining 67 percent are added are surveyed for the first time. The stratification scheme of the survey is applied in a rotating panel as well (State Bank of Pakistan, 2021).

As consumer confidence is an important indicator informing policy makers and researchers about people's perception about the state of current and future economic conditions, there has been an increase in the use of consumer sentiments and inflation expectations in monetary policy statements in Pakistan.[1] Bassey (2015) also emphasizes the need to take into account consumer sentiments using sample surveys while undertaking monetary policy decisions for the Central Bank of Nigeria. This indicates, therefore, that the factors determining and affecting this important indicator have been previously studied and thus part of the literature.

For example, Acemoglu and Scott (1994) found that CCI is a leading indicator for consumption, which in turn is significantly determined by the lagged CCI, housing wealth, real interest rates, and inflation. As political factors can have a bearing on household decision making, Ramalho, Caleiro and Dionfsio (2011), using data from Portugal, showed that both economic and political factors are significant determinants of consumer confidence. Consumers' confidence and the behavior of economic agents are highly affected by economic policy uncertainty.

Economic policy uncertainty refers to the unpredictability of fiscal, regulatory, and monetary policies, which leads to market volatility due to its effect on consumer confidence. Undefined or uncertain future government policies pose economic risk, which is further aggravated due to the deferred spending and investment decisions of the agents. To measure economic policy uncertainty, the economic policy uncertainty (EPU) index was initially measured by Baker et al. (2016), and is used by economists as a measure of uncertainty for analysis and policy decision making. It is a comprehensive measure of economic policy uncertainty and captures uncertainty from news, policy, market, and economic indicators. Many authors have followed their methodology and created EPU indices for their respective countries.[2] Choudhary, Pasha and Waheed (2020) formulated the EPU index for Pakistan.

Empirical literature on the impact of economic uncertainty and EPU is limited but growing. For example, Dalen, Vreese and Albæk (2017) show that EPU impacts CCI negatively in Denmark. Their results remain robust to the use of several model specifications and, more notably, to the addition of controls to account for the tone of economic news. Peric and

[1] For example, see. https://www.sbp.org.pk/m_policy/2019/MPS-May-2019-Eng.pdf

[2] The list of countries with data on their economic policy uncertainty index are available at http://www.policyuncertainty.com

Soric (2018) investigated the impact of EPU on CCI and gross domestic product (GDP) growth using a panel vector autoregressive (VAR) model for 13 countries.[3] For a few countries, they found that there exists a bi-directional Granger causality, and for others, they find no causal effect at all. Hence, their results signify a marginal impact of EPU on consumer confidence and GDP growth.

Our study adds to the literature since Pakistan is one of the very few developing countries that has developed an economic policy uncertainty index and we used this index to look at the impact of EPU on CCI in a developing country context. In this paper we will be investigating the impact of EPU on the consumer confidence index in Pakistan. We use a vector error-correction model (VECM, hereafter) to investigate the impact of EPU on CCI. The sample period utilized in our paper is from January 2012 to February 2020.

2. Data

The main variable of interest, CCI, is the index published on a bimonthly basis by the SBP.[4] Other variables included in the study are the EPU, the Consumer Price Index (P), the quantum index of large-scale manufacturing industries, which serves as a proxy for real output (Y), and the overnight weighted average repurchase rate (R). The variables P, Y, and R are added to our analysis as the CCI survey specifically asks about the current and expected general price level, prices of the durables, and the interest rate.

Furthermore, the interest rate is used as a measure of monetary policy, as it was designated as the operational target by the SBP in 2009 (Mahmood, 2016). All the variables are available on a monthly basis from January 2012 to February 2020.[5] With the exception of R, which is in levels, all variables are in logs (*LEPU, LY, LCPI, LCCI*). All data except the CCI are taken from various online issues of the Monthly Bulletin of Statistics of the SBP. As data on CCI is only available at bimonthly, to obtain a consistent

[3] The countries in their sample are: Canada, China, France, Germany, India, Italy, Japan, Korea, Netherlands, Russia, Spain, the UK and the USA

[4] Details and data of the consumer confidence index can be found at: https://www.sbp.org.pk/research/CCS.asp

[5] Our sample starts in January 2012 as the first observation of the CCI index is available from that time. Our sample ends at February 2020 as it is the month in which the last revised data on Y is available on the official website of Pakistan Bureau of Statistics.

monthly series of these variables, we interpolated the alternate monthly gaps by averaging the two adjacent data points before and after the missing value.

3. Methodology:

We start by testing all the variables for stationarity using a series of augmented Dickey-Fuller (ADF) tests (Enders, 2009). We then estimate a VAR model (Sims, 1980), which takes the typical form:

$$Y_t = \delta_i + \sum_{i=1}^{n} \theta_{i,t} Y_{t-i} + \varepsilon_{i,t} \quad (1)$$

Where Y_t is a vector of endogenous variables at time t, θ are the parameters and ε are the uncorrelated white noise disturbance terms. However, as pointed out in the literature, a VAR level estimated in first differences is misspecified in the presence of non-stationary variables (Engle and Granger, 1987). Therefore, before we implement VAR, we test the data for co-integration introduced by Johansen (1988) and Johansen and Juselius (1990). Given that our sample period is small, Johansen's (2000, 2002), small sample correction is also employed. If a variable or a set of variables are found to be cointegrated, a VECM is estimated.

4. Empirical Results:

We start discussing our results with the stationarity test results. Table 1 contains the results of the ADF test for each of the variables in our paper. The lags for each test are selected using the Akaike Information Criteria (AIC) introduced by Hirotugu (1974).[6] An analysis of Table 1 shows that the variables *CCI, Y* and *P* are non-stationary in log-levels. An analysis of Table 1 also indicates that the interest rate is not stationary in levels.

[6] To be consistent throughout the paper, we use the AIC for selection of lags for the ADF, cointegration tests and the estimation model.

Table 1: Results of Augmented Dickey-Fuller test

	In Log-Levels (Trend and Drift)		In Log-Levels (Drift)	
	Statistic	**Critical-value**	**Statistic**	**Critical-value**
Consumer Confidence Index (CCI)	-1.57	-3.45	-2.56	-2.90
Quantum Index of Large-Scale Manufacturing Industries (Y)	-1.68	-3.45	-1.94	-2.90
Weighted Average Overnight Repurchase Rate (R)	0.33	-3.45	-0.17	-2.90
Consumer Price Index (P)	-1.64	-3.45	0.93	-2.90
Economic Policy Uncertainty Index (EPU)	**-4.41**	-3.45	**-4.42**	-2.90

Notes: The critical values are taken from Table A of the Statistical Tables of Enders (2009) book. The number in bold represents a stationary variable (statistic value lower than the critical value).
Source: Author's calculation.

Table 1 also shows that the economic policy uncertainty index is stationary in log-levels. This means that we do not have to take first differences of log of economic policy uncertainty since it is first differenced in the VECM model.

Table 2 contains the results of the ADF test for variables in first difference.

Table 2: Results of Augmented Dickey-Fuller test

	In 1st Difference (Trend and Drift)		In 1st Difference (Drift)	
	Statistic	**Critical-value**	**Statistic**	**Critical-value**
Consumer Confidence Index (CCI)	**-4.25**	-3.45	**-3.47**	-2.90
Quantum Index of Large-Scale Manufacturing Industries (Y)	**-12.61**	-3.45	**-12.52**	-2.90
Weighted Average Overnight Repurchase Rate (R)	**-5.30**	-3.45	**-4.80**	-2.90
Consumer Price Index (P)	**-4.54**	-3.45	**-3.93**	-2.90
Economic Policy Uncertainty Index (EPU)	**-10.58**	-3.45	**-10.64**	-2.90

Notes: The critical values are taken from Table A of the Statistical Tables of Enders (2009) book. The number in bold represents a stationary variable (statistic value lower than the critical value).
Source: Author's calculation.

An analysis of Table 2 reveals that all the variables in this study are stationary in first difference. As some of the variables are non-stationary in levels, some of the variables may be cointegrated. Therefore, we next tested whether co-integration exists among the non-stationary variables in the system. The variables tested for co-integration are *LCCI, LP, LY* and *R*. The results of the trace test of the co-integration are presented in Table 3.

As cointegration tests are highly sensitive to the number of lags, we use the AIC to select the lags for the test. The AIC suggested using 1 lag for each variable.

Table 3: The Cointegration Test Results (Variables: LP, LY, R and LCCI)

Null Hypothesis	Alternative Hypothesis	Eigen Value	Trace Statistic*	Critical Value**	P values**
r = 0	r = 1	0.373	63.036	47.707	0.006
r = 1	r = 2	0.134	24.490	29.804	0.081
r = 2	r =3	0.116	12.541	15.408	0.185
r = 3	r =4	0.026	2.219	3.841	0.285

* The small sample corrected trace statistic
** The critical value at 5% level of significance and the p values are approximated using the gamma distribution, see Doornik (1998)
Source: Author's calculation.

Table 3 shows that there exists one cointegrating relationship among the non-stationary variables. Hence, the co-integration test shows that the VECM is an appropriate model to estimate.

However, before we estimate VECM, it is important to consider that co-integration analysis may be conducted with a stationary variable inside the co-integration space (Lütkepohl and Kilian, 2017). These authors found that adding a stationary variable to a set of non-stationary variables while testing for co-integration adds an additional cointegrating vector. This means that if we add the *LEPU* to the immediately aforementioned analysis, and if the co-integration analysis is conducted properly, the results should show two significant cointegrating relationships, whereas in actual terms, there only exists a single cointegrating vector among the variables of interest. To see if this is indeed the case, we conducted another co-integration analysis adding *LEPU*. The AIC once again pointed toward the use of 1 lag for each of the variables in the study. The results of the co-integration test are contained in Table 4.

Table 4 shows that there are two co-integrating relationships that are statistically significant. Hence, we see that adding a variable that is stationary in levels i.e. *LEPU* inserts an additional stationary relationship in among the variables. As there is a single co-integrating relationship as verified by the tests we have conducted above, we estimate the VECM using Engle and Granger's (1987) two-step procedure.

Table 4: The Cointegration Test Results (variables: LEPU, LP, LY, R and LCCI)

Null Hypothesis	Alternative Hypothesis	Eigen Value	Trace Statistic*	Critical Value**	P values**
r = 0	r = 1	0.527	120.868	69.611	0.000
r = 1	r = 2	0.355	59.546	47.707	0.002
r = 2	r =3	0.140	23.275	29.804	0.240
r = 3	r =4	0.098	10.761	15.408	0.231
r = 4	r =5	0.025	2.125	3.841	0.145

* The small sample corrected trace statistic
** The critical value at 5% level of significance and the p values are approximated using the gamma distribution, see Doornik (1998)
Source: Author's calculation.

To preserve degrees of freedom, a maximum lag length of 12 lags is considered for the model. The pre-sample extends from 2012:01 to 2013:01, and the estimation of the VECM models is carried out from 2003:02 to 2020:02. The lag length for the model is chosen by the AIC, with the latter suggesting a lag length of 4 for both models. To ensure that the VECM is stable, the residuals from each equation are required to be white noise. To test for serial correlation among the residuals from each VAR equation, we conducted a series of Ljung-Box (1978) tests with the null hypothesis of no autocorrelation. The Q-statistics show that the residuals from each equation in the model estimated are white noise. For a robustness check, both models are also estimated using the maximum lag length of 6.

The results are reported in terms of both the variance decompositions (VDCs) and impulse response functions (IRFs). VDCs show the proportion of the forecast error variance (FEV) of each variable explained by the shocked variable in the system. However, the VDCs do not inform us of the direction of impact of a shocked variable on other variables of the system. Hence, IRFs show the response of variables in a system to a shock to one of the variables in the VAR/VECM system. IRFs not only inform us of the magnitude but also the direction of the impact.

We did not apply the Granger causality test due to its limitations in identifying causal impacts.

To compute VDCs and IRFs, the residuals from the VECM model must be orthogonalized. One technique to compute orthogonalized residuals is the Choleski decomposition of contemporaneous relationships. Under the Choleski decomposition, variables in the system must be ordered in a particular manner. Ordering means placing all variables in decreasing order of exogeneity (causality). Hence, the variables higher in the ordering contemporaneously influence the variables lower in the ordering and not vice versa. For the base model, we use the Choleski decomposition with ordering *EPU*, *P*, *Y*, *R* and *CCI* for the base model.

This ordering is chosen because we are most concerned with the portion of FEV of CCI explained by innovations to *EPU*. *EPU* is the uncertainty of the policies that prevail in an economy. Hence, they impact the economic decisions of the households and firms in current and future periods (through expectations); therefore, it is placed first in the ordering. For the base model, we place *EPU* above *P*, *Y*, *R* and *CCI*. This allows *EPU* to contemporaneously affect *P*, *Y*, *R* and *CCI* (within the same month). *P*, *Y*, *R* and *CCI* do not impact *EPU* contemporaneously, but they do impact this variable through the lags of the system. In the short run, prices are sticky. Hence, *Y* shocks do not have an impact on *P*. This places *P* above *Y*. Assuming markets are efficient and interest rates reflect all the available information quickly, *R* is placed at the end, just before the main variable of interest, that is, *CCI*.

P, *Y* and *R* are placed between *EPU* and *CCI*, and the placement of these variables relative to each other is not critical since we aim to test the impact of *EPU* on *CCI*. The conclusions from the base model do not change when we alter the ordering of *P*, *Y*, and *R* relative to each other or use alternate orders.[7] Therefore, we report the results with ordering *EPU*, *P*, *Y*, *R*, and *CCI*.

[7] The alternate-orderings for the base model containing 4 lags are: EPU, P, Y, R, CCI; EPU, R, P, Y, CCI and EPU, R, Y, P, CCI.

Table 5: Variance Decomposition of the Consumer Price Index in response to a shock to EPU

Horizon	Point Estimate	Standard Error
6	**6.46533**	0.11735
12	**6.89545**	0.13241
24	**6.88591**	0.13224
36	**6.88594**	0.13224
48	**6.88594**	0.13224

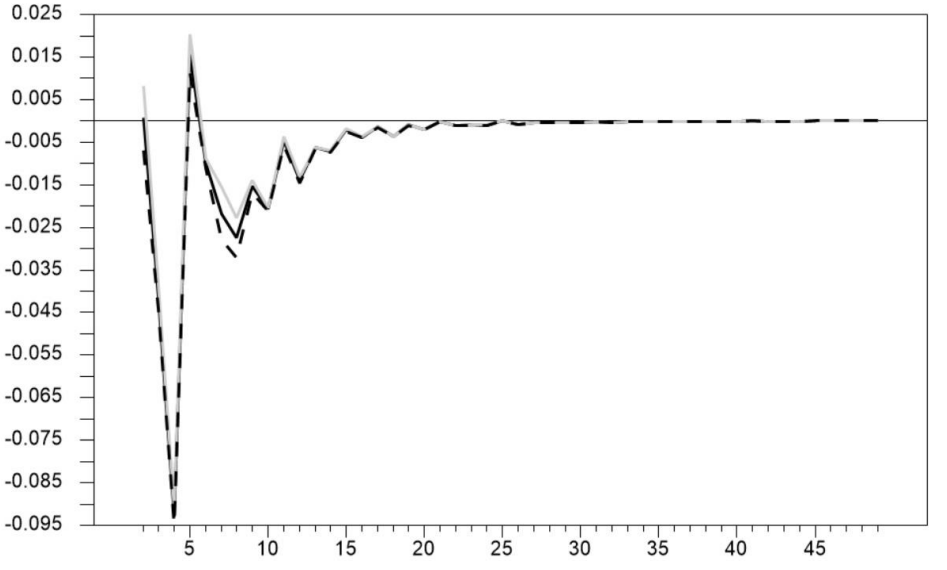
Notes: The numbers in bold represent a statistically significant point estimate.
A point estimate is statistically significant if the point estimate is approximately twice as big as the standard error.

Table 5 contains the results of VDCs. We report the point estimates and the standard errors for horizons 6, 12, 24, 36 and 48. It is evident from the table that a shock to EPU explains more than 6 percent of the forecast error variance in CCI at all forecast horizons. This means that uncertainty related to macroeconomic policies in Pakistan has a strong bearing on how consumer confidence evolves through time. Hence, abrupt changes in policy stance without major economic changes like a crisis or a pandemic such as COVID-19 can have a significant impact on consumer confidence.

The above analysis informs us about the magnitude of impact in terms of forecast error variance but does not provide any information related to the direction of impact of a shock to a variable to other variables in the system. The direction of the impact is shown by the IRF. The impulse response of CCI to EPU is depicted in Figure 1[8].

[8] The confidence intervals for the IRFs are computed via five thousand Monte Carlo draws. A two-standard-deviation confidence interval is reported for each IRF. A confidence interval containing zero indicates lack of statistical significance.

Figure 1: Response of Consumer Confidence to a shock in Economic Policy Uncertainty



Time (in months) from a shock in EPU

An observation of Figure 1 reveals that, with the exception of the 5th forecast horizon, a shock to EPU has a negative and significant impact on CCI for the first 20 forecast horizons with a maximum at the 3rd forecast horizon. The impact becomes insignificant for the 21st forecast horizon but remains significant and negative for a few months thereafter. From the 27th forecast horizon onward, the impact becomes statistically insignificant.

As a robustness check, the base model was also run with different Choleski orderings, estimated with 6 lags. However, the results of the model from all these additional checks qualitatively remained the same.

This result shows that as the uncertainty of the economic policies in Pakistan rises, consumer confidence begins to deteriorate. It is important to note that in the consumer confidence survey, there are questions asking both about the state of general economic conditions, the price of the durables, food, nonfood and energy, the general price level, the interest rate, income, and unemployment in the current time period and 6 months ahead. Hence, it is a very comprehensive measure that informs policy makers about the current state of the economy as well as perceptions about future economic conditions.

Our findings are consistent with Nowzohour and Stracca (2017), Bergman and Worm (2020) and Montes and Nogueira (2021), who provide empirical evidence of the negative impact of economic policy uncertainty on consumer confidence in different developed economies. The findings have important policy implications for policy makers and for monetary policy authorities in particular, as consumer sentiments are clearly an important transmission channel for the transmission of monetary policy shocks along with other conventional channels (Debes et al, 2014).

5. Conclusion:

This empirical paper examined the impact of a shock to economic policy uncertainty on Pakistan on consumer confidence in Pakistan. The sample of the study is from January 2012 to February 2020. The results are reported in terms of VDCs and IRFs. Both the VDCs and IRFs show that a shock to EPU has a significant impact on CCI in Pakistan.

Consumer confidence as an indicator in Pakistan can contain or provide information on expectations of economic agents about the economy, which in turn means that it is an important indicator for policy makers. Both fiscal and monetary policy are forward-looking policies and work well if the expectations of agents in an economy are well anchored. It is therefore important that governments and central banks maintain a stance that is not only consistent with their past actions and future commitments but with the current and future economic situation (which in turn depends primarily on the confidence of consumers in policy actions). This will help to ensure minimal uncertainty about their policies and will improve consumer confidence over time.

Conflict of Interest: The authors declare that they have no conflicts of interest.

Code availability statement: The code that supports the findings of this study is available from the corresponding author, Dr. Ateeb Akhter Shah Syed, upon reasonable request.

References

Acemoglu, Daron, and Andrew Scott. 1994. "Consumer Confidence and Rational Expectations: Are Agents' Beliefs Consistent with the Theory?" *The Economic Journal* 104 (422): 1–19.

Akaike, Hirotugu. 1974. "A New Look at the Statistical Model Identification." *IEEE Transactions on Automatic Control* 19 (6): 716–23. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1100705.

Baker, Scott R, Nicholas Bloom, and Steven J Davis. 2016. "Measuring Economic Policy Uncertainty." *The Quarterly Journal of Economics* 131 (4): 1593–1636.

Bassey, Kufre J. 2015. "The Use of Sample Surveys to Support Monetary and Financial Stability Analysis: An Overview of the Central Bank of Nigeria."

Bergman, U Michael, and Camilla Hu Worm. 2020. "Economic Policy Uncertainty and Consumer Perceptions: The Danish Case," no. November. https://www.researchgate.net/publication/343832963_Economic_Policy_Uncertainty_and_Consumer_Perceptions_The_Danish_Case.

Choudhary, M. Ali, Farooq Pasha, and Mohsin Waheed. 2020. "Measuring Economic Policy Uncertainty in Pakistan." *Munich Personal RePEc Archive*, no. 100013.

Dalen, Arjen Van, Claes H. De Vreese, and Erik Albæk. 2017. "Mediated Uncertainty: The Negative Impact of Uncertainty in Economic News on Consumer Confidence." *Public Opinion Quarterly* 81 (1): 111–30. https://doi.org/10.1093/poq/nfw039.

Debes, Sebastian, Johannes Gareis, Eric Mayer, and Sebastian Rüth. 2014. "Towards a Consumer Sentiment Channel of Monetary Policy." 91.

Doornik, Jurgen A. 1998. "Approximations to the Asymptotic Distributions of Cointegration Tests." *Journal of Economic Surveys* 12 (5): 573–93.

Enders, Walter. 2009. *Applied Econometric Times Series, 3rd Edition Enders, Walter.* Edited by an O'Reilly Media Company Safari. 1st editio. John Wiley & Sons.

Engle, Robert F, and Clive W J Granger. 1987. "Co-Integration and Error Correction: Representation, Estimation, and Testing." *Econometrica: Journal of the Econometric Society*, 251–76.

Johansen, Soren. 1988. "Statistical Analysis of Cointegration Vectors." *Journal of Economic Dynamics and Control* 12 (2–3): 231–54.

———. 2000. "A Bartlett Correction Factor for Tests on the Cointegrating Relations." *Econometric Theory* 16 (5): 740–78.

———. 2002. "A Small Sample Correction for the Test of Cointegrating Rank in the Vector Autoregressive Model." *Econometrica* 70 (5): 1929–61.

Johansen, Soren, and Katarina Juselius. 1990. "Maximum Likelihood Estimation and Inference on Cointegration—with Applications to the Demand for Money." *Oxford Bulletin of Economics and Statistics* 52 (2): 169–210.

Ljung, G M, and G E P Box. 1978. "On a Measure of Lack of Fit in Time Series Models," *Biometrika*, 65(2): 297-303. Stable URL: https://www.jstor.org/stable/2335207

Ludvigson, Sydney C. 2004. "Consumer Confidence and Consumer Spending." *Journal of Economic Perspectives* 18 (2): 29–50.

Lütkepohl, Helmut, and Lutz Kilian. 2017. "Vector Error Correction Models." In *Structural Vector Autoregressive Analysis*, 75–108. Themes in Modern Econometrics. Cambridge: Cambridge University Press. https://doi.org/DOI: 10.1017/9781108164818.004.

Mahmood, Asif. 2016. "Transmission of Volatility of Money Market Overnight Repo Rate along the Yield Curve." *SBP Research Bulletin* 12 (1): 1–18.

Mirza, Salma. 2020. "Consumer Confidence Index Surveys: A New Indicator From Pakistan." The University of Texas at Dallas.

Montes, Gabriel Caldas, and Fabiana da Silva Leite Nogueira. 2021. "Effects of Economic Policy Uncertainty and Political Uncertainty on Business Confidence and Investment." *Journal of Economic Studies* ahead-of-p (ahead-of-print). https://doi.org/10.1108/JES-12-2020-0582.

Nowzohour, Laura, and Livio Stracca. 2017. "More than a Feeling: Confidence, Uncertainty and Macroeconomic Fluctuations."

OECD. 2021. "Consumer Confidence Index (CCI) (Indicator)." 2021. https://doi.org/doi: 10.1787/46434d78-en.

Perić, Blanka Škrabić, and Petar Sorić. 2018. "A Note on the 'Economic Policy Uncertainty Index.'" *Social Indicators Research* 137 (2): 505–26.

Ramalho, Esmeralda A, António Caleiro, and Andreia Dionfsio. 2011. "Explaining Consumer Confidence in Portugal." *Journal of Economic Psychology* 32 (1): 25–32.

Sims, Christopher. 1980. "Macroeconomics and Reality." *Econometrica* 48 (1): 1–48. https://doi.org/10.2307/1912017.

State Bank of Pakistan. 2021. "State Bank of Pakistan." Consumer Confidence Survey / Methodology. 2021. https://www.sbp.org.pk/research/CCS-m.asp.

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Mergers and Acquisitions in the Indian Sub-Continent: 2010-2019

Ali Metwalli
Professor of Finance,
Haworth College of Business, Western Michigan University,
Kalamazoo, Michigan, USA.

Jim P. DeMello
Professor of Finance,
Haworth College of Business, Western Michigan University,
Kalamazoo, Michigan, USA.
james.demello@wmich.edu
(Corresponding Author)

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Abstract:
With rising growth rates and per capita income levels on the Indian subcontinent, foreign direct investment in the region, especially through mergers and acquisitions, has increased over the past decade. Using transaction data regarding the industry affiliation of the target and acquiring firms, deal size, deal structure, and deal completion rates from a worldwide M&A database compiled by Thomson Reuters' Financial Services, this article aims to provide contemporary and comparative information on merger and acquisition (M&A) activity in India, Pakistan, Bangladesh, and Sri Lanka over the last decade, 2010-2019. The largest numbers and values of mergers occurred in India. Surprisingly, Sri Lanka had the second largest number of M&A deals, followed by Pakistan and Bangladesh. Pakistan accounted for the second highest transaction value, followed by Bangladesh and Sri Lanka. The Sri Lankan M&A market had a high ratio (60 percent) of Sri Lankan firms acquiring other Sri Lankan firms, while in Bangladesh, non-Bangladeshi companies accounted for ninety-three percent of the value of all large M&A deals. Future trends, important caveats, policy issues, and implications for managers planning M&A deals in the region are presented.

Keywords: Pakistan, Mergers and Acquisitions, transaction data.

JEL Classification: G34.

Mergers and Acquisitions on the Indian Subcontinent: 2010-2019

Introduction

Past and present research studies show that the transaction value of mergers and acquisitions (M&A) has expanded in most developed countries. Currently, many companies pursue M&A strategies globally to grow their market share and expand their scope of operations (Gaughan, 2005; Ma et al., 2009). During the last two decades, some Southeast Asian countries have performed very well in the global economic integration process (Ma et al., 2009; Wright & Peng, 2005). In Southeast Asia, in recent years, a number of economies have continued to grow and become attractive targets for foreign direct investment (FDI). There was a significant growth of M&As in India, post 1990s, with a further substantial increase during the decade 2000-2009 (Pandya 2018). Similarly, Pakistan, Bangladesh and Sri Lanka have seen a rise in the number of M&A transactions during the same time period. India, Pakistan, and Sri Lanka have enacted competition laws (antitrust, anti-monopoly) and policies (for example, liberalization of trade policy, relaxed foreign investment regulations, easing of ownership requirements, economic deregulation, etc.) and significantly revamped their institutional framework. Moreover, as correctly stated, "the more effective the competition law and policy in an economy, the greater is the effect on local market competition" (Dutz & Khemani 2007).

In one of the few published studies on this topic, Tang and Metwalli (2013) noted that "both the number of deals and transaction values of M&A in India, Pakistan and Bangladesh have expanded significantly from 1990 to 2008." They projected that "in the future, M&A in the region will continue to expand." In the past, authors have created comprehensive reports on FDI in South Asia and have stated that "the year 2009 was an exceptional year because of the many M&A deals which were announced but not executed, and later on, cancelled, because of the global recession and economic crisis (Ahmed & Kanwal 2018). Moreover, M&A transactions have been found to generally be positively associated with the growth in the international equity market" (Joshi 2008).

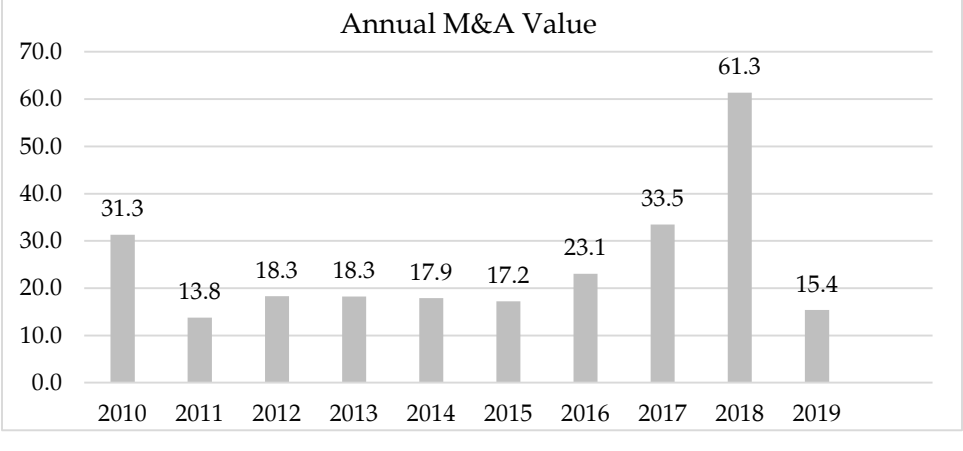
The purpose of this research is to update, expand, fill the gap and provide the most recent information on M&A activities and trends in India,

Pakistan, Bangladesh and Sri Lanka, the four main constituents of the Indian subcontinent. This research study utilizes the most up-to-date, comprehensive, and global source of information for mergers and acquisitions collected by Thomson Financial Services' Worldwide. The analysis covers all known transactions that are valued at greater than one million U.S. dollars each; were announced between January 1, 2010, and December 31, 2019; and involved either a target or an acquiring firm (or both) that originated from one of these four South Asian countries.

An Overview of M&A in the Four South-East Asian Countries:

Merger and acquisition (M&A) activity has expanded consistently in India, Pakistan, Bangladesh, and Sri Lanka over the last decade. Figure 1 shows all the announced M&A transactional values for the four countries from 2010 to 2019. In analyzing the data, we realized that a few of the M&A deals that were announced were not executed and were later cancelled. In 2010, Figure 1 shows that the M&A announced value in the four countries was approximately $31.3 billion. The four countries then experienced a significant drop in the M&A transaction value to $13.8 billion in 2011. Following that decline, the period from 2012 to 2016 witnessed the announced M&A deal value vary from a low of $17.2 billion to a high of $23.1 billion. More recently, the M&A transaction value in these four South Asian nations increased dramatically to $33.5 billion in 2017 before reaching a high of $61.3 billion in 2018. The 2017 increase was mainly due to India's new bankruptcy law, which relaxed the regulations in the foreign direct investment arena.

Figure 1: Announced M&A in India, Pakistan, Bangladesh and Sri Lanka, 2010-2019(US$ billions)



However, by the end of the decade, i.e., in 2019, the M&A value in the Indian subcontinent fell unexpectedly and precipitously to $15.4 billion, i.e., a decline of approximately 75%.

Table 1 presents the announced and realized M&A values in India, Pakistan, Bangladesh, and Sri Lanka from 2010-2019. It is interesting to note that more than 90 percent of the announced M&A deal values were effectively completed in 2010, 2011, 2017, and 2018 collectively. However, during the years 2012 to 2014, only 87 percent of the announced M&A values were implemented. Similarly, only approximately 75 percent of the M&A deal value was realized in 2015 and 2016. The year 2019 was an exception because 100 percent of the announced M&A value was implemented, although the total value of the transactions was comparatively very low, i.e., only $15.4 billion. One wonders whether the Asian subcontinent has lost its attractiveness or appetite for these M&A deals!

It is clear from Table 1 that, on average, during the period 2010-2019, approximately 89 percent of the M&A deal value that was announced was realized in the four countries. This high percentage rate of completion permits us to use the announced M&A data for the research analysis moving forward. However, although we included the cancelled deals when we list the largest M&A activity by country, we did not count those deals that have been cancelled.

Table 1: Announced, cancelled, and realized M&A in India, Pakistan, Bangladesh and Sri Lanka, 2010-2019

Year	Announced M&A values in US$ millions	Cancelled M&A values in US$ millions	Realized M&A values in US$ millions	Percentage of M&A Realized
2010	32,748	1,476	31,271	95%
2011	14,574	804	13,769	94%
2012	20,583	2,262	18,322	89%
2013	20,533	2,277	18,256	89%
2014	20,433	2,535	17,898	88%
2015	22,878	5,657	17,221	75%
2016	30,897	7,845	23,052	75%
2017	34,472	969	33,502	97%
2018	68,195	6,857	61,338	90%
2019	15,452	54	15,398	100%
2010-2019 total	280,764	30,737	250,027	89%

Source: Thomson Financial Service

M&A Transactions by the Nationality (Or Region) of the Target Firms

Table 2 outlines by the nationality (or region) of the target firms all the M&A transaction values and number of deals for the period from 2010 to 2019. During this period, India had 1,606 M&A deals, with a total transaction value of $202.2 billion. During this decade, target firms from India accounted for 77.0 percent of the deals and 80.9 percent of the M&A transaction value. Conversely, M&A deals involving target firms from Pakistan accounted for merely 1.5 percent of the M&A transaction value and 2.1 percent of the number of deals. In comparison, Sri Lanka's share of target firms covers approximately 6.5 percent of the deals and only 0.6 percent of the M&A values. It is obvious that the M&A markets in Pakistan, Bangladesh, and Sri Lanka are not as large and active as those in India. It is interesting to note that the M&A value subtotal for target firms from the four South Asian countries amounted to $209.8 billion (84 percent), while the subtotal for target firms from all other countries was $40.2 billion (16 percent).

Table 2: M&A transaction value in India, Pakistan, Bangladesh and Sri Lanka by the nationality or region of the target firms, 2010-2019

Nationality (country)	Transaction value (US$ million)	% of Total	No. of Deals	% of Total	Average value per deal (US$ million)
India	202,197	80.9%	1,606	77.0%	125.9
Pakistan	3,838	1.5%	44	2.1%	87.2
Bangladesh	2,374	0.9%	18	0.9%	131.9
Sri Lanka	1,420	0.6%	136	6.5%	10.4
Subtotal for the four countries	209,830	83.9%	1,804	86.5%	116.3
Subtotal for target firms from other countries	40,197	16.1%	282	13.5%	142.5
Total	**250,027**	**100.0%**	**2,086**	**100.0%**	**119.9**

Source: Thomson Financial Service

The last column of Table 2 shows that M&A transactions in Bangladesh have the highest average value per deal ($131.9 million), followed by India ($125.9 million), Pakistan ($87.2 million) and Sri Lanka ($10.4 million). Since deals involving South Asian acquirers and target firms from all other countries numbered 282 deals and accounted for $40.2 billion of the M&A transaction value shown in Table 2, the nationalities of these firms are summarized in Table 3. The table shows that companies from India, Pakistan, Sri Lanka, or Bangladesh acquired 82 United States

firms with a total transaction value of $11.3 billion. During the same period, United Kingdom target firms were involved in 25 deals with an M&A value of approximately $2.0 billion. Investors from India, Pakistan, Bangladesh, and Sri Lanka acquired target companies mainly from Singapore, Australia, Mozambique, and Nigeria.

Table 3: Nationalities of the target firms from other countries acquired by India, Pakistan, Bangladesh and Sri Lanka, 2010-2019

Nationality	No. of deals	Transaction value (US$ million)
United States	82	11,346
Nigeria	1	10,700
Australia	10	3,380
Mozambique	2	2,525
United Kingdom	25	2,023
Singapore	15	994
Others	147	9,228
Total	282	40,197

Source: Thomson Financial Service

Home Countries of the Acquiring Firms

Table 4 presents a distribution of the M&A deals and their transaction values that were completed in India, Pakistan, Bangladesh, and Sri Lanka based on the nationality of the acquiring firms during the most recent completed decade, i.e., 2010-2019. It is clear that acquiring firms from the four South Asian countries accounted for 78.6 percent of the deals and 72.7 percent of the transaction value. Additionally, Indian acquiring companies accounted for the majority of the deals and a substantial proportion of the transaction value. Acquiring firms from all other countries accounted for 27.3 percent of the M&A transaction values and only 21.4 percent of the number of deals.

During the most recent decade, if we compare Table 2 to Table 4, we can conclude that more Indian, Pakistani, Bangladeshi, and Sri Lankan firms were involved in M&A activity as target firms (i.e., 1804 deals valued at approximately $210 billion) rather than as acquiring firms (1640 deals valued at $182 billion). For example, Indian firms were involved in 1,606 deals as target firms with a transaction value of $202.2 billion, but only 1,487 deals as acquiring firms with a transaction value of $179.1 billion.

Table 4: M&A transaction value in India, Pakistan, Bangladesh and Sri Lanka by the nationality or region of the acquiring firms, 2010-2019

Nationality	Transaction value (US$ million)	% of Total	No. of Deals	% of Total	Average value per deal (US$ million)
India	179,124	71.6%	1,487	71.3%	120.5
Pakistan	1,465	0.6%	25	1.2%	58.6
Bangladesh	177	0.1%	5	0.2%	35.5
Sri Lanka	979	0.4%	123	5.9%	8.0
Subtotal for the four countries	181,746	72.7%	1,640	78.6%	110.8
Subtotal for target firms from other countries	68,281	27.3%	446	21.4%	153.1
Total	250,027	100.0%	2,086	100.0%	119.9

Source: Thomson Financial Service

Acquisition Methods and the Largest M&A:

The M&A transactions by the acquisition method used in India, Pakistan, Bangladesh, and Sri Lanka from 2010 to 2019 are summarized in Table V. The acquisition of the majority interest of M&A transaction values accounted for 34 percent of the total deal value, with an average value per deal of $96.0 million during that period. Mergers accounted for 31 percent of the M&A transaction value and 22 percent of the number of deals. The asset acquisition, acquisition of remaining interest, acquisition of certain assets and complete acquisition are the other methods used in the four countries.

Table 5: M&A transaction value by acquisition methods in India, Pakistan, Bangladesh and Sri Lanka, 2010-2019

Transaction type	Transaction value (US$ million)	%	No. of deals	%	Average value per deal (US$ million)
Acquisition of majority interest	84,685	33.9%	882	42.3%	96.0
Merger	78,431	31.4%	462	22.1%	169.8
Asset acquisition	74,665	29.9%	555	26.6%	134.5
Acquisition of remaining interest	10,362	4.1%	176	8.4%	58.9
Acquisition of certain assets	984	0.4%	8	0.4%	123.0
Acquisition	900	0.4%	3	0.1%	300.1
Total	250,027	100.0%	2,086	100.0%	119.9

Source: Thomson Financial Service

It is clear that the 100% acquisition method was the least popular one, involving only three deals during this decade, but it had the highest average value per deal, i.e., $300.1 million.

Table 6 lists the twenty largest mergers and acquisitions in India during the 2010-2019 period. In May 2018, the largest deal ($16.0 billion) was the announced purchase of the Flipkart group (an Indian e-commerce firm) by Walmart, Inc. (a United States retail corporation). The deal became effective on August 18, 2018. The Vodafone Group, PLC from India, made the second largest purchase of Idea Cellular Ltd. (an Indian mobile phone company) for $11.6 billion. The purchase of Zain Africa BV (Mobile telecommunication in Nigeria) by Bharti Airtel Ltd. (an Indian Telecommunication service) was the third largest deal, with a transaction value of $10.7 billion. The parties involved in the other seventeen largest M&A transactions are outlined in Table VI. The seventeen deals varied in value from approximately $2.0 billion to $6.8 billion. It is worth noting that fifteen of the acquirers and eighteen of the target companies involved in the twenty largest M&A transactions were from India. Three United States companies and one United Kingdom firm were involved in four of these 20 largest deals in India as acquirers.

The various M&A deals that were completed in India were of different types and involved several different motives. Companies mainly go for M&As to have synergistic gains through the combined firm. Thus, a single theory is not enough to explain the motives behind mergers, acquisitions or takeovers. (Leepsa and Mishra, 2016). Table 6 indicates that the primary motives behind the largest deals that were completed in India during 2010-2019 involved growth, synergy, access to capital and tangible assets, greater diversification, and horizontal and vertical integration, to name a few. Most of these motives for M&As serve as a means of reshaping competitive advantage within the firms' respective industries. Mergers and acquisitions are being increasingly used in India to improve the competitiveness of companies through increased market share, for gaining entry into new markets and geographical locations, for capitalizing on economies of scale, and for broadening their portfolios to reduce their business risk (Nirmala & Aruna, 2013). The analysis of deals completed in India suggests that differential efficiency theory, synergy gain theory, pure diversification theory, and strategic realignment theory best explain the different motives for Indian M&A deals.

Table 6: 20 largest M&A in India, 2010-2019

Rank	Date announced	Date Effective	Target and nationality	Acquirer and nationality	Amount (US$ million)
1	May 9, 2018	August 18, 2018	Flipkart Group (India)	Walmart Inc (United States)	16,000
2	March 20, 2017	August 31, 2018	Idea Cellular Ltd-Mobile Bus (India)	Vodafone Grp PLC-Vodafone Asts (India)	11,627
3	February 14, 2010	June 8, 2010	Zain Africa BV (Nigeria)	Bharti Airtel Ltd (India)	10,700
4	February 12, 2018	December 16, 2019	Essar Steel India Ltd (India)	Undisclosed JV (India)	6,829
5	July 19, 2017	January 31, 2018	Hindustan Petro Corp Ltd (India)	Oil & Natural Gas Corp Ltd (India)	5,784
6	March 7, 2018	May 18, 2018	Bhushan Steel Ltd (India)	Bamnipal Steel Ltd (India)	5,216
7	February 25, 2012	August 17, 2013	Sterlite Industries(India)Ltd (India)	Sesa Goa Ltd (India)	3,911
8	May 21, 2010	September 8, 2010	Piramal Healthcare Ltd- (India)	Abbott Labs (United States)	3,713
9	April 30, 2013	July 4, 2013	Hindustan Unilever Ltd (India)	Unilever PLC (United Kingdom)	3,573
10	April 7, 2014	March 24, 2015	Ranbaxy Laboratories Ltd (India)	Sun Pharm Inds Ltd (India)	3,226
11	January 7, 2019	October 17, 2019	Gruh Finance Ltd (India)	Bandhan Bank Ltd (India)	3,165
12	October 10, 2017	August 29, 2018	Reliance Infrastructure Ltd-Mu (India)	Adani Transmission Ltd (India)	2,932
13	September 28, 2018	January 21, 2019	IDBI Bank Ltd (India)	Life Insurance Corp of India (India)	2,804

Rank	Date announced	Date Effective	Target and nationality	Acquirer and nationality	Amount (US$ million)
14	June 25, 2013	January 8, 2014	Videocon Mozambique Rovuma 1 (Mozambique)	Undisclosed SPV (India)	2,475
15	February 28, 2016	June 29, 2017	Jaiprakash Assoc Ltd-Cement	UltraTech Cement Ltd (India)	2,410
16	November 20, 2014	April 1, 2015	ING Vysya Bank Ltd (India)	Kotak Mahindra Bank Ltd (India)	2,401
17	September 11, 2017	July 4, 2019	Bharat Financial Inclusion Ltd (India)	IndusInd Bank Ltd (India)	2,394
18	June 14, 2015	April 11, 2017	Cairn India Ltd (India)	Vedanta Ltd (India)	2,156
19	December 11, 2018	March 28, 2019	Rec Ltd (India)	Power Finance Corp Ltd (India)	2,101
20	October 21, 2015	April 21, 2016	Viom Networks Ltd (India)	American Tower Corp (United States)	1,954

Source: Thomson Financial Service

The information provided in Tables 7, 8, and 9 summarizes the ten largest M&A deals completed in Pakistan, Bangladesh, and Sri Lanka, respectively. The largest deal for Pakistan was the purchase of BP PLC-Oil & Gas Assets (a Pakistani Oil & Gas Company) for $749 million by United Energy Group Ltd., a firm from Hong Kong. The $448 million acquisition of Engro Food Ltd. (a Pakistani firm) by Friesland Campina Investments from the Netherlands was the second largest transaction. In sum, companies from the United Kingdom, Netherlands, Hong Kong, and Pakistan were involved as acquirers in the largest ten M&A deals in Pakistan.

Our analysis shows that the M&A markets in Pakistan, Bangladesh, and Sri Lanka are relatively smaller and not as active as those in India. This difference is to be expected given the relative differences in the size of the economies, corporate sectors, volume of external trade, extent of globalization, and structural nature of these four countries. Pakistan ranked 3rd on both the M&A transaction value per deal ($87.2 million) and the number of M&A deals (44). Pakistan is one of those developing

economies in which law and order and security issues are creating difficulties for encouraging foreign direct investment. "Economic conditions are not ideal due to which many firms are doing mergers and acquisitions to improve their financial performance" (Abdullah, Shah, & Khan, 2012). The empirical results support the presence of empire building motives that may lead managers to become involved in underperforming M&As in Pakistan. Specifically, we explore these motives from the perspective of synergy theory, agency theory, and behavioral finance. The empirical results for agency theory show the presence of empire building motives that lead to the underperformance of firms in the postmerger acquisition period. (Khan, et al., 2017).

Table 7: 10 largest M&A in Pakistan, 2010-2019

Rank	Date announced	Date Effective	Target and nationality	Acquirer and nationality	Amount (US$ million)
1	December 14, 2010	September 16, 2011	BP PLC-Oil & Gas Assets (Pakistan)	United Energy Group Ltd (Hong Kong)	749
2	July 3, 2016	December 20, 2016	Engro Foods Ltd (Pakistan)	FrieslandCampina Investments (Netherlands)	448
3	November 28, 2012	April 2, 2013	Unilever Pakistan Ltd (Pakistan)	Unilever Overseas Holding Ltd (United Kingdom)	330
4	May 23, 2017	May 23, 2017	Pakistan TeleCommun- (Pakistan)	Pakistan Mobile Communications (Pakistan)	295
5	June 30, 2016	November 7, 2016	United Refrigeration Inds Ltd (Pakistan)	Ardutch BV (Netherlands)	243
6	December 29, 2010	January 27, 2011	United Bank Ltd (Pakistan)	Bestway(Holdings)Ltd (United Kingdom)	229
7	May 7, 2014	July 24, 2014	Pakistan Cement Company Ltd (Pakistan)	Bestway Cement Ltd (Pakistan)	218
8	February 28, 2018	June 28, 2018	Omv Pakistan Expl Gmbh (Pakistan)	Dragon Prime Hong Kong Ltd (Hong Kong)	192
9	December 7, 2016	July 7, 2017	NIB Bank Ltd (Pakistan)	MCB Bank Ltd (Pakistan)	158
10	June 9, 2012	December 28, 2012	ICI Pakistan Ltd (Pakistan)	Viz Lucky Holdings Ltd (Pakistan)	153

Source: Thomson Financial Service

Table 8 indicates that seven of the top 10 M&A acquirers in Bangladesh were foreign companies. The largest transaction worth $1.5 billion was the acquisition of the United Dhaka Tobacco Co. Ltd., by Japan Tobacco Inc. The acquisition of Warid Telecom by Bharti Airtel Ltd., from India for $300 million, was the second largest deal. The other acquirers' nationalities among the top ten M&A transactions included Vietnam, South Korea, the Netherlands, and Sri Lanka.

During the period 2010-2019, Bangladesh completed only 18 M&A deals compared with 1,606 deals in India and 136 deals in Sri Lanka. Bangladesh does not have a specific or a single piece of legislation dealing solely with mergers and acquisitions. Instead, there are various statutes and bylaws in Bangladesh that govern mergers and acquisitions. Interestingly, Bangladesh had the highest value per deal ($131.9 million), followed by India ($131.9), Pakistan ($87.2 million) and Sri Lanka ($10.4 million). Bangladesh's M&A motives focused on value creation through synergy to increase revenue, reduce costs, and enhance firm diversification. These motives set the directions for the firm to focus on synergy gain theory and the pure diversification theory of M&As.

Table 8: 10 largest M&A in Bangladesh, 2010-2019

Rank	Date announced	Date Effective	Target and nationality	Acquirer and nationality	Amount (US$ million)
1	August 6, 2018	November 29, 2018	United Dhaka Tobacco Co Ltd (Bangladesh)	Japan Tobacco Inc (Japan)	1,480
2	January 12, 2010	January 31, 2010	Warid Telecom Bangladesh (Bangladesh)	Bharti Airtel Ltd (India)	300
3	April 27, 2010	April 27, 2010	Teletalk Bangladesh Ltd (Bangladesh)	Viettel Corp (Vietnam)	300
4	March 13, 2017	July 9, 2018	Robin Resources (Malaysia) (Malaysia)	Akij Jute Mills Ltd (Bangladesh)	77
5	December 15, 2016	January 9, 2018	Holcim Cement (Bangladesh) Ltd (Bangladesh)	Lafarge Surma Cement Ltd (Bangladesh)	63
6	March 3, 2016	March 3, 2016	Youngone High-Tech Sportswear (Bangladesh)	Youngone Corp (South Korea)	61
7	April 9, 2013	December 17, 2013	Tullow Bangladesh Ltd (Bangladesh)	KrisEnergy Asia Holdings BV (Netherlands)	42

Rank	Date announced	Date Effective	Target and nationality	Acquirer and nationality	Amount (US$ million)
8	October 6, 2017	January 19, 2018	Nuvista Pharma Ltd (Bangladesh)	Beximco Pharmaceuticals Ltd (Bangladesh)	25
9	January 4, 2019	July 22, 2019	JMI Syringes & Med Devices (Bangladesh)	Nipro Corp (Bangladesh)	22
10	October 12, 2015	October 12, 2015	Petredec Elpiji Ltd (Bangladesh)	Laugfs Gas Plc (Sri Lanka)	19

Source: Thomson Financial Service

The ten largest M&A deals completed in Sri Lanka are shown in Table 9. The largest deal ($163 million) was the announced purchase of Numeric Lanka Technologies PVT, Ltd. (a Sri Lankan technology firm) by Indo Asia Electric PVT, Ltd., (an Indian electric company) in February 2012; the deal became effective in May 2012. The second largest deal was the $109 million purchase of AVIVA NDB Insurance PLC (a Sri Lankan firm) by an investor group from Hong Kong. Table 9 also identifies the parties involved in the other eight largest M&A transactions. The values of these eight M&A transactions varied from $35 million to $106 million. Other acquirers of the largest ten M&A transactions completed in Sri Lanka included companies from Germany, Singapore, and the British Virgin Islands.

Sri Lanka accounted for the second largest number of deals (136) after India (1606) during the 2010-2019 decade. Sri Lanka's M&A motives focused on gaining competitive advantage against competing firms by utilizing horizontal integration strategies to increase market share, vertical integration to build capacity and sharing technology in the process of achieving internationalization of business operations. Strategic realignment theory and market power theory of M&As support the motives that drive acquirers to pursue mergers and acquisitions in Sri Lanka.

Table 9: 10 largest M&A in Sri Lanka, 2010-2019

Rank	Date announced	Date Effective	Target and nationality	Acquirer and nationality	Amount (US$ million)
1	February 10, 2012	May 31, 2012	Numeric Lanka Technologies Pvt (Sri Lanka)	Indo Asian Electric Pvt Ltd (India)	163
2	September 27, 2012	December 5, 2012	AVIVA NDB Insurance Plc (Sri Lanka)	AIA Group Ltd (Hong Kong)	109
3	February 1, 2018	February 26, 2018	Janashakthi Gen Ins Ltd (Sri Lanka)	Allianz SE (Germany)	106
4	March 28, 2018	March 28, 2018	Lanka Orix Leasing Co PLC (Sri Lanka)	Lolc Holdings Pvt Ltd (Sri Lanka)	82
5	December 22, 2017	February 1, 2018	LOLC Micro Credit Ltd (Sri Lanka)	LOLC Finance PLC (Sri Lanka)	77
6	September 13, 2017	September 15, 2017	Singer (Sri Lanka) PLC (Sri Lanka)	Hayleys PLC (Sri Lanka)	71
7	February 16, 2017	April 3, 2017	Causeway Paint Lanka (Pvt) Ltd (Sri Lanka)	Berger International Pvt Ltd (Singapore)	60
8	June 20, 2014	October 30, 2014	Millers Brewery Ltd (Sri Lanka)	Investor Group (Sri Lanka)	40
9	December 4, 2017	August 1, 2018	Trischel Fabric Pvt Ltd (Sri Lanka)	Best Pac Intl Sri Lanka (British Virgin)	36
10	December 15, 2011	March 22, 2012	Suntel Ltd (Sri Lanka)	Dialog Broadband Networks (Sri Lanka)	35

Economic Profiles of India, Pakistan, Bangladesh, and Sri Lanka

Understanding the economies of the four South Asian countries allows us to better compare and contrast the characteristics of the various M&A transactions completed in these countries. The economic profiles of India, Pakistan, Bangladesh, and Sri Lanka are summarized in Table 10. It is very clear that the four countries are very different in terms of their land areas, population sizes and per capita income. In comparison, India's land area (2.97 million square kilometers) is approximately 23 times the size of Bangladesh and approximately 46 times the size of Sri Lanka. India's

population is over 3.1 times larger than the total population of Pakistan, Bangladesh, and Sri Lanka combined. In 2017, the gross domestic product (at purchasing power parity) ranged from a high of $9.47 trillion for India to $1.06 trillion for Pakistan, $690.3 billion for Bangladesh and $275.8 billion for Sri Lanka. However, in 2017, Sri Lanka had the highest per capita income ($12,900), followed by India ($7,200), Pakistan ($5,400), and Bangladesh ($4,200). Interestingly, in 2017, Bangladesh had the highest GDP growth rate (7.40 percent), followed by India (6.70 percent), Pakistan (5.40 percent) and Sri Lanka (3.30 percent).

Table 10: Country Profiles

	India	**Pakistan**	**Bangladesh**	**Sri Lanka**
Land Area (sq km)	2,973,193	770,875	130,170	64,630
Population (thousands) (July 2020 est.)	1,326,093	233,501	162,650,853	22,889
Main religion	Hindu (79.80%)	Muslim (96.40%)	Muslim (89.1%)	Buddhist (70.2%)
GDP at purchasing power parity in (2017) (US$ in billions)	9,474	1,061	690.3	275.8
GDP at official exchange rate in (2017) (US$ in billions)	2,602	305	261.5	87.35
GDP per capita in (2017) (US$)	7,200	5,400	4,200	12,900
Growth rate of GDP (2017)	6.70%	5.40%	7.40%	3.30%
Exports in (2017) (US$ in billions)	304.1	32.88	35.3	11.36
Imports in (2017 est.) (US$ in billions)	452.2	53.11	47.56	20.98
Key trading partners	China, USA, UAE, Saudi Arabia, Switzerland	USA, UK, China, Germany, Afghanistan, UAE, Spain	Germany, USA, UK, Spain, France, Italy	USA, UK, India, Singapore, Germany, Italy

	India	Pakistan	Bangladesh	Sri Lanka
Principal Exports	Petroleum products, precious stones, vehicles, machinery, iron and steel, chemicals, pharmaceutical products, cereals, apparel	Textiles, rice, leather goods, sporting goods, chemicals, manufactures, surgical instruments, carpets and rugs	Garments, knitwear, agricultural products, frozen fish and seafood, jute and jute goods, leather	Textiles and apparel, tea and spices, rubber manufactures, precious stones, coconut products, fish
Labor force (millions) (2017 estimate)	521.9	63.89	66.64	8.937
Unemployment rate (2017 estimate)	8.50%	6%	4.40%	4.40%
Inflation rate (2017)	3.60%	4.10%	5.60%	6.50%
Exchange rate (2017) (1 US$ = national currency)	65.17	105.1	80.69	154.1

Source: CIA World Factbook

In 2017, the major trading partners with all four countries were the United States, China, the United Kingdom, Germany, Italy, and the United Arab Emirates.

Table 11: Country Profiles

	India	Pakistan	Bangladesh	Sri Lanka
Land Area (sq km)	2,973,193	770,875	130,170	64,630
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	India	Pakistan	Bangladesh	Sri Lanka
Imports in (2017 est.) (US$ in billions)	452.2	53.11	47.56	20.98
Key trading partners	China, USA, UAE, Saudi Arabia, Switzerland	USA, UK, China, Germany, Afghanistan, UAE, Spain	Germany, USA, UK, Spain, France, Italy	USA, UK, India, Singapore, Germany, Italy
Principal Exports	Petroleum products, precious stones, vehicles, machinery, iron and steel, chemicals, pharmaceutical products, cereals, apparel	Textiles, rice, leather goods, sporting goods, chemicals, manufactures, surgical instruments, carpets and rugs	Garments, knitwear, agricultural products, frozen fish and seafood, jute and jute goods, leather	Textiles and apparel, tea and spices, rubber manufactures , precious stones, coconut products, fish
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Unemployment rate (2017 estimate)	8.50%	6%	4.40%	4.40%
Inflation rate (2017)	3.60%	4.10%	5.60%	6.50%
Exchange rate (2017) (1 US$ = national currency)	65.17	105.1	80.69	154.1

Source: CIA World Factbook

Table 10 also shows that India had a trade deficit of $148.10 billion, while the trade deficits of Pakistan ($20.23 billion), Bangladesh ($12.26 billion), and Sri Lanka ($9.62 billion) were much smaller in 2017. Of the four countries, India had the highest unemployment rate (8.50 percent) and the lowest inflation rate (3.60 percent) in 2017. Pakistan had the second highest unemployment rate (6.0 percent) and the second lowest inflation rate (4.1 percent).

A Comparison of M&A Activities in India, Pakistan, Bangladesh, and Sri Lanka

As a result of the differences in the economies of the four countries, their M&A activities vary quite a bit. Table 11 presents data that allow comparing the four countries' M&As by the industry of the target firms and provides information for target firms from other countries. The services industry accounted for 33 percent of the M&A transaction value in India, compared to 27 percent in Bangladesh and just over 16 percent in both Pakistan and Sri Lanka. Over 68 percent of the target firms from

Bangladesh were in manufacturing, while 43 percent of the target firms in Sri Lanka operated in the financial industry, such as banking and insurance. Natural resources accounted for 25 percent of the M&A deal value in Pakistan, compared to 7 percent in India and 5 percent in Bangladesh. The target firms responsible for M&A activity in the other countries were involved in a variety of industries, including services (48 percent), manufacturing (30 percent), and natural resources (17 percent).

Table 12: Mergers and acquisitions by the industry of the target firm, 2010-2019 (values in millions of US$)

Country	Services (%)	Manufacturing (%)	Financial (%)	Natural Resources (%)	Wholesale trade and retail (%)	Other (%)	Total (%)
India	66,608	65,638	36,402	14,040	19,466	42	202,197
	32.9%	*32.5%*	*18.0%*	*6.9%*	*9.6%*	*0.0%*	*100.0%*
Pakistan	633	1,625	623	954	3	0	3,838
	16.5%	*42.3%*	*16.2%*	*24.9%*	*0.1%*	*0.0%*	*100.0%*
Bangladesh	629	1,629	0	117	0	0	2,374
	26.5%	*68.6%*	*0.0%*	*4.9%*	*0.0%*	*0.0%*	*100.0%*
Sri Lanka	235	435	612	11	128	0	1,420
	16.5%	*30.6%*	*43.1%*	*0.8%*	*9.0%*	*0.0%*	*100.0%*
Other countries	19,280	11,997	1,940	6,782	190	9	40,197
	48.0%	*29.8%*	*4.8%*	*16.9%*	*0.5%*	*0.0%*	*100.0%*
Total	87,384	81,324	39,576	21,904	19,787	52	250,027
	34.9%	*32.5%*	*15.8%*	*8.8%*	*7.9%*	*0.0%*	*100.0%*

Source: Thomson Financial Service

Table 12 compares the mergers and acquisitions (M&A) completed in India, Pakistan, Bangladesh, and Sri Lanka by the nationalities of the acquirers. We can observe some similarities and differences among the M&A deals completed in these four countries. For example, Sri Lanka had the highest percentage (60 percent) of domestic mergers (i.e., Sri Lanka firms acquiring other Sri Lankan firms) followed by India (57 percent). Comparatively, in Pakistan and Bangladesh, local firms buying other local firms accounted for 35 percent and 4 percent, respectively, of all the M&A deal values completed during the 2010-2019 time frame.

Table 13: Mergers and acquisitions completed in India, Pakistan, Bangladesh and Sri Lanka (M&A value in millions of US$)

India	M&A Value	%	Pakistan	M&A Value	%	Bangladesh	M&A Value	%	Sri Lanka	M&A Value	%
Indian firms acquiring other Indian firms	138,648	57%	Pakistan firms acquiring other Pakistan firms	1,388	35%	Bangladesh firms acquiring other Bangladesh firms	100	4%	Sri Lanka firms acquiring other Sri Lanka firms	898	60%
Indian firms acquiring non-Indian firms	40,476	17%	Pakistan firms acquiring non-Pakistan firms	77	2%	Bangladesh firms acquiring non-Bangladesh firms	78	3%	Sri Lanka firms acquiring non-Sri Lanka firms	82	5%
Non-Indian firms acquiring Indian firms	63,549	26%	Non-Pakistan firms acquiring Pakistan firms	2,450	63%	Non-Bangladesh firms acquiring Bangladesh firms	2,274	93%	Non-Sri Lanka firms acquiring Sri Lanka firms	523	35%
Total	242,674	100%		3,915	100%		2,452	100%		1,502	100%

Source: Thomson Financial Service

In Bangladesh, non-Bangladeshi firms acquiring Bangladeshi companies accounted for 93 percent of the total M&A transaction value, while in Pakistan, non-Pakistani firms acquiring Pakistani companies accounted for only 63 percent of the M&A value. In India, non-Indian firms acquiring Indian companies accounted for only 26 percent of all M&A activity, which was worth $63.5 billion during the 2010 to 2019 time period. It is interesting to note that the M&A market value in India is over 30 times larger than the total of Pakistan, Bangladesh, and Sri Lanka combined.

Finally, Table 13 presents a breakdown of the M&A deals that were completed in the four countries of the Indian subcontinent relative to the economic size (GDP) and level of foreign direct investment (FDI) of each nation. As expected, India, with its relatively larger economic size (81.09% of total GDP) and greater proportion of FDI (89.01%), accounted for the highest percentage of M&A deals, both in terms of the number of deals (89.02%) and their total transaction value (96.87%). Pakistan, which ranked second in terms of GDP (9.03%) and third in terms of FDI inflows (4.30%), accounted for the second highest proportion of M&A deal value (1.57%) and third highest proportion of the number of deals (2.44%). Bangladesh, which ranks third in terms of GDP (7.07%) and second in terms of FDI inflows (4.41%), accounted for the second lowest proportion of deal value (0.98%)

and the lowest proportion of the number of deals (1%), while Sri Lanka, despite being the smallest of the four economies (2.82% of total GDP) and accounting for the lowest proportion of FDI inflows (2.28%), accounted for the second highest proportion of the number of M&A deals (7.54%), although the total deal value was lowest in percentage terms (0.59%).

Table 14: Mergers & Acquisitions completed in Indian Sub-Continent relative to FDI and Size of Economy

Nationality (country)	Transaction value	% of Total Deal Value	No. of Deals	% of total # of deals	FDI Inflows $	% of FDI - Inflows	GDP $	% of GDP
	(US$ million)							
India	242,192.13	96.87%	1,878	89.02%	371,742.49	89.01%	22,090,597,920,394	81.09%
Pakistan	3,915.23	1.57%	47	2.44%	17,963.00	4.30%	2,458,470,162,921	9.03%
Bangladesh	2,451.52	0.98%	20	1.00%	18,422.42	4.41%	1,924,573,921,945	7.07%
Sri Lanka	1,467.12	0.59%	141	7.54%	9,522.47	2.28%	766,995,112,927	2.82%
Subtotal for the four countries	250,026.00	100.00%	1,804	100.00%	417,650.38	100.00%	27,240,637,118,187	100.00%

Source: Thomson Financial Services; UNCTAD STAT

Summary and Conclusions

This article has provided an update and overview of M&A activity in India, Pakistan, Bangladesh, and Sri Lanka for the most recent completed decade, i.e., 2010 to 2019. Earlier, we noted that M&A activities in the four countries expanded in 2010 but decreased significantly in 2011, and the slowdown continued until 2016. Many research studies suggest that the period following the global financial crisis of 2008 witnessed a significantly slower economic growth rate, especially in India, Pakistan, Bangladesh, and Sri Lanka. According to Arvind Subramanian (2019), "since the Global Financial Crisis, India's long-term growth has slowed as the two engines propelling rapid growth, i.e., investment and exports, sputtered. Today, the other engine, i.e., consumption… has also stabilized. As a result, growth has plummeted precipitously over the past few quarters". We noted that both the number of deals and transaction values of M&As in the four countries expanded significantly in 2017 and 2018. It is clear that during 2019, the Asian subcontinent witnessed a dramatic drop in M&A activity both in terms of the volume and number of deals. In the future, the expansion of M&A activity in the region is most likely going to continue but at a slower rate for the following reasons: (1) Frictions in China–US trade will likely create a restrained approach concerning the M&A activities and expansion of trade around the globe; (2) The

continuation of consolidation of companies in manufacturing and telecommunication industries within the region will prompt corporate restructuring efforts; (3) Deregulation, increased privatization, and adoption of effective pro-competitive policies will continue to motivate the inflow of foreign direct investment to the Indian subcontinent; and (4) The size of the domestic market and the availability of skilled labor at a lower cost will continue to motivate foreign firms to invest in the region.

However, we recommend that future investors in the region carefully examine the following issues before investing or expanding their M&A activity in the four countries:

1. Before making a decision to acquire a firm in any of the four countries, investors must evaluate the degree of attractiveness in the political, economic, social and legal systems of India, Pakistan, Bangladesh, and Sri Lanka.
2. Investors should acquire as much factual fluency about the cultural components and priorities and its impact on adding the cost of doing business in these countries.
3. It is critical for the acquiring firm to determine the real dollar valuation of the target firm in any of the four countries. It is recommended that one should utilize the assistance of a local investment banker and/or certified public accounting firm, in addition to a legal firm. In India, Pakistan, Bangladesh, and Sri Lanka, the verification, accuracy and reliability of the assets, liabilities and earnings of the target firm's data must be audited and certified by a trusted public accounting firm doing business in the country.
4. After the decision is made to acquire the firm in the region, the acquiring firm should establish a strategic plan to integrate the resources and manage its capabilities to create a synergy needed to compete successfully within the local economy.
5. Plan on a delay in closure of the M&A agreement because of the longer regulatory approval process (Ayilavarapu & Chandrashekhar 2019).
6. Anticipate a larger and more difficult cultural integration because of the well-established values and norms between both entities.

In conclusion, a gradual increasing trend in M&A activities in India, Pakistan, Bangladesh, and Sri Lanka is providing opportunities and challenges to other global firms and potential investors from Europe, North America, China, Asia, and the Middle East. As George Bernard Shaw is reputed to have said, "we are wise not by recollection of our past,

but by the responsibility for our future," and the future of the Indian subcontinent is bright indeed!

Declarations

a. Funding:

No outside funding was received for this study.

b. Conflict of Interest:

On behalf of all authors, the corresponding author states that there is no conflict of interest.

c. Ethical approval

Not applicable

d. Informed consent

Not applicable

Data Availability:

Our manuscript contains data that will be made available upon reasonable request.

References

Abdullah, F. Shah, A., and Khan, S. (2012). "Firm Performance and the Nature of Agency Problems in Insider-Controlled Firms: Evidence from Pakistan. The Pakistan Development Review. Vol. 51, no. 4, pp. 161-183.

Ahmed, F., Ahmed, A., Kanwal, S. (2018). Mergers and Acquisitions in selected Frontier Markets of Asia. Signifikan: Jurnal Illmu Ekonomi, Vol, 7 (1): 123-136.

Ayilavarapu, D. and Chandrashekhar, V. (2019). India M&A Report Confederation of Indian Industry BAIN and Company and CII.

Dutz, M., Khemani, R.S. (2007). Competition Law and Policy: Challenges in South Asia. The World Bank, Finance & Private Sector Development unit.

Gaughan, P.A. (2005). Mergers: What Can Go Wrong and How to Prevent It. New Jersey: John Wiley & Sons.

Joshi, Ashish S. (2008). "Mergers and Acquisitions in India: A Primer." Michigan Business Law Journal, Summer 2008: 43-50

Khan, M., Khan, S. and Rizwan, F. (2017). "Analysis of Merger and Acquisition in Pakistan." NICE Research Journal, ISSN: 2219-4282, pp. 24-44.

Leepsa, N. M. and Mishra, C. (2016). "Theory and Practice of Mergers & Acquisitions: Empirical Evidence from Indian Cases." IIMS Journal of Management Science, pp. 179-194.

Ma, I., Pagan, I.A., & Chu, Y. (2009). Abnormal Returns to M&A in Ten Asian Stock Markets. International Journal of Business. 14 (3): 235-250.

Nirmala, S. and Aruna, G. (2013). "A Literature Review of Mergers and Acquisitions." International Journal of Management and Information Technology. Vol. 5, No. 1, pp. 435-439.

Pandya, V.U. (2018). Mergers and Acquisitions trends. The Indian Experience. International Journal of Business Administration. Vol.9 No.1.

Subramanian, Arvind, 2019. "GDP Growth overestimated during 2011-12 and 2016-17." Center for International Development at Harvard University, June 2019.

Subramanian. Arvind and Josh Felman, 2019. "It is India's Great Slowdown, where economy seems headed for the ICU." Center for International Development at Harvard University, December 2019.

Tang, Roger Y.W. and A.M. Metwalli, 2013, "M&A in India, Pakistan, Bangladesh, and Sri Lanka." International Journal of Commerce and Management, 23(4), 327-338

Usman, A., Mehboob, U. A., & Farooq, S. I. (2010). Relative operating performance of merger firms in Pakistan. European Journal of Economic, Finance & Administrative Science. 11 (20): 44-48

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How Information and Communication Technologies Affect Intensive and Extensive Margins of Firm Exports: Evidence with Micro Data of South Asian Manufacturing Firms

Muhammad Luqman
Kashmir Institute of Economics
The University of Azad Jammu & Kashmir
Azad Jammu and Kashmir, Pakistan.
luqman.khan@ajku.edu.pk, luqmanraja@gmail.com
(Corresponding Author)

Ghulam Murtaza
Asia Pacific College of Business and Law, Charles Darwin University, Australia.

Rabia Nazir
The Islamia University of Bahawalpur, Bahawalpur, Pakistan.

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Abstract:
International trade plays a pivotal role in growth and development. The use of ICT is profoundly changing the landscape for international trade and expands opportunities especially for developing countries. The key objective of this study is to investigate the effects of different ICT capacities on the extensive and intensive margins of firm-level exports using micro-data of manufacturing firms operating in selected South Asian countries. We employ the Probit and fractional response models as estimation techniques. Findings of the study reveal that different ICT capacities are positively associated with both the extensive and intensive margins of firm-level exports, and our results are robust to the alternative empirical specifications. These results have important implications for designing the export promotion policies in selected South Asian countries. Hence, policy practitioners in these countries should encourage firms to invest in ICT capacities to boost their export performance.

Keywords: ICT, Intensive Margin, Extensive Margin, Manufacturing Firms, South Asia.
JEL Classification: F14, F23, D22.

How Information and Communication Technologies Affect Intensive and Extensive Margins of Firm Exports: Evidence with Microdata of South Asian Manufacturing Firms

1. Introduction

International trade plays a pivotal role in growth and development; trade openness, liberalization, and integration of world economies open up many opportunities for the global south to catch up with the global north (Dollar & Kraay, 2004). For developing countries in the global south, merchandise and services exports to the developed north are a key source of foreign exchange earnings, as they ease balance of payment crises and increase employment opportunities (Thangavelu & Rajaguru, 2004; Xing, 2018). Current literature documents a positive link between extensive margins and export growth. The literature has also found that diversifying exports leads to greater stability in foreign exchange earnings in developing countries (Hummels & Klenow, 2005; Besedes & Prusa, 2011). Similarly, an intensive margin also successfully explains the export growth process. In the last two decades, researchers have shifted their emphasis to the causes and origins of firms' export strategies and their ultimate impact on intensive and extensive margins of exports (Cirera, Marin & Markward, 2015; Regis, 2018).

For firms operating in developing countries, uncovering international market conditions is costly due to informational frictions, which affects international trade (Allen, 2014). Hence, in an increasingly globalized world, innovations in information and communication technologies (ICT) have profoundly reshaped the landscape of international trade. They expand opportunities for firms operating in developing countries by providing access to global markets that increase the scale, customer base and profitability of firms. This signifies the role of ICT in providing a conducive environment for the internationalization of firms through exports and in providing ways for firms to meet the challenges of sustaining the volume of their exports (intensive margin of exports) (Vemuri & Siddiqi, 2009; Cotarelo & Calderón, 2018). In this regard, export market dynamism, that is, changes in demand conditions and competition in the global market, is important for firms operating in developing countries (Cadogan, Kuivalainen, & Sundqvist, 2009; Racela & Thoumrungroje, 2020). Hence, ICT helps firms cope with export market

dynamism by providing up-to-date information (Racela & Thoumrungroje, 2020). A few studies highlighted the role of information networks in helping firms to enter into export markets. For instance, Ricci and Trionfetti (2012) found that information networks increase the probability of exporting (extensive margin of export).

With this background, this study intended to investigate the question: *"To what extent does ICT usage affect firm export outcomes?"* For empirical analysis, we use the data of manufacturing firms from selected South Asian countries, namely, India, Pakistan, and Bangladesh. These countries were selected because each has a vibrant manufacturing sector though their export growth has decreased in the past few years and is estimated to be below potential levels. This situation is depicted in a 2019 report by the World Bank, which reported that in the South Asian region, "export grew at the rate of 4.6 percent in 2017 and 9.7 percent in 2018 while import grew at the rate of 14.9 percent in 2017 and 15.6 percent in 2019". Strong domestic demand fueled by the consumption and investment boom has amplified import growth in these countries. Although economic growth still appears to be robust in general, its sustainability over the long term could be in doubt, due to weak performance on the export front (World Bank, 2019). Hence, this study provides useful insight into the export growth process, looking in particular at intensive and extensive margins in South Asian countries.

This study is relevant to Visser (2019), who investigated the effect of internet penetration on the intensive and extensive margins of differentiated good exports of 162 countries. Moreover, Abeliansky, Barbero, & Rodriguez-Crespo (2021) investigate the effect of ICT usage on the intensive and extensive margins of trade for 150 developed and developing countries. However, this study is different from the existing literature on the subject in three ways: First, instead of country-level data, this study used firm-level data from selected South Asian countries. To the best of our knowledge, few studies have explored the link between ICT usage and the export performance of firms operating in South Asian countries. Second, other researchers have used data from a large number of countries by pooling developed and developing countries into a single sample. However, the presence of unobserved heterogeneity implies that these estimates are subject to an incidental parameter bias that may be substantial in large samples (Hahn & Newey, 2004). Hence, to avoid heterogeneity in the sample, this study used the data set of three South Asian developing countries. Third, this study used explicit survey-level

information on ICT usage and the export performance from the selected South Asian manufacturing firms.

The rest of the paper is organized as follows: Section 2 reviews the relevant literature, while section 3 discusses the methodology employed. Section 4 addresses the findings and discussion, and in section 5 we conclude the study.

2. Literature Review

In developing countries, due to information frictions, the set of goods that an economy can produce and export are determined not only by fundamentals, but also by the number of entrepreneurs engaged in the discovery of appropriate products in the modern sectors of the economy (Hausmann & Rodrik, 2003; Hausmann, Hwang & Rodrik, 2007). Allen (2014) incorporates a costly search process for export market conditions in a model of trade with firm productivity heterogeneity that successfully predicts real-world trade patterns. Similarly, Head and Mayer (2013) argued that despite the low level of traditional trade barriers such as tariffs, quotas, and transport costs, information frictions in the export market substantially hamper international trade. Kneller & Pisu (2011) reported firms' perceptions about major export barriers, and most of the firms identify the initial contact with the prospective client in the international market as a major constraint. In this context, the use of ICT helps firms cope by providing up-to-date information (Racela & Thoumrungroje, 2020). Cotarelo & Calderon (2018) found that the use of ICT is positively associated with export performance in developing countries, while a supportive relationship between exporting firms and their foreign customers mediates the effect of ICT on export success.

Hagsten (2015) investigated the link between ICT usage and export behavior of firms using a distributed data approach. The results of the study revealed that there exists a positive relationship between ICT usage and export decisions. However, the type of ICT that is most useful for firms appears to vary across nations, conceivably associated with the common level of ICT intensity. Similarly, Racela & Thoumrungroje (2020) argued that ICT usage increases a firm's capacity and ability to remain in the export market, and increases their volume of exports. This hypothesis is tested with firm-level data from developing countries. The results substantiate the claim that ICT usage helps firms cope with export market dynamism. Kotnik & Hagsten (2018) found evidence of the positive role of ICT usage by

manufacturing firms in increasing the probability of exporting (extensive margin of exports).

Likewise, Hagsten & Kotnik (2017) found that firms' ICT capacities are positively associated with the probability of exporting and the volume of exports in European countries. However, some studies have argued that there exists complementarity between skills and ICT. For instance, Akerman, Gaarder, & Mogstad (2015) found evidence for the complementarity between ICT usage and skilled labor in the productivity performance of Norwegian manufacturing firms. Ricci & Trionfetti (2012) explored the role of productivity and information networks in the export performance of firms. The authors found evidence of the positive role of network information and firms' productive efficiency for entry into export markets. Similarly, Feiguine & Solovjova (2014) argued that well-educated human resources and ICT capacities are prerequisites for success in the export market. Yushkova (2014) found evidence that ICT innovation reduces trade costs, which in turn magnifies export growth in selected OECD and non-OECD countries. Kneller & Timmis (2016) investigated the effect of broadband usage on the extensive margin of firm exports in the UK and found evidence of the positive effects of broadband usage on the entry of a firm into the export market (extensive margin of export). In the context of African countries, Hinson and Adjasi (2009) investigated the effect of internet usage on export performance in selected African countries. The results revealed that internet usage is positively associated with export performance in selected African countries. In a similar vein, Xing (2018) investigated the effect of ICT usage and e-commerce on the export performance of twenty-one developing and thirty OECD economies. The study supported the claim that the efficient use of ICT unlocks the e-trade potential of developing countries. Similarly, Visser (2019) examined the effect of internet penetration on the extensive and intensive margins of differentiated exports and found that internet penetration facilitates both intensive and extensive margins of differentiated exports. Abeliansky, Barbero, & Rodriguez-Crespo (2021) investigated the effect of ICT usage on the intensive and extensive margin of trade for 150 developed and developing countries and find that ICT usage enhances the intensive and extensive margins of exports.

Lohrke, Franklin, & Frownfelter- Lohrke (2006) argued that the internet reduces transaction costs and works as a conduit for the flow of information and hence is positively associated with export performance. Hagsten & Kotnik (2017) find evidence supporting a positive effect of ICT usage on the export propensity and export intensity of small and medium

firms operating in European countries. To the best of our knowledge, few studies have explored the link between ICT usage and the export performance of firms operating in South Asian countries. Hence, this study fills a gap in the literature by investigating the effect of ICT usage on the intensive and extensive margins of export in selected South Asian countries. ICT usage can reduce information frictions and transaction costs, and works as a conduit for the transmission and diffusion of knowledge. Based on the literature, the following are the key hypotheses of the study:

H1: ICT usage enhances the probability of firms' entry into the export market.

H2: ICT usage enhances the volume of export sales of incumbent firms.

Hence, it is expected that ICT usage can positively influence both the intensive and extensive margins of firm-level exports.

3. Methodology

3.1 Model Specification

This study investigates the question: "*To what extent does ICT usage affect firm export outcomes?*". To achieve this objective, this study developed an empirical model in line with Berman and Hericourt (2010) and Regis (2018) for the extensive margin of firm exports:

$$EXT_{MAR_i} = \alpha + \beta_1 ICT_i + \sum_{j=1}^{n} \gamma_j X_i + \delta_1 D_c + \delta_2 D_i + \varepsilon_i \quad (1)$$

where EXT_{MAR_i} represents exporting decisions of a firm that is binary, which takes the value '1' if firm i is exporting and the value '0' if it is not exporting. ICT_i represents the use of ICTs by firm i. X_i represents a set of control variables that include productivity and human capital measures through skills, labor force, firm size, and age of the firm. D_c and D_i are dummies that capture heterogeneity across industries and countries, while ε_i is the stochastic random error term. Similarly, this study developed an empirical model in line with Berman & Hericourt (2010) and Regis (2018) for the intensive margin of exports:

$$V_i = \alpha + \beta_1 ICT_i + \sum_{j=1}^{n} \gamma_j X_i + \delta_1 D_c + \delta_2 D_i + \varepsilon_i \quad (2)$$

where represents the volume of exports and is measured as a ratio of export sales to total sales. ICT_i represents the use of ICT by firm i. X_i

represents a set of control variables that includes productivity and human capital measures through skills, labor force, firm size, and age of the firm.

3.2 Estimation Strategy

Given the binary nature of the dependent variable, an appropriate estimation strategy would be to use a qualitative response model. A qualitative response model relates the probability of an event to the set of control variables and variables of interest. Hence, in this study, the binary probit model is employed to assess the effect of ICT on the extensive margin of export. The binary probit model would take the form:

$$P\left(export_j \middle| X_j, ICT_j\right) = \Phi\left(X_j\gamma + ICT_j\delta_j + D_c + D_i\right) + \mu_j \quad (3)$$

where $P\left(export_j\right)$ is the probability of exporting by firm j and is known as the extensive margin (EXT_{MAR}) of export. $\dot{Ex_{mar}}_J$ is a latent variable that is not directly observable, and we express it as a binary choice

$$Ex_{mar\,j} = \begin{Bmatrix} Export_d = 1 for \dot{Ex_{mar}}_J > 0 \\ Export_d = 0 for \dot{Ex_{mar}}_J \leq 0 \end{Bmatrix}$$

The intensive margin of export reflects the volume of export sales and is measured as a ratio of export sales to total sales. Hence, due to the fractional nature of the dependent variable, the fraction response model proposed by Pake & Wooldridge (1996) is the most appropriate estimation strategy.

$$E\left(V_j, X_j, ICT_j\right) = \Psi\left(X_j\gamma + ICT_j\delta_j + D_c + D_i + \mu_j\right) \quad (4)$$

3.3 Variables and Data

Our dependent variables are the extensive and intensive margins of export. The extensive margin is dichotomous and measured by a dummy equal to '1' if a firm is exporting and is equal to '0' if a firm is not exporting. However, the intensive margin is a fraction because it is measured as the ratio of export sales to total sales.

This study uses firm-level data for three South Asian economies, namely, India, Pakistan, and Bangladesh, that is taken from World Bank's Enterprise Surveys (World Bank, 2020). These countries were selected for analysis because the manufacturing sector in these countries is more

vibrant than that in other South Asian countries, such as Sri Lanka, Maldives, Bhutan, and Afghanistan. Moreover, the manufacturing sector traditionally plays a key role in the economic uplift of the masses, especially in developing countries. According to the World Bank, their survey takes data from a "random sample of firms is drawn from the population of manufacturing sectors in each country by size, region, and two-digit industry". The data set is available for 2013 in the case of Pakistan and Bangladesh, while for India, data are available for 2014. Table A1 in Appendix A provides a detailed description of the variables of the study.

4. Findings and Discussion

The objective of the study is to investigate the effect of ICT on the intensive and extensive margins of firms' exports. The study employed probit and fractional response models as estimation techniques. Table 1 reports the results of the probit model for the extensive margin of exports.

Table 1: Results of probit estimations for the extensive margin of exports

	(1)	(2)	(3)	(4)
	Exports_ex	**Exports_ex**	**Exports_ex**	**Exports_ex**
size	0.336***	0.305***	0.359***	0.321***
	(0.0158)	(0.0163)	(0.0159)	(0.0166)
age	0.132***	0.125***	0.124***	0.118***
	(0.0256)	(0.0256)	(0.0257)	(0.0258)
prod	0.0510***	0.0412**	0.0581***	0.0483***
	(0.0144)	(0.0145)	(0.0145)	(0.0146)
credit_avail	0.506***	0.513***	0.523***	0.541***
	(0.0593)	(0.0594)	(0.0595)	(0.0597)
imported_tech	0.0942	0.0261		
	(0.0551)	(0.0556)		
workers_skills	0.259***	0.209**		
	(0.0778)	(0.0782)		
F_ownership			0.869***	0.901***
			(0.260)	(0.260)
workers_edu			0.353***	0.392***
			(0.0691)	(0.0697)
ICT_1	0.476***		0.511***	
	(0.0633)		(0.0640)	
ICT_2		0.463***		0.506***
		(0.0439)		(0.0440)
_cons	-3.949***	-3.487***	-3.805***	-3.346***
	(0.225)	(0.228)	(0.218)	(0.220)
N	6449	6449	6451	6451
R^2	0.21	0.18	0.22	0.15

CFE	Yes	Yes	Yes	Yes
IFE	Yes	Yes	Yes	Yes

Heteroskedasticity adjusted robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The average marginal effects are reported except constant.

The results reported in column 2 (specification (1)) of Table 1 show that the ICT capacity of a firm measured in terms of e-mail usage for communication with clients or suppliers (ICT_1) is positively related to the firms' exporting decisions in selected South Asian countries. Similarly, the results in column 3 (specification (2)) of Table 1 show that firms with a website (ICT_2) are on average more inclined toward exporting than their counterparts working without a website. These results further reveal that the use of ICT increases the probability of firms entering the export market. These results are consistent with existing studies such as Hagsten & Kotnik (2017) and Kotnik & Hagsten (2018), whose work found a positive effect of ICT usage on the extensive margin of firm-level exports in selected European countries. Similarly, Kneller & Timmis (2016) found a positive effect of ICT usage on the extensive margin of firms' exports in the UK. The control variables in both empirical specifications (1-2) of Table 1, such as the size of the firms, the age of the firms, the productivity of the firms, the availability of credit to firms, the use of imported technology, and the ratio of skilled workers, are all statistically significant with a positive sign. The results of the study suggest that these factors increase the probability of firms' entry into the export market.

In empirical specifications (3-4) of Table 1, we replace imported technology and the ratio of skilled workers with foreign ownership and workers' education as control variables. The results reported in empirical specification (3) show that ICT in terms of email usage (ICT_1) is statistically significant with a positive sign. Similarly, the results in specification (4) of Table 1 show that the probability of exporting increases for firms with a website (ICT_2). The new control variables foreign ownership and workers' education in empirical specifications (3-4) are also statistically significant with positive signs. We also include dummies in all empirical specifications (1-4) to control for unobserved industry fixed effects (IFE) and country fixed effects (CFE).

The intensive margin of exports reflects the volume of export sales and is measured as a ratio of export sales to total sales. Hence, due to the fractional nature of the dependent variable, the fraction response model proposed by Pake & Wooldridge (1996) is the most appropriate estimation model. Table 2 shows the results of the intensive margin of exports

estimated using a fractional probit model. The results shown in the second column of Table 2 (empirical specification (1)) indicate that the ICT capacity of a firm measured in terms of e-mail usage for communication with clients or suppliers (ICT_1) is statistically significant with a positive sign. Similarly, the results reported in empirical specification (2) of Table 2 show that firms with a website (ICT_2) export more on average than their counterparts working without a website.

Table 2: Fractional Probit estimates for intensive margin of firm level exports

	(1)	(2)	(3)	(4)
	Exports_in	**Exports_in**	**Exports_in**	**Exports_in**
Size	0.353***	0.333***	0.379***	0.350***
	(0.0158)	(0.0170)	(0.0163)	(0.0175)
age	0.0402	0.0338	0.0277	0.0210
	(0.0259)	(0.0263)	(0.0261)	(0.0267)
prod	0.0304*	0.0215	0.0353*	0.0238
	(0.0152)	(0.0152)	(0.0151)	(0.0152)
credit_avail	0.315***	0.317***	0.314***	0.326***
	(0.0602)	(0.0606)	(0.0597)	(0.0599)
Imported_tech	0.211***	0.165**		
	(0.0547)	(0.0557)		
workers_skills	0.834***	0.810***		
	(0.0825)	(0.0834)		
F_ownership			0.926***	0.972***
			(0.236)	(0.247)
workers_edu			0.369***	0.414***
			(0.0737)	(0.0747)
ICT_1	0.378***		0.377***	
	(0.0747)		(0.0739)	
ICT_2		0.362***		0.420***
		(0.0508)		(0.0496)
_cons	-4.290***	-3.939***	-3.633***	-3.253***
	(0.237)	(0.239)	(0.222)	(0.225)
N	6682	6682	6684	6684
CFE	Yes	Yes	Yes	Yes
IFE	Yes	Yes	Yes	Yes
R^2	0.25	0.33	0.29	0.35

Robust standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Average marginal effects are reported

These results appear to support the claim that ICT usage helps firms increase their volume of exports. These results are consistent with literature, such as Hagsten & Kotnik (2017) and Kotnik & Hagsten (2018), who found a positive effect of ICT usage on the intensive margin of firm-

level exports in selected European countries. Similarly, Kneller & Timmis (2016) found a positive effect of ICT usage on the intensive margin of firms' exports in the UK. The control variables in both empirical specifications (1-2) of Table 2, such as the size of the firms, the productivity of the firms, the availability of credit to firms, the use of imported technology, and the ratio of skilled workers, are all statistically significant with a positive sign. However, the age of the firms) is statistically insignificant in both empirical specifications (1-2) with a positive sign.

In empirical specifications (3-4) of Table 2, imported technology and the ratio of skilled workers are replaced with foreign ownership and workers' education as control variables. The results shown in empirical specification (3) show that email usage to communicate with clients or suppliers (ICT_1) is statistically significant with a positive sign. Similarly, the results shown in empirical specification (4) of Table 2 show that firms with a website (ICT_2) export more on average than their counterparts working without a website. These results show that ICT capacities help the firm increase its volume of exports. The control variables in both empirical specifications (3-4) of Table 2, such as the size of the firms, the productivity of the firms, the availability of credit to firms, foreign ownership, and workers' education, are all statistically significant with a positive sign. However, the age of the firms is statistically insignificant in both empirical specifications (3-4) with a positive sign.

In order to test the robustness of our results, a beta regression is estimated after deleting the boundary values from the data. The results of the beta regression are reported in table B1 in Appendix B. The results in alternative specifications validate the claim that ICT capacities help the firm to increase its volume of exports. There is also the possibility of endogeneity because exporting activity or an unobserved variable might cause the ICT capacities of firms. Hence, to avoid any potential endogeneity, endogenous treatment with a control function is also used for a robustness check. The control function approach for endogenous treatment provides an excellent tool to deal with endogeneity in observational studies (Wooldridge, 2010; Wooldridge, 2015). We used the productivity of the firms as correlated with both treatment and outcome. The results of the average treatment effect (ATE) of endogenous treatment are reported in table B2 in appendix B. These results again validate the claim that ICT capacities help the firm to increase its volume of exports. However, the magnitude of impact decreased, as depicted in the results reported in table B2.

4 Conclusions

This study investigated the effect of different ICT capacities on the extensive and intensive margins of firm-level exports. The study used micro-data of manufacturing firms operating in selected South Asian countries, namely, India, Pakistan, and Bangladesh and employed the probit model and the fractional response model as estimation techniques. The results of the study show that ICT capacities in terms of the use of e-mail to communicate with clients or suppliers and website ownership are positively associated with both extensive and intensive margins of firm-level exports. ICT is, therefore, an important catalyst in boosting growth in the export sector. Our results also show that other control variables, such as the size of the firms, the age of the firms, the productivity of the firms, the availability of credit to firms, the use of imported technology, and the ratio of skilled workers, are all positively associated with both extensive and intensive margins of trade. Similarly, firms with a larger share of educated workers and foreign ownership on average export more than their counterparts. The results of this study are robust to alternative empirical specifications. These results have important implications for designing export promotion policies in selected South Asian countries. The results suggest that policymakers should assist in providing ICT infrastructure to different industries to boost growth in the export sector.

This study is based on the data collected from the World Bank's Enterprise Surveys, which provides a limited amount of information on ICT usage. The literature on country-level studies used some advanced measures, such as the number of subscriptions (per capita) and average quality of subscriptions (bandwidth) on the extensive and intensive margins. Hence, future research can focus on additional measures of ICT usage, such as mobile appliances and the average quality of subscriptions.

References

Abeliansky, A. L., Barbero, J., & Rodriguez-Crespo, E. (2021). ICTs quality and quantity and the margins of trade. *Telecommunications Policy*, *45*(1), 102056.

Akerman, A., Ingvil, G., & Mogstad, M. (2015). The skill complementarity of broadband internet. *The Quarterly Journal of Economics, 130*(4), 1781-1824. https://doi.org/10.1093/qje/qjv028

Allen, T. (2014). Information frictions in trade. *Econometrica*, *82*(6), 2041-2083. https://doi.org/10.3982/ECTA10984

Bas, M. (2012). Input-trade liberalization and firm export decisions: Evidence from Argentina. *Journal of Development Economics*, *97*(2), 481-493. https://doi.org/10.1016/j.jdeveco.2011.05.010

Bas, M., & Strauss-Kahn, V. (2014). Does importing more inputs raise exports? Firm-level evidence from France. *Review of World Economics*, *150*(2), 241-275. https://doi.org/10.1007/s10290-013-0175-0

Berman, N., & Héricourt, J. (2010). Financial factors and the margins of trade: Evidence from cross-country firm-level data. *Journal of Development Economics*, *93*(2), 206-217. https://doi.org/10.1016/j.jdeveco.2009.11.006

Bernard, A. B., & Jensen, J. B. (1999). Exceptional exporter performance: Cause, effect, or both? *Journal of International Economics*, *47*(1), 1-25. https://doi.org/10.1016/S0022-1996(98)00027-0

Bernard, A. B., Eaton, J., Jensen, J. B., & Kortum, S. (2003). Plants and productivity in international trade. *American Economic Review*, *93*(4), 1268-1290. https://doi.org/10.1257/000282803769206296

Besedes, T., & Prusa, T. J. (2011). The role of extensive and intensive margins and export growth. *Journal of Development Economics*, *96*(2), 371-379. https://doi.org/10.1016/j.jdeveco.2010.08.013

Cadogan, J. W., Kuivalainen, O., & Sundqvist, S. (2009). Export market-oriented behavior and export performance: Quadratic and moderating effects under differing degrees of market dynamism and internationalization. *Journal of International Marketing*, *17*(4), 71-89. https://doi.org/10.1509/jimk.17.4.71

Caggese, A., & Cunat, V. (2013). Financing constraints, firm dynamics, export decisions, and aggregate productivity. *Review of Economic Dynamics*, *16*(1), 177-193. https://doi.org/10.1016/j.red.2012.10.004

Cieślik, A., & Michałek, J. J. (2017). Innovation forms and firm export performance: empirical evidence from ECA countries. *Entrepreneurial Business and Economics Review*, *5*(2), 85.

Chen, W. C. (2013). The extensive and intensive margins of exports: The role of innovation. *The World Economy*, *36*(5), 607-635. https://doi.org/10.1111/twec.12032

Cirera, X., Marin, A., & Markwald, R. (2015). Explaining export diversification through firm innovation decisions: The case of Brazil. *Research Policy*, *44*(10), 1962-1973. https://doi.org/10.1016/j.respol.2015.06.004

Cotarelo, M., & Calderon, H. (2018). Cooperation as a mediator between ICT and export success. *Journal of Global Marketing*, *31*(3), 197-209. https://doi.org/10.1080/08911762.2017.1350311

Dollar, D., & Kraay, A. (2004). Trade, growth, and poverty. *The Economic Journal*, *114*(493), F22-F49. https://doi.org/10.1111/j.0013-0133.2004.00186.x

Feiguine, G., & Solovjova, J. (2014). ICT investment and internationalization of the Russian economy. *International Economics and Economic Policy*, *11*(1-2), 231-250. https://doi.org/10.1007/s10368-013-0256-5

Greenaway, D., Guariglia, A., & Kneller, R. (2007). Financial factors and exporting decisions. *Journal of International Economics*, *73*(2), 377-395. https://doi.org/10.1016/j.jinteco.2007.04.002

Hagsten, E. (2015). Distributed access to linked microdata: the example of ICT and exports. *Applied economics letters*, *22*(7), 576-580.

Hagsten, E., & Kotnik, P. (2017). ICT as a facilitator of internationalization in small-and medium-sized firms. *Small Business Economics*, *48*(2), 431-446. https://doi.org/10.1007%252Fs11187-016-9781-2

Hagsten, E., & Kotnik, P. (2017). ICT as facilitator of internationalization in small-and medium-sized firms. *Small Business Economics*, *48*(2), 431-446.

Hahn, J., & Newey, W. (2004). Jackknife and analytical bias reduction for nonlinear panel models. *Econometrica*, *72*(4), 1295-1319.

Hausmann, R., & Rodrik, D. (2003). Economic development as self-discovery. *Journal of Development Economics*, *72*(2), 603-633. https://doi.org/10.1016/S0304-3878(03)00124-X

Hausmann, R., Hwang, J., & Rodrik, D. (2007). What you export matters. *Journal of Economic Growth*, *12*(1), 1-25. https://doi.org/10.1007%2Fs10887-006-9009-4

Head, K., & Mayer, T. (2013). What separates us? Sources of resistance to globalization. *Canadian Journal of Economics/Revue Canadienne d'économique*, *46*(4), 1196-1231. https://doi.org/10.1111/caje.12055

Hinson, R. E., & Adjasi, C. K. (2009). The Internet and export: Some cross-country evidence from selected African countries. *Journal of Internet Commerce*, *8*(3-4), 309-324. https://doi.org/10.1080/15332860903467730

Hummels, D., & Klenow, P. J. (2005). The variety and quality of a nation's exports. *American Economic Review*, *95*(3), 704-723. https://doi.org/10.1257/0002828054201396

Kneller, R., & Pisu, M. (2011). Barriers to exporting: What are they and who do they matter to? *The World Economy*, *34*(6), 893-930. https://doi.org/10.1111/j.1467-9701.2011.01357.x

Kneller, R., & Timmis, J. (2016). ICT and exporting: The effects of broadband on the extensive margin of business service exports. *Review of International Economics*, *24*(4), 757-796. https://doi.org/10.1111/roie.12237

Kotnik, P., & Hagsten, E. (2018). ICT use as a determinant of export activity in manufacturing and service firms: Multicountry evidence. *Zbornik Radova Ekonomskog Fakulteta u Rijeci: časopis za ekonomsku teoriju i praksu*, *36*(1), 103-128. https://doi.org/10.18045/zbefri.2018.1.103

Lohrke, F. T., Franklin, G. M., & Frownfelter, C. (2006). The Internet as an information conduit: a transaction cost analysis model of US SME internet use. *International Small Business Journal*, *24*(2), 159-178. https://doi.org/10.1177/0266242606061838

Ma, Y., Qu, B., & Zhang, Y. (2012). Complex goods' exports and institutions: empirics at the firm level. *Review of International Economics*, *20*(4), 841-853. https://doi.org/10.1111/j.1467-9396.2012.01059.x

Manez-Castillejo, J. A., Rochina-Barrachina, M. E., & Sanchis-Llopis, J. A. (2010). Does firm size affect Self-selection and Learning-by-Exporting? *World Economy*, *33*(3), 315-346. https://doi.org/10.1111/j.1467-9701.2010.01258.x

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, *71*(6), 1695-1725. https://doi.org/10.1111/1468-0262.00467

Mulliqi, A., Adnett, N., & Hisarciklilar, M. (2019). Human capital and exports: A microlevel analysis of transition countries. *The Journal of International Trade & Economic Development*, *28*(7), 775-800. https://doi.org/10.1080/09638199.2019.1603319

Nam, J., Liu, X., Lioliou, E., & Jeong, M. (2018). Do board directors affect the export propensity and export performance of Korean firms? A resource dependence perspective. *International Business Review*, *27*(1), 269-280. https://doi.org/10.1016/j.ibusrev.2017.08.001

Nguyen, L. P., & Pham, V. H. T. (2020). Trade of ICT products, government, and economic growth: Evidence from East Asia-Pacific Region. *Journal of Asian Finance, Economics, and Business*, *7*(8), 175-183. https://doi.org/10.13106/jafeb.2020.vol7.no8.175

Obben, J., & Magagula, P. (2003). Firm and managerial determinants of the export propensity of small and medium-sized enterprises in Swaziland. *International Small Business Journal*, *21*(1), 73-91. https://doi.org/10.1177/0266242603021001722

Olney, W. W. (2016). Impact of corruption on firm-level export decisions. *Economic Inquiry*, *54*(2), 1105-1127. https://doi.org/10.1111/ecin.12257

Papke, L. E, Woolridge, J. M. (1996). Econometric methods for fractional response variables with an application to 401(K) plan participation rates. *Journal of Applied Econometrics*, *11*(6), 619-632. https://doi.org/10.1002/(SICI)1099-1255(199611)11:6<619::AID-JAE418>3.0. CO;2-1

Racela, O. C., & Thoumrungroje, A. (2020). Enhancing export performance through proactive export market development capabilities and ICT utilization. *Journal of Global Marketing*, *33*(1), 46-63. https://doi.org/10.1080/08911762.2018.1549302

Regis, P. J. (2018). The extensive and intensive margins of exports of firms in developing and emerging countries. *International Review of Economics & Finance*, *56*, 39-49. https://doi.org/10.1016/j.iref.2018.03.016

Ricci, L. A., & Trionfetti, F. (2012). Productivity, networks, and export performance: Evidence from a cross-country firm data set. *Review of International Economics*, *20*(3), 552-562. https://doi.org/10.1111/j.1467-9396.2012.01038.x

Roberts, M. J., & Tybout, J. R. (1997). The decision to export in Colombia: An empirical model of entry with sunk costs. *The American Economic Review*, 545-564. https://www.jstor.org/stable/2951363

Rodríguez, J. L., & Orellana, B. S. (2020). Human capital and export performance in Spanish manufacturing firms. *Baltic Journal of Management*, *15*(1), 99-119. https://doi.org/10.1108/BJM-04-2019-0143

Serra, F., Pointon, J., & Abdou, H. (2012). Factors influencing the propensity to export: A study of the UK and Portuguese textile firms. *International Business Review*, *21*(2), 210-224. https://doi.org/10.1016/j.ibusrev.2011.02.006

Thangavelu, S. M., & Rajaguru, G. (2004). Is there an export or import-led productivity growth in rapidly developing Asian countries? A multivariate VAR analysis. *Applied Economics*, *36*(10), 1083-1093. https://doi.org/10.1080/0003684042000246795

Tu, M. T. C., & Giang, H. T. T. (2018). Estimating the impact of trade cost on export: A case study of Vietnam. *Journal of Asian Finance,*

Economics, and Business, *5*(3), 43-50. http://doi.org/10.13106/jafeb.2018.vol5.no3.43

Vemuri, V. K., & Siddiqi, S. (2009). Impact of commercialization of the Internet on international trade: A panel study using the extended gravity model. *The International Trade Journal*, *23*(4), 458-484. https://doi.org/10.1080/08853900903223792

Visser, R. (2019). The effect of the Internet on the margins of trade. *Information Economics and Policy*, *46*, 41-54. https://doi.org/10.1016/j.infoecopol.2018.12.001

Vo, Q. T. (2019). Export performance and stock return: A case of fishery firms listing in Vietnam stock markets. *Journal of Asian Finance, Economics, and Business*, *6*(4), 37-43. https://doi.org/10.13106/jafeb.2019.vol6.no4.37

Vu, H. V., Holmes, M., Tran, T. Q., & Lim, S. (2016). Firm exporting and productivity: what if productivity is no longer a black box. *Baltic Journal of Economics*, *16*(2), 95-113.

Wagner, J. (2007). Exports and productivity: A survey of the evidence from firm-level data. *World Economy*, *30*(1), 60-82. https://doi.org/10.1080/1406099X.2016.1187382

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Wooldridge, J. M. (2015). Control function methods in applied econometrics. *Journal of Human Resources*, *50*(2), 420-445.

World Bank (2019). *Exports wanted*. Retrieved from https://www.worldbank.org/en/news/press-release/2019/04/07/south-asia-needs-more-exports-to-maintain-growth.

World Bank (2020). Enterprise Surveys. Retrieved from https://www.enterprisesurveys.org/en/enterprisesurveys

Xing, Z. (2018). The impacts of Information and Communications Technology (ICT) and E-commerce on bilateral trade flows. *International Economics and Economic Policy*, *15*(3), 565-586. https://doi.org/10.1007/s10368-017-0375-5

Yushkova, E. (2014). Impact of ICT on trade in different technology groups: Analysis and implications. *International Economics and Economic Policy*, *11*(1-2), 165-177. https://doi.org/10.1007/s10368-013-0264-5

Appendix A

Table A1: Variables and their Description

Variables	Description
Intensive Margin of Export	Ratio of export sales to total annual sales
Extensive Margin of Export	Dummy variable equal to one if firm export either directly or indirectly
Firm Size	Logarithm of the number of full- time employees.
Productivity of firm	Logarithm of value-added per permanent employee
Age of firm	Logarithm age of an establishment in years
Access to Credit	Percentage of working capital financed by banks and nonbank borrowing
Foreign Ownership	Percentage of the firm owned by private foreign individuals, companies or organization
Worker's skills	Ratio of skilled production workers to unskilled production workers.
Education of Workers	Percentage of full-time permanent workers who completed secondary school
ICT_1	Dummy variable equal to one if establishment use e-mail to communicate with clients or suppliers
ICT_2	Dummy variable equal to one of the establishments has its website
Imported technology	Dummy variable equal to one if the firm use imported technology

Table A2: Descriptive Statistics

Variable	Obs	Mean	Standard Deviation
Extensive margin	8023	.102	.269
Imported technology	8023	.118	.323
Size	8023	3.588	1.302
Access to Credit	8023	.266	.322
Workers Skills	8023	.704	.257
Foreign ownership	8023	.007	.069
Workers Education	8023	.429	.3
Training to employee	8023	.367	.482
ICT_1	8023	.465	.499
ICT_2	8023	.461	.489
age	8023	2.742	.787
Extensive margin	8023	.208	.406
Productivity	8023	13.898	1.332

Appendix B: Results for the robustness check

Table B1: The results of beta regression for intensive margin of export

	(1) Exports_int	(2) Exports_int	(3) Exports_int	(4) Exports_int
size	0.0752**	0.0844**	0.0810**	0.0912**
	(0.0293)	(0.0296)	(0.0290)	(0.0295)
age	0.0356**	0.0364**	0.0374**	0.0384**
	(0.0123)	(0.0122)	(0.0224)	(0.01223)
prod	0.0626**	0.0604**	0.0640**	0.0621**
	(0.0254)	(0.0253)	(0.0255)	(0.0254)
credit_avail	0.251**	0.269**	0.225**	0.241**
	(0.113)	(0.113)	(0.113)	(0.113)
imported_tech	0.100*	0.132*		
	(0.0572)	(0.0573)		
workers_skills	0.328**	0.328**		
	(0.152)	(0.151)		
F_ownership			0.245**	0.307****
			(0.109)	(0.111)
workers_edu			0.0702*	0.0154
			(0.0427)	(0.027)
ICT_1	0.445**		0.464**	
	(0.200)		(0.200)	
ICT_2		0.313***		0.307***
		(0.102)		(0.103)
scale _cons	0.852***	0.857***	0.845***	0.849***
	(0.0419)	(0.0419)	(0.0418)	(0.0419)
N	1484	1484	1484	1484

Robust standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The average marginal effects are reported except constant

Table B2: Results of endogenous treatment with control function approach

	Outcome variable: export intensity Treatment	
	ICT_1	ICT_2
ATE	0.23**	0.18**
	(.1102)	(.081)
N	6682	6682

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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Remittances and Output Volatility: The Role of Financial Development

Aisha Tauqir
Research Analyst,
International Food Policy Research Institute (IFPRI),
Islamabad, Pakistan.
ayesha.tauqir@hotmail.com
(Corresponding Author)

Muhammad Tariq Majeed
Associate Professor and Director,
School of Economics,
Quaid-I-Azam University,
Islamabad, Pakistan.

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Abstract:
This paper examines the impact of remittances on output volatility through the channel of financial development using data for 158 countries from 1971 to 2017. We estimate the role of financial development by looking at multiple features of financial institutions, such as depth, access and efficiency. We used multiple indicators as a proxy of financial development in the remittance-output volatility nexus and employed System Generalized Method of Moments (GMM) and Fixed Effects Instrumental Variable (FE-IV) models. Our findings are robust across specifications. We find a significant positive impact of all indicators of financial development on the remittance-output volatility relationship. The findings suggest that multifaceted financial development is needed for the effective management of output volatility through remittance inflows.

Keywords: Output volatility, remittances, financial development, remittance-output volatility nexus.

JEL Classification: C33, F24.

Remittances and Output Volatility: The Role of Financial Development

1. Introduction

Economic history is replete with output volatility shocks. Events including the British South Sea bubble in 1720, the oil price shock in 1973 and the Great Depression in the 1930s induced significant macroeconomic fluctuations. After the mid-1980s, we had observed a persistent decline in economic fluctuations in the US and other developed economies in the form of steady growth rates. That is, until the financial crisis of 2008 introduced a macroeconomic disturbance globally characterized by low economic growth rates. Therefore, it seems that periods of economic stability are outliers and world economies tend to face the frequent challenge of output instability. But stability in output growth is crucially necessary for a stable and competitive economy. It affects economic growth, poverty and the welfare of nations more generally. Thus, stable output growth remains a fundamental policy objectives worldwide.

The role of the financial sector in these output volatility shocks was evident during the recent global financial crisis of 2007-2008. This crisis reportedly caused the failure of the financial system in general and its financial institutions in particular. These institutions have been playing a substantive role in the provision of financial services. Widespread loan defaults in the US mortgage industry infected capital in financial institutions and left them with highly illiquid assets. As a result, the failure of US financial institutions led to a recession in the US as well as the emergence of the global financial crisis, negatively affecting world economies.

The failure of financial institutions during the crisis motivates us to investigate if the development of financial institutions now play a role in the well-established impact of remittances on output volatility. Financial development, being the progression of financial institutions and markets, is a multidimensional process. Banks are the most important and largest institutions in the financial system. Apart from them, other nonbank institutions (insurance companies, mutual funds, etc.) are also critical entities in the financial sector. Similarly, the features of these banks and non-bank financial institutes have also advanced over time. The important and emerging features of this evolution are access and efficiency (Cihak *et*

al., 2012). Svirydzenka (2016) defines financial development as a combination of the depth, access, and efficiency of the financial system.

Financial access is the ability to access financial services. Financial access measures the commitment to outreach activities in the banking sector. Financial access enables resource constrained entities to solve issues related to resource availability, mobilization and allocation. An increase in financial accessibility can theoretically provide affordable and easy access to financial services to low-income groups. These groups often lack access to financial services offered by the formal financial system because of non-affordability. A developed financial sector is of limited use if it is not accessible to a sufficiently large fraction of the population. Financial access is often identified as a contributor to inclusive growth because.

The efficiency feature of financial development evaluates the ability of institutions to provide financial services at a low cost. This ability is viewed in accordance with sustainable revenues and the level of activity in the capital market (Svirydzenka, 2016). If the sector is inefficient, its contribution to economic growth would be limited despite being sizeable and wide reaching. Financial efficiency is the core of the high-performing financial sector. Improvement in it boosts financial profits and reduces financial risks. It is measured through the efficiency ratio. This ratio suggests that the financial sector requires fewer expenses to generate greater revenues, thereby ensuring consistent productivity and growth.

In this study, we analyze how the efficiency features of financial development, along with traditional depth features, mediate the remittance-output volatility relationship. Financial depth can mediate the volatility of output growth when remittance flows improve credit availability in the financial sector. When the inflows are steady, they decrease the altruistic, saving, and insurance needs of recipient families. This reduction in turn can hamper the development of the financial sector (Aggarwal *et al.*, 2011). Similarly, greater financial accessibility can help magnify the impact of remittances on output volatility through the provision of financial systems to a higher proportion of the population. Moreover, when surplus remittances move from recipient savers to that of productive investors, it helps organize the financial system and thereby can affect output volatility differently. Therefore, studying the multiple dimensions of financial development can help economists and policymakers realize the role of remittances through the channel of finance.

Output volatility is affected by multiple factors (Beck *et al.*, 2000). Factors such as institutional quality, structural changes, risk-sharing mechanisms and political stability play a crucial role in determining output stability. Moreover, the extent of integration with the outside world and exposure to external shocks also induce growth volatility (Beck *et al.*, 2000; Majeed & Noreen, 2018).

Remittances, as the second largest source of capital inflows, is transformational toward the achievement of sustainable output growth (Chami *et al.*, 2007; Ahamada & Coulibaly, 2011; Chami *et al.*, 2012; Adeniyi *et al.*, 2019). Remittances predominantly stabilize recipient economies in two ways. First, they help to provide the necessities of life and improve living standards of many households, due to being person-to-person transfers from migrants to relatives back home. Second, on a macro level, these inflows fuel economic growth. This growth takes place through the channel of investment in human and physical capital and financing new businesses. Consequently, remittances can potentially lead to stable and elevated growth.

Remittances also improve the social safety net and induce stable output growth (Chami *et al.*, 2012). As remittance income permits the recipients to consume more, they are crucial in helping families move up from subsistence consumption. This increase in consumption generates short-term economic growth which in turn can lead to long-run stable growth through industrial expansion (Chami *et al.*, 2012). However, remittances can also reduce economic growth through the remittance trap. This trap increases dependence on payments, and makes economic growth conditional on the continued incidence of these flows (Chami *et al.*, 2018).

Studies such as Chami *et al.* (2007), Craigwell *et al.* (2008), Bugamelli (2011), Chami *et al.* (2012), Bouoiyour *et al.* (2014) and Jidoud (2015) investigate the impact of remittances on output volatility. On the other hand, studies such as Beck *et al.* (2000), Cermeno (2012), and Majeed & Noreen (2018) analyze the impact of financial development on output volatility.

However, there are very few studies that analyze the role of financial development as a mediator of the remittance-output volatility nexus. Studies such as Ahamada & Coulibaly (2011) and Adeniyi *et al.* (2019) are the only studies that look at the confounding role of financial development in this realm. However, the findings of these studies are inconclusive. Moreover, another weakness in these studies is that they

have used conventional indicators of financial development (domestic credit provided by banks and credit to the financial sector), thereby ignoring its multidimensional and complex nature. These indicators are actually just one feature (depth) of financial development (Cihak *et al.*, 2012; Svirydzenka, 2016). Therefore, the studies did not consider the other two characteristics (access and efficiency) of financial development, thus leaving a gap in the literature.

Our study provides a better understanding of the multidimensional impact of financial development on the remittance-output volatility relationship. The present study focuses on financial depth, access, and efficiency as potential mediators in the remittance-output volatility nexus. There are only two other studies, Ahamada & Coulibaly (2011) and Adeniyi *et al.* (2019), that have used common measures of financial depth as an indicator of financial development, though both have shortcomings and neglect to use the standard determinants of output volatility. For instance, the well-established roles of real and monetary sector uncertainty as potential determinants of output volatility are ignored in both of them. Furthermore, Ahamada & Coulibaly (2011) covered 109 developing economies for the period 1975-2007, whereas Adeniyi *et al.* (2019) used data from 71 countries for the period 1996-2012. Therefore, both studies use smaller samples over a relatively shorter time period as compared to our analysis. In addition, these studies did not include country-specific characteristics in their analyses.

Since financial depth, access, and efficiency are the features of a financial system needed to represent a complete picture of the sector, their roles should be analyzed in the remittance-output domain. It is worth considering what direct and mediating roles these different indicators play on output volatility. Our empirical analysis provides new insights in particular regarding the mediating roles of key features of financial development. Moreover, this study covers a large sample of 158 countries for the 1971-2017 time period, thereby providing fresh evidence related to both the direct and mediating roles of financial development. In addition, we control for country-specific effects, as well as estimating a System GMM model.

This study attempts to answer three crucial questions: First, do remittance inflows help decrease output volatility? Second, does the impact of financial development vary depending upon its features (and method of measurement)? Third, what are the interactive impacts of

remittances and financial development and are these impacts on output volatility deteriorating or augmenting?

We used two measures of each of the characteristics of financial development: for financial depth, domestic credit to the private sector by banks and credit provided by the financial sector was used. Similarly, for financial access, bank branches per 100,000 adults and ATM per 1,000 km^2, and for financial efficiency, bank lending-deposit spread and bank return on assets were used. In addition, this study was conducted for a sample of 158 countries over a forty-six year period. Furthermore, we also employed System GMM to manage endogeneity and FE-IV to control for unobserved country-specific characteristics.

We find that the impact of remittances on output volatility is negative and significant, indicating that inflows stabilize output growth. This shows that output volatility decreases as remittances flow into an economy. Furthermore, the results indicate that output volatility responds differently to the various features and measures of financial development. For instance, the depth characteristic of financial development increases output volatility, as both of its measures have a positive impact.

However, the role of access in financial development is inconclusive: one of the measures (bank branches) enhances output volatility, whereas the other (ATM) helps reduce output fluctuations. Furthermore, the efficiency of financial development is a stabilizer of output growth. Since both measures mitigate output volatility, the efficiency of financial institutions is an important contributor to output stability. Furthermore, most importantly, the interactive impacts of these features and their measures are positive and statically significant. Last, the main findings suggest that when remittance inflows affect output volatility through the development of different facets of the financial system, it magnifies output fluctuations despite its direct volatility reducing/enhancing impact.

The remainder of the study is organized as follows: Section 2 presents a review of the relevant literature. Section 3 incorporates a discussion of the data, methodology and statistical analysis. Furthermore, Section 4 reports on the empirical results and interpretation. Finally, Section 5 concludes the study and suggests some policy implications.

2. Literature Review

Output volatility remains one of the central concerns of policymakers worldwide. The literature on minimizing output fluctuations has evolved over time, and there is sufficient theoretical and empirical evidence available in this regard. In this section, first, we will present early theories of the business cycle. In the second subsection, we will focus on the theoretical and empirical literature on remittances' role in output volatility. The third subsection will discuss theoretical arguments and empirical evidence related to the impact of financial development on the volatility of output growth. Finally, in the last subsection, we will present a brief review of the available literature on the collective role of remittances and financial development on fluctuations in output growth.

2.1. Early theories of the business cycle

To understand early theories pertaining to business cycles, we must look at different schools of economic thought: According to the Keynesian school of thought, it is the demand side factors that induce business cycle fluctuations; as an alternative to the Keynesian school, real business cycle (or RBC) theorists suggested that it is technological shocks that initiate business cycle fluctuations. These shocks are generally the result of events like bad weather, tight rules and regulations, innovations, and changes in input prices; neo-classical theorists suggest that it is the structural change between sectors that induces business cycle uncertainty, an uncertainty that has resulted from a decrease in unemployment. Consequently, reductions in economic agents' income and a rise in aggregate demand shocks occur; according to monetarist theorists, it is fluctuations in the interest rate that induce variability in long-term investment and hence variability in the business cycle. Likewise, another monetary theory of 'crisis of overproduction' given by Karl Marx recognized that inadequate purchasing power decreases aggregate demand and overloaded inventories, thereby inducing contraction in output growth.

2.2. Empirics of Remittances and Output Volatility

The theoretical arguments regarding remittances and output volatility can be traced back to the following theories. First, the theory of moral hazard advocates that remittance inflows amplify growth volatility. Remittances could in theory function as disincentives for recipients to work as they make less effort in seeking employment and prefer leisure over labor. In this way, productivity decreases, increasing uncertainty in

output growth. Alternately, it can be argued within the context of this theory that recipients of remittances often prefer to work, but they demand better work incentives by raising their reservation wage. This rise in wages theoretically can result in workers dropping out of the labor force and results in upward pressure on commodity prices. With the rise in prices, exports can become less competitive, and the output of the country fluctuates. Third, according to the Dutch Disease effect, remittances appreciate the real exchange rate causing reallocation of resources from the traded to the non-traded sectors. This process of reallocation of resources induces volatile growth rates. Fourth, remittances can deteriorate the quality of governance. It is argued that access to remittances enables recipients to be indifferent about a government role in the general welfare and in the fulfilment of their needs, so the dependency on government decreases. As a result, the government can become inefficient. Moreover, tolerance toward corruption and incompetence also increases as recipients view it as less costly to bear; consequently, institutional and governance quality deteriorates. This deterioration leads the economy toward a rise in social conflict on the incidence of even slight internal or external uncertainty leading to volatile growth rates (Abdih *et al.*, 2008; Chami *et al.*, 2012). Lastly, it is possible that as remittance flows increase, positive technological shocks result in demands for wage increases. This augments the income effect and, as a consequence, increases output volatility.

On the other hand, however, there is literature that highlights a favorable effect of remittances on output volatility. The most widely promoted theory in this regard is the altruistic motive. According to this theory, as remittances increase, the recipient's consumption constraints are removed. This increase in consumption covers the basic necessities of life and improves living standards; as a result, output growth stabilizes. Second, according to the theory of insurance, increasing the incidence of remittances provides insurance against economic risk, which in turn helps stabilize output growth. Additionally, this insurance also improves the investment portfolio of the country. It provides an increased opportunity to diversify investments in both human and physical capital, thereby inducing stability in output growth. Third, with an increase in inflows, short-run economic growth transforms into industrial expanded long-run growth and hence stabilizes output.

On the empirical front, the role of remittances is debatable, as studies have documented both positive and negative impacts. Initial studies on the relationship analyzes output volatility predominantly through the lens of economic uncertainty. The first strand of the literature

suggests that output volatility diminishes as a result of remittances. This is supported by studies such as Ahamada & Coulibaly (2011), Chami *et al*. (2012), Bettin *et al*. (2012), Jidoud (2015) and Adeniyi *et al*. (2019), as all of them pointed to remittances as output volatility stabilizers. The authors argue that when inflows are specifically for consumption and investment purposes, it smooths out both. Thus, stable consumption and investment as components of a national income accounting identity reduce output volatility.

In contrast, the second strand of literature reports augmented effects of remittances on volatile output growth. A study such as Bugamelli & Paterno (2011) argue for the positive impact of remittances on output volatility. The authors justified this augmented impact through the Dutch Disease effect. As remittances remove consumption constraints, this can potentially reduce the labor supply of recipients which in turn causes output to fluctuate more (Bugamelli & Paterno, 2011).

2.3. Empirics of Financial Development and Output Volatility

Similar to remittances, there are various transmission channels from financial development to output volatility. First, it is argued that with an increase in financial development, there are fewer liquidity constraint in financial markets. This removal of constraints provides favorable incentives for investment in profitable long-term projects, which in turn improves the investment profile of a country. Moreover, financial development also eases the transfer of funds, thereby decreasing the chances of delayed or cancelled investment projects. Consequently, fluctuations in the business cycle diminish, and output growth stabilizes. Second, with the development of the financial sector, growth prospects also flourish through the allocation of risk to riskier yet fruitful investment ventures. It might happen that in an attempt to diversify the portfolio, investors invest in riskier yet more profitable investment projects. As a result, total factor productivity increases, which in turn stimulates stable growth.

However, there are also transmission channels through which financial development enhances output volatility. First, as the financial sector develops, it exposes the economy to dynamic shocks. Therefore, output volatility increases through financial institutions. Second, with financial development, access to loanable funds increases. This increased access raises investment in short-run riskier projects, thereby enhancing volatility in output growth.

The empirical literature of financial development and output volatility can be grouped as follows: The first strand of literature suggests a mixed effect of financial development on output volatility, depending upon which of its measures is used in the analysis. Studies such as Bernanke & Gertler (1989) focus on financial accelerators, and Gertler (1992) focuses on the capacity building aspect of financial development as output volatility enhancement. Easterly *et al*. (2000) separated the financial sector into capital and equity markets and found that the capital market is relatively less vulnerable to output volatility. Bacchetta and Caminal (2000) focused on the role of credit market imperfections and advocated mixed results. Easterly *et al.* (2001), while focusing on financial depth, pointed out that financial development reduces output volatility up to a certain point, whereas private credit measures increase volatility. Cermeno *et al.* (2012) explored the impact of the nature and level of financial deepening as the volatility reducing factor in the Mexican economy. Similarly, Majeed and Noreen (2018) have used financial sector depth, efficiency, stability and access measures of financial development, providing mixed results.

The second strand of literature points out that it is the nature of a shock through which the impact of financial development on output volatility can be determined. Bacchetta & Caminal (2000) advocate that the development of the financial sector causes a reallocation of capital from one firm to another, which introduces additional unanticipated productivity shocks in the economy. Similarly, Beck *et al.* (2000) go one step further in the analysis and point to volatility of the real (terms of trade) and the monetary (inflation) sectors and that of policy (government expenditure) uncertainty as the channels through which the financial sector affects (either positive or negative) volatility of output growth.

2.4. Empirics of Tripartite (Financial Development in Remittance-Output Volatility Nexus)

The theoretical argument regarding the tripartite relationship among financial development, remittances, and output volatility is traced as financial development increases, which enhances the absorptive capacity of the economy. With this enhanced capacity, when remittance inflows increase, financial development channels excess funds from savers to investors; as a result, financial constraints lessen and the number of long-term investment projects increase. These long-run investments ensure stable growth paths, thereby decreasing output volatility.

On the empirical front, the literature is limited and there have been only two studies on this. Ahamada & Coulibaly (2011) analyzed the influence of financial development in the relationship of remittances-output volatility. The findings of the study suggest that remittances' impact on growth volatility is nonlinear. It is the level of financial development that determines how much remittances help to stabilize output volatility. Likewise, another recent study by Adeniyi *et al.* (2019) concluded that both remittances, as well as financial development individually, dampen output uncertainty. However, the mediating role of financial development is mixed. For instance, it is advocated that the impact of banking sector credit is positive but insignificant, whereas the effect of credit on the private sector is negative and significant, concluding overall inconclusive results.

In sum, the theoretical literature illustrates the negative and positive impacts of remittances on output volatility. Similar is the case with financial development. The empirical literature predominantly emphasizes the negative effect of remittances. However, there is no dominant impact of financial development, and its mediating role in the remittance-output nexus is inconclusive.

3. Data and Methodology

The literature provides evidence about a number of factors that collectively determine output volatility. For instance, trade openness is investigated by Easterly *et al.* (2001), Bekaert *et al.* (2002), Wacziarg & Welch, (2003), Kose *et al.* (2006) and Haddad *et al.* (2013). Likewise, terms of trade shocks are focused on by Beck *et al.* (2000), Ceechetti *et al.* (2005) and Rumler & Scharler (2011). Several studies also investigated country size as an important determinant. A large country size reflects a large resource base, which helps diminish output volatility (Mobarak, 2005; Furceri & Karras, 2007; Chami *et al.,* 2012). The share of government consumption in GDP is an essential input to ensure stable economic growth (Rodrik, 1998; Chami *et al.*, 2012). Another potential input to output volatility is institutional quality (Acemoglu & Zilibotti, 1997; Acemoglu *et al.,* 2003). Therefore, there are a variety of possible determinants of output volatility; hence, the output production function in the general form can be expressed as follows:

$$OV = f(inputs|volatility) \quad (1)$$

Where OV is output volatility and inputs to volatility are the numbers of factors determining the uncertainty in output growth.

A closer analysis of the possible determinants of output volatility shows that most of them are interlinked and can be generalized and grouped into a uniform set of possible inputs. For instance, trade openness can be viewed as an external factor affecting output volatility. Loayza *et al.* (2007) and Chami *et al.* (2012) also pointed out trade as an external shock affecting the growth rate. Similarly, the terms of trade can be viewed as real sector volatility since it induces unanticipated shocks in the production function. Studies such as Beck *et al.* (2000) and Majeed & Noreen (2018) proxy terms of trade volatility as a shock to the real sector. As monetary shocks affect banks' supply of loanable funds and inflation uncertainty alters the motives for money demand affecting aggregate supply, the literature also finds that inflation volatility can be grouped under monetary sector volatility.

Variables such as country size, finance, institutional environment/quality and government consumption can collectively be perceived as internal country-specific characteristics. Furthermore, few studies have pointed to government expenditure as an additional fiscal policy shock (Wang *et al.,* 2007). Surprisingly, the impact of this shock can be felt either through real or monetary shock (Beck *et al.,* 2000). For instance, when a shock occurs through finance, its effect can be felt via real sector volatility. In contrast, if the incidence of the shock is due to financing in bonds or by inflation tax, then it can be observed via monetary sector volatility (Beck *et al.,* 2000).

Following the above discussion, the simplest model of output volatility can be written as:

$$OV = f(E, R, M, I) \tag{2}$$

where E, R, M and I represent vectors of external factors, real sector shock, monetary sector volatility and internal factors (country-specific characteristics), respectively.

The literature identifies several variables under each vector. However, studies have used different variables because of the reliability of the measure, data availability and other limitations.

Our empirical investigation included *VTOT* (volatility of terms of trade) as the variable associated with the real sector vector, *VINF* (volatility of inflation) for the vector related to the monetary sector, *TO* (trade openness) representing the external shock vector, and internal vector restricted to POP (population) growth as follows:

$$OV = f(VTOT, VINF, |, POP) \tag{3}$$

Remittances are an important determinant of output volatility being countercyclical and the most stable form of external capital flow. The effects of these inflows are ambiguous in the literature. It is assumed that since remittance flows are exogenous, they induce uncertainty in the economy, similar to terms of trade. On the other hand, remittances are output stabilizers due to their altruistic motives and countercyclical nature (Chami *et al.*, 2005).

The effect of financial development is also extensively mentioned in the output volatility literature. The literature highlighted the negative impact of financial development through the channel of improvement in the availability of funds. Financial development is known to alter the absorptive capacities of economies. Well-developed and well-functioning financial markets enable the provision of excess funds (including possibly remittances) to economic agents who are in need of finance. Therefore, financial development helps smooth out investment constraints and increases production with a resultant reduction in output volatility (Ahamada & Coulibaly, 2011; Adeniyi *et al.*, 2019). Given the importance of financial development, studies still use the common indicators of financial depth to capture the impact. However, the diversity of the concept and its unexplored dimensions demands investigation of the impact in a broader way.

This study explores the potential determinants of output volatility by focusing on remittances and financial development. Therefore, we extend equation (3) as follows:

$$OV = f(VTOT, VINF, |, POP, PR, FD) \tag{4}$$

where *PR* is personal remittances and *FD* is financial development.

To analyze the mediating role of financial development in the remittance-output volatility nexus, the interaction term of remittances and financial development has been introduced in equation 4 as follows:

$$OV = f(VTOT, VINF, |, POP, PR, FD, PR \quad FD) \ldots\ldots (E) \tag{5}$$

Econometrically, the model incorporating remittances' impact (alone) can be written as follows:

$$LOV \quad = \alpha_0 + \alpha_1 LOV_{-1} + \alpha_2 PR \quad + \alpha_3 VTOT \quad + \alpha_4 VINF \quad + \alpha_5 LPOP \quad + \alpha_6 \quad + \nu_t + \mu_t + u \tag{6a}$$

where *PR* is personal remittances.

Similarly, the regression models containing six distinct indictors of financial development (alone) can be represented as follows:

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 DCB \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6a}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 DCF \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6b}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 BB \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6c}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 ATM \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6d}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 BS \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6e}$$

$$LOV \quad = \beta_0 + \beta_1 LOV_{-1} + \beta_2 BA \quad + \beta_3 VTOT \quad + \beta_4 VINF \quad + \beta_5 LPOP \quad + \beta_6 \quad + \nu_t + \mu_t + \varepsilon \tag{6f}$$

where t = year, ranging from 1971 to 2017, i = country index ranging from 1, 2,….158, *LOV* is the natural log of output volatility, *DCB* is credit to private sector by banks, DCF is a credit provided by the financial sector, *BB* is bank branches per 100,000 adults, *ATM* is ATM per 1,000 km^2, *BS* is bank lending-deposit spread and *BA* is bank return on asset. Among control variables, *LPOP* is the log of population growth, while the rest of the terms are summarized in Appendix: Table 1A.

For the mediating role of financial development in the remittance output volatility nexus, the following econometric models are estimated using interaction terms:

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 DCB + \gamma_4 PR\ DCB + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7a)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 DCF + \gamma_4 PR\ DCF + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7b)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 BB + \gamma_4 PR\ BB + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7c)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 ATM + \gamma_4 PR\ ATM + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7d)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 BS + \gamma_4 PR\ BS + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7e)$$

$$LOV = \gamma_0 + \gamma_1 LOV_{-1} + \gamma_2 PR + \gamma_3 BA + \gamma_4 PR\ BA + \gamma_5 VTOT + \gamma_6 VINF + \gamma_7 LPOP + \gamma_8 + \nu_t + \mu_t + и \quad (7f)$$

where *PR*DCB* is the interaction of remittances with credit to the private sector by banks, *PR*DCF* is the interaction of remittances with credit provided by the financial sector, *PR*BB* is the interaction of remittances with bank branches per 100,000 adults, *PR*ATM* is the interaction of remittances with *ATM* per 1,000 km^2, and *PR*BS* is the interaction of personal remittances with bank lending-deposit spread. Finally, *PR*BA* represents the interaction effect of remittances with bank return on assets.

3.1. Econometric Methodology

Our study covers 158 countries over the period of 1971-2017 using data from the World Bank (2018) and International Financial Statistics (2018). The sample of the study is restricted because of data limitations. We have used a System GMM model and FE-IV model in our analysis. The System GMM technique was proposed by Arellano and Bover (1995) and Blundell and Bond (1998). The technique combines the standard moment conditions of first differences with the additional moment conditions that are derived from the equation in levels. In standard moment conditions,

the lagged values are used as instruments. However, the additional moment conditions are based on an assumption concerning the correlation between the dependent variable (x and the country-specific effect($\eta|i$). The system GMM assumes that the difference of x is uncorrelated with the individual effects but is correlated with η_i. In System GMM, the additional moment conditions are represented at levels as follows:

$$E[\Delta y|i(t-1)\mu \ ] = 0 \text{where, } \mu \ = \eta_i + \nu \quad (8)$$

$$E[\Delta x|\mu \ ] = 0 \quad (9)$$

The use of a System GMM estimator enables us to control the effects of time-invariant country-specific characteristics and endogeneity issues due to lagged dependent variables. Table 1A illustrates the definition and sources of variables used in the analysis.

3.2. Descriptive Statistics

Table 1 presents the descriptive statistics of the variables used in this study.

Table 1: Descriptive Statistics

Variables	Obs.	Mean	Median	Std. Dev.	Minimum	Maximum
Dependent Variable						
Output Volatility	1071	212.87	75.22	385.66	4.95 (Bangladesh)	3941.37 (United Arab Emirates)
Focused Variable						
Personal Remittances	1071	5.21	2.11	7.32	0.008 (Bulgaria)	90.74 (Poland)
Different Measures of Financial Development						
Domestic Credit to Private Sector by Banks	1071	46.62	36.29	38.38	1.42 (Norway)	201.29 (Sudan)
Domestic Credit by Financial Sector	1071	62.69	49.51	56.39	-31.77 (Malta)	267.66 (Sudan)
Different Measures of Financial Inclusion						
Bank Branches per 100,000 adults	1071	16.36	11.46	18.85	0.58 (Ghana)	258.32 (Bahrain)
Automated Teller Machines (ATMs) per 1,000 km2	1071	46.88	8.66	168.59	0.03 (Zambia)	3395.13 (Netherlands)
Different Measures of Financial Efficiency						
Bank Lending-Deposit Spread	1071	7.40	5.96	6.36	1.56 (Cuba)	37.12 (Lesotho)
Bank Return on Assets	1071	1.59	1.59	1.28	-0.74 (Namibia)	4.88 (Azerbaijan)

Variables	Obs.	Mean	Median	Std. Dev.	Minimum	Maximum
Control Variables						
Terms of Trade Volatility	1347	11.75	8.79	12.58	1.07 (Australia)	209.912 (Canada)
Inflation Volatility	1347	8.28	6.91	6.75	0.14 (China)	307.94 (New Caledonia)
Population Growth	1347	1.50	1.34	1.27	-0.41 (West Bank and Gaza)	7.844 (Faroe Islands)
Trade Openness	1347	83.20	78.67	33.99	11.43 (Seychelles)	417.64 (Somalia)

3.3. Correlation Matrix

Correlation is a statistical technique that is used to explain the direction and strength of the linear relationships between two variables. To identify multicollinearity, a correlation matrix is used. Tables 2 and 3 report a correlation matrix for personal remittances and various proxies of financial development, respectively. Remittances have a negative correlation with output volatility. Furthermore, all the indicators of financial development have a positive correlation with output volatility except bank lending spread and bank return on assets. Domestic credit to the private sector has the highest correlation, with a value of 0.39.

Table 2: Correlation Matrix for Personal Remittances

Variables	OV	PR	VTOT	VINF	POP	TO
OV	1					
PR	-0.172	1				
VTOT	-0.079	0.024	1			
VINF	-0.077	0.083	0.025	1		
POP	-0.117	-0.022	0.147	0.021	1	
TO	0.271	0.073	-0.063	-0.055	-0.152	1

Table 3: Correlation Matrix of Financial Development

Vari.	OV	DCB	DCF	BB	ATM	BS	BA	VTOT	VINF	POP	TO
OV	1										
DCB	0.39	1									
DCF	0.30	0.85	1								
BB	0.19	0.42	0.37	1							
ATM	0.20	0.30	0.22	0.01	1						
BS	-0.23	-0.40	-0.36	-0.25	-0.17	1					
BA	-0.16	-0.32	-0.31	-0.17	-0.25	0.24	1				
VTOT	0.01	-0.23	-0.25	-0.12	-0.08	0.09	0.05	1			
VINF	-0.16	-0.28	-0.24	-0.15	-0.11	0.28	0.17	0.01	1		
POP	0.26	-0.02	-0.21	-0.25	-0.02	0.10	0.22	0.15	0.10	1	
TO	0.25	0.19	0.03	0.02	0.54	-0.12	0.03	-0.03	-0.15	0.02	1

4. Empirical Results

4.1. Pre-Estimation Analysis

In the initial step of the analysis, the pre-estimation tests related to multicollinearity, heteroscedasticity and autocorrelation are employed. Table 4 reports the findings of these tests. The result of the variance inflation factor (VIF) concludes that there is unlikely to be a problem of multicollinearity. However, the result of the Breusch–Pagan test shows that there is the problem of heteroskedasticity in the remittances-output volatility nexus. This problem is addressed using the System GMM technique. Similarly, there is also the problem of autocorrelation, as the value of Wooldridge's test is less than 0.1.

Table 4: Pre-estimation tests

Dependent Variable: Volatility of Output	
VIF	1.16
Breusch–Pagan Test	0.235
Wooldridge's Test	0.000

Source: Authors' calculations.

4.2. Results of Fixed and Random Effects

Table 5 presents the regression results obtained from fixed and random effects estimation. Remittances contribute negatively to output volatility, implying that they help mitigate output fluctuations. The estimated value suggests that a 1 percent increase in remittances brings about an approximately 0.003 percent decrease in output volatility. This decrease is consistent with the findings of Chami *et al.* (2007), Adeniyi *et al*. (2019) and Bugamelli & Paterno (2011), who argued that remittances stabilize output volatility. Here, the countercyclical impact of remittances is dominant. This negative impact is supported by the altruistic and insurance theory of remittances. The inflows loosen budget constraints for migrants' families and resultantly induce smooth consumption. Moreover, remitted amounts might also be used to ensure against economic risk. Furthermore, remittances may in some cases be helping to diversify investment portfolios with the objective of hedged against economic jeopardization, thereby diminishing output volatility (Chami *et al.*, 2007; Chami *et al.*, 2012).

The effect of output volatility lag shows that a 1 percent increase in previous year volatility enhances current growth volatility by 0.756

percent. The result suggests that current volatility has a lagged effect. Here, the magnitude of the effect is quite large and statistically significant, indicating that volatility in previous years is one of the most crucial determinants of current volatility.

The estimates of terms of trade uncertainty show that a one percent rise in it enhances output volatility by 0.001 percent. This rise is consistent with the findings of Beck *et al.* (2000) and Majeed & Noreen (2018). This shock arises mostly due to international shocks. The terms of trade volatility occur through fluctuations in the relative prices of imports and exports resulting in volatile growth.

The impact of trade is positive and significant at the 1 percent level of significance. This positive effect is in accordance with the results obtained by Easterly *et al.* (2001), Bugamelli & Paterno (2009) and Adeniyi *et al*. (2019). With openness to trade, a country's exposure to external shocks increases. More integrated trade intends the economy to specialize and produce the product of the comparative advantage, thereby increasing exposure to external product-specific shocks. Furthermore, financial vulnerability may also increase because trade openness induces additional uncertainty in the economy.

Population growth also affects output volatility and is the most common proxy for an economy's size. The results of random effects estimation suggest that output volatility diminishes with a higher population. This result is in line with the result drawn by Furceri & Poplawski (2008). With increases in population growth, endowment, and resource base in the country, output growth is consequently sustained. Moreover, a large country size enables feasible output diversification, which in turn diminishes output volatility vulnerability.

The Hausman test indicates that a fixed effect is appropriate and chosen over a random effect.

Table 5: Fixed and Random Effects Estimates of Remittances

Dependent Variable: Volatility of Output		
Variables	**FE**	**RE**
Volatility of Output $_{t-1}$	0.756***	0.948***
	(0.010)	(0.005)
Remittances	-0.003*	-0.003***
	(0.002)	(0.001)
Volatility of Inflation	0.004**	-0.0001
	(0.001)	(0.001)
Volatility of Terms of Trade	0.001***	0.001***
	(0.0005)	(0.003)
Trade	0.002***	0.001***
	(0.0002)	(0.0001)
Population	0.019	-0.042***
	(0.016)	(0.008)
Constant	0.981	0.184
	(0.055)	(0.026)
Adjusted R-square	0.931	0.933
F-Probability	0.000	0.000
No. of Observation	3656	3656
Hausman/Wald Statistics	404.64	51102.90
	(0.000)	(0.000)

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

Table 6 reports the results of various measures of financial development on output volatility by employing fixed effects. The results show that domestic credit to banks, credit provided by the financial sector and bank branches per 100,000 adults have positive signs, suggesting that an increase in them augments output volatility. The impact of bank branches is slightly stronger (0.005) than that of credit to banks (0.001) and credit to the financial sector (0.001). However, ATM per 1,000 km^2, bank lending spread, and bank return on assets decrease output volatility. Among these, the effect of bank return on assets is stronger (0.014) than the magnitude of ATM and bank lending spread (0.0003 and 0.004, respectively).

The positive effects of domestic credit on banks, the financial sector and bank branches on volatility is important. There could be multiple reasons behind this: First, with a rise in these indicators, the availability of finance improves. This excess finance encourages investment in short-term riskier projects, which in turn enhance growth volatility (Easterly *et al.*, 2001). Second, as these measures increase, the economy is exposed to dynamic shocks, thereby increasing output volatility through the channel of financial institutional development (Easterly *et al.*, 2001; Adeniyi *et al.*, 2019; Majeed & Noreen, 2018).

On the other hand, the negative impact of ATMs and bank return on assets is also important. This could be because the development of these indicators represents the movement of excess funds from savers to the borrower. This movement resultantly removes financial (consumption and investment) constraints, and consequently, output volatility decreases. Particularly, with an increase in access to financial services, investment and consumption constraints are removed. As a result, the number of income-generating activities increases, and growth prospects improve, enabling output volatility to decline. Similarly, a rise in the number of ATMs enables an efficient payment mechanism, which in turn strengthens the resources of financial institutes, thereby diminishing output volatility. An increase in the spread between lending and savings rates would tend to reduce volatility by reducing lending possibly to less productive projects. Last, a rise in bank return on assets can encourage savers to save more, leading to stable output growth through the channel of increased availability of funds for investment. These findings are in accordance with the negative impact of financial development on output volatility reported by Ahamada & Coulibaly (2011).

Table 6: Fixed Effects Estimates of Financial Development

Variables	Dependent Variable: Volatility of Output					
	Domestic Credit to Private Sector by Banks	Domestic Credit to Private Sector by Banks	Bank Branch per 100,000 adults	ATMs per 1,000 km²	Bank Lending-Deposit Spread	Bank Return on Assets
Volatility of Output $_{t-1}$	0.771***	0.770***	0.676***	0.670***	0.744***	0.717***
	(0.009)	(0.009)	(0.017)	(0.018)	(0.012)	(0.013)
Volatility of Inflation	0.001	0.001	0.005	-0.005**	0.001	-0.003***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Volatility of Terms of Trade	0.002***	0.001***	0.004***	0.004***	0.001***	0.002***
	(0.004)	(0.004)	(0.001)	(0.001)	(0.0004)	(0.001)
Trade	0.0002*	0.0002*	0.001*	0.001***	0.00002*	0.001***
	(0.0003)	(0.0003)	(0.0007)	(0.0007)	(0.0003)	(0.0005)
Population	-0.002	-0.004	-0.024	-0.021	0.006	0.007
	(0.014)	(0.014)	(0.028)	(0.027)	(0.018)	(0.020)
Financial Development	0.001***	0.001*	0.005***	-0.0003*	-.004***	-0.014***
	(0.0004)	(0.0002)	(0.003)	(0.0001)	(0.001)	(0.008)
Constant	0.919	0.935	1.184	1.277	1.077	1.147
	(0.051)	(0.051)	(0.107)	(0.106)	(0.061)	(0.071)
Adjusted R-square	0.938	0.938	0.942	0.936	0.927	0.938
F- Probability	0.000	0.000	0.000	0.000	0.000	0.000
No. of Observations	4002	3979	1823	1708	2917	2672
Hausman Test	408.56	416.87	280.23	274.68	357.93	362.29
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

RE estimates of different measures of financial development are presented in Table 7. Similar to FE, RE is also consistent, indicating that increases in credit to the financial sector, bank and bank branches augment output volatility. However, the impact of ATM, bank lending spread and bank return on assets is volatility decreasing, thereby helping to stabilize output volatility.

Table 7: Random Effects Estimates of Financial Development

Variables	Dependent Variable: Volatility of Output					
	Domestic Credit to Private Sector by Banks	Domestic Credit to Private Sector by Banks	Bank Branch per 100,000 adults	ATMs per 1,000 km²	Bank Lending-Deposit Spread	Bank Return on Assets
Volatility of Output $_{t-1}$	0.941***	0.943***	0.943***	0.946***	0.948***	0.941***
	(0.005)	(0.005)	(0.007)	(0.007)	(0.005)	(0.005)
Volatility of Inflation	-0.0003	-0.001	0.001	-0.0008	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Volatility of Terms of Trade	0.001***	0.001***	0.002***	0.001***	0.001***	0.001***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.0003)	(0.0001)
Trade	0.0003***	.0004***	0.0003*	0.001***	0.001***	0.0004***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0002)
Population	-0.017***	-0.020**	-.024***	-.035***	-.031***	-0.022***
	(0.008)	(0.009)	(0.012)	(0.128)	(0.009)	(0.009)
Financial Development	0.001***	0.001***	0.003***	-0.0001*	-0.003**	-0.015***
	(0.0002)	(0.0001)	(0.001)	(.00003)	(0.001)	(0.006)
Constant	0.164	0.167	0.136	0.181	0.195	0.156
	(0.025)	(0.025)	(0.036)	(0.042)	(0.031)	(0.031)
Adjusted R-square	0.939	0.939	0.945	0.945	0.929	0.941
No. of Observations	4002	3979	1823	1708	2917	2672
Wald Statistics	47727.29	46200.58	54273.56	26689.63	26338.35	20736.71
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

4.3. Results of System GMM

This study includes instruments in specified models and employs the System GMM approach to solve the problem of endogeneity. We have taken lagged values of explanatory variables and time dummies as exogenous instruments. Moreover, instruments of remittances such as latitude distance (Desousa & Duval, 2010), unemployment (Aggarwal *et al.*, 2011) and instruments of financial development, capital account openness (Majeed & Norren, 2018) and urban population (Beck *et al.*, 2000) are incorporated as external instruments.

Latitude is often used as a proxy of the bilateral distance between remittance sending and receiving economies. It is a time-invariant variable. The latitudinal distance between migrants' home and host economy impacts the flows through different channels. First, when the distance is viewed as a proxy of the cost migrants expend in sending the remittances amount back to their home economy, the flows decline. However, the inflows rise, first, when they are sent to loosen consumption and investment constraints of the dependent (recipient) families back in the home economy. Second, remittance flows also increase when the cost of migration is high. This increase in remittance inflows is to cover the cost migrants' families endure in the process of moving migrants abroad.

Remittance flows are also correlated with unemployment. This association can be explained as follows: when unemployment in the home country increases, people tend to migrate across the border in search of a job. This search, in turn, reduces consumption and investment constraints in the home economy in the form of remittance transfer. Hence, remittance inflows in the home economy can consequently rise.

Capital account openness is one of the instruments of financial development. The more open the overall capital account is, the greater the chances of financial development. As the liberalization of capital accounts increases, it welcomes foreign investors and the use of financial institutions, leading to an increase in the development of the financial sector.

The urban population is also correlated with financial development. As the urban population increases, their demand for finance for motives (transitory, precautionary and speculative) of holding cash also rises. This increase in demand consequently enhances the supply of financial intermediates, thereby leading to financial development.

The results presented in Table 8 report the impact of remittances on output volatility using System GMM. The estimates indicate that remittances have a negative and statistically significant impact on volatility. This implies that output volatility decreases by 0.034 percent as a result of a 1 percent rise in remittances. This finding is consistent with results drawn by Bugamelli & Paterno (2011) and Chami *et al.* (2012). The decline in output volatility implies that remittances provide an extra source of finance. The probability of the Hansen test confirms that the instruments are valid. Moreover, the value of AR (2) is insignificant, indicating that the error term is uncorrelated and that the issue of serial correlation does not exist.

Table 8: System GMM estimates of remittances

Dependent Variable: Volatility of Output	
Variables	**Coefficient**
Volatility of Output $_{t-1}$	0.507***
	(0.135)
Remittances	-0.034***
	(0.015)
Volatility of Inflation	0.013
	(0.021)
Volatility of Terms of Trade	0.028
	(0.018)
Trade	0.014***
	(0.005)
Population	-0.737***
	(0.194)
Constant	0.679
	(0.872)
Adjusted R-square	1395
No. of Instruments	78
AR (1) Pr > z	0.365
AR (2) Pr > z	0.344
Hansen Test Prob > Chi	0.646

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

Table 9 below reports the results of System GMM for various indicators of financial development. The coefficient reflects that output volatility magnifies by 0.193, 0.017 and 0.123 percent as a result of a 1 percent rise in credit to the financial sector, credit provided by banks and bank branches per 100,000 adults, respectively. However, output volatility diminishes by 0.002, 0.044 and 0.085 percent as a result of a 1 percent rise in ATM, bank lending spread and bank return on assets. These impacts are consistent yet much stronger, as the size of the coefficients is relatively large compared to the estimates of FE and RE. In addition, the probability values of the Hansen test and AR (2) signify that instruments are valid and that the issue of serial correlation does not arise.

Table 9: System GMM Estimates of Financial Development

Variables	Dependent Variable: Volatility of Output					
	Domestic Credit to Private Sector by Banks	Domestic Credit to Private Sector by Banks	Bank Branch per 100,000 adults	ATMs per 1,000 km²	Bank Lending-Deposit Spread	Bank Return on Assets
Volatility of Output $_{t-1}$	0.689***	0.568***	0.311***	0.955***	0.923***	0.841***
	(0.026)	(0.030)	(0.032)	(0.021)	(0.022)	(0.041)
Volatility of Inflation	0.009***	-0.099***	-0.016	-0.066***	0.004	-0.020
	(0.003)	(0.014)	(0.014)	(0.013)	(0.001)	(0.021)
Volatility of Terms of Trade	0.031***	0.476***	0.009***	0.033***	0.032***	0.051***
	(0.009)	(0.012)	(0.005)	(0.014)	(0.009)	(0.015)
Trade	-0.001	-0.001	0.001	0.005***	0.0004	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0004)	(0.001)
Population	0.036	0.258***	0.386***	-0.098***	-.203***	-0.671***
	(0.061)	(0.073)	(0.149)	(0.056)	(0.048)	(0.156)
Financial Development	0.193***	0.017***	0.123***	-0.002***	-.044***	-0.085***
	(0.001)	(0.001)	(0.012)	(0.001)	(0.011)	(0.051)
Constant	0.008	0.875	0.993	0.086	0.238	0.405
	(0.132)	(0.226)	(0.254)	(0.239)	(0.159)	(0.381)
No. of Observations	1504	1523	1203	1023	1117	1485
AR (1) Pr > z	0.002	0.369	0.016	0.000	0.017	0.571
AR (2) Pr > z	0.112	0.492	0.902	0.472	0.105	0.829
Hansen Test- Prob > Chi =	0.629	0.581	0.999	0.229	0.454	0.194

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

Table 10 below illustrates the impact on output volatility incorporating the interaction terms. The coefficients of interaction show that a 1 percent rise in remittances interacted with credit by banks, credit to the financial sector and bank branches causes output volatility to increase by 0.001, 0.0017 and 0.008 percent, respectively. Similarly, output volatility increases by 0.001, 0.006 and 0.035 percent because of a 1 percent rise in the interaction of remittances with ATM, bank lending spread and bank return on assets, respectively.

Table 10 illustrates that the coefficients on the interaction terms are much smaller in size than the coefficient on remittances. This small size shows that remittances' impact is negative, yet its impact is not overcome by the positive impact of financial development. In other words, financial development indicators not only enhance output volatility but also suppress the impact of remittances. In other words, economies are directly vulnerable to the volatility-enhancing effects of financial development and

indirectly vulnerable to the augmented impact of financial development on the remittance-output volatility nexus.

By comparing the coefficient of indicators of financial development and remittances, it can be observed that the negative coefficient on remittances is fairly large in size in comparison to the relatively small positive/negative coefficients on the financial sector variables. This comparison tells us that because the coefficients on the indicators of financial development are small, they are dominated by the larger, negative coefficient on remittances.

Furthermore, insignificant values (0.250, 0.446, 0.104, 0.189, 0.336 and 0.106) of AR (2) reflect no problem of serial correlation. The probability value of the Hansen test is greater than 0.1 in all the models (0.633, 0.962, 0.955, 0.334, 0.605, 0.263), indicating that the instruments are valid.

Table 10: System GMM with Interaction Terms

Variables	**Dependent Variable: Volatility of Output**					
	Domestic Credit to Private Sector by Banks	**Domestic Credit to Private Sector by Banks**	**Bank Branch per 100,000 adults**	**ATMs per 1,000 km²**	**Bank Lending-Deposit Spread**	**Bank Return on Assets**
Volatility of Output $_{t-1}$	0.573***	0.485***	0.488***	0.882***	0.781***	0.829***
	(0.031)	(0.037)	(0.058)	(0.032)	(0.039)	(0.032)
Volatility of Inflation	0.025***	-.068***	-0.040**	-.063***	0.017	-0.033**
	(0.006)	(0.016)	(0.019)	(0.011)	(0.013)	(0.013)
Volatility Terms of Trade	0.026**	0.043***	0.045**	0.028**	0.014**	0.021***
	(0.010)	(0.014)	(0.021)	(0.011)	(0.008)	(0.008)
Trade	-0.001	-0.002**	-0.001	0.0003	-0.001	0.001**
	(0.001)	(0.001)	(0.002)	(0.0008)	(0.001)	(0.0005)
Population	-0.074	-0.043	0.171	-.163***	-.888***	-0.263**
	(0.071)	(0.089)	(0.117)	(0.041)	(0.116)	(0.128)
Remittances	-0.106***	-.137***	-0.107*	-0.025**	-0.075**	-0.051**
	(0.037)	(0.039)	(0.058)	(0.011)	(0.034)	(0.024)
Financial Development	0.019***	0.015***	0.075***	-0.002**	-0.028	-0.164**
	(0.002)	(0.002)	(0.013)	(0.001)	(0.018)	(0.075)
Remittances* Financial Development	0.001**	0.0017**	0.008**	0.001**	0.006**	0.035**
	(0.0007)	(0.0006)	(0.003)	(0.0003)	(0.003)	(0.016)
Constant	0.670	1.584	0.927	0.884	1.060	0.941
	(0.261)	(0.293)	(0.565)	(0.281)	(0.324)	(0.267)
No. of Observations	1393	1409	1094	936	855	1023
AR (1) Pr > z	0.002	0.358	0.085	0.000	0.000	0.000
AR (2) Pr > z	0.250	0.446	0.104	0.189	0.336	0.106
Hansen Test- Prob > Chi	0.633	0.962	0.955	0.334	0.605	0.263

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

4.4. Fixed Effect Instrumental Variable

IV-FE is employed to overcome the issue of correlation between the error term and independent variables while capturing unobserved country-specific effects. The estimated results are reported in Table 11. The main results are consistent with previously employed estimation techniques. For instance, the results of interaction terms are output volatility enhancing thereby destabilizing output growth. In the diagnostic analysis, the statistics of the Wu-Hausman test for endogeneity reveal that the treated endogenous variables and their variation can be treated as exogenous since the null hypothesis of exogeneity is accepted.

Table 11: IV-FE with Interaction Terms

Variables	Dependent Variable: Volatility of Output					
	Domestic Credit to Private Sector by Banks	Domestic Credit to Private Sector by Banks	Bank Branch per 100,000 adults	ATMs per 1,000 km²	Bank Lending-Deposit Spread	Bank Return on Assets
Volatility of Output $_{t-1}$	0.711***	0.709***	0.658***	0.660***	0.617***	0.710***
	(0.016)	(0.016)	(0.212)	(0.019)	(0.029)	(0.015)
Volatility of Inflation	0.003	0.003	0.009**	0.006**	0.002	0.004*
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Volatility of Terms of	0.002*	0.002*	0.006**	0.004**	0.002	0.002***
Trade	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Trade	0.001**	0.002**	0.002**	0.001**	0.001*	0.0004
	(0.0005)	(0.001)	(0.001)	(0.0008)	(0.001)	(0.0005)
Population	-0.003	-0.002	-0.053	-0.002	0.057	0.015
	(0.032)	(0.031)	(0.045)	(0.031)	(0.046)	(0.022)
Remittances	-0.013**	-0.011**	-0.022	-0.0003	-0.022**	-0.005
	(0.005)	(0.005)	(0.012)	(0.006)	(0.011)	(0.004)
Financial Development	0.00003	-0.0001	0.003	-0.002**	-0.032**	-0.048**
	(0.0007)	(0.0005)	(0.004)	(0.0007)	(0.012)	(0.022)
Remittances* Financial	0.0002**	0.0001*	0.001**	0.0003**	0.001*	0.002**
Development	(0.0001)	(0.0001)	(0.0008)	(0.0002)	(0.001)	(0.001)
Constant	0.759	0.760	0.856	0.880	1.107	0.813
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. of Observations	1654	1649	1096	1381	990	1070
R-Square	0.948	0.948	0.953	0.956	0.949	0.947
Wu-Hausman Stats	0.512	0.453	0.631	0.600	0.527	0.509

Note: ***p<0.001, ** p<0.05,* p<0.1. Values in parenthesis represent standard error.

5. Conclusion

Output volatility is one of the macroeconomic channels faced in the path toward achieving stable output growth. There is a chain of financial and economic hazards that arise because of volatile output. Therefore,

understanding output volatility is critically important. The financial crisis of 2008 led to the failure of financial institutions that initially spilled over to the US economy and later to the majority of the world economies. Since the financial crisis induced an unexpected global economic slowdown, we are motivated to analyze what impact the development of the financial sector in terms of depth, access and efficiency may have on volatile output growth.

Remittances are the second largest and the most stable source of foreign capital flows, and their effects on output growth and the financial sector motivate us to investigate this study. This study examines the mediating impact of several indicators of financial development on the remittance-output volatility relationship using large panel data of 158 countries from the long period of 1971-2017. The output volatility is computed from five years moving the standard deviation of the cyclical component in per capita GDP constant 2010 US$. For remittances, the personal remittance variable is used. However, financial development is proxied using two measures in each of three features of financial development. For instance, financial depth is proxied by domestic credit provided by banks and credit to the financial sector, financial access is represented by bank branches per 100,000 adults and ATM per 1,000 km^2, and financial efficiency is represented by bank lending deposit spread and bank return on assets.

The role of the financial sector as a mediator in the remittance-output volatility nexus remains relatively neglected in the literature. Moreover, the recent empirics regarding remittances impact and the direct and mediating role of financial development for a large sample are also missing in the literature. To the best of our knowledge, this study is one of the first attempt of its kind to fill these gaps. The literature used common indicators of financial development for the mediating role, presenting an incomplete picture (Ahamada & Coulibaly, 2011; Adeniyi *et al.,* 2019). Moreover, they ignored the standard determinants of output volatility given by Beck *et al.* (2000) and have the limited number of estimation techniques employed. This study incorporates less explored indicators of financial depth along with unexplored measures of financial access and efficiency incorporating the multiple dimensional nature of financial development. Moreover, advanced System GMM and FE-IV techniques are also employed to address the econometric issues and reaffirm the findings.

The findings obtained from both employed specifications are robust and consistent. The results can be summarized as follows. The individual (direct) impact of remittances on volatility is negative and statically significant. This implies that remittance inflows act as a stabilizer for output volatility. Second, the direct impact of financial development is inconclusive since different measures have dissimilar impacts on output volatility. For instance, credit to the financial sector and credit provided by bank and bank branches increase output volatility. On the other hand, ATM per 1,000 km^2, bank lending-deposit spread, bank return on assets helps diminish output fluctuations. Third, the interaction effects of remittances with different measures of financial development have positive and significant impacts on output volatility. This implies that the negative (direct) impact of remittances on volatility is partly cancelled out.

The empirical findings of this study suggest the following policy recommendations. First, since remittances play an important role in diminishing output fluctuations, it may be encouraged by providing ease to the process of receiving remittance amounts so that stability in output can be achieved. Second, as few measures of financial development elevate output volatility while others deteriorate it, countries may execute control and consequently adopt specific reforms in the process of financial sector development. Third, as the findings suggest that the direct impacts of remittances are partly undone by the positive interaction effect, policymakers should ensure that such policies are formulated that minimize the meditating role of financial development in the remittance-output volatility relationship. Furthermore, policymakers may try to mitigate present output fluctuations as much as possible since output volatility has a strong and significant lag effect.

This study is open to the possibility of future research in the following areas: First, this study used several features and indicates of financial development one by one. The index of financial development can be generated by incorporating different proxies, so that the overall impact can be analyzed. Second, the possibility of getting effect by neighboring economies' shocks increases greatly as the economies are more integrated and globalized now. Therefore, further research can be done on isolating the spillover effects of neighboring shocks and then analyzing the impact on output fluctuations.

References

Abdih, Y., Dagher, J., Chami, R., & Montiel, P. (2008). Remittances and Institutions: Are Remittances a Curse?. *International Monetary Fund*, 8-29.

Acemoglu, D., & Zilibotti, F. (1997). Was Prometheus Unbound by Chance? Risk, Diversification, & Growth. *Journal of Political Economy*, *105*(4), 709–751.

Acemoglu, D., Johnson, S., Robinson, J., & Thaicharoen, Y. (2003). Institutional Causes, Macroeconomic Symptoms: Volatility, Crises and Growth. *Journal of Monetary Economics*, *50*(1), 49-123.

Acosta, P.A., Baerg, N.G., & Mandelman, F.S. (2009). Financial Development, Remittances, and Real Exchange Rate Appreciation. *Federal Reserve Bank of Atlanta*, *Economic Review 94* (1), 1–12.

Adeniyi, O., Ajide, K., & Raheem, I. (2019). Remittances and Output Growth Volatility: Does Financial Development Dampen or Magnify the Effects?. *Empirical Economics*, *56*(3), 865-882.

Aggarwal, R., Demirguc-Kunt, A., & Peria, M. (2011). Do Remittances Promote Financial Development?. *Journal of Development Economics, 96*, 255–264.

Ahamada, I., & Coulibaly, D. (2011). How Does Financial Development Influence the Impact of Remittances on Growth Volatility?. *Economic Modeling*, *28*(6), 2748-2760.

Arellano, M. & Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error-Components Models. *Journal of Econometrics*, 68, 29-51.

Bacchetta, P., & Caminal, R. (2000). Do Capital Market Imperfections Exacerbate Output Fluctuations?. *European Economic Review*, *44*(3), 449-468.

Beck, T., Levine, R., & Loayza, N. (2000). Finance and the Sources of Growth. *Journal of Financial Economics*, *58*(1), 261–300.

Beine, M., Lodigiani, E., & Vermeulen, R. (2012). Remittances and Financial Openness. *Regional Science & Urban Economics*, *42*(5), 844-857.

Bekaert, G., Harvey, C., & Lundblad, C. (2002). *Growth Volatility and Equity Market Liberalization* (Working Paper No.12). Duke University.

Bernanke, B., & Gertler, M. (1989). Agency Costs, Net Worth, and Business Fluctuations. *American Economic Review*, *79*(1), 14–31.

Bettin, G., Lucchetti, R., & Zazzaro, A. (2012). Financial Development & Remittances: Micro-Econometric Evidence. *Economics Letters*, *115*(2), 184-186.

Blundell, R. & Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics*, 87,115-143.

Bouoiyour, J., Miftah, A., & Selmi, R. (2014). *Do Financial Flows Raise or Reduce Economic Growth Volatility? Some Lessons from Moroccan Case* (MPRA Paper No. 57258). University Library of Munich, Germany.

Bugamelli, M., & Paterno, F. (2011). Output Growth Volatility and Remittances. *Economica*, *78*(311), 480-500.

Bugamelli, M. (2009). Output Growth Volatility and Remittances. *Economica*, *77*(441), 330-340.

Cecchetti, S. G., Genberg, H., & Wadhwani, S. (2005). *Asset Prices in a Flexible Inflation Targeting Framework* (Working Paper No. 8970). National Bureau of Economic Research.

Cermeno, R., Garcia, R., & Gonzalez-Vega, C. (2012). *Financial Development and Growth Volatility: Time Series Evidence for Mexico & the United States* (Working Paper No. 544). CIDE.

Chami, R., Hakura, D. S., & Montiel, P. (2012). Do Worker Remittances Reduce Output Volatility in Developing Countries?. *Journal of Globalization and Development*, *3*(1), 854-923.

Chami, R., Fullenkamp, C., & Jahjah, S. (2005). Are Immigrant Remittance Flows a Source of Capital for Development?. *IMF Staff papers*, *52*(1), 55-81.

Chami, R., Barajas, A., Cosimano, T., Fullenkamp, C., Gapen, M., & Montiel, P. (2007). Macroeconomic Consequences of Remittances. *IMF Staff papers*, *72*, 259-270.

Chami, R., Ernst, E., Fullenkamp, C., & Oeking, A. (2018). Is There a Remittances Trap?. *Finance and Development*, *55*(3).

Chowdhury, M. (2011). Remittances Flow and Financial Development in Bangladesh. *Economic Modelling*, *28*(6), 2600-2608.

Cihak, M., Demirgüç-Kunt, A., Feyen, E., & Levine, R. (2012). *Benchmarking Financial Systems around the World* (Working Paper No. 6175). World Bank, Washington, DC.

Coulibaly, D. (2009). Remittances, Financing Constraints and Growth Volatility: Do Remittances Dampen or Magnify Shocks?. *Economic Modelling, 32*, 193-212.

Craigwell, R., Jackman, M., & Moore, W. (2008). Economic Volatility and Remittances. *International Journal of Development Issues*, *9*(1), 25-42.

Desousa, J., and Duval, L. (2010). Geographic Distance and Remittances in Romania: Out of Sight, Out of Mind?. *Economie Internationale*, (1), 81-97.

Easterly, W., Islam, R., & Stiglitz, J. E. (2001). Shaken & Stirred: Explaining Growth Volatility. *Annual World Bank Conference on Development Economics*, 2000, 191-211.

Furceri, D., & Karras, G. (2007). Country Size and Business Cycle Volatility: Scale Really Matters. *Journal of the Japanese and International Economies*, *21*(4), 424-434.

Furceri, D., & Poplawski Ribeiro, M. (2008). *Government Consumption Volatility and Country Size* (Working Paper No. 17). Centre D'tudes Prospectives et D'Informations Internationales.

Gupta, S., Pattillo, C. A., & Wagh, S. (2009). Effect of Remittances on Poverty and Financial Development in Sub-Saharan Africa. *World Development*, *37*(1), 104-115.

Haddad, M., Lim, J., Pancaro, C., & Saborowski, C. (2013). Trade Openness Reduces Growth Volatility When Countries are Well Diversified. *Canadian Journal of Economics*, *46*(2), 765-790.

Hakura, D.S. (2009). Output Volatility in Emerging Market and Developing Countries: What Explains the Great Moderation of 1970–2003? *Czech Journal of Economic & Finance*, *59*(3), 229–254.

Jidoud, A. (2015). Remittances and Macroeconomic Volatility in African Countries. *International Monetary Fund,* 15-49.

Kose, M. A., Prasad, E. S., & Terrones, M. E. (2006). How Do Trade and Financial Integration Affect the Relationship Between Growth and Volatility?. *Journal of International Economics*, *69*(1), 176–202.

Loayza, N. V., Ranciere, R., Serven, L., & Ventura, J. (2007). Macroeconomic Volatility and Welfare in Developing Countries: An Introduction. *The World Bank Economic Review*, *21*(3), 343-357.

Majeed, M. T., & Noreen, A. (2018). Financial Development and Output Volatility: A Cross-Sectional Panel Data Analysis. *Lahore Journal of Economics*, *23*(1), 97-141.

Mobarak, A.M. (2005). Democracy, Volatility and Development. *Review of Economics and Statistics 87*(2), 348-361.

Rodrik, D. (1998). Why Do More Open Economies Have Bigger Governments?. *Journal of Political Economy*, *106*(5), 997 –1032.

Rumler, F., & Scharler, J. (2011). Labor Market Institutions and Macroeconomic Volatility in a Panel of OECD Countries. *Scottish Journal of Political Economy*, *58*(3), 396-413.

Svirydzenka, K. (2016). Introducing New Broad-based Index of Financial Development. *International Monetary Fund*, *16*(5).

Wacziarg, R., & Welch, K. H. (2003). Trade Liberalization and Growth: New Evidence. *National Bureau of Economic Research*, *73*, 726-730.

Wang, P., & Wen, Y. (2013). *Financial Development and Long-run Volatility Trends* (Working Paper No.54). FRB of St. Louis.

Appendix

Table 1A: Summary of Variables

Variables	Label by	Measured in	Sources
Dependent Variable			
Output Volatility	OV	Five years SD of cyclical component of GDP per capita constant 2010 US Dollars	Author's Calculation
Focused Variables			
Personal Remittances	PR	Percentage of GDP	WDI (2018)
Different Measures of Financial Depth			
Domestic credit to private sector by banks	DCB	Percentage of GDP	WDI (2018)
Domestic credit provided by financial sector	DCF	Percentage of GDP	WDI (2018)
Different Measures of Financial Access			
Bank branches per 100,000 adults	BB	Number	WDI (2018)
Automated Teller Machines (ATMs) per 1,000 km2	ATM	Number	FAS (2018)
Different Measures of Financial Efficiency			
Bank Lending-Deposit Spread	BS	Rate	IFS (2018)
Bank Return on Assets	BA	Percentage	Bankscope, Bureau van Dijk (BvD)
Control Variables			
First Lag of Output Volatility	OV(-1)	First lag of five years SD of cyclical component of GDP per capita constant 2010 US Dollars	Author's Calculation
Volatility of Terms of Trade	VTOT	Five years SD of Terms of Trade	Author's Calculation
Volatility of Inflation	VINF	Five years SD of inflation, consumer price index (2010 = 100)	Author's Calculation
Population Growth	POP	Annual Percentage	WDI (2018)
Trade Openness	TO	Percentage of GDP	WDI (2018)

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