The Integration of Financial Markets in Pakistan: New Extensions and Evidence from Bounds Testing and TYDL Granger Non-Causality Approach

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Abstract
*This study analyzes the dynamic interlinkages between money, currency, and capital markets for Pakistan using Autoregressive-Distributed Lag (ARDL) Bounds testing, and Augmented Vector Autoregression (*VAR). Furthermore, we *employ the Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996)-TYDL-methodology to examine the causal relationship between money, currency, and capital markets over the period of January 2001 to June 2014. The empirical findings based on the ARDL Bounds testing show that a steady state long run equilibrium relation exists among the three markets of Pakistan which is also confirmed by the Johansen cointegration analysis. Moreover, the empirical results of the TYDL Granger Non-causality establish interlinkages among the three markets suggesting bi-directional causality among stock market and currency market whereas unidirectional causal flow is been established from money market to stock market and from currency market towards money market of Pakistan. Provided with the fact that the three markets are interlinked, it is therefore suggested that any policy measure in this regard should be mindful of the implications of the decision.*
Keywords: Capital Markets, Money Markets Currency Markets, ARDL Bounds Testing, Augmented VAR, TYDL Granger Causality.

Numerous studies show that one of the drastic difference between traditional finance and modern finance theory is the increased integration between financial markets. Financial markets today are much more integrated than ever before owing to the recent waves of economic liberalization, globalization and innovations coupled with increased deregulations and the spread of information technology in financial markets. It has led us to amplified and ever growing integration and enhanced capital mobility across financial markets. The financial integration is a multidimensional phenomenon and is basically the unification of various markets to enable their convergence for assets of similar maturity and risk adjusted returns across the markets, due to which access to financial assets have become increasingly borderless and unbounded, (Reserve Bank of India, 2007; henceforth RBI).

Integration of financial markets is believed to have two positive impacts within and across economies, firstly the improvement in the allocative efficiency of capital markets and secondly risk diversification (Ho, 2009). Similarly, the conventional economic wisdom and the theory of financial economics tell us that financial integration bear the significant benefits of low trading costs for financial assets. This gives investors greater freedom to diversify their portfolios and provide relatively more stability in consumption patterns especially in periods of high economic volatility, provided that capital mobility is not restricted that allows to supplement the domestic pool of savings (Asian Development Bank, 2013; henceforth ADB). Furthermore Jain and Bhanumurthy (2006) argue that in some segments of the financial sector, increased integration is necessary to help reduce the 'arbitrage advantage' that may lead to the increase in 'depth and breadth' of the domestic financial markets that in turn will lead to an enhanced financial intermediation process, primarily by virtue of depressing costs and excessive profits that are associated with monopolistic markets; hence providing efficient resource allocation opportunities. However, on the other hand, they also highlights at the same time that increase in integration across financial markets is not without fundamental risks like increased volatility, reversals of capital flows resulting in fragility and instability in the financial system.

However it is worth noting that financial integration is a wide-spectrum phenomenon and encompasses a complex array of various economic factors. In this regards, Reddy (2002) and Bank for International Settlements (2006; henceforth BIS), identify three dimensions for integration across financial markets, namely; national, regional and global. Conversely USAID (1998) provides an alternative outlook and classify financial market integration as horizontal and vertical. The horizontal integration is characterized by the integration within the inter-segments of the domestic market whereas the vertical integration can happen across borders.

Money market, currency market and stock market are said to be strange bedfellows and sometimes augment the movement of each other. Moreover, financial sector reforms in emerging economies have led to the increased perception of interlinkages between various segments of the financial sector (Khalid & Rajaguru, 2006) for instance point towards the popularity of the strong linkage between stock prices, exchange rates and the influence of the two on interest rates. Like many emerging economies, Pakistan, too, has taken numerous measures of financial reforms and liberalization during the 1990s under broader and macroeconomic structural adjustment programs, aimed for competitive and a relatively transparent financial sector. (Ariff & Khalid, 2005; Hussain & Qayyum, 2005; Hussain, 2006; Khan & Qayyum, 2006). Similarly Jain et al. (2006) argues that these measures among others are primarily designed to enhance the productivity and efficiency of the overall economy thus aimed for making it globally competitive. From Pakistan's perspective, these measures of financial sector liberalization include, inter alia, the privatization of major nationalized banks, deregulation of interest rates and credit ceilings and reducing of preemption of resources from banks through reduced reserve requirements along with prudential regulations to enhance the central bank's monitoring capability[1] (Iimi, 2004). Further these liberalization policies also had positive impact on the domestic economy and led to a slight appreciation in the local currency that improved the country's credit ratings. Resultantly these factors, such as stock prices, exchange rates and interest rate became reflective of market forces (Khalid et al. 2006)[2]. One of the peculiar and intended objectives of these reforms in the early 1990s (and later in 1997 when the second phase of 'banking reforms' were introduced) was to develop the various sectors of financial system into an integrated one with the basic idea of reducing the interlinkages so as to eliminate what Jain et al. (2006) calls the 'arbitrage opportunities' and to achieve higher level of operational efficiency in the market and enhance the effectiveness of monetary policy.

However, more than two decades have been passed since these reforms and liberalization policies were put into place, still, an important question remains open for discussion that to what extent we were able to achieve a reasonable degree of integration both within domestic and international markets[3] by narrowing down the 'inter-market divergence'?. Jain et al. studied this in the context of India. Furthermore in corollary to the aforesaid reforms, inter alia, the central bank of Pakistan had a limited intervention in foreign exchange and domestic money markets; and these factors are subject to external as well as internal shocks, in case the markets are interlinked, then an exposed shock may have impact on the other markets as well. Khalid et al. (2006) studied this particular phenomenon in the context of Pakistan over the period of 1999-2006. In this study we intend to combine both of these notions within the economic framework of Pakistan and study these with new evidences and in the light of most recent circumstances through an empirical exercise to extend the existing body of literature—particularly pertaining to the post-crises era. As alluded to as earlier, Hussain (2011), argues that the global financial crises of 2008 that turned into the worst economic recession, led to some serious 'soul searching' among the intellectuals and practitioners about the way the financial sector has been regulated and supervised. Moreover Ho (2009) argues that the recent recession is a question mark against the cited benefits, and manifest that financial integration could bear substantial costs. Hence it is imperative to investigate the said nexus and the inter-temporal linkages between money, currency and stock markets—particularly in post-crises scenario. Thus this study is mainly designed to navigate that gap in the case of Pakistan.

Although several studies have been conducted to investigate various dimensions of integration among financial markets; for instance,

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[1] As a result of these measures, Pakistan (at that time) witnessed a 133% increase in the local stock market index by 1991 (Emerging Markets Fact Book).

[2] For detailed overview of Financial Liberalization and its impacts on the country's financial sector, see Khan et al. (2006).

[3] However in this study we are only discussing the domestic paradigm.

Abdalla et al. (1997) studied the interactions of exchange rate and stock prices for emerging financial markets. Similarly Yang et al. (2003) studies the short and long run dynamic causal linkages among the developed and emerging markets in the context of Asian financial crisis; Alfaro et al. (2004) links the role of financial markets with FDI and economic growth. Mukharjee and Mishra (2010) documents evidence for volatility and spillovers for India and its Asian counterparts. Kose et al. (2011) investigates the notion of thresholds in international financial integration. Claeys et al. (2012) studies the crowding effects of debt, interest and integration of financial markets. On a very promising and unorthodox notion, Majdoub and Mansour (2014) checks for the integration among five emerging Islamic equity markets, including Pakistan, with US markets. Finally, Seth and Sharma (2015) examines the informational efficiency of selected Asian and US markets. Similarly, some perspectives from Pakistan have also been documented in likely fashion such as Shahbaz and Rahman (2010) investigates the role of foreign capital inflows and growth nexus and economic growth under ARDL cointegration procedure for Pakistan over the period of 1971-2008. Similarly, Muhammad and Umer (2010) studies the causality between financial development and economic growth under the same bounds testing approach for Pakistan. Shahbaz and Islam (2011) explores the relationship of income inequality and financial development. Aleemi and Azam (2015) explores the nexus of financial development with that poverty and economic growth with the context of political instability. Finally, Azher and Iqbal (2016) links foreign exchange risk and market segmentation.

Given the above dimensions and paradigms, in this paper we have investigated the nexus of financial market integration that materializes within the national dimension or horizontal integration between the different segments of the domestic financial market. Hence this study is particularly intended to examine the integration within national markets in the economic framework of Pakistan. The goal of the research emphasis is to investigate the inter-linkages between the money market, currency market and stock market co-movements and causality. The contribution of this study is threefold: Firstly, this study combines two components of literature i.e., it investigates the degree of integration within the domestic financial markets (Jain et al. 2006) and the inter-temporal linkages (Khalid et al. 2006). Secondly, it investigates the nexus with new evidences in the post-crises scenario. Thirdly, we have taken relatively high frequency and most recent data under the Bounds Testing Procedure and TYDL Granger Non-Causality approach, which to the best of our knowledge is the first of its kind endeavor, particularly in the case of Pakistan.

Theoretical background: Concepts and Theories

This section is devoted to discuss some of the concepts and theories regarding the financial markets and the integration among them.

Furthermore this section also discusses the issues and the ways for measurement of the extent of integration among financial markets.

In order to capture the real effects of financial market integration, it is of equal importance to understand the mechanisms and channels of transmission within the financial sector. A well-developed financial sector is believed to perform several functions, however the matter is of considerable debate. For instance, Gries et al. (2008) identified two important channels for the effects of Financial Sector namely the "Cumulative Channels" and the "Allocative Channels". Aziz and Duenwald (2002) points about three main channels: reducing information asymmetries, reducing costs and frictions and raising private investments. Moreover Levine (1997) and also Beck (2008) links financial sector to perform the following five elementary errands as:

1) Providing trading amenities, hedging, diversification and sharing of risk.
2) Efficient Resource allocation
3) Exercise corporate control and governance
4) Mobilize and pool savings
5) Alleviate friction and smoothen the process of exchange of goods or services.

Economic theory suggests that unrestricted capital mobility across borders enhance allocative efficiency of financial resources. The rationale for this belief is that capital should be flowing from 'capital-abundant' nations to the 'capital-scarce' countries. This is more like the supply siders' view that holds that financial markets are said to be integrated when the 'law of one price' holds (Japelli and Pagano, 2008). The law of one price was pioneered by Cournot (1927) and Marshall (1930) and holds that in the absence of restrictive policies; the risk adjusted return on securities of identical cash flows should command the same price across markets. Japelli et al. (2008) explains this phenomenon as, if a borrower issues a security in two different countries or regions, it must warrant the same interest to the lenders in both countries. The same notion also holds true for the credit market as well. In simple words it implies that when segmented markets turn out to be open and unified, the economic agents would enjoy the same unrestrained access. This in turn leads us to an interesting proposition that to measure the degree of integration in a country or a region, one simply needs to compare prices or the rates of return for comparable securities. This leads us to price based measures and return based measures like interest rate differentials.

However an abundant portion of financial literature suggests some other alternative measures as well that establish operational linkages among different segments of financial markets, like the term structure of interest rates that derives from the paradigms of unbiased expectations

(Blinder, 2008). The basic idea behind term structure is that it provides a complete schedule of interest rates over time that encompasses the anticipation of future events from the market's perspective and that is too with differential maturities (Cox et al. 1985). Similarly the Capital Asset Pricing Model (CAPM) that is used to establish linkages between systematic risk and financial instruments. The CAPM is believed to be a positive theory where the investors are believed to be Markowitz efficient investors targeting the specific portfolio points on the efficient frontier, having the opportunity of risk free rates and characterized with homogenous expectations, no taxes and transaction costs (Sharpe, 1964). Another contender in this regards is the famous Black-Scholes' model of option pricing which is one of the most effective partial differencing equation model in financial history. The main postulates of Black-Scholes' is the linkage between derivatives and spot rates of the underlying assets, governed by the put-call parity principle. Provided with that in the absence of arbitrage opportunities, derivative instruments can be imitated in terms of spot price of the underlying asset (RBI, 2007).

Alluded to as earlier, some of the direct measures for the extent of integration can be tested with the convergence of return that is typically measured with various interest parity conditions such as purchasing power parity (PPP), Covered Interest Parity (CIP), Uncovered Interest Parity (UCIP) and Real Interest Parity (RIP) Jain and Bhanamurthy (2005). However indirectly the same can be done with the degree of correlation between national savings and investments as argued by (Feldstien and Horoika, 1980; Feldstien, 1983).

Apart from economic and theoretical doctrines, integration among financial markets can also occur due to information efficiency. In this regards, the efficient market hypothesis considers that a market is believed to be efficient if the prevailing rate in the market reflects all relevant and existing information and instantaneously fine-tunes accordingly (Fama, 1970). The idea behind is that economic participants form optimistic expectations for a future course of action or policy. Resultantly even if certain inefficiencies between markets and intermediaries still remain due to restrictive policies, the economic agents form expectation that such restrictive measures would be discontinued in the long run with policy shifts and provided with liberalization of markets over time (Malkiel, 2003).

From empirical perspectives, Ho (2009) summarizes three types of measures for empirical investigation of the degree of financial integration including, interest rate differentials of (Frankel and MacArthur, 1988). A recent example for instance could be, Mohsin and Rivers (2011), who studied and documented empirical evidence for the financial integration in south Asian markets under this interest rate differential and a modified form of Feldstein Horoika (FH) model over the period of 1970-2006. Secondly, the IMF developed an on/off indicator to indicate the restrictions for cross border capital flows. An example of this measure is Quinn (1977). The IMF's measure is a description of current controls and assigns a dummy of zero and one to indicate the absence and presence of restrictive rules on current and capital accounts. And finally a popular ratio of international assets and liabilities as a percentage of GDP is also used to measure the actual ratio of financial openness. In this regard a classical example comes from Fleming and Mundell (1963) that argued that aggregate policy indicators remarkably depends on the opening of the financial system.

Given the above reflections and further alluded to the theories and conceptual discussions regarding the integration among financial markets, it does suggest that sufficient economic conditions exist for the financial integration to lead towards convergence in returns in the long run. Furthermore it is expected that markets are tend to be more efficient with more integration. Hence with this backdrop we study the integration among financial markets in Pakistan.

Research Methodology

In this study we utilize relatively high frequency time series data for monthly observations over the period of Jan-2001 to most recent of June-2014. The data in this study is acquired from the State Bank of Pakistan Statistical Bulletins (henceforth SBP), and the variables included in the model(s) are based on well-established economic theory and long standing economic relationships.

Given the above discussions in the preceding chapter, to model the underlying dynamic relationship and the interlinkages among the time series variables, we propose a dynamic granger causality approach. The Granger causality approach has been chosen in this study because of its promising response to both large and small samples Odhiambo (2009). However before addressing the causality issues, we first need to ascertain the cointegration or the long run steady state equilibrium relationship among the variables. The long run cointegration in time series can be estimated with various methods like the traditional Engle and Granger (1987) or the Johansen (1990) approaches. However the traditional cointegration methods have certain shortcomings in the case of small samples. Furthermore, if variables are not stationary then first differencing of the same is required which means loss of degrees of freedom. That is why in this study we employ the modified Autoregressive Distributed Lag Model (ARDL) based bounds testing approach to cointegration that is relatively newly advanced by Pesaran, Shin and Smith (2001). The ARDL bounds testing approach to cointegration bears several advantages against the traditional methods of cointegration like it allows for testing of cointegration in the case of arbitrarily mixed order of integration: no matter if the variables in the model are integrated of order I(1), I(0) or even fractionally integrated in the case of I(1)/I(0). Further Pesaran and Shin (1999) has confirmed by Monte Carlo simulation that the bounds testing perform better in the case of small samples as compared to other conventional methods. There are several examples which can be presented in this regards like Tang and Nair (2002), Narayan and Smyth (2003) and Narayan and Smyth (2004) among others who worked effectively with small samples using the bounds testing approach to cointegration. Furthermore the ARDL can easily be reparametrized to yield a dynamic mechanism of unrestricted error correction model (UECM) by means of simple linear transformation. The UECM has a greater advantage that without compromising to lose the long run information, it can integrate the short run underlying forces with the long run equilibrium, (Shahbaz et al. 2013). In such case scenarios, the UECM bounds testing becomes very handy as it does not push the short run dynamics into the residual term. (Banerjee et al. 1993; 1998)

Moreover, under the bounds testing UECM, we can simultaneously estimate both the long and short run dynamics of the parameters in a single equation setting, hence providing a great deal of ease to researchers to deal with the issues of simultaneity and endogeneity in the model. And finally the ARDL bounds testing is reported to provide unbiased long run estimates and valid t-statistics even in the presence of endogenous variables (Narayan, 2005: Odhiambo, 2009: Amusa et al. 2009).

In addition, as bounds testing is independent of the pre-testing condition of the order of integration, Pesaran and Pesaran (1997) argues that this pre-testing can sometimes be problematic in the cases where the unit root tests have limited or low power and in the cases where there is a switch between the distribution function of the test statistics where one or more roots of the X_t process approach unity.

We start with the following basic representation of an ARDL (*p,q*) model:

$$\Delta y_t = \alpha_o + \alpha_1 y_{t-1} + \beta_1 x_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta y_{t-j} + \sum_{i=0}^{q} \delta_i \Delta x_{t-i} + u_t \quad \ldots (1)$$

In the similar fashion, an ARDL (*p,q*) model in the form of unrestricted error correction model (UECM) from equation (1) can be specified as:

$$\Delta y_t = \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{p-1} \delta_j \Delta x_{t-j} + \varphi[y_{t-1} - \{\beta_o + \beta_1 x_{t-1}\}] + \varepsilon_t \ldots (2)$$

Where X_t is a set of explanatory variables and γ and δ stands for the short run coefficients for the lagged dependent and explanatory variables respectively. Moreover β represents the coefficients in the long run and φ is the coefficient denoting the speed of adjustment towards the equilibrium process in the long run. The expressions within the square brackets include the regression for the long run growth that tends to act as forcing for equilibrium. Finally the ε_t is a white noise or stochastic disturbance term expressed under the assumption as; $\varepsilon_t \sim IID(0, \sigma^2)$. All β_i are believed to be BLUE under these assumptions (Aleemi & Azam, 2015).

Resultantly, equation (2) is represented to produce the following models:

$$\Delta \ln SP_t = \beta_o + \sum_{i=1}^{p} \beta_i \Delta \ln SP_{t-i} + \sum_{j=0}^{q} \beta_j \Delta \ln ER_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln IR_{t-k} + \alpha_0 \ln SP_{t-1} + \alpha_1 \ln ER_{t-1} + \alpha_2 \ln IR_{t-1} + \mu_t \ldots (3)$$

$$\Delta \ln ER_t = \beta_o + \sum_{i=1}^{p} \beta_i \Delta \ln SP_{t-i} + \sum_{j=0}^{q} \beta_j \Delta \ln ER_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln IR_{t-k} + \alpha_0 \ln SP_{t-1} + \alpha_1 \ln ER_{t-1} + \alpha_2 \ln IR_{t-1} + \mu_t \ldots (4)$$

$$\Delta \ln IR_t = \beta_o + \sum_{i=1}^{p} \beta_i \Delta \ln SP_{t-i} + \sum_{j=0}^{q} \beta_j \Delta \ln ER_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln IR_{t-k} + \alpha_0 \ln SP_{t-1} + \alpha_1 \ln ER_{t-1} + \alpha_2 \ln IR_{t-1} + \mu_t \ldots (5)$$

Where
Δ is the first difference operator
$lnSP_t$ = KSE-100 Share Price Index
$lnIR_t$= Interest Rates, represented by 30 days KIBOR rate
$lnER_t$= Exchange Rate (Local currency against US $)
μ_t= Stochastic disturbance term with white noise properties.
All the data is in natural log form.

Notice that equations (3) to (5) are more like a traditional ECM, Except that we have replaced the Error Correction term with that of α's, and what we are doing here is that we do not restrict their coefficients and hence we call it the "Unrestricted ECM" or in the words of Pesaran et al. "Conditional ECM".

The next step to ascertain the long run and steady state equilibrium in the model is to estimate the combined significance of the lagged variables in order to find cointegration. For that purpose, all we have to do is to estimate the associated F-Statistic by finding the joint significance of the coefficients with the traditional Wald test. The asymptotically distributed F-Statistic is tested under the null hypothesis that in the above equations (3) to (5);

$$H_0: \alpha_o + \alpha_1 + \alpha_2 = 0$$

Against the alternative that H_0 is simply not true. The rejection of H_0 indicates the presence of long term relationship. The bounds testing procedure is based on the non-standard distribution of asymptotic joint F-Statistic tested under the null hypothesis of no cointegration. Unfortunately the exact critical values for the asymptotic F-Statistic are not available for an arbitrary mix of $I(0)$ and $I(1)$ variables. However Pesaran et al. provided us with two asymptotic critical bounds for a given level of significance, the lower bound assumes the variables to be $I(0)$, while the upper bound assumes the variables to be $I(1)$. Where if the estimated test statistic falls below the lower critical bound, the null hypothesis of no cointegration cannot be rejected, and above the upper critical bound, the null hypothesis is rejected indicating cointegration among the variables in the model, whereas if the estimated F statistic falls between the two extremes, the result is inconclusive.

TYDL-Granger Causality Approach

Various time series techniques are available to model the underlying dynamic relationship among time series, however the issue of causality is widely been debated in empirical literature. Granger (1969) analyzed the underlying dynamic causal relationship among variables in term of granger causality test which requires the included variables in the model must be stationary. In absence of cointegration, granger causality is performed through first differencing of the variables in an augmented VAR system, however in the presence of cointegrating vector the granger causality is widely tested through Error Correction Model (ECM) and Vector Error Correction Model (VECM). However Toda and Yamamoto (1995) argue that in an unrestricted VAR the asymptotic distribution of the test has nonstandard distribution and nuisance parameter. Similarly Rambaldi and Doran (1996) and Zapata and Rambaldi (1997) contend that in a finite sample the ECM and VECM causality analysis is sensitive to the value of the nuisance parameter and hence make the results slightly unreliable. Similarly Sims (1972) has shown that in the presence of cointegration, testing granger causality in a bi-variate model is mainly due to an omitted variable which may be causing one or both of the variables provided in a univariate system, making the causal inferences to be unreliable. That's why in a possibly cointegrating system, testing for causality in a possibly unstable VAR has become an issue of grave concerns.

Resultantly, to address this issue Sims et al. (1990) proposes a trivariate VAR system which was later on extended by Toda and Phillips (1993) and then on by Toda and Yamamoto (1995) who proposed a modified granger causality approach, which requires estimating a VAR in levels and augmented with the maximum order of integrations among the variables in model denoted as d. Accordingly the procedure is then based on applying linear restrictions on the resultant unrestricted VAR (k) model by Wald test statistic for testing Granger non-causality that will have asymptotic χ^2 distribution when a VAR ($k+d_{max}$) model is estimated which means that there is sufficient cointegration.

However Giles and Mirza (1990) raised another important point that testing for granger causality requires pre testing for stationarity and cointegration, as a result there is a chance of over rejecting of the null hypothesis of non-causality and can potentially lead us to wrong notions about causal flow. To cater with such inferential distortions, Toda and Yamamoto (1995) and Dolado and Lutekpohl (1996), proposed an alternative measure for causality testing that is most commonly referred to as TYDL model. In this study we use the said TYDL model to estimate the long run causal relationship among the variables in our model.

The pragmatic grounds for selecting TYDL model are that it does not require pre testing for stationarity and cointegration. However Padhan (2007) argues that it is a complementary method and does not necessarily imply the replacement for the conventional testing of the same. Furthermore Yamada and Toda (1998) performed a Monte Carlo simulation to investigate the performance of three causality approaches namely, ECM (Error Correction Modeling), FMVAR (Fully Modified VAR) and TYDL; they found that ECM and FMVAR tend to suffer from larger size distortions as compared to TYDL approach.

Given the superiority of the TYDL, we specify the following augmented VAR model in levels with $p = (k + d_{(max)})$ lag length;

$$\boldsymbol{X_t = \mu_t + \sum_{i=1}^{p-1} \Gamma_i X_{t-k} + \varepsilon_t} \qquad \dots (\mathbf{6})$$

Where X_t is r x 1 column vector of p variables, μ is an n x 1 vector of constant term, Γ is coefficient matrix while k signifies maximum lag length whereas ε_t is a p dimensional Gaussian error term with white noise properties i.e. independently and identically distributed i.i.d. (Padhan, 2007).

In a bivariate system, the augmented Toda and Yamamoto (1995) Granger causality test is expressed by the following systems;

$$\boldsymbol{Y_t = \alpha + \sum_{i=1}^{k+d} \beta_i Y_{t-i} + \sum_{i=1}^{k+d} \gamma_j Y_{t-j} + \varepsilon_t} \qquad \dots (\mathbf{7})$$

$$\boldsymbol{X_t = \alpha + \sum_{i=1}^{k+d} \vartheta_i X_{t-i} + \sum_{i=1}^{k+d} \delta_j X_{t-j} + \varepsilon_t} \qquad \dots (\mathbf{8})$$

Where d is the maximal order of integration and k is the optimal lag length for Y_t and X_t, whereas ε_t are error terms with white noise properties of zero mean, constant variance and no autocorrelation.

TYDL is a two-step approach, initially the optimal lag length is determined with appropriate information criteria like AIC or SIC among others, whereas the second step involves selecting the maximal order of integration (d_{max}). The estimation of the above augmented VAR warrants the asymptotic χ^2 distribution of the modified Wald statistic (MWald). The above bivariate augmented VAR system is usually estimated with SURE method (Seemingly Unrelated Regression Estimation), in this study we would follow the same as Rambaldi and Doran (1996), shows that the efficiency of the Wald test is improved when SURE method is used. In necessary conditions, equations (7) and (8) can also be augmented with linear deterministic and quadratic trends and even other auxiliary variable might be included. In similar fashion we specify the following tri-variate system for this study as:

$$\begin{bmatrix} lnSP_t \\ lnER_t \\ lnIR_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} + \sum_{i=1}^{k+d} \begin{bmatrix} lnSP_{t-i} \\ lnER_{t-i} \\ lnIR_{t-i} \end{bmatrix} \begin{bmatrix} \beta_{1i}\gamma_{1i} & \emptyset_{1i} \\ \beta_{2i}\gamma_{2i} & \emptyset_{2i} \\ \beta_{3i}\gamma_{3i} & \emptyset_{3i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \dots . (9)$$

To test the causal flow that $lnER_t$ and $lnIR_t$ does not Granger causes $lnSP_t$ in the above model, the following null hypothesis can be drawn as;

$$H_0: \beta_{11} = \beta_{12} = \beta_{13} = 0$$

Or in other terms causality from $lnSP_t$ to $lnER_t$ and then to $lnIR_t$ implies that $\beta_{1i} \neq 0 \ \forall_i$. Similarly other null hypotheses for $lnER_t$ and $lnIR_t$ are drawn as follows;

$$H_0: \gamma_{11} = \gamma_{12} = \gamma_{13} = 0$$
$$H_0: \emptyset_{11} = \emptyset_{12} = \emptyset_{13} = 0$$

Significantly rejecting these null hypotheses would imply the existence of causality between Share Prices, Exchange Rate and Interest Rate, which would be established through the significance of the MWALD statistic for the above identified group of lagged independent variables.

Empirical Results

Some preliminary descriptive statistics along with correlations among the three variables is presented in Table-I below.

Table 1. *Descriptive Statistics and Correlation Matrix*

Variables	$ln\mathrm{SP}_t$	$ln\mathrm{ER}_t$	$ln\mathrm{IR}_t$
Mean	8.874049	4.252592	1.979873
Median	9.156030	4.117347	2.209921
Maximum	10.05676	4.670302	2.623218
Minimum	7.033004	4.047038	-0.174353
SD	0.786314	0.196703	0.685459
Skewness	-0.904059	0.532572	-1.604929
Kurtosis	2.750535	1.648877	4.543153
Jaque-Bera	21.37727	18.99375	81.39229
Probability	0.000023	0.000075	0.000000
$ln\mathrm{SP}_t$	1.000000		
$ln\mathrm{ER}_t$	0.582280	1.000000	
$ln\mathrm{IR}_t$	0.415824	0.584188	1.000000

In order to ascertain the order of integration that is $d_{(max)}$,in this study we performed two unit root test i.e. ADF (Augmented Dickey Fuller) and PP (Philips Perron) test. The results for the two are presented in Table-II below;

Table 2*: Unit Root Test for the order of integration*

Variables	ADF		PP	
	At Level	1st Difference	At Level	1st Difference
$lnSP_t$	-1.535827	-11.50055*	-1.588474	-11.47968*
$lnER_t$	-2.216759	-6.542458*	-1.871913	-10.67998*
$lnIR_t$	-1.981702	-11.37667*	-2.036626	-11.33949*

*denotes significance at the 1% level of significance.

Both of the tests conclude that all of the three variables under study become stationary at first difference that is the maximum order of integration is one *I*(1). These results are in line with Khalid et al. (2006) who utilized daily observations for Exchange rate, Interest rate and Share Prices over the period of 1999-2005 and reported the three variables to be integrated of order one *I*(1). The next step is to ascertain the maximum lag length (*k*) for the augmented VAR, which is selected on the basis of AIC (Akaike Information Criteria) and SC (Schwarz Bayesian Information Criteria) with the results presented in the following table. Both of the above mentioned criteria select a maximum lag length of one for the variables in our model.

Table 3: *VAR Lag Length Selection*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-210.4222	NA	0.003735	2.923592	2.984899	2.948502
1	676.6898	1725.615	2.23e-08*	-9.105340*	-8.860112*	-9.005698*
2	681.7274	9.592200	2.35e-08	-9.051061	-8.621912	-8.876688
3	689.3087	14.12407	2.40e-08	-9.031627	-8.418557	-8.782522
4	702.6208	24.25343	2.27e-08	-9.090696	-8.293705	-8.766860

* indicates Lag Length selected by the Criterion

With these preliminary and background information at hand, an ARDL Bounds test has been performed to ascertain the long run steady state equilibrium relationship between the variables. The results for our ARDL have been presented in the Table-IV below and the associated F-Statistic has been obtained to find the long run cointegrating relationship accordingly.

Table 4: *ARDL bounds test for cointegration*

Variables	$lnSP_t$	$lnER_t$	$lnIR_t$
F-Statistics	2.756006	4.760128**	2.679632
Critical Bounds	1%	5%	10%
I(0)	4.29	3.23	2.72
I(1)	5.61	4.35	3.77
R^2	0.061353	0.150043	0.155977
Adj. R^2	0.022779	0.115114	0.121052
F-Statistics	1.590515	4.295579*	4.466054*

Diagnostic Tests

Test	F-Statistic	P. Value	F-Statistic	P. Value	F-Statistic	P. Value
χ^2 Normal	0.19832	0.9343	2.01321	0.3601	3.13001	0.2078
χ^2 Serial	0.34571	0.5934	0.90884	0.4142	0.93457	0.4976

χ^2 ARCH	0.18507	0.6977	0.19806	0.6502	0.20136	0.6187
χ^2 White	0.15933	0.8902	0.67293	0.7330	0.43265	0.5208
χ^2 Ramsey	1.99086	0.1817	1.17088	0.2787	2.17175	0.1557

*, ** and *** denotes statistical significance at 1, 5 and 10% levels. An ARDL (1,1,1,0) selected on the basis of AIC and SIC.

For the critical values Pesaran et al. (2001), Table CI(iii) case(III) has been adopted for the reason being that we are neither restricting our intercept nor including any linear trend in our model. The results show that the estimated F-Statistic exceeds the critical upper bound in the case of Exchange Rate ($lnER_t$) at 5 and 10% levels, rejecting the null hypothesis of no cointegration and implying the presence of cointegration when $lnER_t$ is used as predicted variable. However the rest of the F-Statistics for $lnSP_t$ and $lnIR_t$ falls below the lower critical bounds where we fail to reject the null hypothesis of no cointegration. Hence it can be said that a steady state long run equilibrium exist between the three variables when $lnER_t$ is taken as independent variable. However we also checked the robustness our ARDL estimates by performing Johansen cointegration Test with the results as follows;

Table 5. *Johansen Cointegration Test*

Hypotheses	Trace Statistics	Maximal Eigenvalue
R = 0	54.79186*	41.57340*
R ≤ 1	13.21845	10.05096
R ≤ 2	3.167487	3.167487

* denotes statistical significance at 1%

Again both of the Trace Statistics and the Maximal Eigenvalues in the Johansen Cointegration test indicate the praesence of one cointegrating vector or one cointegrating equation in our model, producing remarkably consistent results with the ARDL Bounds testing proposed in this study and confirms that a steady state long run equilibrium relationship exists between Share Prices, Exchange Rate and Interest Rate in the case of Pakistan. However these results are in contrast to that of Khalid et al. (2006) who found no cointegration among the three markets over the period of 1999-2005.

Finally we also check the structural stability of our ARDL models by Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Recursive Residual Squared (CUSUMSQ) with the results reported by Figures 1, 2 and 3 for our models 3, 4 and 5 respectively. The tests are significant at 5% level implying that all the final estimated models are structurally dynamically stable as the estimated recursive residuals are strictly within the critical bounds.

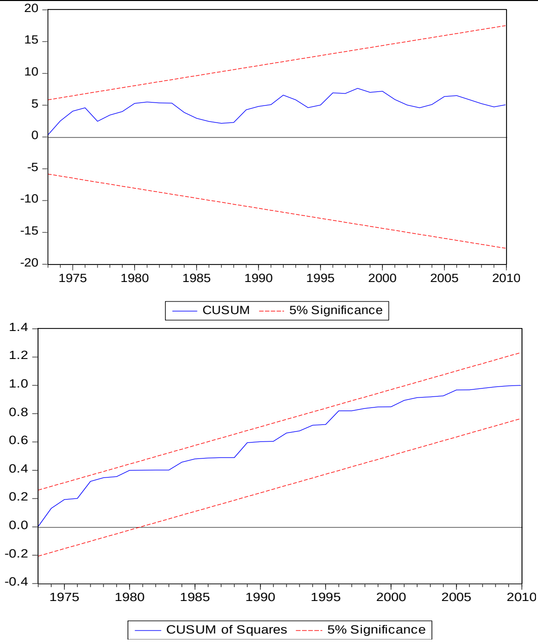

Figure 1. *Stability test for Equation (3)*

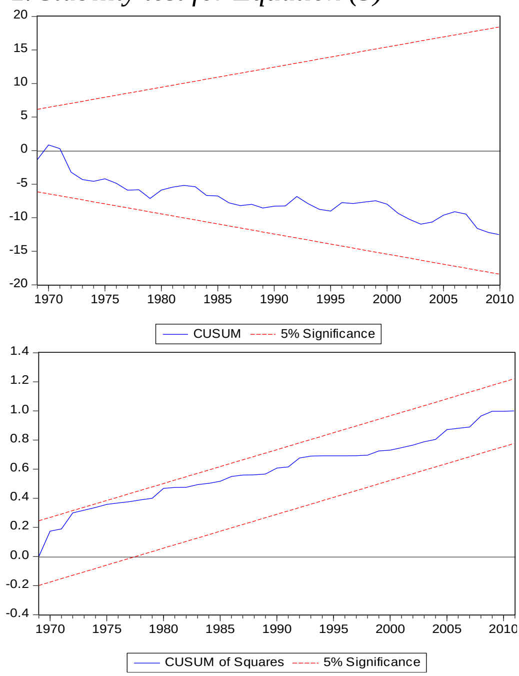

Figure 2. *Stability test for Equation (4)*

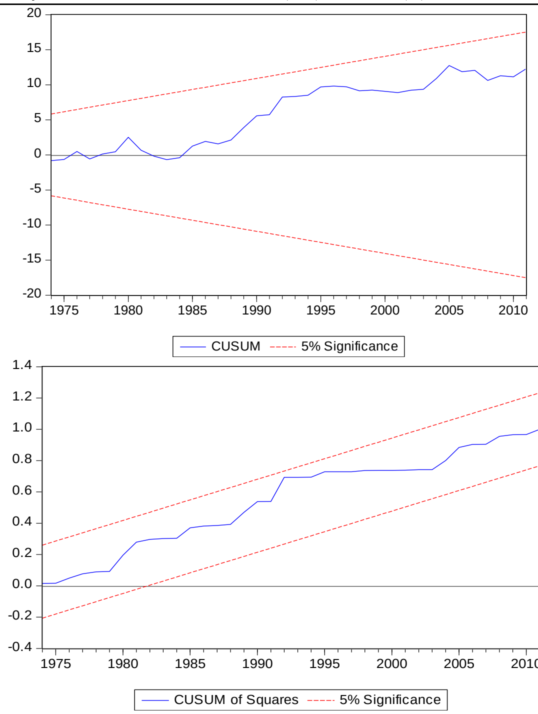

Figure 3. *Stability test for Equation (5)*

TYDL Granger Causality Analysis

The existence of the long run relationship leads us to find out the direction of causality. We employed the TYDL Granger Non-Causality framework to find out the causal nexus or the interlinkages among Share Prices, Exchange Rate and Interest rate for Pakistan that will have crucial implications by understanding the underlying dynamic relationship between financial markets. The results of the TYDL Granger Non-Causality with the modified Wald statistics are presented in table VI;

Table 6: *TYDL Granger Non-Causality Test Results*

Null Hypotheses	MWald Test (χ^2 Statistic)	P-Values	Decision
$lnSP_t$ does not Granger causes $lnER_t$	8.35885*	0.0153	Reject the Null
$lnER_t$ does not Granger causes $lnSP_t$	7.12357**	0.0284	Reject the Null
$lnSP_t$ does not Granger causes $lnIR_t$	4.36430	0.1128	Fail to Reject the Null
$lnIR_t$ does not Granger causes $lnSP_t$	6.00948**	0.0496	Reject the Null
$lnER_t$ does not Granger causes $lnIR_t$	10.45582*	0.0054	Reject the Null
$lnIR_t$ does not Granger causes $lnER_t$	0.27268	0.8725	Fail to Reject the Null

*, ** and *** indicates significance at 1, 5 and 10% levels.

As indicated by the MWald χ^2 test statistics, there is a bi-directional causality between Share Prices and Exchange Rate, and unidirectional causal relation running from Interest Rate towards Share Prices and from Exchange Rate towards Interest Rates. Khalid et al. (2006) reported unidirectional causality from currency market towards stock market and from stock market towards money market under the standard Granger causality framework. The results in this study however endorse the former causal flow and refutes the later in the most recent scenario for Pakistan.

Conclusion

In this study we investigated the dynamic interlinkages between the money, currency and capital market of Pakistan with most recent and relatively high frequency data for the period of Jan-2001 to June-2014. Utilizing three different and relatively advanced econometric testing procedures to find whether the three markets are interlinked in the context of Pakistan. The empirical findings based on the ARDL Bounds testing produces that a steady state long run equilibrium relation exists among the three markets of Pakistan which is also confirmed by the Johansen cointegration analysis. The findings of the long run relationship led us to investigate the causal relationship, we did this by the augmenting a VAR under the TYDL Granger Non-causality approach which to the best of our knowledge is the first attempt of its kind in the case of Pakistan. The empirical results of the TYDL Granger Non-causality found interlinkages among the three markets suggesting bi-directional causality among stock market and currency market whereas unidirectional causal flow is been established from money market to stock market and from currency market towards money market of Pakistan.

Provided with the fact that the three markets are interlinked, it is therefore suggested that any policy measure in this regard should be mindful of the implications of the decision. As a way forward; integrated financial markets are vital for the transmission process and subsequently for the smooth conduct of monetary policy measures. In addition, financial integration also leads to better diversification of risks and makes a positive contribution to financial stability by enhancing the ability of the economies to absorb potential shocks. However, on the other hand, highly integrated financial markets also bear the potential risk to amplify shocks to propagate more quickly among economic agents and market participants, which needs to be mitigated appropriately. To mitigate the risks and maximize benefits from financial integration, it is imperative that the financial markets are developed further. Enhanced co-operation among various regulatory authorities is also important for ensuring effective corrective action in an increasingly integrated environment. Further, it is necessary to establish further linkages amongst the various components of financial infrastructure – the trading, payment, clearing, settlement and custodian systems.

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