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Capital Inflows, Inflation, and the Exchange Rate Volatility: An Investigation for Linear and Nonlinear Causal Linkages

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This paper empirically examines the effect of foreign capital inflows on domestic price levels, monetary expansion, and the exchange rate volatility for Pakistan using linear and nonlinear causality tests. The key message emerging from the analysis is that there is a significant inflationary impact of capital inflows, in particular during the period of surges in capital inflows. Specifically, we find evidence of a significant nonlinear Granger causality running from capital inflows to the change in domestic prices. We also show that domestic prices are nonlinearly caused (in Granger sense) by the growth of domestic debt and money supply-to-GDP ratio. Our results, however, suggest that the market interest rate and the nominal exchange rate do not have significant relationships with domestic prices. The findings suggest that there is a need to manage the capital inflows in such a way that they should neither create an *inflationary pressure* in the economy nor fuel the *exchange rate volatility*.

JEL Classification: C22, C32, F21, F31, F32
Keywords: Capital Inflows, Inflationary Pressures, the Exchange Rate Volatility, Monetary Expansion, Nonlinear Dynamics

1. INTRODUCTION

Examination of how macroeconomic indicators respond to foreign capital inflows is important to understand the role of foreign funds in host countries. Several studies have empirically examined the effects of ebbs and surges in capital inflows on macroeconomic performance of host countries. The findings of these studies are inconclusive at best, however. On the one hand, large number of studies have documented that surges in foreign capital inflows help promote investments, stimulate economic development, improve resource allocation, interact human capital, deepen domestic financial sector, and encourage positive growth externalities. Examples of these studies include, among others, De Mello (1996, 1997), Reisen and Soto (2001), Hermes and Lensink (2003), Alfaro, *et al.* (2004), Buch, *et al.* (2005), Adams (2009), Wang and Wong (2009), Choong, *et al.* (2010), and Azman-Saini, *et al.* (2010). Researchers have also shown that access to international funds help countries in attaining sustainable economic growth,

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provide benefits associated with international financial integration, and ensure domestic macroeconomic stability [Kose, *et al.* (2009) and Obstfeld (2009)].

On the other hand, several studies have argued that the abrupt integration of emerging market countries with international capital markets has created some problems for the host economies. In particular, researchers have observed that foreign capital inflows create difficulties for the recipient countries [e.g., Rodrik and Velasco (1999), Aghion, *et al.* (2000), Ventura (2002), Eichengreen (2004), Caballero and Krishnamurthy (2006), Baharumshah and Thanoon (2006), Edwards (2007a, 2007b), Mendoza and Terrones (2008), Reinhart and Reinhart (2008), Caballero, *et al.* (2008), Hegerty (2009), Cardarelli, *et al.* (2010), Kim and Yang (2011), Furceri, *et al.* (2011), Cecen and Xiao (2012), Sethi and Sucharita (2012), Caballero (2012), and Furceri, *et al.* (2012)]. These difficulties generally include appreciation in currencies and in turn loss of foreign competitiveness, high inflation rates, and increased vulnerability to banking crises. Large capital inflows also help fuel headwinds in financial markets, surges in money supply, excessive private credit growth, spending booms, asset market bubbles, and the undermining of a strategy to achieve monetary stability by pegging the exchange rate. Further, some studies such as Bernanke (2005) argue that a glut of global savings leads to large international trade imbalances.[1]

There is a growing agreement in the literature that preserving stability of real and financial sectors during episodes of surges in international capital inflows requires effective *absorption* and *sterilisation* of foreign capital inflows.[2] For instance, the central bank should intervene in the foreign exchange market in order to absorb the foreign exchange brought in by the capital inflows. However, such policy measures are not costless. For example, buildup of foreign reserves as a result of the central bank's foreign exchange purchases not only helps increase the *monetary base* of the economy but also expands bank deposits and loans. Such surges in the money supply result in excessive private credit growth and in a sequence generate inflationary dynamics. Further, the expansion of bank balance sheets owing to international capital inflows may increase the fragility of the banking system if bank supervision is weak.

In theory, the effects of capital inflows on domestic financial and real indicators depend on the ways in which they flow into an economy. The effects also depend on whether the inflows are sustainable or temporary. Theoretically, the forces driving capital inflows differ from country to country and can be classified into three clusters: (1) an exogenous increase in the domestic productivity of capital, (2) an autonomous increase in the domestic money demand function, and (3) external factors, such as a reduction in international interest rates. The former two are known as "*pull*" factors and the latter one is called "*push*" factor.[3]

[1]However, Laibson and Mollerstorm (2010) show that instead of an excessively abundant supply of global savings, mismatch of international balances is mainly the result of domestic consumption booms and national asset bubbles.

[2]See Obstfeld, *et al.* (2005), Reinhart and Reinhart (2008), Glick and Hutchison (2009), Aizenman and Glick (2009), Cardarelli, *et al.* (2010), and De Gregorio (2012) for effective policy measures in response to capital flow bonanzas.

[3]Other things remain constant, capital inflows owing to "pull" factors will cause an upward pressure on domestic interest rates, whereas, capital inflows caused by "push" factors, such as a fall in international interest rates, will have a tendency to put downward pressure on domestic interest rates on one hand. On the other hand, it will initially drive up nominal and real balances, but then, as domestic price level increases, real balances may decline. See, Rashid and Husain (2010) for the potential differential effects of capital inflows caused by "pull" and "push" factors on financial indicators.

This paper aims to examine how domestic prices respond to foreign capital inflows. Specifically, we propose a simple empirical model of the equilibrium price by incorporating foreign capital inflows into the standard classical quantity theory of demand for money. We also empirically study the inflationary effects of capital inflows for a relatively small open economy, namely Pakistan, using monthly data covering the period 1990–2012. In particular, the paper investigates the causal linkages between capital inflows, domestic price levels, the growth of domestic debt, money supply, the market interest rate, and the nominal exchange rate using the linear and nonlinear cointegration and Granger causality tests. The paper also examines the impact of capital inflows on the exchange rate volatility. The full sample period is divided into two sub-samples in order to examine the differential effects of capital inflows across episodes of low and high capital inflows. Three different measures of foreign capital inflows are used in empirical investigation.

The results of the paper suggest a significant inflationary impact of foreign capital inflows, in particular during the period of surges in capital inflows. Specifically, we show that there is a significant co-movement in capital inflows and the price level. Results concerning short-run dynamics indicate that there is significant linear as well as nonlinear Granger causality running from capital inflows to the rate of inflation. Our regression results also reveal that domestic prices are nonlinearly caused (in Granger sense) by the growth of domestic debt and the money supply-to-GDP ratio. However, our results suggest that the market interest rate and the nominal exchange rate do not have significant relationships with domestic prices. We also observe that capital inflows amplify the volatility of real effective exchange rate irrespective of whether the influx of foreign capital is low or high.

The rest of the paper proceeds as follows. Section 2 reviews the inflow of foreign funds and the rate of inflation in Pakistan. Section 3 describes the empirical model, the empirical methodology, and the data used to assess the relationship between capital inflow surges and the price level. Section 4 presents the empirical results. Section 5 concludes the paper.

2. FOREIGN FUNDS AND THE RATE OF INFLATION: PAKISTANI CONTEXT

We start our empirical investigation by estimating correlations between foreign capital inflows and the other variables included in the analysis. We divide the full-sample period into two sub-periods. The first sub-sample period ranges from January 1990 to December 2000, while the second sub-sample runs from January 2001 to June 2012. This division seems rational because there was a large capital surge during 2001 to 2012. The correlation matrices for first and second sub-sample periods are presented in Tables1 and 2, respectively.[4,5]

[4]See data Section 4 of the paper for definition of the variables.

[5]The breakdown of the whole sample is based on the flow of foreign capital inflows, as our main objective is to analyse the differential effect on domestic price levels and the exchange rate volatility of foreign capital inflows across low and large flows. However, one should note that the objective of our study is not to test apparently the presence of structure break in the capital inflows–domestic prices relationship. For testing the possibility of structure breaks, a separate comprehensive analysis is required. One may extend our analysis along these lines by applying sophisticated econometric techniques such as Carrion-i-Silvestre and Sanso (2006).

Table 1

Correlation Coefficients; Sample Period: January 1990 to December 2000

	Ratio Series				First Difference of Series			
Variables	CAR	FAR	FRR	MSR	LCPI	MMR	LNER	LDC
FAR	**–0.260**							
FRR	0.130	**0.648**						
MSR	**–0.322**	0.047	0.125					
LCPI	**0.316**	–0.023	0.130	–0.098				
MMR	–0.203	0.095	0.040	**0.246**	–0.089			
LNER	–0.037	–0.066	–0.129	0.022	–0.026	–0.040		
LDC	0.182	**–0.249**	–0.040	–0.003	0.011	0.229	**0.239**	
LMPI	**0.326**	–0.076	**0.166**	0.165	**0.395**	**0.314**	**0.403**	**0.415**

Note: Bold values indicate that the correlation is significantly different from zero at the 5 percent level. MMR = the market interest rate, LNER = the log of nominal exchange rate, LCPI = the log of consumer price index, FAR = net foreign assets-GDP ratio, CAR = capital account-GDP ratio, FRR = the ratio of foreign reserves to GDP ratio, LMPI = the log of manufacturing production index, MSR = the ratio of money supply to GDP, LDC = the log of domestic credit.

The correlation estimates suggest that the relationship among the variables has changed dramatically during the *massive* capital surge episode in 2001-2012. For instance, the ratio of money supply to GDP is significantly correlated (it is also interesting to note that the magnitude is negative) with the capital account to GDP ratio during the period 1990–2000 when the inflow of foreign funds was stumpy and inconsistent. The net foreign assets to GDP ratio and the foreign reserves to GDP ratio, however, are not significantly related to money supply during the period 1990–2000. During the period of relatively large capital inflows (2001 to 2012), not only the magnitude of correlation between the money supply-to-GDP ratio, the net foreign assets-to-GDP ratio and the foreign reserves-to-GDP ratio has considerably increased but also the correlation appears statistically significant. This implies that after the year 2001, the foreign capital inflows have played a significant role in expanding the monetary base of Pakistan's economy.

Table 2

Correlation Coefficients; Sample Period: January 2001 to June 2012

	Ratio Series				First Difference of Series			
Variables	CAR	FAR	FRR	MSR	LCPI	MMR	LNER	LDC
FAR	**0.436**							
FRR	0.121	**0.963**						
MSR	**0.763**	**0.834**	**0.827**					
LCPI	**0.439**	**0.509**	**0.483**	**0.354**				
MMR	**0.561**	**–0.361**	**–0.531**	–0.009	–0.023			
LNER	0.045	–0.128	–0.116	–0.071	–0.124	–0.036		
LDC	**0.283**	**0.365**	**0.358**	**0.523**	0.076	0.132	0.007	
LMPI	**0.639**	**0.708**	**0.583**	**0.472**	**0.677**	**0.537**	**0.556**	**0.693**

Note: Bold values indicate that the correlation is significantly different from zero at the 5 percent level. MMR = the market interest rate, LNER = the log of nominal exchange rate, LCPI = the log of consumer price index, FAR = net foreign assets-GDP ratio, CAR = capital account-GDP ratio, FRR = the ratio of foreign reserves to GDP ratio, LMPI = the log of manufacturing production index, MSR = the ratio of money supply to GDP, LDC = the log of domestic credit.

The estimates of the correlation between the rate of inflation and the net capital inflows-to-GDP ratio, the balance of capital account-to-GDP ratio, and the foreign reserves-to-GDP ratio provide fascinating insight about the association of foreign funds and inflationary pressures. The inflation rate is significantly correlated with the three ratios with a positive sign during the period of 2001-2012, whereas, it was only significantly related to the capital account-to-GDP ratio over the period 1990–2000. The growth in domestic debt is approximately 50 percent correlated with the monetary base of the economy during the latter sub-period, though both were independent of each other in earlier period.

In sum, the coefficients of correlation provide some preliminary evidence of the dynamic interactions between capital inflows and inflationary pressures: a theme that is explored in this paper. Moreover, the estimates of correlation clearly indicate that there is a *structure break* in 2001. Thus, it is very likely that *nonlinearities* exist in the salient economic relationships. This motivates us to apply the nonlinear cointegration and Granger causality test to examine the long- and short-run linkages among the variables.

The correlation coefficients presented in Tables 1 and 2 provide insights about the ineffectiveness of the policy used by the State Bank of Pakistan (SBP) to manage the foreign capital inflows, particularly, during the second sub-period. Theoretically, the change in monetary base driven by capital inflows depends on the central bank's decision to maintain a fixed exchange rate or to allow it to float freely with no intervention. If there is an intervention, then an accumulation of international reserves results in an increase in the net foreign exchange assets of the central bank and directly affects the monetary base of the economy. The inefficient intervention by the central bank further aggravates the problem of expansion in the monetary base.

For effective *absorption* and *sterilisation* of foreign exchange reserves, it is necessary to know whether the relationships between foreign capital inflows, the monetary base of the economy, and the price level, are stable in the long run or just short-term in nature. This paper tries to address this question. If there is a significant causation running from capital inflows to the rate of inflation, then, definitely, the continuity of the existing foreign exchange management policy could spell trouble for the economy.

Our paper contributes to the existing literature in at least four major dimensions. First, we propose a simple model for equilibrium prices, which predicts a positive impact of capital inflows on domestic price levels. Second, we empirically examine the influence of foreign capital inflows, the growth of domestic debt, the market interest rate, the monetary base of the economy, and the real and nominal exchange rates on domestic price levels. We also examine the impact of capital inflows on the exchange rate volatility. Third, and more importantly, we consider the possibility of nonlinearities in the relationship between capital inflows and the other underlying variables with domestic prices. Fourth, and finally, we examine the differential effects of capital inflows and the other said variables on the price level during periods of low (1990–2000) and high (2001–2012) capital inflows.

3. EMPIRICAL MODEL, METHODOLOGY, AND DATA

3.1. The Empirical Model

The impact of foreign capital inflows on domestic prices can be explained through the following example. Suppose the private sector of an economy receives a gift of G dollars from abroad. Now government does not allow the private sector to use these dollars and buys the dollars from the private sector at the current exchange rate, e, and adds G dollars to its reserves. Consequently, the aggregate expenditures can be defined as follows:

$$E = \bar{M} + eG \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where E denotes the nominal expenditures on goods and services, $\bar{M}$ is the pre-gift nominal money stock, and e is the nominal exchange rate. As expression (1) also represents the demand for money, the money market equilibrium condition is:

$$M^d = M^s = \bar{M} + eG \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Considering the quantity theory of demand for money, the nominal price (P_N), in equilibrium is defined as[6]

$$P_N = \frac{V \times M^s}{Y} = \frac{V \times \bar{M} + eG}{Y} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

Where V is the income velocity of money and Y denotes the aggregate level of output. Equation (3) describes a positive relationship between foreign capital inflows and domestic price levels (i.e., $\frac{\partial P_N}{\partial G} > 0$) and negative relationship between the level of output and prices (i.e., $\frac{\partial P_N}{\partial Y} < 0$). Thus, as long as the government adds the gift G to its reserves, and does not allow it to be absorbed in the economy, it would produce only an inflationary effect.

Different explanatory variables are used in estimation of Equation (3) to ensure that empirical links between capital inflows and inflationary dynamics are not spurious. The choice of explanatory variables in our empirical work is based on availability of data, previous evidence found in the literature, and aforesaid theoretical rationale.

3.2. The Empirical Methodology: Nonlinear Cointegration and Granger Causality Tests

Regarding the linear long- and short-run relationship, we use the standard Johansen's cointegration test and the Granger causality test, respectively. As these two tests are very common in the literature. Below, however, the nonlinear cointegration and causality tests are explained in detail. We use the Lin and Granger (2004) tests to explore the nonlinear long-run relationships between foreign capital inflows and domestic price levels.

[6]We can understand that prices in a country such as Pakistan are not fully determined by market forces. They are commonly twisted by providing subsidies and setting ceiling and floor price. However, we do not consider government distortion in price determination in order to keep our model simple.

As in Lin and Granger (2004), let x_t be a linear integrated process and y_t and x_t are nonlinearly cointegrated with function f provided $u_t = y_t - f(x_t)$ has asymptotic order smaller than those of y and $f(x)$. Lin and Granger (2004) define the following steps to test the null of nonlinear cointegration against alternative of no nonlinear cointegration.

(1) Identify the possible nonlinear function for using Alternative Conditional Expectation (ACE) criterion (i.e., logarithm, exponential, square root, Box-Cox transformation, etc.).
(2) Apply the Nonlinear Least Square (NLS) method to estimate the parameters of the specified function.
(3) Obtain the residuals from the estimated model and store.
(4) Apply KPSS test for estimated residual to test the null of nonlinear cointegration.[7]

To examine the nonlinear short-run causality, we use the Hristu-Varsakkeis and Kyrtsou (2010) nonlinear Granger causality test—known as the bivaraite noisy Mackey-Glass (hereafter M-G) model and is based on a special type of nonlinear structure developed by Kyrtsou and Labys (2006). The model is given below:

$$X_t = \alpha_{11}\frac{X_{t-\tau_1}}{1+X_{t-\tau_1}^{c_1}} - \delta_{11}X_{t-1} + \alpha_{12}\frac{Y_{t-\tau_2}}{1+Y_{t-\tau_2}^{c_2}} - \delta_{12}Y_{t-1} + \xi_{1t}\ \xi_{1t} \approx N(0,1) \quad \ldots \quad (4)$$

$$Y_t = \alpha_{21}\frac{X_{t-\tau_1}}{1+X_{t-\tau_1}^{c_1}} - \delta_{21}X_{t-1} + \alpha_{22}\frac{Y_{t-\tau_2}}{1+Y_{t-\tau_2}^{c_2}} - \delta_{22}Y_{t-1} + \xi_{2t}\ \xi_{2t} \approx N(0,1) \quad \ldots \quad (5)$$

where X and Y are a pair of related time series variables, the α_{ij} and δ_{ij} are parameters to be estimated, τ_l are delays, c_i are constants.

As mentioned in Kyrtsou and Labys (2006, 2007), Kyrtsou and Vorlow (2009), and Kyrtsou and Terraza (2010), the principle advantage of Model (4) over a simple VAR alternative is that the nonlinear M-G terms are able to capture more complex dependent dynamics in a time series. The test aims to capture whether past samples of a variable Y have a significant nonlinear effect (of the type $\frac{Y_{t-\tau_2}}{1+Y_{t-\tau_2}^{c_2}}$) on the current value of variable X.

Testing procedure begins by estimating the parameters of a M-G model that best fits the given series, using ordinary least squares. To test reverse causality (i.e., from X to Y), a second M-G model is estimated, under the constraint $\alpha_{22} = 0$. Let $\hat{\xi}_{1t}$ and $\hat{\xi}_{1t}$ be the residuals produced by the unconstrained and constrained best-fit M-G models, respectively. Next, we compute the sums of squared residuals $S_c = \sum_{t=1}^{N}\hat{\zeta}_{1t}$ and $S_u = \sum_{t=1}^{N}\hat{\xi}_{1t}$. Let m be the number of free parameters in the M-G model and k is the

[7]Lin and Granger (2004) argue that if the null hypothesis is specified as cointegration, then the KPSS test would give the right distribution under the null hypothesis and power approaching one as sample size grows under the alternative.

number of parameters set to zero when estimating the constrained model, then the test statistic is defined as:

$$S_F = \frac{(S_c - S_u)/k}{S_u/(N-m-1)} \approx F_{k,N-m-1}$$

If the calculated statistics is greater than a specified critical value, then we reject the null hypothesis that Y does not nonlinearly cause X (in Granger sense).

3.3. The Data

We use monthly data from January 1990 to June 2012. The main source of data is the IMF's International Financial Statistics database. The variables are market interest rate (line 60b and denoted by MMR), the log of nominal exchange rate (linear and denoted by LNER), the log of real effective exchange rate (line 65um and denoted by LREER), the log of manufacturing (industrial) production index (line 66ey and denoted by LMPI), the log of consumer price index (line 64 and denoted by LCPI), the ratio of net foreign assets to GDP (line 31n divided by line 90b and denoted by FAR), the ratio of capital account to GDP (line 37a divided by 90b and denoted by CAR), the ratio of foreign reserves to GDP ratio (line 1Id times linear divided by line 90b and denoted by FRR), the ratio of money supply to GDP (lines 34 plus 35 divided by line 90b and denoted by MSR) and the log of domestic credit (line 32 and denoted by LDC).[8]

4. EMPIRICAL RESULTS

4.1. Identifying the Order of Integration

We start our investigation of the existence of long-run relationship between foreign capital inflows and domestic price levels by testing the order of integration. In particular, to examine whether variables are integrated of order zero or one, we employ the ADF and the KPSS [proposed by Kwiatkowski, *et al.* (1992)] unit root tests. The results for both sub-periods are presented in Table 3. To find an appropriate lag length for ADF tests, we use the criterion developed by Campbell and Perron (1991). Under this procedure, one should start with a maximum lag length (say k) and sequentially delete insignificant lags until the last lag appears statistically significant. The ADF results show that the null hypothesis of non-stationarity cannot be rejected at any common level of significance for all the series. This implies that the series at their levels are non-stationary. Said differently, they have unit roots at their levels. These findings hold for both sub-periods.

The KPSS test statistics η_u and $\hat{\eta}_\tau$ are estimated to test the null hypothesis of stationarity against the alternative hypothesis that the series contains a unit root with and without a linear time trend, respectively. Since the estimated test statistics, η_u and $\hat{\eta}_\tau$, are greater than the critical values for all the said series, we reject the null hypothesis of stationarity in favour of the alternative hypothesis of unit root. That is, all the series at

[8]Here, the domestic debt includes claims on general government (net), claims on non-financial public enterprises, claims on private sector, and claims on nonblank financial institutions.

their levels have unit roots. The KPSS unit root test results confirm the results of the ADF unit root test. Since the first differences of the series under study appear stationary, we conclude that all the series are integrated of order one (i.e. $I(1)$).[9]

Table 3

Unit Root Test Results for Level Series

	January 1990 to December 2000				January 2001 to June 2012			
	ADF		KPSS		ADF		KPSS	
Series	$t_{ADF(c)}$	$t_{ADF(c+t)}$	$LM_{KPSS(c)}$	$LM_{KPSS(c+t)}$	$t_{ADF(c)}$	$t_{ADF(c+t)}$	$LM_{KPSS(c)}$	$LM_{KPSS(c+t)}$
FAR	–2.456	–2.708	0.516	0.197	–2.570	–1.561	1.254	0.447
FRR	–2.156	–2.205	1.013	0.589	–2.037	–1.278	1.013	0.589
CAR	–1.074	–3.152	2.446	0.218	–0.071	–2.126	1.815	0.385
MSR	–2.193	–1.179	0.960	0.341	–1.399	–3.120	1.682	0.239
LCPI	–2.203	–0.574	2.732	0.542	2.430	–2.076	2.166	0.477
LMMR	–1.668	–1.552	0.517	0.235	–1.955	–2.244	0.610	0.404
LNER	0.205	–3.429	2.720	0.224	–2.142	–2.129	0.522	0.532
LREER	–1.137	–3.726	1.932	0.471	–1.982	–2.091	0.581	0.407
LDC	–2.251	–0.938	2.679	0.505	2.568	–2.381	2.135	0.451
LMPI	1.325	–0.796	1.295	0.640	–1.087	–1.963	1.982	0.521

Notes: $t_{ADF(c)}$ and $t_{ADF(c+t)}$ are the standard ADF test statistics for the null of non-stationarity of the variable in the study without and with a trend, respectively, in the model for testing. $LM_{KPSS(c)}$ and $LM_{KPSS(c+t)}$ are the KPSS test statistics for the null of stationarity of the variable in the study without and with a trend, respectively, in the model for testing. MMR = the market interest rate, LNER = the log of nominal exchange rate, LREER = the log of real effective exchange rate, LCPI = the log of consumer price index, FAR = net foreign assets-GDP ratio, CAR = capital account-GDP ratio, FRR = the ratio of foreign reserves to GDP ratio, LMPI = the log of manufacturing production index, MSR = the ratio of money supply to GDP, LDC = the log of domestic credit.

4.2. The Linear Relationship between Capital Inflows and Domestic Prices

To examine the short- and long-run relationship between capital inflows and the price level, we apply cointegration and Granger causality tests. The results from multivariate Johansen's cointegration procedure for the first sub-period (January 1990-December 2000) as well as for the second sub-period (January 2001-June 2012) are given in Tables 4 and 5, respectively.

We use three different measures, namely, the net foreign assets to GDP ratio, the foreign reserves to GDP ratio, and the capital account surplus to GDP ratio, as proxies for foreign capital inflows. Accordingly, the four models are estimated using a set of other control variables, which vary from model to model, to explore the impact of capital inflows on the price level. The estimates provide strong evidence of the existence of, at least one cointegrating vector. The existence of the long-run relationship holds for all models. This indicates that the cointegration results that we report here are robust to different proxies for foreign capital inflows and to different specifications. The results also suggest that evidence about the presence of long-run relationship between foreign capital inflows and domestic prices holds for both sub-periods. This implies that foreign capital inflows and domestic price levels are integrated (in cointegration sense) during periods of small as well as massive capital inflows.

[9]The unit root test results for first differences of the variables are not given here to economise the space. However, are available from authors.

Table 4

Results from Multivariate Johansen's Cointegration Tests (January 1990 to December 2000)

	Model I		Model II		Model III		Model IV	
Null Hypothesis	λ_{max}	λ_{Trace}	λ_{max}	λ_{Trace}	λ_{max}	λ_{Trace}	λ_{max}	λ_{Trace}
$r = 0$	31.36*	66.95*	39.63*	104.50*	41.50*	84.93*	51.94*	126.12*
$r \leq 1$	21.11	35.59*	27.31	64.87*	18.80	43.43*	31.52*	74.17*
$r \leq 2$	9.00	14.48	23.86	17.57	17.38	24.62	21.83	42.65*
$r \leq 3$	5.48	5.48	9.53	13.71	7.25	7.25	11.77	20.82
$r \leq 4$	–	–	4.17	4.17	–	–	9.05	9.05

Note: *Denotes the rejection of the hypothesis at the 1 percent level of significance.

Model I: *LCPI = f (FAR, LMMR, LMPI)*.

Model II: *LCPI = f (FRR, LMMR, MSR, LMPI)*.

Model III: *LCPI = f (CAR, LDC, LNER)*.

Model IV: *LCPI = f (FAR, LMMR, LDC, LREER)*.

MMR = the market interest rate, LNER = the log of nominal exchange rate, LREER = the log of real effective exchange rate, LCPI = the log of consumer price index, FAR = net foreign assets-GDP ratio, CAR = capital account-GDP ratio, FRR = the ratio of foreign reserves to GDP ratio, LMPI = the log of manufacturing production index, MSR = the ratio of money supply to GDP, LDC = the log of domestic credit.

The results given in Tables 4 and 5 suggest that there is a long-run co-movement between domestic prices and capital inflows. These findings imply that capital inflows are significant in determining price levels in the host economy. A possible explanation for the existence of a significant relationship between foreign capital inflows and domestic price levels is that the surge in foreign capital inflows not only increases the monetary base of the economy but also increases the aggregate expenditures in the recipient economy. Consequently, the price level would increase in the economy. The capital inflows may also positively affect domestic prices if they are caused by an exogenous growth in productivity of domestic capital or/and by a drop in interest rate in foreign money markets. These findings are in accordance with several previous empirical studies including Kim and Yang (2009, 2011), Sayek (2009), Rashid (2010), Bernanke (2010), Nazir, *et al.* (2012), and Tillmann (2013) that document a significant association between foreign capital inflows and prices.

Table 5

Results from Multivariate Johansen's Cointegration Tests (January 2001 to June 2012)

	Model I		Model II		Model III		Model IV	
Null Hypothesis	λ_{max}	λ_{Trace}	λ_{max}	λ_{Trace}	λ_{max}	λ_{Trace}	λ_{max}	λ_{Trace}
$r = 0$	32.58*	45.62*	44.16*	76.43*	37.85*	65.72*	46.66*	95.85*
$r \leq 1$	13.21	15.01	38.48*	49.62*	17.94	36.14*	19.57	23.76
$r \leq 2$	11.54	13.76	15.14	26.12	13.63	14.98	13.38	17.49
$r \leq 3$	0.02	0.02	10.09	11.80	0.98	0.98	9.62	10.37
$r \leq 4$	–	–	0.06	0.06	–	–	0.83	0.83

Note: *Denotes the rejection of the hypothesis at the 1 percent level of significance.

Model I: *LCPI = f (FAR, LMMR, LMPI)*.

Model II: *LCPI = f (FRR, LMMR, MSR, LMPI)*.

Model III: *LCPI = f (CAR, LDC, LNER)*.

Model IV: *LCPI = f (FAR, LMMR, LDC, LREER)*.

MMR = the market interest rate, LNER = the log of nominal exchange rate, LREER = the log of real effective exchange rate, LCPI = the log of consumer price index, FAR = net foreign assets-GDP ratio, CAR = capital account-GDP ratio, FRR = the ratio of foreign reserves to GDP ratio, LMPI = the log of manufacturing production index, MSR = the ratio of money supply to GDP, LDC = the log of domestic credit.

4.3. The Response of Domestic Prices to Capital Inflow Shocks

We estimate impulse response functions (IRFs) as *an additional* check of the cointegration test's findings. Order and Fisher (1993), Cholesk-type of contemporaneous identifying restrictions are employed to draw a meaningful interpretation. The recursive structure assumes that variables appearing first contemporaneously influence the latter variables but not vice versa. It is important to list the exogenous variables earlier than the endogenous variables.

Impulse response functions for the first and second sub-periods are presented in Figures 1 and 2 given in the annexure, respectively. The response is considered significant if confidence intervals do not pass through zero line. For both the periods, the directions of changes observed in the impulse responses are according to economic theory. For the first sub-period, the immediate and permanent effect of a one standard deviation shock to net foreign reserves on domestic price levels is positive. The effect of a one standard deviation shock to the ratio of money supply to GDP on price levels is negative in the short-run; however, it is positive in the long run. The graphs also reveal that the money market rate, the nominal exchange rate, manufacturing output, and the capital account surplus to GDP ratio do not have any significant long run effect on domestic prices.

For the second sub-period, the net effect on domestic price levels of a one standard deviation shock to the ratio of foreign assets to GDP, the ratio of money supply to GDP, and the change in level of domestic debt is positive in the short run as well as in the long run. One the other hand, we observe that a one standard deviation shock to the ratio of capital account surplus to GDP has a positive effect initially but the permanent effect is negative. Impulse response functions confirm the findings of cointegration tests that there exists a long-run equilibrium relationship between foreign capital inflows and domestic price levels.

After confirming the existence of the long-run relationship (cointegration) between foreign capital inflows and domestic price levels, we explore the short-run dynamics. Since the variables are cointegrated, using the Vector Error Correction (VEC) model, we test whether the variables individually Granger cause domestic price levels in all the four models. For this, we test for the joint significance of lagged coefficient of each variable along with the error correction term. The estimated results for the first sub-period are reported in Table 6.

One can see from the Table that the null hypothesis of no short-run Granger causality cannot be rejected for the net foreign assets-to-GDP ratio as well as for the foreign reserves-to-GDP ratio. This implies that neither the net foreign assets nor the amount of foreign reserves significantly cause (in Granger sense) domestic prices during the period 1990–2000. These findings suggest that the foreign capital inflows do not have causal linkages with the price level during the periods of low capital inflows. That is, smooth flows of foreign capital do not create inflationary pressure in the recipient country. This finding is consistent with the literature that indicates that only large episodes of foreign capital inflows do matter for the host economy. The results regarding our third proxy of foreign capital inflows that is the ratio of capital account to GDP reveal that domestic prices are significantly Granger caused by foreign capital inflows via capital account surplus.[10]

[10]This differential causal impact across different proxies of foreign capital inflows suggests that it would be worth exploring the impact of different components of foreign capital inflows such as foreign direct investment (FDI), foreign portfolio investment (FPI), foreign bank borrowing, remittances, etc. on domestic price levels. Further, it would also be useful to investigate the differential effects of private versus public foreign inflows on host economies. However, one should note that we do not extend our analysis along these lines in order to emphasise more on the objectives of our study.

Table 6

Linear Granger Causality Test Results for January 1990 to December 2000

Null Hypothesis	Number of Lags	χ^2 – Square	Decision (at the 5% level)
Model I: *LCPI = f (FAR, LMMR, LMPI)*			
LCPI is not Granger caused by FAR	3	3.089	Do not reject
LCPI is not Granger caused by MMR	3	2.356	Do not reject
LCPI is not Granger caused by LMPI	3	9.178	Reject
Model II: *LCPI = f (FRR, LMMR, MSR, LMPI)*			
LCPI is not Granger caused by FRR	3	0.129	Do not reject
LCPI is not Granger caused by MMR	3	3.188	Do not reject
LCPI is not Granger caused by MSR	3	10.769	Reject
LCPI is not Granger caused by LMPI	3	12.994	Reject
Model III: *LCPI = f (CAR, LDC, LNER)*			
LCPI is not Granger caused by CAR	3	7.908	Reject
LCPI is not Granger caused by LDC	3	10.232	Reject
LCPI is not Granger caused by LNER	3	1.150	Do not reject
Model IV: *LCPI = f (FAR, LMMR, LDC, LREER)*			
LCPI is not Granger caused by FAR	3	4.115	Do not reject
LCPI is not Granger caused by LDC	3	21.699	Reject
LCPI is not Granger caused by MMR	3	5.020	Do not reject
LCPI is not Granger caused by LREER	3	1.808	Do not reject

Note: MMR = the market interest rate, LNER = the log of nominal exchange rate, LREER = the log of real effective exchange rate, LCPI = the log of consumer price index, FAR = net foreign assets-GDP ratio, CAR = capital account-GDP ratio, FRR = the ratio of foreign reserves to GDP ratio, LMPI = the log of manufacturing production index, MSR = the ratio of money supply to GDP, LDC = the log of domestic credit.

The results do not provide any significant evidence of the rejection of the null hypothesis that domestic price level is not Granger caused by the money market rate and the exchange rate (neither the nominal nor the real one) in any estimated model during the period 1990–2000. These observations indicate that the interest rate and the exchange rate both do not have any significant short-run causal relationship with domestic price levels. These findings also suggest that during the period 1990–2000, both interest rate and exchange rate policies were not effective in controlling inflation in the economy.

The results given in Table 6 also show that the domestic price level is significantly influenced (in Granger sense) by domestic credit and money supply. This implies that increases in monetary base of the economy during the period 1990–2000 have inflated domestic prices. Likewise, more credit supply to domestic sector has also significantly and positively contributed to the price level. We find that there is a significant Granger causality sunning from manufacturing output to domestic prices. This implies that the level of industrial output has a significant short-run impact (in Granger sense) on the level of prices.

On the whole, we observe from the results presented in Table 6 that during January 1990 to December 2000, the capital account to GDP ratio, the money supply to GDP ratio, and the level of domestic debt significantly cause the domestic price level. However, we show that the net foreign assets to GDP ratio, the foreign reserves to GDP ratio, the money market rate and both nominal and real effective exchange rates do not

significantly influence the rate of inflation. Thus, we can say that during the period 1990–2000, domestic prices are significantly caused by domestic macroeconomic factors, namely money supply, domestic credit, and manufacturing output, instead of foreign capital inflows in the short run.

The results for the second sub-period spanning January 2001 to June 2012– a period of large capital surge—are given in Table 7. Contrary to the period of low capital inflows (1990–2000), yet consistent with our expectation, foreign capital inflows are significantly related to short-run dynamics of inflation during surges in capital inflows. In particular, we find strong evidence to reject the null hypothesis of no Granger causality for net foreign assets in Model I and Model IV. This implies that domestic prices are significantly Granger caused by the net foreign assets-to-GDP ratio. There is also significant evidence of the presence of the short-run causal relationship between the ratio of foreign reserves to GDP and the price level (see Model II). These findings suggest that the impacts of foreign capital inflows that we reported here are robust to different proxies of foreign exchange rate and different specifications, and thus, any specific proxy or any particular specification of the model does not drive them.

It is noteworthy that both the proxies for capital inflows, namely the net foreign assets to GDP ratio and the foreign reserves to GDP ratio, do not have any short-run causal relationship with domestic price levels during an episode of smooth capital inflows (January 1990 to December 2000). Nonetheless, during the period of large capital inflows ranging from 2001–2012, both of the proxies have a significant impact (in Granger sense) on domestic price levels, which is what we expect. This implies that the higher the level of the foreign capital inflows, the higher the level of the inflation. These findings suggest that the abrupt increase in foreign capital inflows would not only undermine central bank's ability to achieve monetary stability but also increase monetary base, fuel spending booms, and cause asset market bubbles without benefiting significantly the real sector of the host economy. Thus, capital inflow bonanzas generate inflationary pressures in the recipient country. These findings also suggest that policymakers can provide nominal anchor to the economy by stabilising the dynamics of foreign capital inflows. Our findings are consistent with those studies that document that large and sudden capital inflows significantly fuel domestic credit growth and price levels in host economies.

It is also important to note that although, during the period 1990–2000, capital account surplus to GDP ratio Granger causes domestic prices, we do not find any significant evidence of the presence of the short-run causal relationship between capital account surplus and the price level during 2001–2012. This finding is contrary to the preliminary evidence provided by correlation estimates that capital account surplus is significantly related to the price level during both the sub-periods. Similarly, there is no evidence of the short-run impact of market interest rate on the price level.

This finding holds for both sub-periods. Further, the results reveal that consistent with the first sub-period, neither the nominal nor the real exchange rate is significantly related to the short-run dynamic of inflation. Finally, we find that domestic debt, manufacturing output, and money supply significantly Ganger cause domestic price levels. These findings also hold for both sub-periods, indicating the persistent inflationary effect of these variables. These findings suggest that domestic credit growth and industrial output are significant for controlling inflationary dynamics in Pakistan. However, both the exchange rate and the money market rate cannot be effectively used as policy tools for stabilising short-run price dynamics.

Table 7

Linear Granger Causality Test Results for January 2001 to June 2012

Null Hypothesis	Number of Lags	χ^2 – Square	Decision (at the 5% level)
Model I: *LCPI = f (FAR, LMMR, LMPI)*			
LCPI is not Granger caused by FAR	2	6.726	Reject
LCPI is not Granger caused by LMMR	2	0.638	Do not reject
LCPI is not Granger caused by LMPI	2	8.076	Reject
Model II: *LCPI = f (FRR, LMMR, MSR, LMPI)*			
LCPI is not Granger caused by FRR	2	6.326	Reject
LCPI is not Granger caused by LMMR	2	1.175	Do not reject
LCPI is not Granger caused by MSR	2	8.254	Reject
LCPI is not Granger caused by LMPI	2	9.984	Reject
Model III: *LCPI = f (CAR, LDC, LNER)*			
LCPI is not Granger caused by CAR	2	2.637	Do not reject
LCPI is not Granger caused by LDC	2	16.609	Reject
LCPI is not Granger caused by LNER	2	1.487	Do not reject
Model IV: *LCPI = f (FAR, LMMR, LDC, LREER)*			
LCPI is not Granger caused by FAR	2	13.980	Reject
LCPI is not Granger caused by LDC	2	10.721	Reject
LCPI is not Granger caused by LMMR	2	1.843	Do not reject
LCPI is not Granger caused by LREER	2	1.654	Do not reject

Note: MMR = the market interest rate, LNER = the log of nominal exchange rate, LREER = the log of real effective exchange rate, LCPI = the log of consumer price index, FAR = net foreign assets-GDP ratio, CAR = capital account-GDP ratio, FRR = the ratio of foreign reserves to GDP ratio, LMPI = the log of manufacturing production index, MSR = the ratio of money supply to GDP, LDC = the log of domestic credit.

4.3. The Effect of Capital Inflows on the Exchange Rate Volatility

In this section, we examine the impact of capital inflows on the exchange rate volatility. In particular, we investigate the differential effect of capital inflows on the nominal and real exchange rate volatility during periods of low and large capital inflows. The volatility of nominal exchange rate (VNEX) and real effective exchange rate (VREER) has been calculated by using the three-period moving average standard deviation: $S.D_t = [(1/m\sum_{i=1}^{m}(EX_{t+i-1} - EX_{t+i-2})^2]^{1/2}$, where m = 3 and EX denotes the underlying exchange rate series. Before examining the influence of capital inflows on the exchange rate volatility, we test the order of integration of generated volatility series. For this, we apply the ADF and the KPSS unit root tests. The results for both sub-periods are given in Table 8. The results indicate that both volatility series are stationary at their levels.

Table 8

Unit Root Test Results: The Exchange Rate Volatility

	January 1990 to December 2000		January 2001 to June 2012	
Volatility Series	ADF	KPSS	ADF	KPSS
VNEX	–5.469*	0.484*	–3.654*	0.312*
VREER	–7.100*	0.119*	–5.783*	0.453*

* Indicates the series is stationary at the 1 percent level.

Since the exchange rate volatility series are stationary at their levels, we estimate the VAR model for testing the short-run Granger causality between the exchange rate volatility and the change in foreign capital inflows. The results summarised in Table 9 provide evidence that both the nominal and real effective exchange rate volatility is significantly influenced by the change in net foreign reserves during 1990–2000. This implies that during the first sub-period, capital inflows are significantly related to the short-run dynamic of both nominal and real exchange rates. Although during this period, the flows are relatively small and smooth, they play significant role in determining exchange rate fluctuations. It should be noted that during this period, foreign capital inflows not only affect the nominal exchange rate volatility but also the real effective exchange rate volatility. Thus, in turn, the inflows affecting foreign competitiveness increase international trade imbalances and escalate vulnerability to a financial crisis.

Table 9

Granger Causality Test Results: Capital Inflows and the Exchange Rate Volatility

	January 1990 to December 2000		January 2001 to June 2012	
Direction of Causality	χ^2–Square	Decision (at the 5% level)	χ^2–Square	Decision (at the 5% level)
ΔFAR $\rightarrow$ VNEX	7.579 (3)	Do not reject	0.930 (2)	Reject
ΔFAR $\rightarrow$ VREER	8.776 (3)	Do not reject	8.546 (2)	Do not reject

Note: Here the arrow points out the direction of causality. Values in parentheses are optimal lag-length selected by the AIC.

When we observe the Granger causality results for the second sub-period from January 2001 to June 2012, we find that the change in capital inflows has a significant impact (in Granger sense) on the volatility of real effective exchange rate. This finding indicates the persistent effect of capital inflows on the real exchange rate volatility during both sub-periods. This implies that the real effective exchange rate volatility is significantly influenced by the inflows of foreign capital regardless of whether these flows are smooth or of bonanza nature. The effects of foreign capital inflows on the real effective exchange rate that we presented here are consistent with the findings previously reported in the literature [Calvo, *et al.* (1993), Bandara (1995), Edwards (1998), Agenor (1998), Chen and Rogoff (2003), Lartey (2007, 2008), Cashin, *et al.* (2004), Lee, *et al.* (2009), Saborowski (2009), Rashid (2010), and Combes, *et al.* (2012)].[11] These studies

[11]Our findings regarding the effects on the exchange rate volatility of capital inflows are, however, inconsistent with Li and Rowe (2007), Mongardini and Rayner (2009), and Hussain, *et al.* (2009), who show that official foreign capital inflows are not significantly associated with the real effective exchange rate.

also document significant impacts of foreign capital inflows on real exchange rates. Our findings are also consistent with the view that ebb and flow of foreign capital inflows deteriorate macroeconomic and financial management in the recipient countries and overheat the economy by causing real appreciation. This set of findings suggests that there is a critical need to adopt more flexible exchange rate policies that would be useful in dampening the real exchange rate volatility, which stem from surges in capital flows.

4.4. The Nonlinear Causation between Capital Inflows and Domestic Prices

In this sub-section, we comprehensively analyse the existence of nonlinearity in capital inflows-domestic prices nexus. To test a long-run nonlinear relationship, we run a bi-variate regression of LCPI on a constant and BOX-COX transform of the underlying explanatory variable. Specifically, the function is defined as follows:

$$LCPI_t = \frac{\left((|X_t|)^{\theta} - 1\right)}{\theta} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

where X_t denotes the underlying explanatory variable. We use the nonlinear least squares (NLS) method to estimate the underlying parameters ($\hat{\theta}$), and then apply the KPSS test to the residual to test the null hypothesis of nonlinear cointegration against an alternative hypothesis of no nonlinear cointegration. The estimates are given in Table 10.

Table 10

Pairwise Nonlinear Cointegration Test Results

Variables included in Cointegration Equation	Sample Period: January 1990 to December 2000		Sample Period: January 2001 to June 2012	
	$LM_{KPSS(c)}$	$LM_{KPSS(c+t)}$	$LM_{KPSS(c)}$	$LM_{KPSS(c+t)}$
LCPI and FAR	1.286	0.102*	1.329	0.132*
LCPI and LDC	0.107**	0.098*	0.113*	0.162*
LCPI and MSR	1.261	0.137**	0.457*	0.201*
LCPI and LMPI	0.187*	0.121*	0.235*	0.117*
LCPI and MMR	1.412	0.238	1.377	0.275
LCPI and LNER	1.167	0.546	1.876	0.921

Note: * and ** denote rejection of the null hypothesis at the 1 percent and 5 percent significant levels, respectively. FAR = the ration of net foreign reserves to GDP, LDC = the log of domestic debt, MSR = the ratio of money supply to GDP, LMPI = the log of manufacturing output index, MMR = money market rate, and LNER = the log of nominal exchange rate.

The results provide strong evidence of the presence of nonlinear cointegration between domestic price levels and the net foreign assets-to-GDP ratio, the money supply-to-GDP ratio, manufacturing output, and domestic debt in both the examined periods. On the other hand, the results reveal that there is no significant nonlinear association between the price level and both market interest and nominal exchange rates. In particular, we find that the null hypothesis of nonlinear cointegration between foreign capital inflows and domestic prices cannot be rejected when we include a linear time trend in the KPSS test specification. The existence of the long-run nonlinear relationship between capital

inflows and price levels holds for both sub-periods. This observation suggests that nonlinearity in the capital inflows—domestic prices nexus is not attributed to the size of the waves of capital inflows. Rather, this asymmetric association may be heritable and stem from economic wellsprings.

To examine the nonlinear short-run causality between domestic prices and the other underlying variables, we use the Hristu-Varsakkeis and Kyrtsou (2010) nonlinear Granger causality test—known as the bi-varaite noisy Mackey-Glass model. The first step is to estimate the nonlinear VEC model (i.e., Equation (4) is estimated using the first differences of the variables and error correction term by ordinary least squares, in a specification $\tau_1 = \tau_2 = 4$ and $c_1 = c_2 = 2$) selected by the Log Likelihood procedure without and with restriction on lagged parameters of explanatory variable. We then obtain the residuals to calculate the test statistics (says S_F) for testing nonlinear Granger causality between the variables. For each variable, we estimate separately the nonlinear VEC model to examine the nonlinear causal impact on domestic prices of the underlying variable. We examine the nonlinear short-run causality during both sub-periods. Specifically, we aim to analyse whether the nonlinear short-run influence of capital inflows on prices depends on the size of flow of foreign capital inflows. However, for nonlinear Granger causality analysis, we utilise only the net foreign assets-to-GDP ratio as foreign capital inflows proxy. Table 11 presents the estimated S_F for both sub-periods.

Table 11

Pairwise Nonlinear Granger Causality Test Results

	Sample Period: January 1990 to December 2000		Sample Period: January 2001 to June 2012	
Direction of Nonlinear Causality	S_F – *statistic*	Decision (at the 5% level)	S_F – *statistic*	Decision (at the 5% level)
FAR → LCPI	0.364	Reject	9.454	Do not reject
LDC → LCPI	3.283	Do not reject	3.987	Do not reject
MSR → LCPI	4.247	Do not reject	9.545	Do not reject
LMPI → LCPI	3.673	Do not reject	7.169	Do not reject
LNER → LCPI	1.446	Reject	0.004	Reject
MMR → LCPI	1.318	Reject	0.164	Reject

Note: The arrow points to the direction of nonlinear causality. FAR = the ration of net foreign reserves to GDP, LDC = the log of domestic debt, MSR = the ratio of money supply to GDP, LMPI = the log of manufacturing output index, MMR = money market rate, and LNER = the log of nominal exchange rate.

We do not find any significant evidence of the existence of the nonlinear short-run causality between foreign capital inflows (the net foreign assets-to-GDP ratio) and domestic prices during the first sub-period when capital inflows are relatively smooth and small in size. During the second sub-period when there are surges in capital inflows, however, domestic price levels are significantly nonlinearly Granger caused by foreign capital inflows. This implies that the nonlinear short-run association between the price level and foreign capital inflows is asymmetric, depending on the amount of capital inflows. These findings are similar to our earlier findings of linear Granger causality tests—Granger causality running from capital inflows to domestic prices only for the period of massive capital inflows.

Results regarding other variables indicate that there is a significant nonlinear Granger causality running from the level of domestic debt, manufacturing output, and the money supply to GDP ratio to the rate of inflation. These results hold for both sample periods, suggesting the persistence in nonlinear short-run inter-linkages across low and high capital inflow regimes. In other words, ebbs and flows of foreign capital do not affect the nonlinear association between domestic prices, domestic debt, manufacturing output, and money supply to GDP ratio. Finally, we do not find significant evidence of the nonlinear Granger causality running from the market interest rate as well as the nominal exchange rate to the level of price in either period.

Several striking findings emerge from the evidence presented here. First, although the long-run linear and nonlinear association between foreign capital inflows and domestic price levels is independent of the size of foreign capital inflows, the short-run linear and nonlinear Granger causality exists merely during surges in capital inflows. Second, the causal impact on the level of price of domestic factors, namely money supply, manufacturing output, and domestic credit growth is robust regardless of whether foreign capital inflows are in small amount or of bonanza nature. Third, both the market interest rate and the exchange rate do not have any causal influence (in Granger sense) on domestic prices. Fourth, pronounced waves of foreign capital inflows significantly fuel the real effective exchange rate volatility. The significant influences of foreign capital inflows on domestic prices and the exchange rate volatility provide indication of so called "transfer problem"—which generally refers to the effect of foreign capital movements on the recipient economy. Our findings suggest that exchange rate flexibility and effective absorption and sterilisation of foreign capital inflows are necessary to penalise destructive capital inflows and lessen inflationary effects of capital inflows in the host economy. These measures, in turn, would be significant in dampening financial system vulnerability originating from surges in capital inflows.

5. CONCLUSIONS AND POLICY IMPLICATIONS

This paper has empirically investigated the inflationary effects of foreign capital inflows for Pakistan using monthly data covering the period from January 1990 to June 2012. To provide economic intuition, the paper has also proposed an empirical model of the equilibrium prices based on the standard classical quantity theory of demand for money subject to capital inflows. Further, we have divided the full sample into two sub-samples to study the differential effects of capital inflows on the price level across the low and high episodes of capital inflows.

Our empirical results suggest that there is a positive and significant impact of foreign capital inflows (in Granger sense) on domestic price levels, particularly, during the periods of massive capital inflows from 2001 to 2012. Our results, however, suggest lack of causality between capital inflows and domestic price level for the period 1990–2000. Besides the existence of linear causation between capital inflows and price levels, we find significant evidence of nonlinear Granger causality running from capital inflows to the rate of inflation. This implies that hikes in domestic price levels are not only linearly but also nonlinearly caused by changes in foreign capital inflows. The presence of nonlinearity in capital inflows-domestic prices linkages that we have unfolded in this paper would definitely provide new insights about the existence of causal links between

the price level and capital inflows. We also show that both the market interest and the exchange rate do not have any cause-effect relationship with the rate of inflation in either period. Finally, we find that foreign capital inflows have significant causal linkages with the exchange rate volatility. Our analysis suggests that the influence of capital inflows on the real effective exchange rate volatility holds during both low and high flow of capital inflows.

From the policy perspective, the findings are of particular interest to the government authority and the SBP. Since the capital inflows have played a significant role to push up domestic prices, particularly during the period of capital inflows surges (2001–2012), the foreign exchange management policy of SBP is questionable. The findings suggest that there is a need to absorb the capital inflows in such a way that they should neither create an inflationary pressure in the economy nor fuel the exchange rate volatility. More precisely, the SBP should put the limit to arbitrate in the forex market and should allow the private sector to use the foreign capital for productive purposes to increase the production in the economy, rather than just to add it to government foreign reserves. This policy can prevent the economy from overheating and dampen financial fragility.

The most effective ways to deal with capital inflows would be to deepen the financial markets, strengthen financial system supervision and regulations, where needed, and improve the capacity to design and implement sound macroeconomic and financial sector policies. These actions would certainly help increase the absorption capacity and resilience of the economy and financial systems to the risk associated with the inflows. The analysis may establish a useful base for future empirical work in this field and suggest that researchers should also consider nonlinearity in modelling to test the influence of surges in capital inflows on inflationary dynamics. We have unambiguously linked foreign capital inflows to consumer prices and the exchange rate volatility in both linear and nonlinear causality terms. It would also be enlightening to know how capital inflows and outflows differently affect asset price dynamics, in particular, house price inflation.

ANNEXURE

Fig. 1. The Response of Domestic Price Levels to One S.D. Innovations ± 2 S.E., Sample Period: January 1990 to December 2000

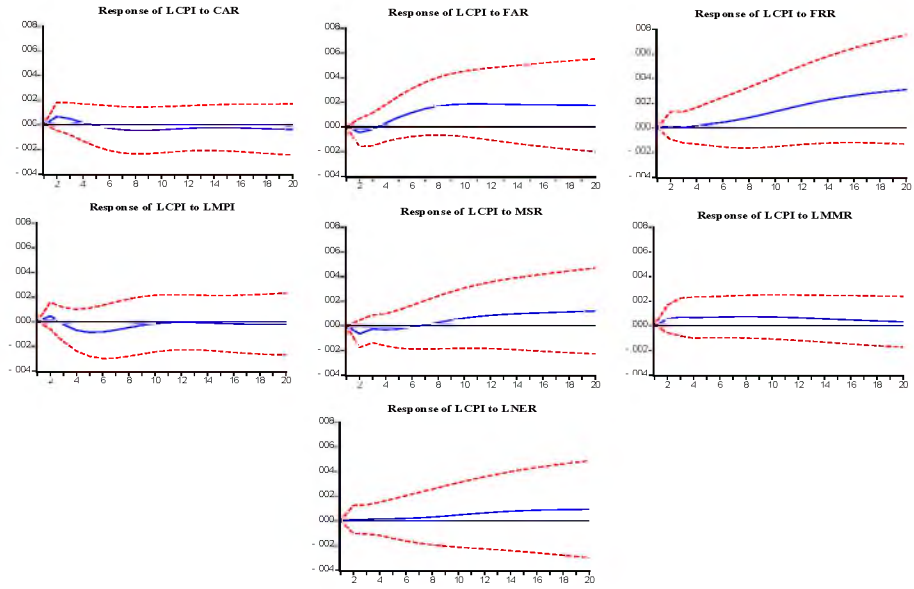
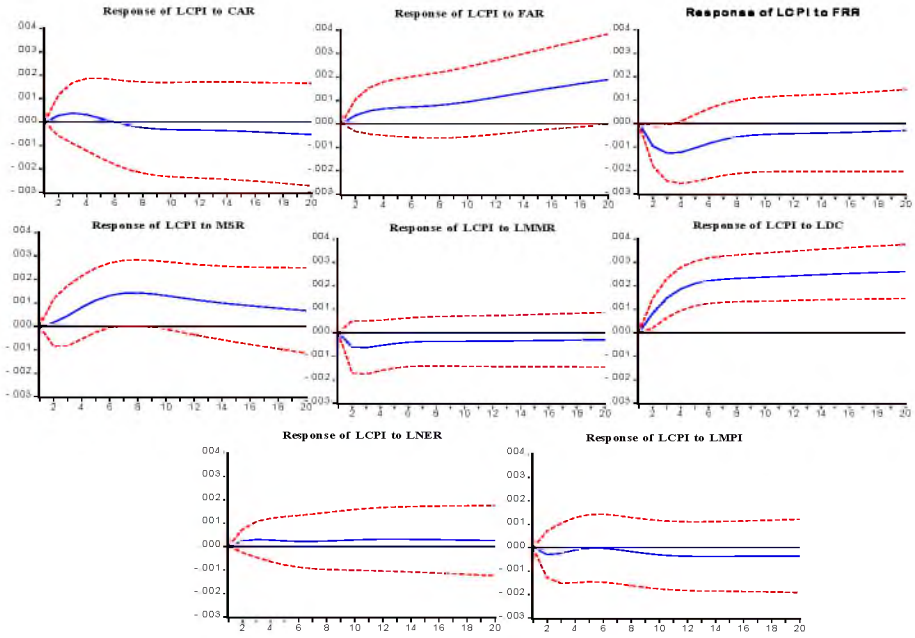


Fig. 2. The Response of Domestic Price Levels to One S.D. Innovations ± 2 S.E., Sample Period: January 2001 to June 2012



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