# Dynamic Relations between Stock Prices and Exchange Rates in Sri Lanka: Some Empirical Evidence

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## 1. Introduction

Growth of international trade and financial liberalisation have exposed firms to foreign exchange risk that affect input prices and assets denominated in foreign currencies

Share prices of firms that are engaged in foreign trade are affected by changes in profits due to exchange rate fluctuations

Share prices of firms with no foreign trade may also be indirectly affected

Bahmani-Oskooee and Sohrabian (1992) argue that changes in stock prices may affect exchange rates through firm's portfolio adjustments

## 1.Introduction…

Qiao (1996) also provides a similar argument that capital outflows affect exchange rates if changes in stock prices are sufficiently persistent to generate or destroy confidence of stock market investors

Efficient Market Hypothesis of Fama (1965) asserts that stock prices rapidly adjust to publicly available information. Therefore, any stock market participant cannot beat the stock market on a continuous basis and earn abnormal returns

Due to the above there has been an increased attention of researchers, particularly, during the past three decades.

## Objective of the study

To examine the dynamic relationships between stock prices and four exchange rates in a developing country such as Sri Lanka using new developments in techniques for testing unit roots of variables. Further, this study carefully selects the deterministic components using Pantula principle proposed by Granger (1992). Previous studies have used cointegration tests without due regard to the selection of deterministic components in testing for cointegration. This raises the validity of the results and therefore, the conclusions of these studies.

## 2. Methodology and Data

### A.Unit root tests

Ng-Perron (2001) unit root tests
Elliot, Rothenberg and Stock (ERS) point optimal test:

$$MP_T^d = \begin{cases} (\bar{c}_k^2 - \bar{c}T^{-1}(y_T^d)^2)/f_0 & \text{if } x_t = \{1\} \\ (\bar{c}_k^2 + (1-\bar{c})T^{-1}(y_T^d)^2)/f_0 & \text{if } x_t = \{1,t\} \end{cases}$$

$$k = \sum_{t=2}^{T} (y_{t-1}^d)^2 / T^2$$

$$\bar{c} = \begin{cases} -7 & \text{if } x_t = \{1\} \\ -13.5 & \text{if } x_t = \{1,t\} \end{cases}$$

$f_0$ = is the zero frequency spectrum term, and

$MZ_\alpha^d$ , $MZ_t^d$ and $MSB^d$ , are the enhancements of the Phillips-Peron (PP) test statistics

$$MZ_\alpha^d = (T^{-1}(y_T^d)^2 - f_0)/2k$$

$$MZ_t^d = MZ_\alpha \times MSB^d$$

$$MSB^d = (k / f_0)^{1/2}$$

All four statistics are based on a specification *xt* and a method for Estimating $f_0$.

B. Johansen Cointegration Test

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + Bx_t + \varepsilon_t$$

Trace test statistic

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \log(1 - \hat{\lambda}_i)$$

***r = 0, 1, 2,…,n-1***

where *T* is the number of observations and $\hat{\lambda}_i$ is the *i*th eigenvalue

Maximum eigen value statistic

$$\lambda_{\max} = -T \log(1 - \hat{\lambda}_{r+1})$$

***r = 0, 1, 2,…,n-2,n-1***

To make inferences about the number of cointegrating relationships, the trace and maximum eigen value statistics are compared with critical values tabulated in Osterwald and Lunum (1992)

## Selection of the deterministic component in the cointegration test

Pantula Principle (Johansen, 1992)

Start from the most restrictive model, i.e. no deterministic components, and then compare the rank test statistic with the chosen quantile of the corresponding table. If the model is rejected, continue to the model that restricts the constant to the cointegration space. If this model is also rejected, go to the model with an unrestricted constant. In the case of rejection, proceed to the model with linear trends in the variables and the cointegration space. If this is also rejected, repeat the procedure for the next rank. Continue until the null hypothesis cannot be rejected for the first time.

## Error-correction model (ECM), short and long-run causality and variance decomposition analysis (Engle and Granger (1987)

$$\Delta x_t = a_1 + b_1 ect_{t-1} + \sum_{i=1}^{m} c_1 \Delta x_{t-i} + \sum_{i=1}^{n} d_1 \Delta y_{t-i} + e_{1t}$$

$$\Delta y_t = a_2 + b_2 ect_{t-1} + \sum_{i=1}^{m} c_2 \Delta y_{t-i} + \sum_{i=1}^{n} d_2 \Delta x_{t-i} + e_{2t}$$

The ECM opens up another channel of causality through the ECM term which is ignored in standard Granger causality tests. Therefore, causality can be tested by examining

(i) The statistical significance of the EC term by a separate t-test

(ii) The joint significance of the lags of each explanatory variable by an F- or Wald $x^2$ test or

(iii) By testing the joint significance of the EC term and the lagged terms of each explanatory variable by a joint F-or Wald $x^2$ test.

Variance decomposition analysis

Granger causality test indicates only in-sample causality tests. To gain insights into causal relationships out-of-sample, we can use variance decomposition analysis

In variance decomposition analysis, we partition the variance of the forecast error of a particular variable into proportions attributable to innovations (shocks) in each variable in the system including its own.

Impulse response analysis (IRA)

The results of the IRA demonstrate for how long the shocks given to the innovations of an equation for a variable within the system are likely to have an effect and with what intensity.

It answers the following question:

"What is the effect of a shock of size $\delta$ hitting the system at time $t$ on the state of the system at time $t+n$, given that no other shocks hit the system?".

The responses of the stock prices and exchange rates to the 'shocks' in each of the explanatory variables can be plotted as diagrams.

## Data

All share Price Index (ASPI) of the Colombo Stock Exchange,

Exchange rates for Indian rupee, Japanese yen, UK pound and US dollar

These exchange rates were selected on the basis of their availability in the Monthly Bulletins published by the Central Bank of Sri Lanka

## Data sources

ASPI - the data bases of the CSE.

Exchange rates **(expressed as the amount of Sri Lankan rupees per unit of each currency) - Monthly Bulletins published by the Central Bank of Sri Lanka.**

### Sample period:

January 1986 to December 2004

## 3. Results

**Table 1. Descriptive statistics for the variables**

| | ASPI | IR | JPY | UKP | USD |
|---|---|---|---|---|---|
| Mean | 6.206 | 0.622 | -0.819 | 4.468 | 3.986 |
| Median | 6.364 | 0.580 | -0.726 | 4.402 | 3.923 |
| Maximum | 7.336 | 0.869 | 0.010 | 5.308 | 4.652 |
| Minimum | 4.837 | 0.396 | -1.984 | 3.670 | 3.314 |
| Range | 2.499 | 0.472 | 1.993 | 1.638 | 1.338 |
| Standard Deviation | 0.667 | 0.155 | 0.491 | 0.395 | 0.400 |
| Coefficient of Variation (%) | 10.752 | 24.906 | -59.999 | 8.851 | 10.028 |
| Skewness | -0.633 | 0.197 | -0.339 | 0.046 | 0.051 |
| Kurtosis | 2.378 | 1.377 | 2.096 | 2.351 | 1.904 |
| Jarque-Bera | 18.905[a] | 26.505[a] | 12.136[a] | 4.084 | 11.517[a] |

| Table 2. unit root test results | | | | |
|---|---|---|---|---|
| Variable | Unit root test statistic | | | |
| | MZa | MZt | MSB | MPT |
| ASPI | 0.905 | 0.819 | 0.905 | 57.463 |
| | -3.789 | -1.376 | 0.363 | 24.045 |
| Δ ASPI | -101.306[a] | -7.115[a] | 0.070[a] | 0.246[a] |
| | -107.951[a] | -7.347[a] | 0.068[a] | 0.845[a] |
| IR | -1.559 | -0.859 | 0.551 | 15.249 |
| | -1.444 | -0.564 | 0.391 | 35.880 |
| Δ IR | -106.846[a] | -7.263[a] | 0.068[a] | 0.314[a] |
| | -111.996[a] | -7.470[a] | 0.067[a] | 0.861[a] |
| JPY | 1.259 | 2.175 | 1.728 | 205.614 |
| | -4.977 | -1.548 | 0.311 | 18.162 |

| Table 2 continued… | | | | |
|---|---|---|---|---|
| Δ JPY | -0.196 | -0.184 | 0.937 | 47.619 |
| | -14.128 | -2.634[c] | 0.186[c] | 6.595[c] |
| UKP | 1.838 | 3.170 | 1.725 | 228.979 |
| | -8.031 | -1.949 | 0.243 | 11.513 |
| Δ UKP | -126.391[a] | -7.921[a] | 0.063[a] | 0.243[a] |
| | -141.892[a] | -8.410[a] | 0.059[a] | 0.686[a] |
| USD | 1.561 | 3.620 | 2.319 | 387.525 |
| | -9.535 | -2.180 | 0.229 | 9.572 |
| Δ USD | -65.752[a] | -5.733[a] | 0.087[a] | 0.374[a] |
| | -133.462[a] | -8.165[a] | 0.061[a] | 0.695[a] |

**Table 3. Johansen Cointegration Test Results for Exchange Rates and Stock Prices**

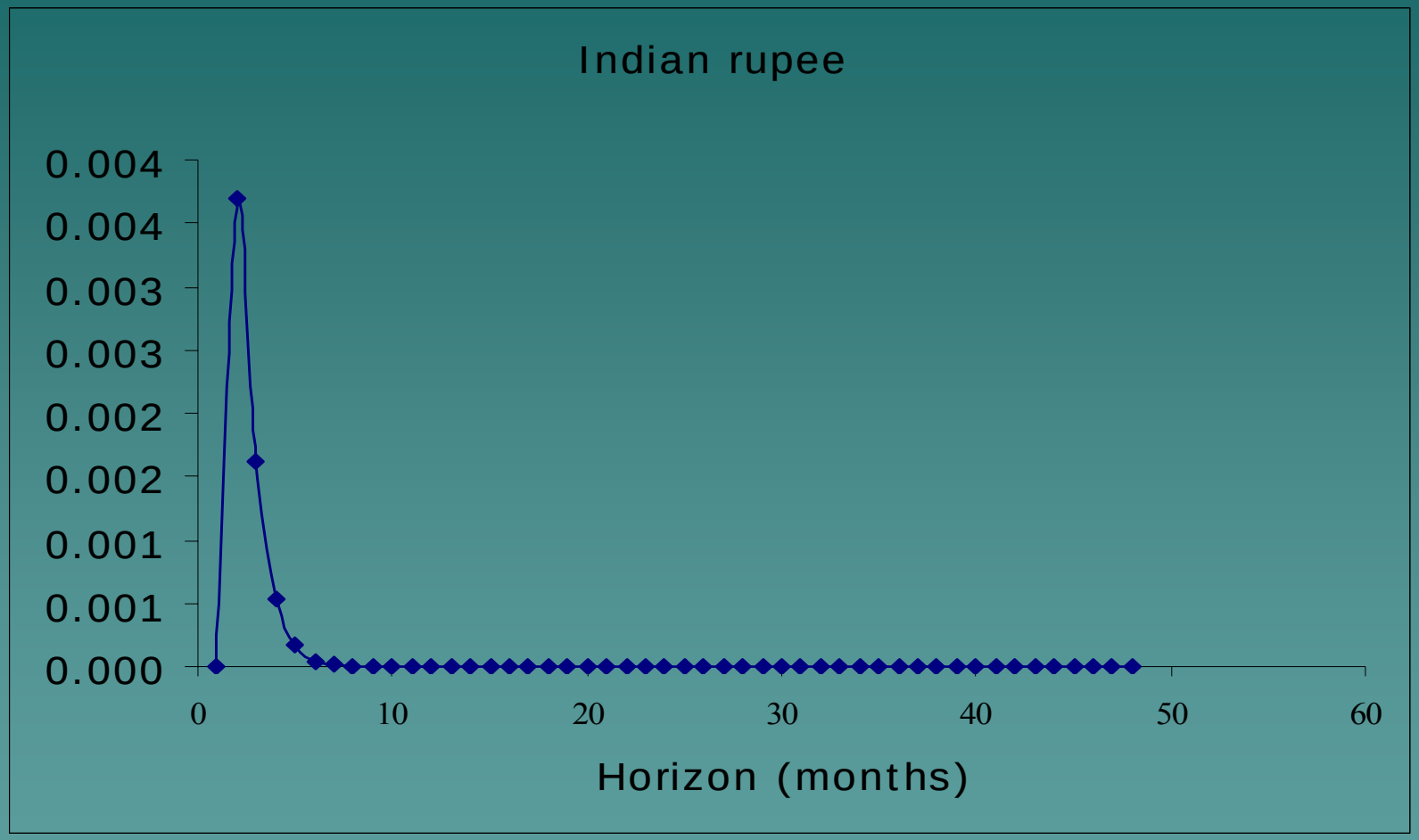
| Pairs of Currencies | Number of Lags in VAR | Trend Assumption | Null Hypothesis | Trace Statistic | Maximal EigenValue Statistic |
|---|---|---|---|---|---|
| ASPI and IR | 2 | 1 | $r = 0$ | 7.603 | 6.906 |
| | | | $r \leq 1$ | 0.697 | 0.697 |
| ASPI and JPY | 5 | 2 | $r = 0$ | 7.699 | 5.415 |
| | | | $r \leq 1$ | 2.284 | 2.284 |
| ASPI and UKP | 8 | 2 | $r = 0$ | 6.665 | 6.654 |
| | | | $r \leq 1$ | 0.011 | 0.011 |
| ASPI and USD | 3 | 2 | $r = 0$ | 9.487 | 9.370 |
| | | | $r \leq 1$ | 0.117 | 0.117 |

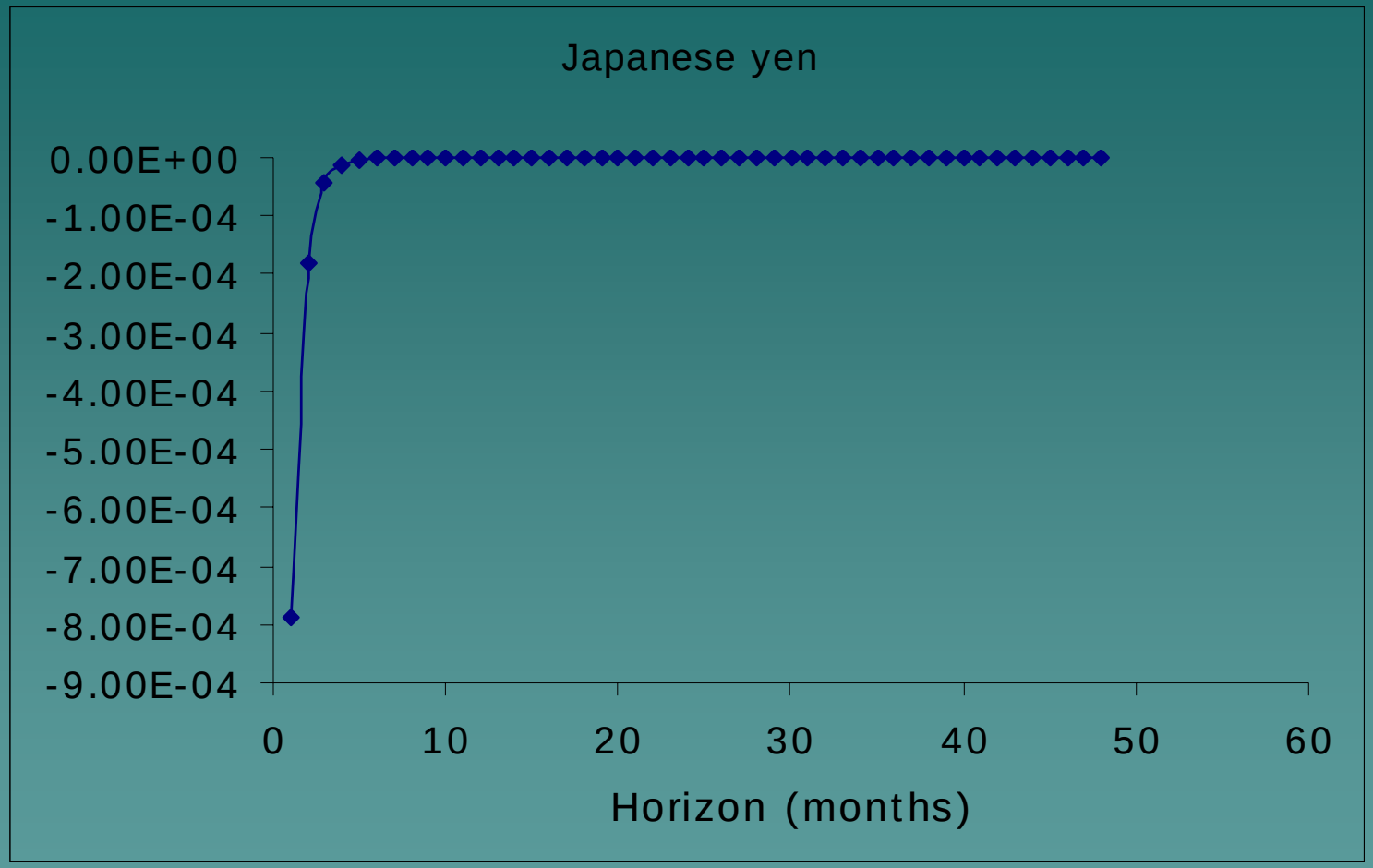
| Table 4. Granger causality test results | | | |
|---|---|---|---|
| Causality | | $\chi^2$ test statistic | Direction of causality |
| From | To | | |
| ASPI | IR | 0.001 | No causality |
| IR | ASPI | 0.584 | |
| ASPI | JPY | 0.001 | No causality |
| JPY | ASPI | 0.209 | |
| ASPI | UKP | 11.080 | No causality |
| UKP | ASPI | 6.489 | |
| ASPI | USD | 5.918[c] | ASPI to USD |
| USD | ASPI | 0.003 | |

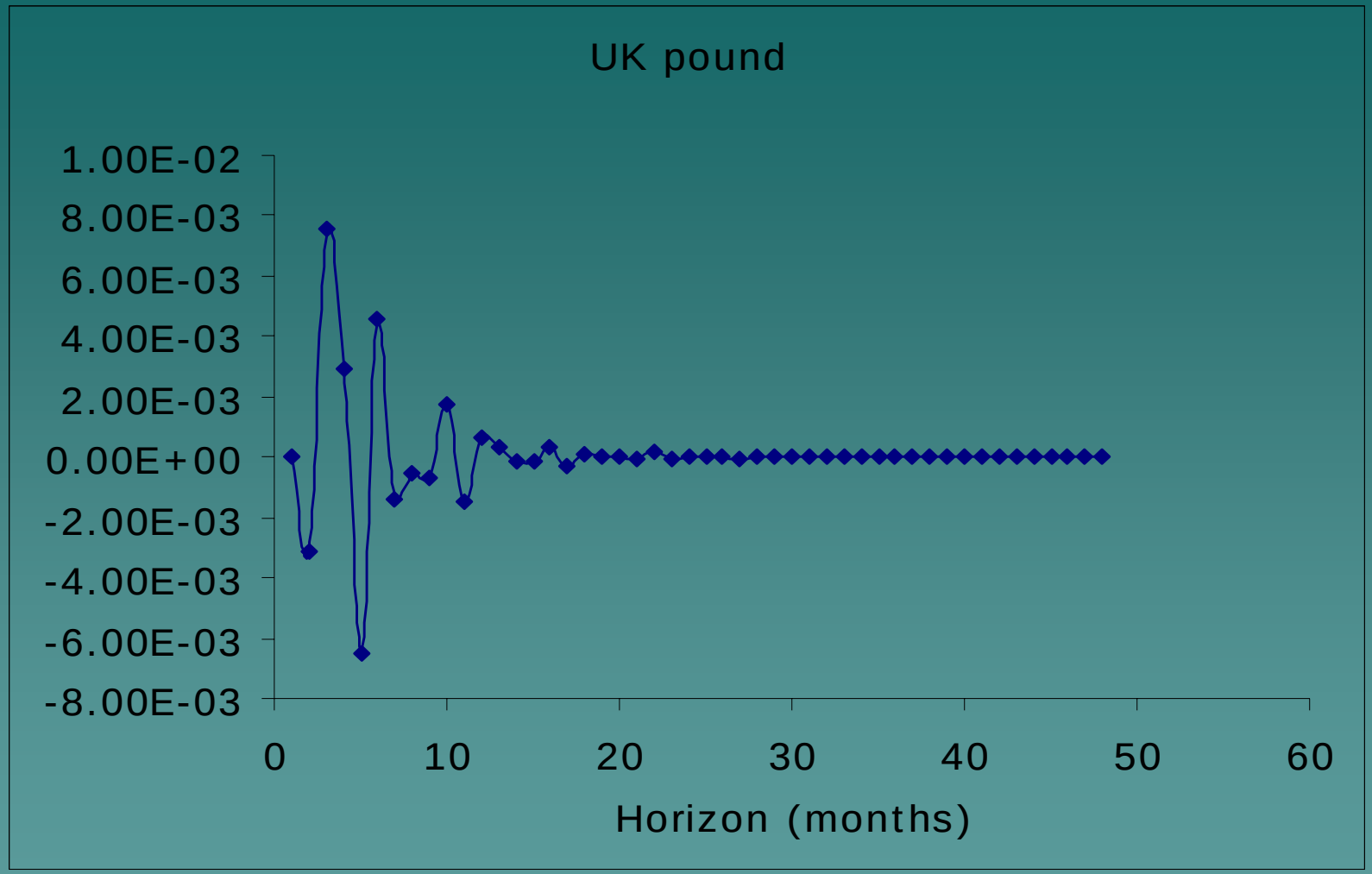
| Table 5. Percentage of forecast variance in ASPI explained by innovations in | | | | |
|---|---|---|---|---|
| Months | IR | JPY | UKP | USD |
| 1 | 0.000 | 0.000 | 0.000 | 0.000 |
| 12 | 2.548 | 0.157 | 0.104 | 0.064 |
| 24 | 7.302 | 0.449 | 0.710 | 0.139 |
| 36 | 13.239 | 1.482 | 2.129 | 0.516 |
| 48 | 19.522 | 2.895 | 4.388 | 1.214 |

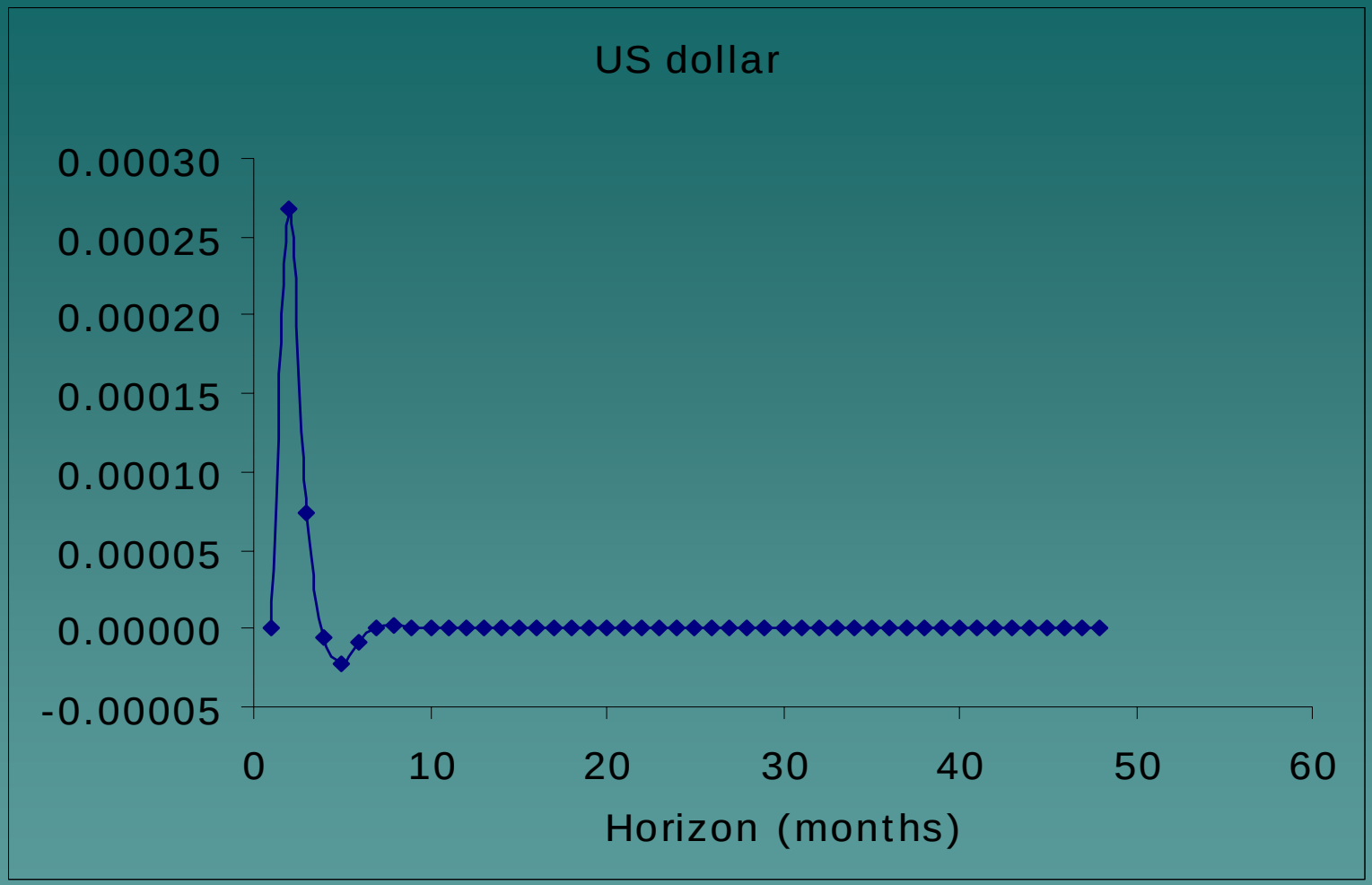
| Table 6. Percentage of forecast variance in exchange rates explained by innovations in ASPI | | | | |
|---|---|---|---|---|
| Months | IR | JPY | UKP | USD |
| 1 | 0.897 | 0.072 | 0.578 | 1.018 |
| 12 | 0.638 | 0.627 | 5.415 | 16.554 |
| 24 | 0.579 | 1.707 | 3.192 | 23.427 |
| 36 | 0.533 | 4.509 | 3.664 | 28.252 |
| 48 | 0.494 | 7.449 | 6.171 | 31.846 |

## Figure 1. Impulse response of ASPI to one standard deviation in the equations for exchange rates

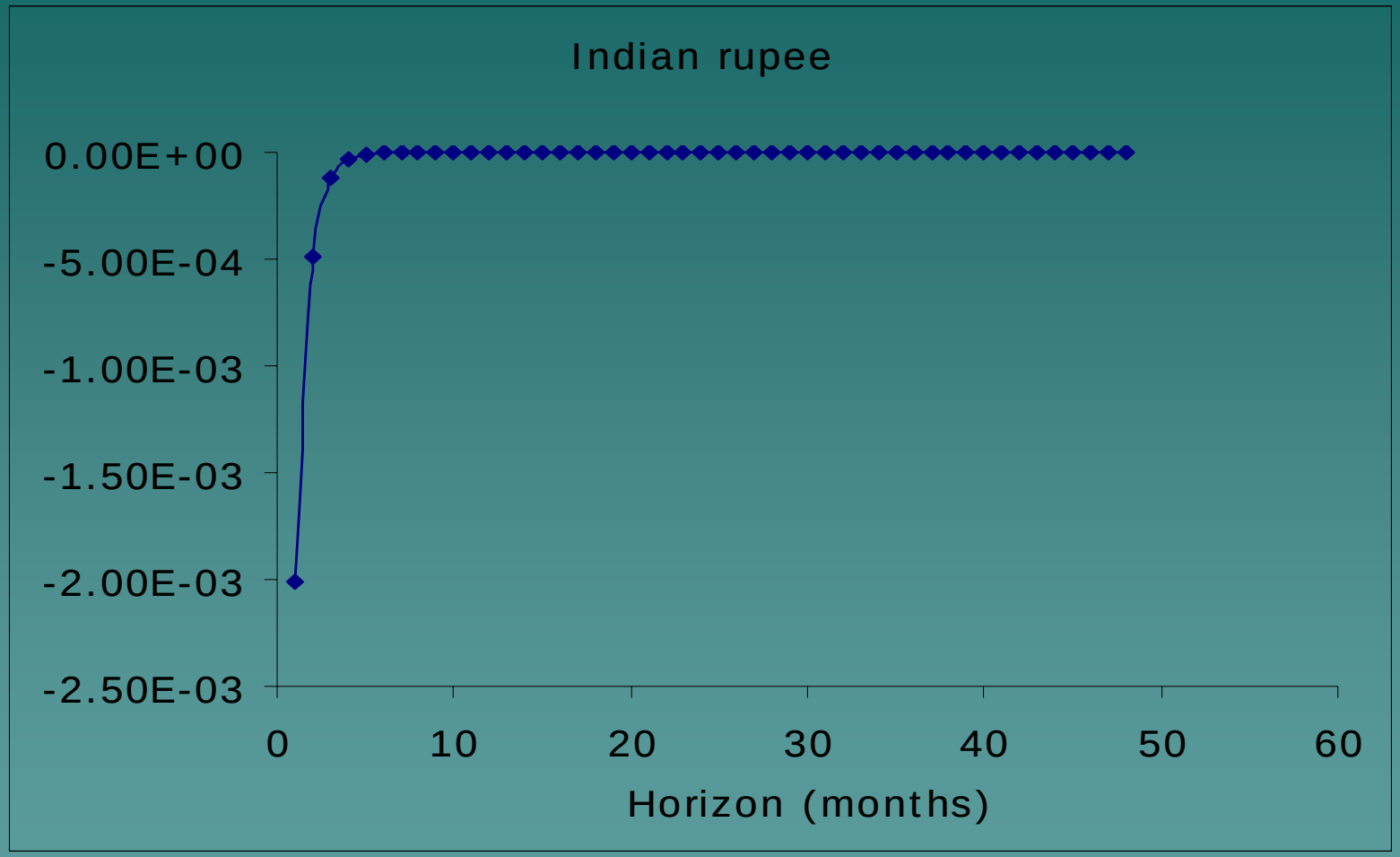


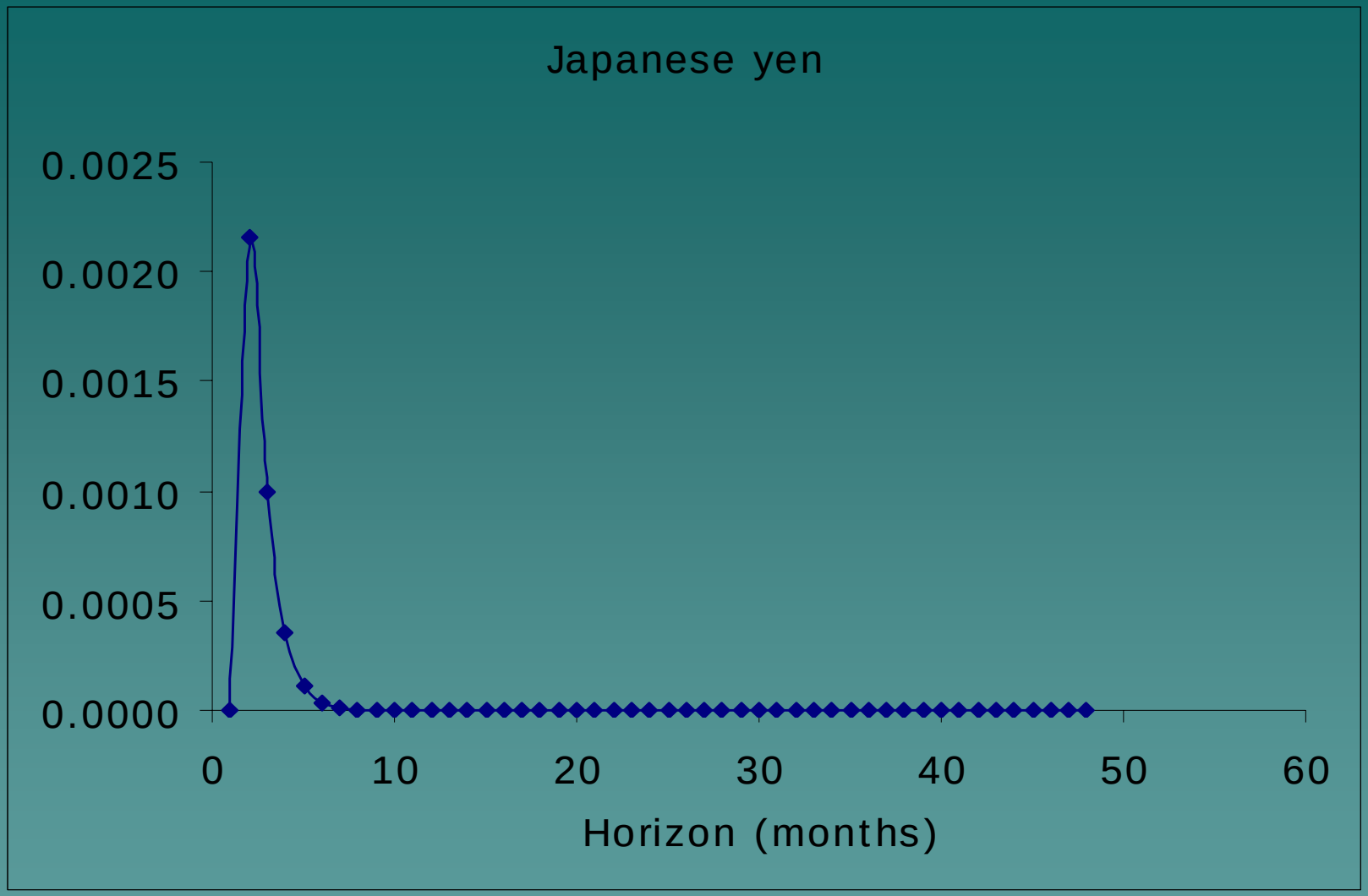

Japanese yen
0.00E+00
-1.00E-04
-2.00E-04
-3.00E-04
-4.00E-04
-5.00E-04
-6.00E-04
-7.00E-04
-8.00E-04
-9.00E-04
0
10
20
30
40
50
60
Horizon (months)

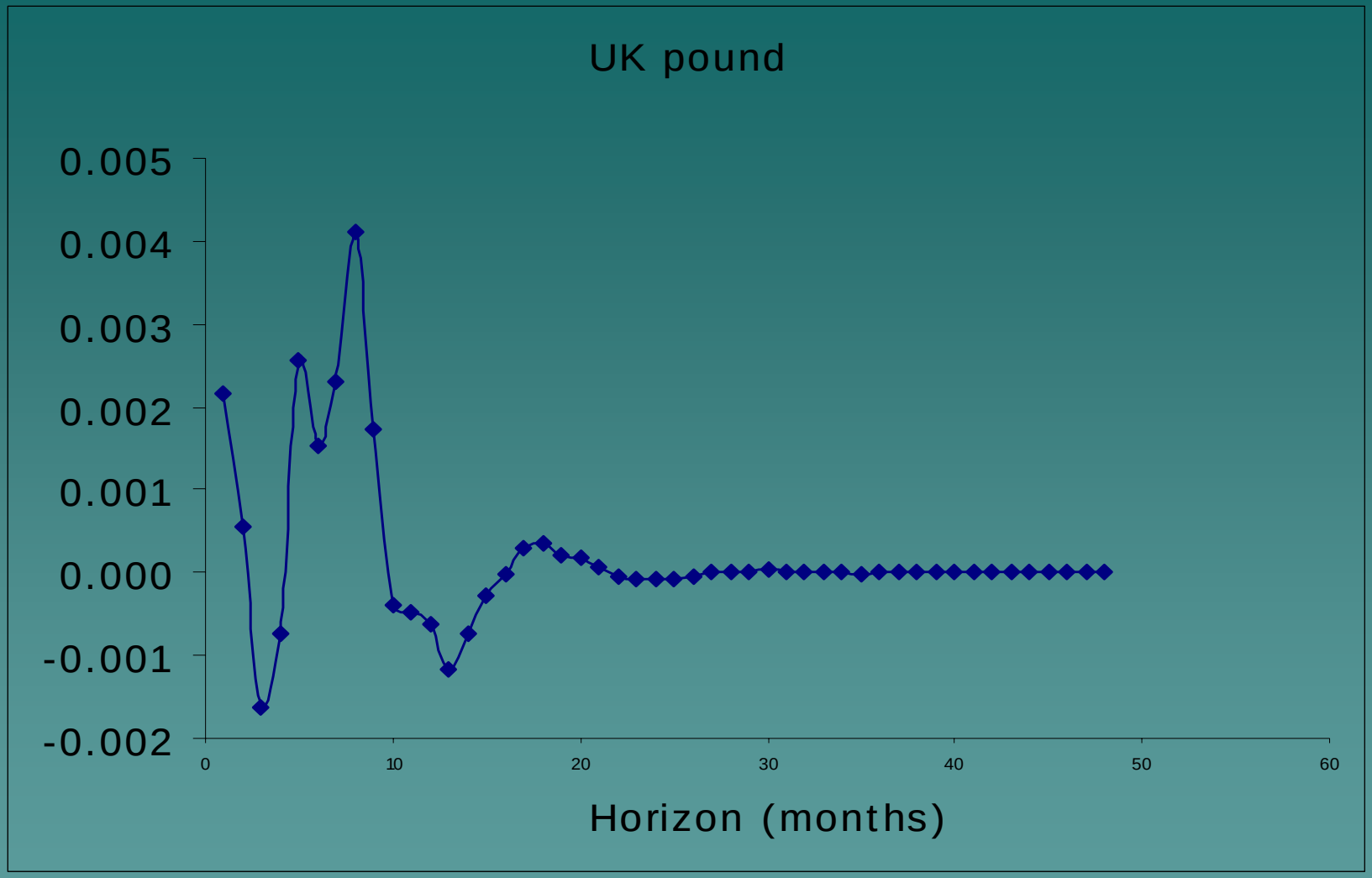

UK pound
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
0
10
20
30
40
50
60
Horizon (months)


US dollar
0.00030
0.00025
0.00020
0.00015
0.00010
0.00005
0.00000
-0.00005
0
10
20
30
40
50
60
Horizon (months)

## Figure 2. Impulse response of exchange rates to one standard deviation shock in the equation for ASPI




Japanese yen
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
0
10
20
30
40
50
60
Horizon (months)

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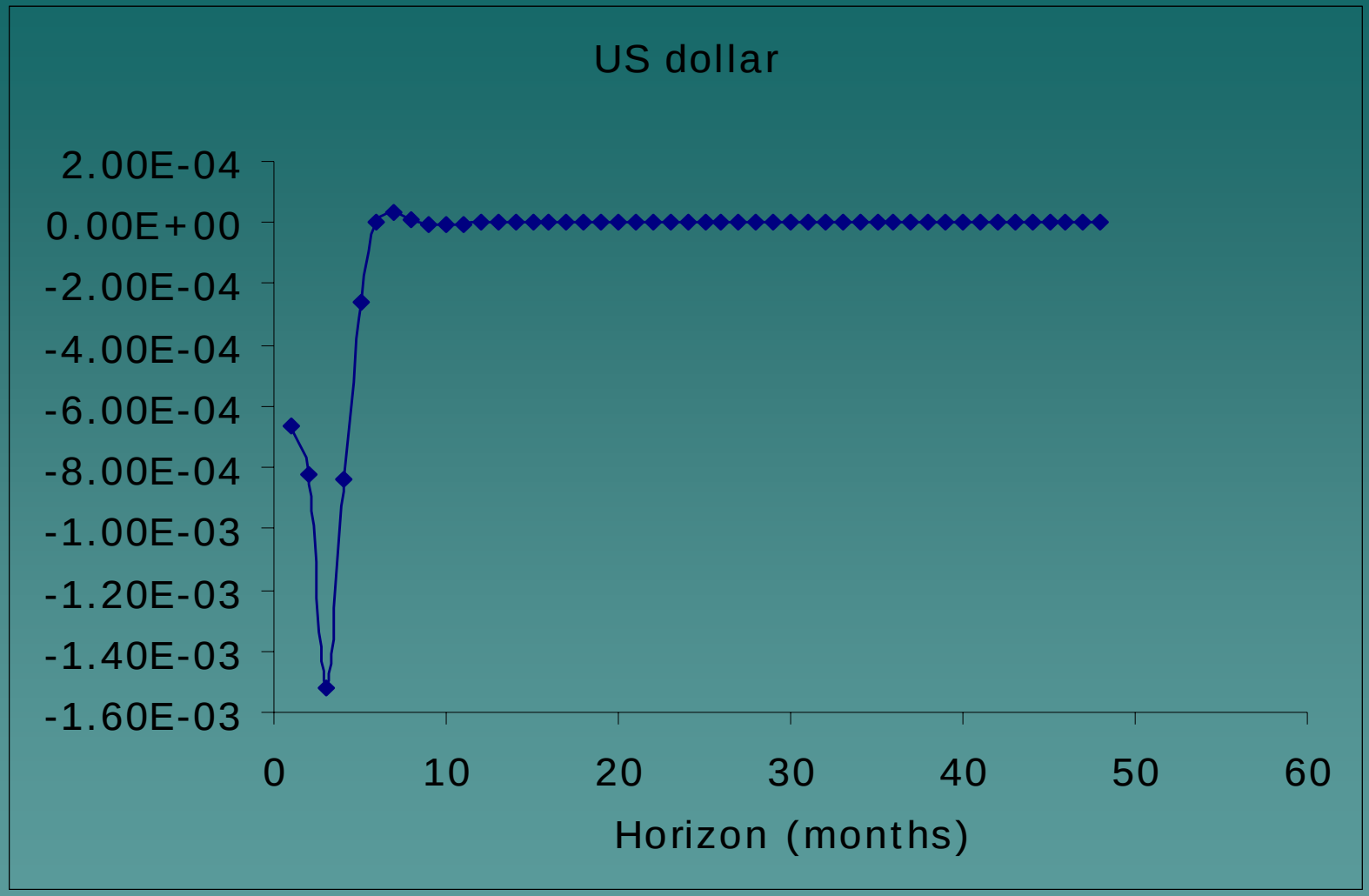
in Sri Lanka


US dollar
2.00E-04
0.00E+00
-2.00E-04
-4.00E-04
-6.00E-04
-8.00E-04
-1.00E-03
-1.20E-03
-1.40E-03
-1.60E-03
0
10
20
30
40
50
60
Horizon (months)

## Conclusions

In this paper, we investigated the causal nexus between stock market prices and four exchange rates in Sri Lanka

Unit roots of the variables were examined using more powerful techniques than those used in many of the previous papers

Cointegration tests found no long-run relationship between stock prices and exchange rates.

Variance decomposition analysis found that there is causal relationships from Indian rupee to ASPI and from US$ to ASPI. Impulse response analysis found that shocks to innovations of any variable in the system are short-lived.

The analysis of short-run causal relationships found one uni-directional relationship between stock prices and the US dollar exchange rates.

The above results indicate that the Sri Lankan share market is not efficient in the semi-strong form.