

**School of Economics and Finance**

**Essays in Exchange Rate Economics**

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Dedicated to  
my family , Syeda Nasreen Jahan, Sahil Muammer Wally and Syeda Naomi Tasnim  
whose support and sacrifices gave me confidence to reach at this stage.

## **Declaration**

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

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## **Abstract**

This research analyses the key issues in exchange rate economics. It provides a systematic treatment of exchange rate volatility and its manifestations; the presence of nonlinearity in exchange rates; and the interaction between national price levels and exchange rates. The approach is broadly empirical and applies recent econometric and modelling techniques to a wide range of up-to-date data on the major as well as developing countries. The issues covered in this study are among the most controversial in international finance. They raise questions about the degree to which domestic inflationary propensities and their transmission across countries are conditioned by the nature of the exchange rate regimes. These questions themselves concern the more fundamental problems of exchange rate determination, the degree of monetary independence and its implications for macroeconomic policy. This research aims to formally examine these issues with the specific objective of making original and substantial contribution to knowledge. Specifically, the results of this study is expected to contribute to an understanding of the intriguing questions regarding the nature and extent of exchange rate volatility; the role of nonlinearity, outlier and structural change in exchange rate returns; and the link between the exchange rate instability and domestic inflation.

Chapter 1 sets the stage for the other chapters in this thesis to follow. The broad features of major exchange rates since the early 1970s, and a comparison of these features with those of the 1960s are the subject of Chapter 2. Also included in this chapter is an analysis of whether these features are manifested in real interest rates and in commodity prices. The results indicate that exchange rates are not as volatile as widely perceived.

A systematic analysis is conducted in Chapter 3 regarding the time series properties of a mixed bundle of currencies since major currencies returned to the floating system in the early 1970s. The sample includes all major currencies and several other relatively less liquid currencies, all denominated in British pound-sterling. The purpose of including relatively less liquid currencies is to examine if nonlinearity is more of a phenomenon for the currencies of less-developed countries. The results indicate the presence of nonlinearity in exchange rates. However, the outliers and structural breaks are not found to be significant in affecting the results.

Chapter 4 provides an empirical re-examination of the purchasing power parity (PPP) theory for a mixed bundle of currencies using panel data techniques. Alternative panel unit root tests are implemented with the British pound sterling (GBP) as the numeraire currency. Results are then compared with a U.S. dollar-based panel. The panel unit root tests failed to provide support for PPP. The data are then analysed using alternative panel cointegration tests. The idea is that, non-rejection of unit roots in the real exchange rates does not necessarily imply a rejection of PPP. If nominal exchange rates and relative price levels are integrated of order one (in levels), then it is possible that these two variables may be cointegrated, implying a close relationship in the long run. Again, the results are not encouraging for PPP. The sample is then divided into 3 sub-group of countries to check if the results are sensitive to country characteristics. The results are mixed and the data tend to reject PPP.

Chapter 5 provides a further check on the results in Chapter 4, this time using a Divisia index approach. This approach has a similarity with the panel approach in the previous chapter in that it provides a test of PPP based on several countries jointly, rather than taking pairs of countries in isolation from the rest of the world. Using this framework, the short-run results indicate that the predictions of PPP do not hold up well. On the other hand, the long-run data are quite consistent with the PPP hypothesis. The results identify five years as a broad measure of the length of the long run in so far as PPP is concerned. Chapter 6 concludes the thesis.

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# Chapter 1

## Introduction

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### 1.1 Aims and Background

This research analyses the key issues in exchange rate economics. It provides a systematic treatment of exchange rate volatility and its manifestations; the presence of nonlinearity in exchange rates; and the interaction between national price levels and exchange rates. The approach is broadly empirical and applies appropriate econometric and modelling techniques to a wide range of up-to-date data on the major as well as developing countries. The issues covered in this study are among the most controversial in international finance. They raise questions about the degree to which domestic inflationary propensities and their transmission across countries are conditioned by the nature of the exchange rate regimes. These questions themselves concern the more fundamental problems of exchange rate determination, the degree of monetary independence and its implications for macroeconomic policy. This research aims to formally examine these issues with the specific objective of making original and substantial contribution to knowledge. Specifically, the results of this study, as indicated in Section 1.3, is expected to contribute to an understanding of the intriguing questions regarding the nature of exchange rate dynamics; the role of nonlinearity, outlier and structural change in exchange rate returns; and the link between the exchange rate instability and domestic inflation.

This chapter sets the stage for the other chapters in this thesis to follow. In the rest of this chapter, a skeletal background is provided, followed by some stylised facts, and an overview of other chapters in this thesis. All chapters are self-contained and consequently, the background material in this chapter is kept short to minimise duplication of material in other chapters. The whole thesis is written in such a way that specialists in international finance can skip this chapter without loss of continuity.

An exchange rate is the international value of a country's domestic currency. In an open-economy world, this value affects household purchasing power and corporate financial decision-making, which in turn, would influence global trade and capital flow patterns. Chen (2014) argued that, understanding exchange rate behaviour and its macroeconomic policy implications have historically occupied the centre stage of

research in international finance. The last decade or so has seen important theoretical and empirical advances in this area, but the ongoing puzzles concerning exchange rate determination and related issues and ramifications still persist. The recent economic turbulence triggered by sovereign debt crises in the euro zone, preceded by the global financial crisis, give further evidence to the importance of having a clear understanding of exchange rate behaviour, Taylor and Manzur 2013 argued that these remains many important but unresolved theoretical and empirical questions on exchange rate.

Following the break-down of the Bretton-Woods system in early 1970s, the behaviour of exchange rates has changed dramatically (see Wali and Manzur, 2013). The ‘collapse’ of the purchasing power parity (PPP), as reported by Frenkel (1981), followed by Meese and Rogoff’s (1983) important result that a simple random walk model outperforms most of the time-series and structural exchange rate models, presented new challenges in appreciating the complexity behind the exchange rate dynamics. Several interesting approaches have recently been developed to study a host of important issues including, for example, the connection between economic fundamentals and exchange rates, the purchasing power parity (PPP) puzzle, the expenditure-switching effects of exchange rate movements, the output and welfare effects of alternative exchange rate regimes, the short-run versus long-run influences in exchange rates and so on.

On the theoretical side, two major developments figure prominently. The first is what is now widely known as the new open economy macroeconomics (NOEM), pioneered by Obstfeld and Rogoff (1995). NOEM emphasises the normative implications of alternative international monetary regimes, and gives an integrative treatment of exchange rates, output and the current account in a dynamic general equilibrium framework. While the approach is theoretically quite developed, its empirical implementation is still at an early stage, and would require considerable further development (see Justiniano and Preston, 2010, for a recent empirical contribution). The second major theoretical development is the extension of the present-value models of exchange rates to world commodity prices, initiated by Chen and Rogoff (2003), and Chen et al. (2010). In this framework, the exchange rate is determined in a forward-looking manner (like all other asset prices, such as stocks,

bonds and so on), and the current spot rate is equal to the discounted sum of its expected future value of the economic fundamentals. As world commodity prices are part of the economic fundamentals, changes in world commodity prices are essentially exogenous to those in the exchange rates and consequently, serve as clear and identifiable terms-of-trade shocks to these exchange rates (see Chen et al., 2010).

Recent advances in empirical research far outstrip their theoretical counterparts. Accelerated computer power, increased availability of high quality data, and the development and adaptation of more sophisticated econometric procedures have seen an enormous increase in the empirical exchange rate literature. To circumvent the power problem of the traditional tests, long-span studies and panel data methodologies are introduced (see, for a survey, Taylor and Manzur, 2013). Here, the basic idea is to utilise the cross section dimension to increase the power of the unit root test. Under certain conditions, the increase in the cross section dimension is equivalent to adding more information per unit of time and thus improves the power of the test.

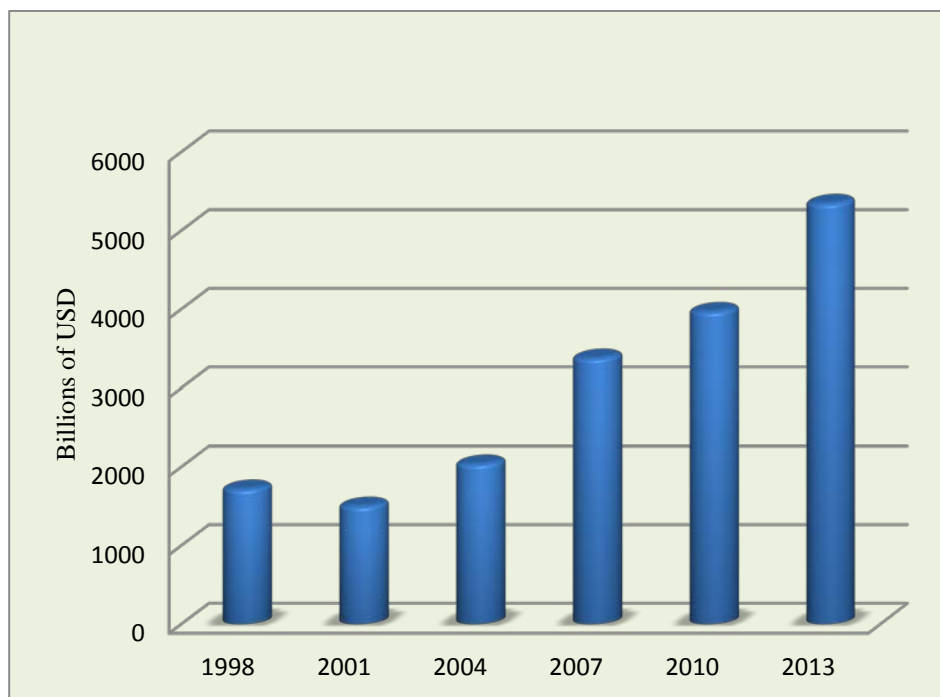
There has been a tsunami of interest in nonlinear modelling of exchange rate volatility. Since Engle (1982), many different modelling approaches have been applied to volatility forecasting. Many of these models are surveyed in Bollerslev et al, (1994) and subsequently, Engle (2002a; 2002b), among others. These models allow for nonlinearity, asymmetry and long memory properties of volatility in returns that can be non-normal with a variety of parametric and nonparametric distributions (Engle, 2004). In general, most studies detect the presence of nonlinear dependencies in exchange rate returns series. Interestingly, PPP figures prominently in the research in nonlinear dynamics of exchange rates (see such as, Cuestas and Mourelle (2011), Kim and Moh, (2010), Yoon (2010), Sollis (2008), Villavicencio (2008).

Significant theoretical and empirical advances notwithstanding, the properties and dimensions of exchange rate volatility are still far from fully understood and needs considerable new work. Empirical applications and evidence provided in this study would make useful contributions towards filling the gaps in the existing literature. While the history of exchange rate is interesting, it is also long and complicated and it is not the focus of the thesis. Interested readers can refer to Frankel and Harry (2013) or Edward, S.,(2003) for details.

## 1.2 Some Stylized Facts

Currency trading (measured in dollar terms) constitutes the largest financial market in the world with a phenomenal growth rate. In its 2013 Triennial Central Bank Survey, the Bank for International Settlements reports that global trading volume in foreign exchange markets averaged \$5.3 trillion each day. As can be seen in figure 1.1, this is more than twice the volume of currency that was traded just a decade ago. As growth in currency trading accelerates with increased globalisation, there is an increased need for a proper understanding of the currency behaviour.

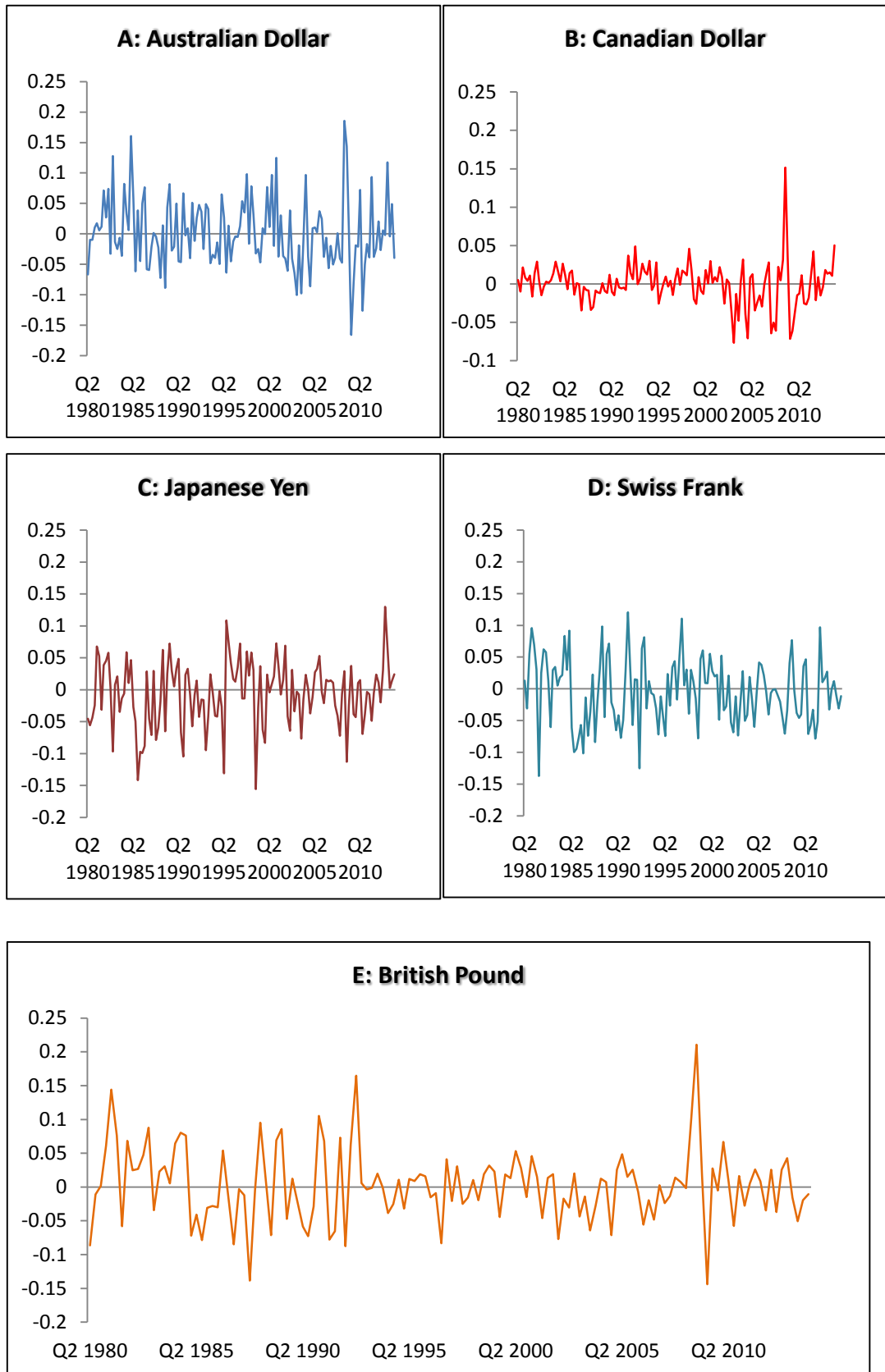
**Figure 1.1: Global foreign exchange market turnover**



Source: BIS Triennial Central Bank Survey 2013

Figure 1.2 gives the time-series plots of nominal exchange rates (in log-changes  $\times 100$ ) of five major currencies, namely, Australian dollar, Canadian dollar, Japanese yen, Swiss franc and the British pound sterling, all denominated in the U.S. dollar. The choice of log-difference as measurement of returns is consistent with the

**Figure 1.2: Exchange rate log-change:  
5 major currencies, 1980(Q1)-2014(Q1)**





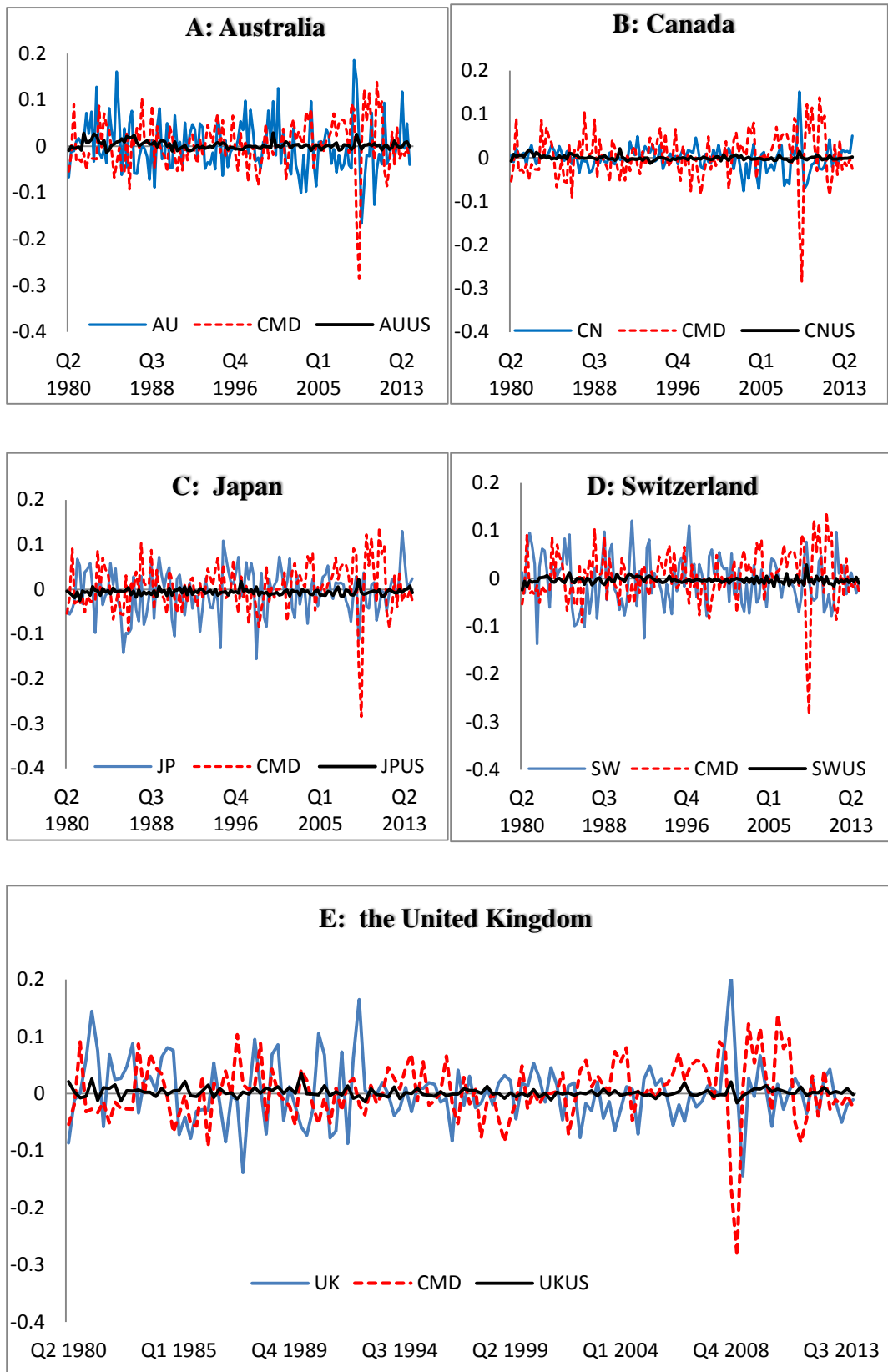
literature and the results presented here remain robust using the alternative measure such as percentage change. The data are quarterly and for the period 1980 (Q1) - 2014 (Q1). All data are from International Monetary Fund's (IMF) 'International Financial Statistics' (IFS) through DataStream and appended at the end of this chapter. As can be seen, the quarterly swings in the Australian dollar have been larger in amplitude compared to those in the Canadian dollar over the entire sample period. It can also be seen that Japanese yen, Swiss franc and British pound sterling are equally volatile with a tendency for the British pound sterling to slightly dominate. In all cases, the swings tended to have peaked during 2007-2008 – a period that coincides with the start of the global financial crisis.

For a *prima facie* comparison, exchange rate data for these five countries (as in Figure 1.2) are plotted with the inflation differential (domestic inflation minus the US inflation) and world commodity prices, as in Figure 1.3. CPI is used to measure inflation and Commodity Research Bureau (CRB) spot world commodity price index is used for commodity prices. Again all data are from IMF's IFS through DataStream and appended at the end of this chapter. Figure 1.3 is done for each country individually. As can be seen, exchange rates and commodity prices reflect some similarity in their quarterly oscillations, but the variability in relative inflation is considerably smaller. Thus, Figure 1.3 reveals little (if any) relationship between exchange rates and national inflation levels. Given the stationary nature of the returns, the unconditional mean can be interpreted as the long run change. This long-run, or underlying, change broadly approximates the inflation differential in Figure 1.3. This idea derives from PPP which is the subject of considerable investigation in the chapters to follow.

### **1.3 A Preview of Other Chapters**

Chapter 2 describes the broad features of major exchange rates since the early 1970s, and compares these features with those of the 1960s. Also included is an analysis of whether these features are manifested in real interest rates and in commodity prices. The results indicate that exchange rates are not as volatile as they are generally viewed. This chapter is based on Wali and Manzur (2013).

**Figure 1.3: Exchange rate, inflation differential and commodity price index: 5 major countries 1980(Q1)-2014(Q1)**



Chapter 3 gives a systematic treatment of the time series properties of a mixed bundle of currencies since major currencies returned to the floating system in the early 1970s. The sample includes four major currencies and eight other relatively less-liquid currencies, all denominated in British pound-sterling. The purpose of including relatively less liquid currencies is to compare and check if nonlinearity is more of a phenomenon for the currencies of less-developed countries. The results indicate the presence of nonlinearity in exchange rates. However, the outliers and structural breaks are not found to be significant in affecting the results. This chapter is based on Wali et al. (2014).

Chapter 4 provides a re-examination of the empirical content of PPP for a mixed bundle of 12 currencies using panel data techniques. Alternative panel unit root tests are implemented with the British pound sterling (GBP) as the numeraire currency. Results are then compared with a U.S. dollar-based panel. The panel unit root tests failed to provide support to PPP. The data are then analysed using alternative panel cointegration tests. The reason for this further analysis is that non-rejection of unit roots in real exchange rates does not necessarily imply a rejection of PPP. If nominal exchange rates and relative price levels are integrated of order one (in levels), then it is possible that these two variables may be cointegrated, implying a close relationship in the long run. Again, the results are not encouraging for PPP. The sample of 12 countries is then divided into 3 sub-groups to check if the results are sensitive to country characteristics. The results are mixed and the data tend to reject PPP.

Chapter 5 provides a further check on the results in Chapter 4, this time using a Divisia index approach. This approach has a similarity with the panel approach in the previous chapter in that it provides a test of PPP based on several countries jointly, rather than taking pairs of countries in isolation from the rest of the world. Using this framework, the short-run results indicate that the predictions of PPP do not hold up well. On the other hand, the long-run data are quite consistent with the PPP hypothesis. The results also identify five years as a broad measure of the length of the long run in so far as PPP is concerned. Interestingly, the results in this chapter are at variance with those in previous chapter. This tends to be a puzzle. It could be a challenge to explain this puzzle. Chapter 6 concludes the thesis.

As can be seen from the above, this thesis takes a multidisciplinary approach to investigate the nature of exchange rate. As such, substantive literature review has been taken in each quantitative chapter to highlight the development in each separated but related approach to exchange economics; hence a separate chapter may induce unnecessarily repetition.

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## Appendix to Chapter 1

This appendix contains exchange rate, commodity price index and price level differential data used in the analysis of this chapter. All data are quarterly and in log-change form. The numerarie currency is the U.S. dollar for all the exchange rates. The columns giving the exchange rates in Table A1.1 are defined as: AU=Australia, CN=Canada, JP=Japan, SW= Switzerland, UK= British pound sterling, CMD = commodity price index. The last 5 columns contain the price level differential data. It expresses difference between the log-change of domestic CPIs and the US CPI. For example, AUUS represents log-change of Australian CPI minus log-change of US CPI. The soft copies of the data are in excel files, available upon request.

**Table A1.1: Exchange rates, commodity prices and price level differentials (log-change): 1980(Q2)-2014(Q1)**

YR/QTR	AU	CN	JP	SW	UK	CMD	AUUS	CNUS	JPUS	SWUS	UKUS
Q2 1980	-0.0665	0.0050	-0.0456	0.0127	-0.0863	-0.0537	-0.0092	-0.0081	-0.0037	-0.0241	0.0212
Q3 1980	-0.0098	-0.0100	-0.0557	-0.0310	-0.0111	-0.0174	-0.0003	0.0080	-0.0082	-0.0056	0.0028
Q4 1980	-0.0100	0.0217	-0.0438	0.0547	0.0014	0.0905	-0.0044	0.0025	-0.0131	-0.0167	-0.0074
Q1 1981	0.0105	0.0082	-0.0244	0.0957	0.0609	-0.0313	-0.0032	0.0048	-0.0188	-0.0044	-0.0044
Q2 1981	0.0176	0.0042	0.0678	0.0698	0.1442	-0.0272	-0.0016	0.0070	-0.0059	-0.0080	0.0260
Q3 1981	0.0058	0.0109	0.0526	0.0303	0.0761	-0.0335	-0.0086	0.0018	-0.0250	-0.0062	-0.0119
Q4 1981	0.0119	-0.0166	-0.0316	-0.1371	-0.0580	-0.0140	0.0281	0.0111	-0.0030	-0.0072	0.0103
Q1 1982	0.0713	0.0142	0.0385	0.0247	0.0685	-0.0511	0.0088	0.0176	-0.0070	0.0015	0.0092
Q2 1982	0.0270	0.0292	0.0451	0.0620	0.0247	-0.0149	0.0087	0.0143	-0.0051	0.0023	0.0155
Q3 1982	0.0741	0.0042	0.0580	0.0578	0.0266	-0.0263	0.0150	0.0031	-0.0132	0.0032	-0.0131
Q4 1982	-0.0324	-0.0149	0.0032	0.0131	0.0473	-0.0266	0.0268	0.0123	0.0061	0.0058	0.0051
Q1 1983	0.1279	-0.0033	-0.0967	-0.0604	0.0877	-0.0273	0.0227	0.0082	-0.0024	0.0000	0.0048
Q2 1983	-0.0134	0.0031	0.0076	0.0295	-0.0342	0.0868	0.0089	-0.0011	-0.0026	-0.0069	0.0066
Q3 1983	-0.0248	0.0014	0.0208	0.0343	0.0229	-0.0016	0.0054	0.0051	-0.0133	-0.0077	0.0024
Q4 1983	-0.0061	0.0046	-0.0348	0.0049	0.0306	0.0702	0.0127	-0.0007	0.0019	-0.0007	0.0026
Q1 1984	-0.0359	0.0136	-0.0139	0.0180	0.0055	0.0453	-0.0134	0.0030	-0.0061	0.0003	-0.0050

Table A1.1 (Continued)

YR/QTR	AU	CN	JP	SW	UK	CMD	AUUS	CNUS	JPUS	SWUS	UKUS
Q2 1984	0.0821	0.0291	-0.0061	0.0218	0.0643	0.0343	-0.0080	-0.0029	-0.0025	-0.0044	0.0095
Q3 1984	0.0334	0.0164	0.0586	0.0833	0.0806	-0.0070	0.0026	-0.0009	-0.0105	-0.0089	-0.0019
Q4 1984	0.0063	0.0034	0.0105	0.0297	0.0761	-0.0674	0.0046	-0.0026	0.0032	0.0025	0.0046
Q1 1985	0.1604	0.0262	0.0463	0.0916	-0.0721	-0.0370	0.0091	0.0052	-0.0051	0.0120	0.0058
Q2 1985	0.0578	0.0117	-0.0273	-0.0610	-0.0411	-0.0027	0.0103	-0.0011	-0.0043	-0.0063	0.0216
Q3 1985	-0.0615	-0.0068	-0.0494	-0.0998	-0.0786	-0.0545	0.0160	0.0050	-0.0038	-0.0091	-0.0036
Q4 1985	0.0386	0.0141	-0.1418	-0.0948	-0.0306	-0.0567	0.0091	-0.0027	-0.0055	0.0004	-0.0052
Q1 1986	-0.0445	0.0175	-0.0974	-0.0763	-0.0279	0.0309	0.0215	0.0107	-0.0020	-0.0005	0.0049
Q2 1986	0.0500	-0.0140	-0.0992	-0.0571	-0.0298	-0.0924	0.0181	0.0092	0.0042	0.0005	0.0150
Q3 1986	0.0764	0.0009	-0.0882	-0.1017	0.0539	0.0179	0.0191	0.0045	-0.0125	-0.0124	-0.0069
Q4 1986	-0.0579	-0.0005	0.0286	-0.0134	-0.0168	-0.0009	0.0245	0.0066	-0.0040	0.0005	0.0089
Q1 1987	-0.0591	-0.0345	-0.0454	-0.0741	-0.0848	0.0394	0.0075	-0.0014	-0.0174	-0.0015	0.0002
Q2 1987	-0.0210	-0.0037	-0.0710	-0.0356	-0.0031	-0.0029	0.0011	0.0002	-0.0012	-0.0136	0.0016
Q3 1987	0.0013	-0.0080	0.0294	0.0225	-0.0122	0.1034	0.0051	-0.0013	-0.0137	-0.0086	-0.0092
Q4 1987	-0.0043	-0.0086	-0.0788	-0.0840	-0.1383	0.0151	0.0087	-0.0009	-0.0054	-0.0003	0.0031
Q1 1988	-0.0223	-0.0338	-0.0591	-0.0199	-0.0044	0.0073	0.0124	0.0027	-0.0101	0.0016	-0.0008
Q2 1988	-0.0721	-0.0301	-0.0188	0.0311	0.0951	0.0115	0.0046	0.0002	-0.0064	-0.0088	0.0108
Q3 1988	0.0141	-0.0085	0.0625	0.0980	0.0140	0.0877	0.0045	-0.0015	-0.0118	-0.0129	0.0008
Q4 1988	-0.0887	-0.0109	-0.0651	-0.0445	-0.0710	-0.0457	0.0099	-0.0045	-0.0032	-0.0052	0.0099
Q1 1989	0.0431	-0.0119	0.0250	0.0546	0.0690	0.0429	-0.0015	0.0020	-0.0164	0.0020	0.0051
Q2 1989	0.0815	0.0011	0.0722	0.0712	0.0856	0.0012	0.0097	0.0014	0.0071	-0.0062	0.0122
Q3 1989	-0.0276	-0.0092	0.0301	-0.0215	-0.0472	-0.0112	0.0127	0.0052	-0.0066	-0.0060	0.0005
Q4 1989	-0.0208	-0.0117	0.0053	-0.0332	0.0122	-0.0221	0.0106	-0.0010	-0.0022	0.0092	0.0109
Q1 1990	0.0498	0.0120	0.0334	-0.0652	-0.0230	-0.0551	0.0001	-0.0035	-0.0140	0.0004	0.0004
Q2 1990	-0.0451	-0.0104	0.0485	-0.0417	-0.0585	0.0420	0.0051	-0.0011	0.0026	-0.0008	0.0356
Q3 1990	-0.0464	-0.0149	-0.0667	-0.0773	-0.0729	0.0222	-0.0100	-0.0063	-0.0135	-0.0061	-0.0005
Q4 1990	0.0665	0.0068	-0.1047	-0.0491	-0.0287	-0.0209	0.0100	-0.0017	-0.0018	0.0031	-0.0010
Q1 1991	-0.0025	-0.0045	0.0231	0.0277	0.1052	-0.0528	-0.0098	0.0207	-0.0019	0.0098	-0.0022
Q2 1991	0.0092	-0.0060	0.0328	0.1204	0.0679	-0.0078	-0.0048	0.0006	0.0038	0.0062	0.0142

Table A1.1 (Continued)

YR/QTR	AU	CN	JP	SW	UK	CMD	AUUS	CNUS	JPUS	SWUS	UKUS
Q3 1991	-0.0401	-0.0047	-0.0083	0.0290	-0.0777	-0.0519	-0.0015	-0.0024	-0.0080	0.0020	-0.0035
Q4 1991	0.0509	-0.0078	-0.0575	-0.0568	-0.0653	0.0095	0.0017	-0.0078	0.0059	0.0047	0.0033
Q1 1992	-0.0113	0.0369	-0.0083	0.0149	0.0729	-0.0300	-0.0079	-0.0037	-0.0119	0.0043	-0.0025
Q2 1992	0.0258	0.0143	0.0145	0.0142	-0.0874	0.0181	-0.0094	-0.0023	0.0053	0.0018	0.0135
Q3 1992	0.0476	0.0063	-0.0424	-0.1253	0.0627	0.0263	-0.0078	-0.0036	-0.0118	-0.0066	-0.0085
Q4 1992	0.0362	0.0490	-0.0154	0.0635	0.1647	-0.0198	-0.0029	-0.0036	-0.0037	0.0030	-0.0036
Q1 1993	-0.0247	-0.0004	-0.0161	0.0812	0.0056	-0.0371	0.0019	-0.0008	-0.0077	0.0053	-0.0144
Q2 1993	0.0488	0.0070	-0.0948	-0.0310	-0.0035	0.0144	-0.0044	-0.0062	0.0014	0.0017	0.0084
Q3 1993	0.0408	0.0262	-0.0416	0.0119	-0.0013	-0.0173	0.0002	-0.0004	0.0004	-0.0022	-0.0017
Q4 1993	-0.0481	0.0160	0.0240	-0.0069	0.0197	0.0010	-0.0044	-0.0006	-0.0090	-0.0048	-0.0027
Q1 1994	-0.0344	0.0123	-0.0048	-0.0095	-0.0007	0.0459	-0.0028	-0.0129	-0.0065	-0.0028	-0.0060
Q2 1994	-0.0396	0.0301	-0.0407	-0.0307	-0.0384	0.0272	0.0003	-0.0087	-0.0020	-0.0082	0.0120
Q3 1994	-0.0139	-0.0081	-0.0423	-0.0718	-0.0253	0.0083	-0.0026	-0.0047	-0.0108	-0.0077	-0.0086
Q4 1994	-0.0495	-0.0025	-0.0022	-0.0117	0.0109	0.0463	0.0048	-0.0003	0.0006	-0.0032	0.0021
Q1 1995	0.0649	0.0282	-0.0263	-0.0417	-0.0318	0.0694	0.0080	0.0007	-0.0136	0.0050	0.0002
Q2 1995	0.0270	-0.0256	-0.1311	-0.0744	0.0118	-0.0128	0.0033	-0.0006	-0.0067	-0.0052	0.0094
Q3 1995	-0.0634	-0.0116	0.1083	0.0233	0.0088	0.0561	0.0075	-0.0016	-0.0063	-0.0020	-0.0016
Q4 1995	0.0133	0.0004	0.0754	-0.0262	0.0192	-0.0201	0.0045	-0.0043	-0.0053	-0.0043	-0.0027
Q1 1996	-0.0450	0.0095	0.0418	0.0342	0.0160	-0.0124	-0.0070	-0.0059	-0.0129	-0.0054	-0.0048
Q2 1996	-0.0124	-0.0034	0.0169	0.0434	-0.0150	0.0027	-0.0026	-0.0019	-0.0029	-0.0087	0.0032
Q3 1996	-0.0043	0.0040	0.0125	-0.0167	-0.0088	0.0656	-0.0027	-0.0042	-0.0065	-0.0056	-0.0038
Q4 1996	-0.0052	-0.0145	0.0347	0.0508	-0.0834	-0.0186	-0.0055	-0.0004	-0.0049	-0.0047	-0.0008
Q1 1997	0.0126	0.0061	0.0721	0.1108	0.0413	-0.0527	-0.0054	-0.0017	-0.0088	-0.0024	-0.0010
Q2 1997	0.0535	0.0200	-0.0137	0.0056	-0.0207	0.0284	-0.0070	-0.0002	0.0174	-0.0063	0.0085
Q3 1997	0.0351	-0.0009	-0.0137	0.0303	0.0306	-0.0178	-0.0070	-0.0015	-0.0041	-0.0041	0.0057
Q4 1997	0.0979	0.0173	0.0601	-0.0391	-0.0249	0.0074	-0.0013	-0.0040	0.0002	-0.0016	0.0053
Q1 1998	-0.0163	0.0151	0.0222	0.0298	-0.0158	-0.0766	0.0002	0.0024	-0.0066	-0.0027	0.0004
Q2 1998	0.0782	0.0113	0.0584	0.0116	0.0104	-0.0139	0.0003	-0.0028	-0.0006	-0.0054	0.0130
Q3 1998	0.0315	0.0459	0.0308	-0.0154	-0.0195	-0.0001	-0.0012	-0.0027	-0.0098	-0.0040	-0.0008



Table A1.1 (Continued)

YR/QTR	AU	CN	JP	SW	UK	CMD	AUUS	CNUS	JPUS	SWUS	UKUS
Q4 1998	-0.0321	0.0179	-0.1555	-0.0783	0.0191	-0.0467	0.0003	-0.0014	0.0056	-0.0051	0.0005
Q1 1999	-0.0248	-0.0200	-0.0278	0.0470	0.0318	-0.0840	-0.0040	-0.0027	-0.0136	0.0005	-0.0082
Q2 1999	-0.0470	-0.0259	0.0371	0.0604	0.0230	-0.0431	-0.0050	0.0021	-0.0063	-0.0070	0.0013
Q3 1999	0.0091	0.0089	-0.0625	0.0093	-0.0445	-0.0145	0.0019	-0.0003	-0.0094	-0.0021	-0.0057
Q4 1999	-0.0003	-0.0091	-0.0832	0.0087	0.0185	0.0485	-0.0009	-0.0028	-0.0065	-0.0032	0.0009
Q1 2000	0.0767	-0.0131	0.0238	0.0550	0.0133	-0.0268	-0.0007	-0.0041	-0.0149	-0.0035	-0.0050
Q2 2000	0.0115	0.0182	-0.0042	0.0279	0.0534	0.0035	-0.0032	-0.0029	-0.0095	-0.0082	0.0070
Q3 2000	0.0969	0.0005	0.0090	0.0193	0.0282	-0.0180	0.0287	0.0022	-0.0095	-0.0054	-0.0060
Q4 2000	-0.0195	0.0297	0.0207	0.0218	-0.0149	0.0011	-0.0011	0.0022	-0.0070	-0.0007	0.0012
Q1 2001	0.1248	0.0012	0.0726	-0.0489	0.0457	0.0004	0.0005	-0.0076	-0.0129	-0.0100	-0.0111
Q2 2001	-0.0371	0.0089	0.0378	0.0521	0.0151	0.0037	-0.0021	0.0068	-0.0109	-0.0023	0.0025
Q3 2001	0.0304	0.0032	-0.0074	-0.0339	-0.0460	0.0373	0.0026	-0.0012	-0.0042	-0.0023	-0.0008
Q4 2001	-0.0365	0.0219	0.0156	-0.0278	0.0136	-0.0719	0.0101	-0.0059	-0.0015	0.0003	0.0013
Q1 2002	-0.0403	0.0088	0.0688	0.0209	0.0189	-0.0237	0.0052	0.0023	-0.0146	-0.0015	-0.0031
Q2 2002	-0.0606	-0.0255	-0.0417	-0.0527	-0.0769	0.0397	-0.0034	0.0043	-0.0020	-0.0024	0.0014
Q3 2002	0.0384	0.0058	-0.0642	-0.0686	-0.0172	0.0585	0.0026	0.0068	-0.0056	-0.0090	-0.0002
Q4 2002	-0.0409	0.0014	0.0310	-0.0120	-0.0303	0.0120	0.0038	0.0010	-0.0046	0.0017	0.0052
Q1 2003	-0.0640	-0.0362	-0.0338	-0.0735	0.0201	0.0312	0.0039	0.0041	-0.0136	-0.0085	-0.0040
Q2 2003	-0.1005	-0.0766	-0.0032	-0.0217	-0.0436	0.0146	-0.0036	-0.0047	0.0004	0.0007	0.0083
Q3 2003	-0.0189	-0.0130	-0.0074	0.0278	-0.0141	0.0049	0.0001	-0.0013	-0.0057	-0.0111	-0.0022
Q4 2003	-0.0978	-0.0479	-0.0766	-0.0503	-0.0643	0.0740	0.0037	0.0011	-0.0032	0.0042	0.0050
Q1 2004	-0.0118	0.0015	-0.0155	-0.0415	-0.0275	0.0556	0.0014	-0.0037	-0.0102	-0.0104	-0.0033
Q2 2004	0.0968	0.0317	0.0232	0.0186	0.0125	0.0803	-0.0092	-0.0028	-0.0120	-0.0023	-0.0004
Q3 2004	-0.0368	-0.0394	0.0015	-0.0163	0.0071	-0.0468	-0.0010	-0.0024	-0.0036	-0.0110	0.0013
Q4 2004	-0.0861	-0.0710	-0.0373	-0.0599	-0.0711	0.0050	0.0025	-0.0013	-0.0018	0.0048	0.0035
Q1 2005	0.0092	0.0082	-0.0112	-0.0058	0.0256	-0.0030	0.0013	-0.0024	-0.0126	-0.0089	-0.0031
Q2 2005	0.0107	0.0128	0.0276	0.0413	0.0485	0.0112	-0.0077	-0.0048	-0.0125	-0.0041	-0.0017
Q3 2005	0.0029	-0.0344	0.0329	0.0377	0.0153	-0.0100	-0.0030	-0.0036	-0.0133	-0.0175	-0.0086
Q4 2005	0.0372	-0.0243	0.0530	0.0215	0.0255	0.0134	0.0013	-0.0033	-0.0044	0.0060	0.0009

Table A1.1 (Continued)

YR/QTR	AU	CN	JP	SW	UK	CMD	AUUS	CNUS	JPUS	SWUS	UKUS
Q1 2006	0.0246	-0.0150	-0.0035	-0.0041	-0.0075	0.0170	0.0025	-0.0001	-0.0065	-0.0076	-0.0027
Q2 2006	-0.0376	-0.0295	-0.0213	-0.0404	-0.0558	0.0351	-0.0016	-0.0067	-0.0134	-0.0071	-0.0002
Q3 2006	-0.0063	-0.0006	0.0154	-0.0064	-0.0193	0.0706	0.0035	-0.0054	-0.0024	-0.0116	0.0032
Q4 2006	-0.0563	0.0156	0.0130	-0.0011	-0.0484	0.0227	0.0075	0.0065	0.0056	0.0107	0.0193
Q1 2007	-0.0196	0.0281	0.0145	-0.0007	0.0025	0.0496	-0.0086	-0.0012	-0.0147	-0.0149	-0.0016
Q2 2007	-0.0504	-0.0643	0.0109	-0.0102	-0.0236	0.0579	-0.0070	-0.0034	-0.0151	-0.0047	-0.0031
Q3 2007	-0.0393	-0.0504	-0.0248	-0.0202	-0.0131	0.0561	0.0034	-0.0031	-0.0012	-0.0083	0.0009
Q4 2007	0.0012	-0.0609	-0.0408	-0.0449	0.0138	0.0321	0.0024	-0.0083	-0.0033	0.0060	0.0056
Q1 2008	-0.0405	0.0220	-0.0721	-0.0706	0.0075	-0.0143	0.0015	-0.0082	-0.0124	-0.0093	-0.0054
Q2 2008	-0.0474	0.0049	-0.0066	-0.0341	-0.0016	0.0909	-0.0066	-0.0008	-0.0125	-0.0053	-0.0017
Q3 2008	0.1855	0.0316	0.0292	0.0401	0.1013	0.0786	-0.0005	-0.0019	-0.0022	-0.0140	-0.0024
Q4 2008	0.1434	0.1517	-0.1130	0.0765	0.2107	-0.1636	0.0261	0.0151	0.0224	0.0283	0.0208
Q1 2009	0.0080	0.0327	-0.0252	-0.0027	0.0165	-0.2842	0.0062	0.0010	-0.0077	-0.0080	-0.0164
Q2 2009	-0.1660	-0.0714	0.0373	-0.0382	-0.1439	0.0061	-0.0061	-0.0021	-0.0113	-0.0022	-0.0035
Q3 2009	-0.0813	-0.0613	-0.0385	-0.0460	0.0274	0.1221	0.0032	-0.0051	-0.0091	-0.0111	0.0023
Q4 2009	-0.0189	-0.0378	-0.0429	-0.0405	-0.0051	0.0538	0.0031	-0.0010	-0.0070	0.0050	0.0087
Q1 2010	-0.0210	-0.0147	0.0108	0.0358	0.0667	0.1148	0.0051	0.0010	-0.0050	-0.0040	0.0079
Q2 2010	0.0720	-0.0129	0.0150	0.0464	0.0083	0.0301	0.0010	0.0010	-0.0030	0.0030	0.0141
Q3 2010	-0.1260	0.0111	-0.0693	-0.0712	-0.0575	-0.0297	0.0060	0.0050	-0.0070	-0.0120	0.0033
Q4 2010	-0.0500	-0.0253	-0.0388	-0.0581	0.0164	0.1383	0.0010	0.0030	-0.0010	0.0040	0.0082
Q1 2011	-0.0167	-0.0267	-0.0035	-0.0329	-0.0275	0.0790	0.0029	-0.0050	-0.0159	-0.0109	0.0043
Q2 2011	-0.0384	-0.0182	-0.0072	-0.0783	0.0052	0.0964	-0.0078	-0.0029	-0.0146	-0.0106	0.0006
Q3 2011	0.0934	0.0121	-0.0488	-0.0517	0.0261	-0.0507	0.0010	-0.0029	-0.0048	-0.0158	0.0007
Q4 2011	-0.0376	0.0422	-0.0054	0.0969	0.0086	-0.0859	0.0019	0.0048	-0.0001	-0.0001	0.0120
Q1 2012	-0.0239	-0.0212	0.0239	0.0105	-0.0348	-0.0424	-0.0067	-0.0029	-0.0047	-0.0097	-0.0038
Q2 2012	0.0205	0.0088	0.0114	0.0166	0.0257	0.0306	-0.0028	-0.0028	-0.0076	-0.0036	0.0025
Q3 2012	-0.0264	-0.0152	-0.0198	0.0269	-0.0370	-0.0393	0.0114	-0.0029	-0.0079	-0.0079	0.0017
Q4 2012	0.0057	-0.0040	0.0313	-0.0325	0.0257	0.0406	0.0009	-0.0009	-0.0009	-0.0009	0.0109
Q1 2013	-0.0020	0.0182	0.1300	-0.0009	0.0426	-0.0277	-0.0019	-0.0018	-0.0067	-0.0087	-0.0001

Table A1.1 (Continued)

YR/QTR	AU	CN	JP	SW	UK	CMD	AUUS	CNUS	JPUS	SWUS	UKUS
Q2 2013	0.1176	0.0134	0.0663	0.0122	-0.0155	-0.0110	-0.0009	-0.0009	-0.0006	-0.0016	0.0039
Q3 2013	-0.0043	0.0151	0.0027	-0.0106	-0.0505	-0.0201	0.0074	-0.0009	0.0013	-0.0057	0.0008
Q4 2013	0.0489	0.0107	0.0137	-0.0311	-0.0193	-0.0026	0.0102	0.0000	0.0078	0.0028	0.0092
Q1 2014	-0.0394	0.0503	0.0241	-0.0116	-0.0106	-0.0252	-0.0011	0.0020	-0.0074	-0.0095	-0.0019

## Chapter 2

### Exchange Rate Manifestations

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#### 2.1 Introduction

As alluded to in the previous chapter, exchange rates have been markedly volatile since switch to floating rates by major currencies in the early 1970s. Higher exchange rate volatility implies increased uncertainty for global business and finance, which can be enormously costly. In order to cope with this increased exchange rate volatility, economic managers have been constantly looking for alternative arrangements. The best example of a potential solution is the European Union whose member countries revoked use of their national currencies and adopted a single currency (the euro). A number of emerging economies have struggled with variants of managed exchanged rate regimes. Smaller countries like Panama and Ecuador have gone for dollarization; and other high-inflation countries like Mexico and Argentina are viewed as likely candidates for this option. Consequently, the issue of exchange rate volatility is of great concern for policymakers and business.

How volatile have real exchange rates been since a return to floating by the major currencies? Do other financial variables such as interest rates or commodity prices exhibit similar volatility? In this chapter, I provide a descriptive analysis of the broad features of major exchange rates since the early 1970s, and compare these with those of the 1960s. Also included is an analysis of whether these features are manifested in real interest rates and commodity prices. The purpose here is to describe the features rather than to explain them. A descriptive historical study is useful in abstracting a global picture corroborating the stylized facts that are fundamental to understanding the behaviour of exchange rates. These results have implications for several unresolved issues in exchange rate modelling, such as asymmetric exchange rate dependence (see, for example, Patton, 2006), financial risk management (see, for example, Christoffersen and Diebold, 2006), international trade and capital flows (see, for example, Kiyota and Urata, 2004), and the political economy of exchange rate regimes (see, among others, Willett, 2007; Wilson and Ng, 2007).

The chapter is organised as follows. The next section gives the details of the data used in this chapter. Section 2.3 contains a descriptive analysis of the exchange

rate data before and after the float. Exchange rate data are then compared with the corresponding real interest rates and commodity prices in Section 2.4, followed by a discussion on correlations in Section 2.5. The last section concludes the chapter. This chapter is based on Wali and Manzur (2013).

## **2. 2 Data**

I use real rather than nominal exchange rates involving most major currencies, namely the Group of Seven (G-7) and the Australian dollar. The three European currencies in the G-7 (Italian lira, French franc and German mark) have been replaced by the Euro for post-2003 data. All exchange rates are denominated in the U.S. dollar. Real exchange rates are calculated as nominal rates (expressed as domestic currency costs of \$US1) multiplied by the ratio of the domestic price level to the US price level. The consumer price index (CPI) is used for prices. Harmonized CPI is used for Euro zone prices. All data are from DataStream, and are quarterly, starting from 1960:Q1 to 2014:Q1. For our purposes, data for the 1960s represent the experience of the fixed-exchange rate period. The sample for the flexible regime is further truncated into three sub-periods to allow for possible shocks that might have introduced structural breaks into the series. The first sub-period 1973:Q1–1986:Q2 witnessed a set of common shocks associated with sharp fluctuations in the price of oil and contractionary monetary policy in major industrial economies. The second sub-period, 1986:Q3–2003:Q4 represents the globalization period characterised by dramatic increases in the volume of cross-border trade in both goods and assets. The third sub-period 2004:Q1–2014:Q1 covers recent developments including the global financial crisis and sovereign debt problems in the Euro zone.

For commodity prices, I have used the Commodity Research Bureau (CRB) spot world commodity price index.<sup>1</sup> Note that, this index is a measure of price movements of a collection of sensitive basic commodities whose markets are presumed to be among the first to be influenced by changes in economic conditions. As such, it serves as one early indication of impending changes in business activity. So the volatility of the index can be used as the perfect substitute to the volatility of

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<sup>1</sup> Back ground, description, estimation procedure and other detailed information on CRB spot index is available at [http://www.crbtrader.com/crbindex/spot\\_background.asp](http://www.crbtrader.com/crbindex/spot_background.asp).

the underlying commodities. Hence, it is no difference to consider share market index versus the firm stock price. The idea is to provide an overview on the market rather than just one particular commodity. Except for Japan during the 1960s, long-term government bond rates are used for nominal interest rates for the entire sample. For Japan, because of data unavailability, quarterly Treasury bill rates are used for the 1960s.<sup>2</sup> The data are appended at the end of this chapter.

### **2.3 Results**

Table 2.1 contains descriptive statistics of quarterly log-changes of real exchange rates for the G-7 plus the Australian dollar before and after the float. The last column gives the means across currencies. A positive change is a real depreciation of the domestic currency against the U.S. dollar. Looking at mean changes for the 1960s, all these currencies had, on average, depreciated against the U.S. dollar. Similar results obtain for the full sample of the floating regime period (1973-2014), except for the Japanese yen, and the German mark, which, on average, had appreciated against the U.S. dollar. The mean changes for the sub-periods under the floating regime are slightly mixed, but on average, the value of the U.S. dollar has been in decline against these currencies from 1986 onwards. Interestingly, the mean quarterly change across all currencies for the entire floating rate sample (1973-2014) is not too far away from zero (.05, see the fifth entry from top in the last column of Table 2.1). This may have implications for the long-run adjustments of exchange rates to purchasing power parity (PPP). Manzur (1990) argued that, real exchange rate changes tend to persist on a quarter-to-quarter, bilateral basis, for an individual country, but they may wash away on a longer-term, multi-currency basis. Note that PPP, which postulates an equilibrium relationship between exchange rates and national price levels, is viewed as an anchor for exchange rate dynamics (Rogoff, 1996).

Looking at the standard deviation measures in Table 2.1, they have increased noticeably in the period 1973-2014 than in the 1960s for all currencies. The average

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<sup>2</sup> Only long term bonds are available for all the countries and for the entire period under study. Other instruments like T-bills or other short term bonds are not available for all the countries and for the period 1960-2014.

**Table 2.1: Quarterly real exchange rates (log-change):  
1960s vs post-float**

Statistics	AU	CN	JP	UK	GER	FRA	ITA	EUR	Mean
<b>1960s:</b>									
Mean	0.58	0.34	0.69	0.71	-0.35	0.64	0.29	-	0.42
Std Dev	2.94	0.92	1.23	1.90	1.74	1.30	1.25	-	1.61
Skewness	1.04	1.47	0.34	2.31	-2.21	2.38	0.63	-	0.85
Kurtosis	8.11	6.80	2.49	9.47	10	10.19	2.68	-	7.11
Jarque- Bera	120.5***	37.57***	1.19	102.7***	112***	121***	2.78	-	
<b>1973 –2014:</b>									
Mean	0.26	0.07	-1.09	0.54	-1.14	0.27	2.04	-0.53	0.05
Std Dev	5.37	2.75	5.04	4.97	5.31	5.20	5.45	4.43	4.28
Skewness	1.64	0.71	-0.26	1.09	0.02	0.23	0.63	0.93	0.62
Kurtosis	11.07	10.82	3.26	5.98	2.58	2.47	3.33	4.42	5.49
Jarque- Barra	395.1*	434.24*	2.33	93.83*	0.78	2.10	7.4**	13.5***	
<b>1973-1986:</b>									
Mean	2.92	0.85	-1.19	1.80	-1.37	1.23	3.54	-	1.11
Std Dev	5.48	1.67	5.45	5.39	5.56	5.50	5.20	-	4.89
Skewness	0.76	-0.17	-0.29	0.13	-0.16	0.01	0.30	-	0.08
Kurtosis	2.32	2.83	3.22	2.57	2.35	2.29	3.08	-	2.66
Jarque- Barra	1.60	0.31	0.89	0.58	1.18	1.15	0.84		
<b>1986-2003:</b>									
Mean	0.15	-0.17	-1.22	-0.20	-0.89	-0.76	-0.42	-	-0.38
Std Dev	4.18	2.06	5.31	4.50	5.06	4.70	5.30	-	4.44
Skewness	0.62	-0.64	-0.36	1.33	0.30	0.39	1.18	-	0.40
Kurtosis	4.61	5.25	2.70	7.56	2.79	2.90	4.82	-	4.40
Jarque-Barra	12.0***	19.55***	1.75	86.58***	0.86	1.30	18.4***	-	
<b>2004-2012:</b>									
Mean	-0.45	-0.57	-0.72	0.15	-	-	-	-0.46	-0.41
Std Dev	6.83	4.31	0.04	4.97	-	-	-	4.45	4.92
Skewness	2.21	1.29	-0.48	2.26	-	-	-	1.40	1.53
Kurtosis	12.44	7.44	4.48	11.88	-	-	-	5.49	8.35
Jarque- Barra	185.4***	45.18***	5.37**	169.5***	-	-	-	23.90***	

Notes: \*, \*\* and \*\*\* represent 10%, 5% and 1% significance level, respectively. As the Australian dollar was floated in 1983, the data for Australia are adjusted accordingly for the sub-samples. Euro data for the period 1973-2014 starts from January 1999. Germany, Italy and France data finishes at December 1998. The last column gives the means across the rows. AU, CN, EUR, FRA, GER, ITA, JP, UK and US stands for Australia, Canada, Euro, France, Germany, Italy, Japan, the United Kingdom, and the United States respectively.

standard deviation of these four currencies is at least 2.5 times larger than that in the 1960s (see the last column of the table). Looking into the three sub-periods of the floating exchange rate system, the standard deviations for the first two sub-periods are more or less comparable, but have increased for each of these currencies except for the Japanese yen in the last sub-period. The reduction in variability of the yen in the last sub-period may not be the result of heavy interventions in the foreign

exchange market<sup>3</sup> by the Bank of Japan since early 1990s, but that cannot be ruled out (see, for example, Kim and Sheen, 2006). Overall, the results indicate that variability of real exchange rates has increased since exchange rates were set to float. This is consistent with the literature (see Mussa, 1987 and Manzur, 2003). Note that this result finds support in the asset approach to exchange rates, whereby exchange rates being asset prices adjust instantaneously to ‘news’, and consequently, increased variability under a floating regime can be viewed as a matter of rule, rather than exception (see Mussa 1982).

Table 2.1 also reports the skewness and kurtosis measures of real exchange rate changes as a check for their empirical distributions. Skewness is a measure of symmetrical distribution of a series, while the coefficient of kurtosis is informative of the tail behaviour of a series, both being issues that have drawn substantial interest in exchange rate economics (see, Bai and Ng, 2005, among others, for more details). As can be seen from the observed values of skewness, real exchange rate change distributions are approximately symmetric in all cases, except for the British pound sterling in the 1960s, and Australia in the last sub-period (2004-2012). In all cases except for those in the sub-period 1973-1986, the observed values of kurtosis exhibit a pronounced ‘fat-tailed’ property when compared to the normal. The Jarque-Bera (J-B) test (Jarque and Bera, 1980) statistic rejects the null of normality in most cases. Again, the perverse yen result may have implications for the Bank of Japan’s short-term control of the money supply with an external exchange rate objective since the move to floating exchange rates in 1973 (see, among others, Hutchison, 1988). As can be seen yen appreciated throughout the floating period. During that period Bank of Japan actively intervened in the foreign exchange market on a regular basis to keep the Yen value within a targeted range. Note that modelling leptokurtic behaviour of exchange rates has been among the active areas of research since the work of Engle (1982). See, for example, Hsieh (1988; 1989; and 1991), and more recently, Emekter et al. (2009), for empirical applications. While it is conventional to provide and compare density plots based on these histograms, this is not appropriate in this context

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<sup>3</sup> Bank of Japan, in coordination with the Ministry of Finance, launched a reserve targeting program during that period and kept Japanese yen exchange rate at the targeted level by buying and selling yen in the foreign exchange market.



**Table 2.2: Quarterly real interest rates (log-change): 1960s vs post-float**

Statistics	AU	CN	JP	UK	GER	FRA	ITA	EUR	US	Mean
<b>1960s:</b>										
Mean	0.05	0.01	0.03	-0.03	-0.06	0.11	-0.13	-	-0.11	-0.02
Std Dev	4.77	3.21	5.81	4.22	5.65	3.16	6.93	-	2.35	4.51
Skewness	0.06	0.59	-0.29	0.54	-0.42	0.28	0.37	-	0.11	0.15
Kurtosis	4.42	3.63	3.01	2.48	2.28	3.18	2.34	-	1.43	2.85
Jarque Bera	8.05*	2.92	0.54	2.32	2.02	0.55	1.60	-	4.09	
<b>1973 – 2014:</b>										
Mean	-0.01	-0.02	0.01	0.02	0.01	0.02	0.01	0.02	-0.03	0.00
Std Dev	2.99	2.64	4.30	5.31	3.70	2.07	3.26	3.54	2.77	3.39
Skewness	0.59	0.46	0.03	0.55	-0.35	0.14	0.76	0.08	0.88	0.35
Kurtosis	7.83	4.32	5.43	4.37	3.85	3.16	6.77	1.96	9.58	5.25
Jarque barra	128.68*	17.90*	40.57*	21.28*	8.40*	0.74	113.69*	2.78	319*	
<b>1973 – 1986:</b>										
Mean	0.24	0.07	0.10	0.08	0.14	0.13	0.12	-	0.08	0.12
Std Dev	3.72	2.26	5.66	7.19	4.52	2.40	5.29	-	2.53	4.20
Skewness	1.12	0.27	0.11	0.73	-0.43	-0.09	0.47	-	0.39	0.32
Kurtosis	4.60	3.33	4.56	3.05	2.55	2.98	2.95	-	3.17	3.40
Jarque Barra	4.43	0.88	5.59**	4.79***	2.08	0.07	2.02	-	1.41	
<b>1986-2003:</b>										
Mean	-0.03	-0.03	-0.04	-0.02	-0.04	-0.05	-0.07	-	-0.07	-0.04
Std Dev	3.26	2.59	4.02	4.74	3.95	1.60	1.52	-	1.60	2.91
Skewness	0.45	0.43	-0.22	-0.09	-0.27	0.21	0.36	-	-0.28	0.07
Kurtosis	8.22	4.52	3.00	3.96	3.72	3.95	3.23	-	2.79	4.17
Jarque Barra	81.84*	8.91*	0.56	2.77	2.36	3.15	1.63	-	1.03	
<b>2004-2014:</b>										
Mean	-0.29	-0.28	6.01	2.97	-	-	-	-1.84	-0.95	0.94
Std Dev	1.48	1.48	27.34	24.50	-	-	-	7.57	3.56	10.9
Skewness	-0.47	-0.48	4.67	6.02	-	-	-	-2.99	-1.81	0.82
Kurtosis	4.30	4.28	24.40	37.84	-	-	-	21.41	10.72	17.2
Jarque Barra	4.43	4.42	931.44*	2322*	-	-	-	640.17*	124*	

See notes to Table 2.1

since the focus is on the tails of exchange rate distributions. In this case, the density plots may potentially be misleading since there are not sufficient number of observations in the tails to construct robust density plots.

## 2.4 A Comparative Picture

For comparison purposes, I now turn to similar features of other financial variables such as commodity prices and real interest rates. The real interest rates are the nominal rates adjusted for inflation (ex-post). CPI is used to measure inflation. Note that changes in exchange rates and commodity prices are dimensionally consistently with ‘levels’ of real interest rates.

Table 2.2 is the real interest version of Table 2.1. As can be seen across the 1960s and the 1973-2014 period, the mean changes are somewhat comparable, but there are divergences in the standard deviations. The standard deviations of real interest rates for most of the countries in the sample have tended to decline, except for US (2.35 to 2.77) and the UK (4.22 to 5.31). Comparing the last column in Table 2.2 with the last column in Table 2.1, it can be seen that on average, the volatility of real interest rates tends to exceed that of exchange rates both under fixed and flexible exchange rate systems. Based on the observed values of skewness and kurtosis, the J-B test statistics reject the null of normality in most cases.

Table 2.3 reports results for world commodity prices. As can be seen, the mean changes are not wildly different from those for real exchange rates and real interest

**Table 2.3: Summary statistics of commodity price index (log-change):  
1960s vs post-float**

<u>Period</u>	<u>Mean</u>	<u>SD</u>	<u>Skewness</u>	<u>Kurtosis</u>	<u>Jarque Berra</u>
1960s:	0.24	2.68	0.31	2.59	0.9609
1973-2014:	0.79	5.74	-0.65	6.43	92.32*
1973-1986:	1.04	6.22	0.23	2.30	1.5574
1986-2003:	0.31	3.84	0.13	2.99	0.2076
2004-2014:	1.30	7.58	-1.57	7.45	50.51*

rates for all periods. The standard deviations indicate that world commodity prices are no less volatile than real exchange rates and real interest rates. Looking into the last sub-period, commodity prices tend to be more volatile than real exchange rates, but less so compared to real interest rates. J-B test statistics reject the null of normality for the full floating rate sample (1973-2014) and the last sub-period (2004-2014).

## 2.5. Correlations

Comparing the results in Table 2.1 with those in Tables 2.2 and 2.3, one may observe that it is not necessarily expected that the additional variability in real exchange rates in the post-float sub-period (simply as a consequence of the asset prices *vis-a-vis* national price levels) would necessarily carry over to commodity prices and interest rates. Can that possibility be ruled out? A crude way to handle this question is to examine correlations among these variables. Table 2.4 reports correlation coefficients across the four real exchange rates in pre- and post-float periods (Italy, France and Germany are dropped here for brevity). As can be seen correlations across the four currencies are either negative or close to zero in the 1960s. For 1973-2014, the coefficients are all positive and substantially larger as expected, except for the Japanese yen-Australian dollar and Japanese yen-Canadian dollar.

**Table 2.4: Correlation among the currencies: 1960s vs post-float**

	<u>1960s:</u>					<u>1973-2014:</u>			
	Australia	Canada	Japan	UK		Australia	Canada	Japan	UK
Australia	1.00				Australia	1.00			
Canada	-0.02	1.00			Canada	0.70	1.00		
Japan	0.06	-0.15	1.00		Japan	0.05	-0.01	1.00	
UK	-0.11	0.06	0.07	1.00	UK	0.51	0.48	0.32	1.00

Note: All the values are statistically significant.

Table 2.5 gives the correlations of changes in real exchange rates, real interest differentials (relative to the U.S. real interest rate) and commodity prices for 1973-2012 for these four countries. For each of the currencies, the real exchange rate tends to be either uncorrelated or negatively correlated with the real interest rate and commodity prices. However, the correlation coefficients of Australian and Canadian dollars with world commodity prices are both negative (a negative change is a real

**Table 2.5: Correlations of exchange rates, interest rates and commodity prices, 1973 – post-float**

	Australia				Canada		
	Dollar	Interest rate	Commodity price		Dollar	Interest rate	Commodity price
Dollar	1.00			Dollar	1.00		
Interest rate	0.077	1.00		Interest rate	0.083	1.00	
Commodity price	-0.339	-0.059	1.00	Commodity price	-0.327	-0.238	1.00
	Japan				UK		
	Yen	Interest rate	Commodity price		Pound	Interest rate	Commodity price
Yen	1.00			Pound	1.00		
Interest rate	-0.007	1.00		Interest rate	0.042	1.00	
Commodity price	0.023	0.018	1.00	Commodity price	-0.262	0.116	1.00

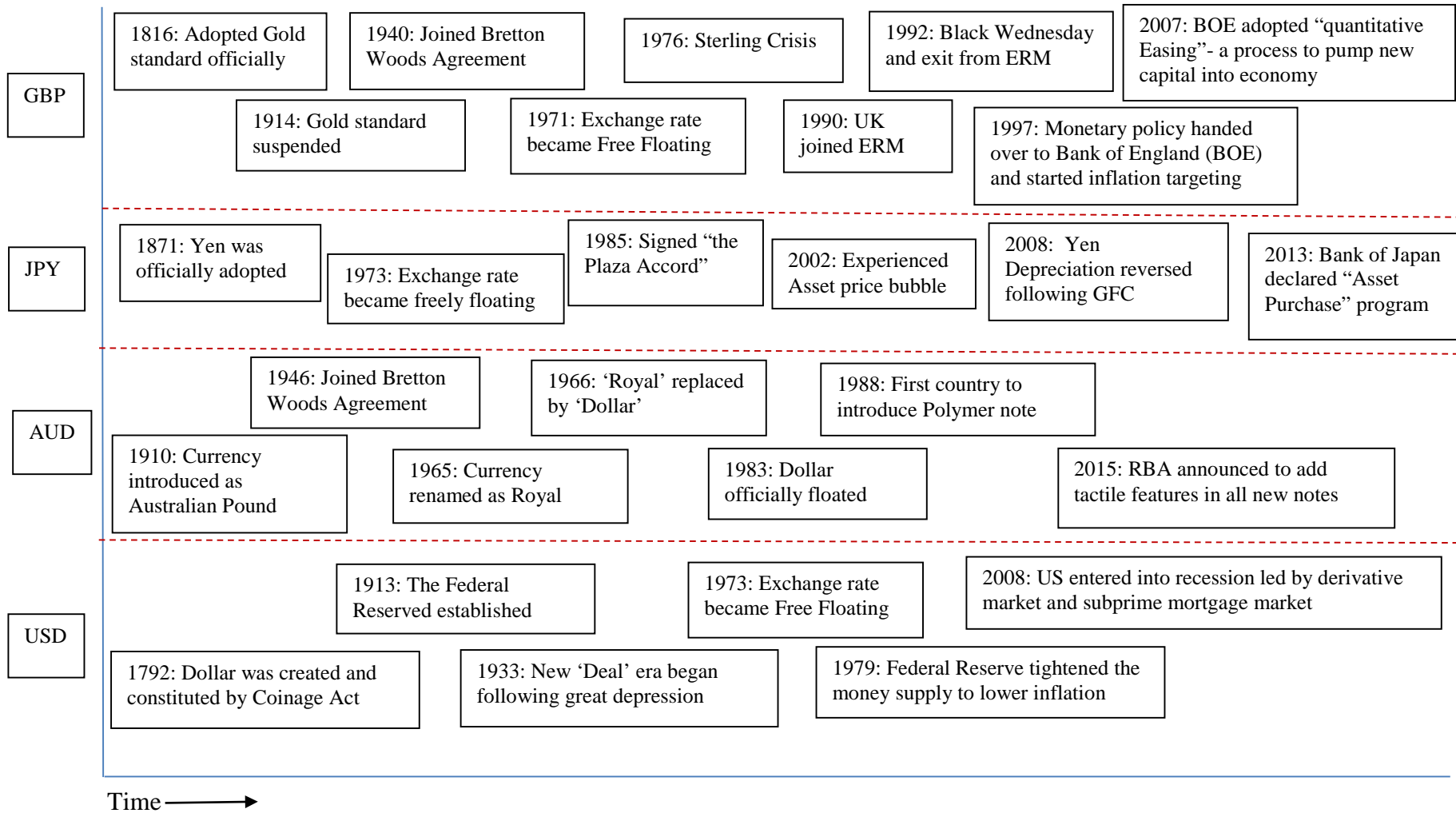
Note: Australian data starts from 1984. All values are statistically significant.

appreciation of the home currency) and relatively larger. This result may have implications for the interactions between exchange rates and world commodity prices (see, Chen and Rogoff, 2003; Clements and Fry, 2008, among others). However, I am reluctant to draw any conclusion regarding being or not being a commodity currency from this, as it requires further analysis on data that is yet to be collected.

## 2.6. Conclusions

Based on the first and second-order moments of real exchange rates, real interest rates and commodity prices, this chapter indicates that exchange rates may not be as volatile as they are generally viewed. There is a tendency for changes in real exchange rates to wash away in the long run. Curiously, real exchange rates have tended to be either uncorrelated or negatively correlated with real interest differentials; however, correlations of both the Australian and the Canadian dollars with world commodity prices tend to provide anecdotal support to a close relationship between exchange rates and of world commodity currency prices. These results have useful implications for further research in exchange rate dynamics, as well as for policymakers and businesses routinely grappled with exchange rate puzzles. Finally, I would like to finish the chapter by providing a diagram containing major historical events of selected currencies.

**Figure: 2.1 Major Currency History**



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## Appendix to Chapter 2

This appendix contains real exchange rates and commodity prices in logarithm form and real interest rates that have been used in this chapter. All data are quarterly and for the period 1960Q1-2014Q1. The numerarie currency is the U.S. dollar for all the exchange rates. Table A2.1 contains the real exchange rate data for Australian dollar (AU), Canadian dollar (CN), Japanese yen (JP), the United Kingdom pound sterling (UK), French franc (FR), Deutsch mark (DM), Italian lira (IT) and euro (EU). The commodity price data (CMD) are given in the last column. Table A2.2 contains the corresponding real interest rates data with an 'I' added to denote interest rates for the respective countries. Soft copies of all data are contained in excel files and available on request.

**Table A2.1: Real exchange rates and commodity prices (in logarithm):  
1960(Q1)-2014(Q2)**

YR/QTR	AU	CN	JP	UK	FR	DM	IT	EU	CMD
Q1 1960	-0.6590	-0.0642	6.2027	-1.7771	1.3205	2.0521	5.2398	-	4.5850
Q2 1960	-0.6421	-0.0481	6.2010	-1.7701	1.3120	2.0447	5.2318	-	4.6062
Q3 1960	-0.6437	-0.0491	6.2071	-1.7716	1.3212	2.0367	5.2318	-	4.6082
Q4 1960	-0.6387	-0.0357	6.2063	-1.7638	1.3242	2.0416	5.2490	-	4.5890
Q1 1961	-0.6231	-0.0323	6.2207	-1.7605	1.3235	2.0395	5.2505	-	4.5623
Q2 1961	-0.6204	-0.0282	6.2382	-1.7427	1.3235	2.0082	5.2490	-	4.6191
Q3 1961	-0.6229	0.0095	6.2601	-1.7302	1.3349	2.0088	5.2486	-	4.5870
Q4 1961	-0.6346	0.0136	6.2827	-1.7421	1.3554	2.0196	5.2648	-	4.5901
Q1 1962	-0.6470	0.0246	6.2969	-1.7275	1.3627	2.0343	5.2653	-	4.6042
Q2 1962	-0.6534	0.0489	6.3042	-1.7197	1.3645	2.0345	5.2806	-	4.5931
Q3 1962	-0.6384	0.0604	6.3062	-1.7170	1.3734	2.0226	5.2806	-	4.5570
Q4 1962	-0.6379	0.0590	6.3085	-1.7164	1.3823	2.0398	5.3033	-	4.5486
Q1 1963	-0.6453	0.0531	6.3475	-1.7096	1.3927	2.0544	5.3400	-	4.5497
Q2 1963	-0.6443	0.0602	6.3707	-1.6948	1.4013	2.0506	5.3404	-	4.5433
Q3 1963	-0.6511	0.0634	6.3744	-1.7157	1.4113	2.0315	5.3546	-	4.5497
Q4 1963	-0.6504	0.0611	6.3781	-1.7009	1.4198	2.0482	5.3767	-	4.5726
Q1 1964	-0.6455	0.0630	6.3752	-1.7081	1.4211	2.0552	5.3704	-	4.5778
Q2 1964	-0.6454	0.0707	6.3927	-1.6806	1.4294	2.0552	5.3939	-	4.5788
Q3 1964	-0.6366	0.0687	6.3889	-1.6839	1.4224	2.0448	5.4067	-	4.5768
Q4 1964	-0.6246	0.0649	6.4098	-1.6702	1.4306	2.0593	5.4067	-	4.6367
Q1 1965	-0.6153	0.0741	6.4278	-1.6592	1.4388	2.0668	5.4262	-	4.6492
Q2 1965	-0.6115	0.0772	6.4481	-1.6539	1.4401	2.0726	5.4192	-	4.6653
Q3 1965	-0.6062	0.0764	6.4373	-1.6471	1.4411	2.0749	5.4307	-	4.6672
Q4 1965	-0.6053	0.0726	6.4484	-1.6578	1.4344	2.0834	5.4244	-	4.6793
Q1 1966	-0.6112	0.0798	6.4611	-1.6509	1.4355	2.0896	5.4361	-	4.7185
Q2 1966	-0.6038	0.0806	6.4677	-1.6420	1.4365	2.0961	5.4287	-	4.7449
Q3 1966	-0.6162	0.0793	6.4550	-1.6419	1.4325	2.0670	5.4141	-	4.7344
Q4 1966	-0.6125	0.0849	6.4596	-1.6492	1.4407	2.0704	5.4091	-	4.6858



Table A2.1 (Continued)

YR/QTR	AU	CN	JP	UK	FR	DM	IT	EU	CMD
Q1 1967	-0.6136	0.0842	6.4778	-1.6379	1.4494	2.0764	5.4096	-	4.6540
Q2 1967	-0.6099	0.0915	6.4698	-1.6453	1.4379	2.0769	5.4207	-	4.6131
Q3 1967	-0.5978	0.0928	6.4609	-1.6547	1.4285	2.0600	5.4058	-	4.6082
Q4 1967	-0.6075	0.0863	6.4865	-1.5809	1.4370	2.0580	5.3988	-	4.5839
Q1 1968	-0.6248	0.0948	6.4882	-1.5034	1.4429	2.0597	5.3882	-	4.5880
Q2 1968	-0.6210	0.0879	6.4791	-1.4867	1.4431	2.0475	5.3737	-	4.5921
Q3 1968	-0.6263	0.0891	6.4733	-1.4804	1.4562	2.0376	5.3652	-	4.5675
Q4 1968	-0.6270	0.0826	6.4770	-1.4804	1.4564	2.0312	5.3550	-	4.5685
Q1 1969	-0.6303	0.0780	6.4675	-1.4826	1.4632	2.0360	5.3651	-	4.6131
Q2 1969	-0.6381	0.0807	6.4675	-1.4784	1.4620	2.0212	5.3667	-	4.6653
Q3 1969	-0.6487	0.0819	6.4807	-1.4889	1.5211	1.9955	5.3566	-	4.7068
Q4 1969	-0.6595	0.0674	6.4726	-1.4990	1.5685	1.9171	5.3540	-	4.7371
Q1 1970	-0.6648	0.0646	6.4919	-1.4928	1.5716	1.9192	5.3631	-	4.7441
Q2 1970	-0.6714	0.0481	6.4897	-1.4884	1.5636	1.8985	5.3456	-	4.7553
Q3 1970	-0.6667	0.0002	6.4814	-1.4831	1.5645	1.8829	5.3484	-	4.7327
Q4 1970	-0.6646	-0.0198	6.4896	-1.4800	1.5609	1.8799	5.3414	-	4.7095
Q1 1971	-0.6707	-0.0305	6.4989	-1.4658	1.5674	1.9007	5.3361	-	4.6653
Q2 1971	-0.6645	-0.0261	6.5049	-1.4401	1.5701	1.8857	5.3417	-	4.6959
Q3 1971	-0.6659	-0.0169	6.4850	-1.4504	1.5705	1.8333	5.3394	-	4.6886
Q4 1971	-0.6785	-0.0300	6.4372	-1.4719	1.5773	1.8295	5.3363	-	4.6710
Q1 1972	-0.6980	-0.0184	6.3586	-1.4963	1.5117	1.7895	5.2918	-	4.6756
Q2 1972	-0.6997	-0.0387	6.3588	-1.4890	1.4974	1.7839	5.2891	-	4.7441
Q3 1972	-0.6926	-0.0328	6.3501	-1.4204	1.5008	1.7829	5.3070	-	4.7774
Q4 1972	-0.6935	-0.0247	6.3586	-1.3661	1.5278	1.8070	5.3192	-	4.8122
Q1 1973	-0.7996	-0.0131	6.3045	-1.3873	1.4696	1.7514	5.3245	-	4.8798
Q2 1973	-0.8384	-0.0052	6.2703	-1.4191	1.3891	1.6564	5.3700	-	5.0026
Q3 1973	-0.8442	-0.0011	6.2753	-1.4155	1.3358	1.5009	5.3295	-	5.1469
Q4 1973	-0.8628	-0.0098	6.3300	-1.3584	1.3888	1.5653	5.3559	-	5.2730
Q1 1974	-0.8695	-0.0341	6.4477	-1.3054	1.5093	1.6229	5.4723	-	5.3279
Q2 1974	-0.8602	-0.0443	6.4258	-1.3255	1.5105	1.5312	5.4948	-	5.4510
Q3 1974	-0.8219	-0.0239	6.4964	-1.3113	1.4973	1.5492	5.5371	-	5.4245
Q4 1974	-0.7053	-0.0225	6.5147	-1.2856	1.4699	1.5065	5.5880	-	5.4570
Q1 1975	-0.7101	-0.0057	6.4958	-1.2709	1.3986	1.4296	5.5624	-	5.3371
Q2 1975	-0.6912	0.0217	6.5035	-1.1700	1.3574	1.4414	5.5615	-	5.3157
Q3 1975	-0.6592	0.0462	6.5128	-1.0575	1.4226	1.5020	5.6170	-	5.2460
Q4 1975	-0.6015	0.0369	6.5417	-1.0005	1.4427	1.5190	5.6522	-	5.3269
Q1 1976	-0.5808	0.0146	6.5484	-0.9546	1.4774	1.5141	5.7956	-	5.2380
Q2 1976	-0.5531	0.0017	6.5561	-0.8299	1.5387	1.5070	5.9643	-	5.2847
Q3 1976	-0.5473	-0.0002	6.5262	-0.7985	1.5891	1.4769	5.9565	-	5.3514
Q4 1976	-0.4327	0.0182	6.5491	-0.6955	1.6098	1.4289	6.0286	-	5.2973
Q1 1977	-0.3725	0.0587	6.5232	-0.7026	1.6046	1.4199	6.0786	-	5.3078
Q2 1977	-0.3824	0.0830	6.4919	-0.6851	1.5996	1.3966	6.0974	-	5.3900
Q3 1977	-0.3821	0.1058	6.4471	-0.6922	1.6056	1.3549	6.1074	-	5.3313
Q4 1977	-0.3839	0.1450	6.3724	-0.7309	1.6003	1.3178	6.1260	-	5.3078
Q1 1978	-0.3977	0.1579	6.3220	-0.7930	1.5834	1.2440	6.1165	-	5.3622
Q2 1978	-0.3975	0.1693	6.2451	-0.7403	1.5540	1.2287	6.1192	-	5.4293
Q3 1978	-0.4175	0.1857	6.0935	-0.7997	1.5079	1.1650	6.0924	-	5.4381

Table A2.1 (Continued)

YR/QTR	AU	CN	JP	UK	FR	DM	IT	EU	CMD
Q4 1978	-0.4152	0.2115	6.0644	-0.8273	1.4912	1.0875	6.0970	-	5.4976
Q1 1979	-0.4061	0.2141	6.0935	-0.8394	1.4792	1.0674	6.1151	-	5.5227
Q2 1979	-0.3910	0.1827	6.1592	-0.8692	1.4969	1.0686	6.1305	-	5.6265
Q3 1979	-0.4207	0.1772	6.1417	-0.9081	1.4636	0.9993	6.0942	-	5.6394
Q4 1979	-0.3938	0.1810	6.2198	-0.8719	1.4409	0.9607	6.1258	-	5.6326
Q1 1980	-0.4085	0.1549	6.2197	-0.9078	1.4420	0.9427	6.1562	-	5.6591
Q2 1980	-0.4384	0.1517	6.1705	-0.9003	1.4538	0.9452	6.1907	-	5.6054
Q3 1980	-0.4714	0.1497	6.1066	-0.9408	1.4446	0.9072	6.2037	-	5.5880
Q4 1980	-0.4825	0.1739	6.0497	-0.9488	1.5162	0.9717	6.3017	-	5.6785
Q1 1981	-0.4845	0.1869	6.0064	-0.9216	1.6127	1.0538	6.4236	-	5.6472
Q2 1981	-0.4656	0.1980	6.0684	-0.7912	1.7303	1.1364	6.5694	-	5.6200
Q3 1981	-0.4730	0.2107	6.0960	-0.6783	1.8099	1.1831	6.6404	-	5.5865
Q4 1981	-0.4434	0.2052	6.0614	-0.6927	1.8016	1.1079	6.6543	-	5.5725
Q1 1982	-0.3852	0.2371	6.0929	-0.6654	1.8814	1.1570	6.7395	-	5.5215
Q2 1982	-0.3409	0.2806	6.1329	-0.6109	1.9407	1.1664	6.7985	-	5.5066
Q3 1982	-0.2616	0.2879	6.1777	-0.5933	2.0373	1.1975	6.8747	-	5.4802
Q4 1982	-0.2016	0.2853	6.1870	-0.5433	2.0719	1.2183	6.9459	-	5.4536
Q1 1983	-0.1697	0.2902	6.0879	-0.4646	2.0726	1.1868	6.9569	-	5.4263
Q2 1983	-0.0861	0.2922	6.0929	-0.4728	2.1672	1.2099	7.0271	-	5.5130
Q3 1983	-0.0878	0.2987	6.1004	-0.4429	2.2422	1.2639	7.1020	-	5.5114
Q4 1983	-0.1077	0.3025	6.0676	-0.4134	2.2775	1.2812	7.1586	-	5.5816
Q1 1984	-0.1433	0.3191	6.0476	-0.3931	2.2996	1.2877	7.2003	-	5.6269
Q2 1984	-0.1222	0.3453	6.0391	-0.3573	2.3110	1.2844	7.2184	-	5.6612
Q3 1984	-0.0442	0.3609	6.0871	-0.2854	2.3893	1.3405	7.2948	-	5.6542
Q4 1984	-0.0486	0.3617	6.1008	-0.2161	2.4402	1.3913	7.3585	-	5.5869
Q1 1985	0.0837	0.3931	6.1420	-0.1223	2.5093	1.4605	7.4486	-	5.5499
Q2 1985	0.2089	0.4037	6.1104	-0.2205	2.4581	1.4010	7.4350	-	5.5471
Q3 1985	0.1791	0.4019	6.0571	-0.3143	2.3805	1.3039	7.4019	-	5.4926
Q4 1985	0.2033	0.4132	5.9098	-0.3641	2.2803	1.2055	7.3329	-	5.4359
Q1 1986	0.2044	0.4415	5.8104	-0.3604	2.1899	1.1101	7.2559	-	5.4668
Q2 1986	0.2067	0.4367	5.7154	-0.3931	2.1898	1.0655	7.2291	-	5.3744
Q3 1986	0.3625	0.4420	5.6148	-0.3863	2.1352	0.9708	7.1584	-	5.3923
Q4 1986	0.3461	0.4481	5.6394	-0.3376	2.1068	0.9334	7.1331	-	5.3914
Q1 1987	0.3179	0.4123	5.5765	-0.4109	2.0375	0.8404	7.0743	-	5.4308
Q2 1987	0.2564	0.4088	5.5043	-0.4732	2.0164	0.8111	7.0665	-	5.4279
Q3 1987	0.2616	0.3995	5.5200	-0.4668	2.0276	0.8106	7.0885	-	5.5313
Q4 1987	0.2853	0.3900	5.4358	-0.5436	1.9606	0.7337	7.0345	-	5.5464
Q1 1988	0.2752	0.3589	5.3666	-0.5705	1.9460	0.7182	7.0307	-	5.5538
Q2 1988	0.2020	0.3290	5.3414	-0.5831	1.9612	0.7284	7.0540	-	5.5653
Q3 1988	0.1790	0.3190	5.3921	-0.5061	2.0467	0.7982	7.1401	-	5.6530
Q4 1988	0.1413	0.3036	5.3238	-0.5585	2.0001	0.7483	7.0963	-	5.6073
Q1 1989	0.1303	0.2937	5.3325	-0.5371	2.0359	0.7932	7.1330	-	5.6502
Q2 1989	0.2255	0.2962	5.4118	-0.4579	2.0721	0.8309	7.1718	-	5.6514
Q3 1989	0.2555	0.2922	5.4353	-0.4434	2.0632	0.8097	7.1546	-	5.6402
Q4 1989	0.2436	0.2795	5.4383	-0.4300	2.0080	0.7547	7.1252	-	5.6181
Q1 1990	0.2636	0.2880	5.4578	-0.4780	1.9271	0.6796	7.0658	-	5.5630
Q2 1990	0.2657	0.2764	5.5089	-0.4673	1.9093	0.6676	7.0508	-	5.6050

Table A2.1 (Continued)

YR/QTR	AU	CN	JP	UK	FR	DM	IT	EU	CMD
Q3 1990	0.2044	0.2552	5.4286	-0.5770	1.8449	0.5963	7.0024	-	5.6272
Q4 1990	0.2476	0.2603	5.3222	-0.6191	1.7845	0.5359	6.9604	-	5.6062
Q1 1991	0.2424	0.2765	5.3434	-0.6031	1.8130	0.5330	6.9877	-	5.5535
Q2 1991	0.2462	0.2711	5.3800	-0.4541	1.9342	0.6619	7.1115	-	5.5456
Q3 1991	0.2317	0.2640	5.3637	-0.4415	1.9412	0.6749	7.1262	-	5.4938
Q4 1991	0.2305	0.2485	5.3121	-0.4877	1.8775	0.6183	7.0709	-	5.5033
Q1 1992	0.2630	0.2816	5.2918	-0.4895	1.8675	0.6185	7.0735	-	5.4733
Q2 1992	0.2466	0.2936	5.3116	-0.4986	1.8549	0.6185	7.0778	-	5.4914
Q3 1992	0.2754	0.2963	5.2574	-0.5609	1.7547	0.5178	7.0049	-	5.5177
Q4 1992	0.3183	0.3417	5.2383	-0.3739	1.8118	0.5702	7.1918	-	5.4978
Q1 1993	0.3362	0.3405	5.2145	-0.3155	1.8643	0.6427	7.3223	-	5.4607
Q2 1993	0.3200	0.3412	5.1210	-0.3433	1.8472	0.6326	7.3006	-	5.4751
Q3 1993	0.3587	0.3669	5.0799	-0.3258	1.9068	0.6720	7.3579	-	5.4578
Q4 1993	0.3544	0.3823	5.0949	-0.3168	1.9100	0.6689	7.4093	-	5.4588
Q1 1994	0.2955	0.3818	5.0836	-0.3239	1.9109	0.6987	7.4279	-	5.5047
Q2 1994	0.2722	0.4032	5.0409	-0.3267	1.8812	0.6635	7.3805	-	5.5320
Q3 1994	0.2500	0.3904	4.9878	-0.3678	1.8131	0.5979	7.3583	-	5.5403
Q4 1994	0.2332	0.3876	4.9862	-0.3900	1.8035	0.5800	7.3768	-	5.5865
Q1 1995	0.2496	0.4165	4.9462	-0.3890	1.7738	0.5398	7.4137	-	5.6559
Q2 1995	0.2813	0.3903	4.8084	-0.3936	1.7204	0.4751	7.4407	-	5.6431
Q3 1995	0.2714	0.3771	4.9104	-0.3804	1.7263	0.5001	7.4122	-	5.6992
Q4 1995	0.2653	0.3732	4.9806	-0.3723	1.7233	0.4886	7.4114	-	5.6792
Q1 1996	0.2481	0.3768	5.0095	-0.3580	1.7418	0.5183	7.3954	-	5.6668
Q2 1996	0.1995	0.3716	5.0235	-0.3500	1.7636	0.5482	7.3850	-	5.6694
Q3 1996	0.2011	0.3714	5.0294	-0.3753	1.7443	0.5289	7.3599	-	5.7351
Q4 1996	0.1870	0.3565	5.0592	-0.4273	1.7569	0.5435	7.3590	-	5.7164
Q1 1997	0.2032	0.3610	5.1225	-0.4302	1.8333	0.6292	7.4327	-	5.6637
Q2 1997	0.2081	0.3808	5.1262	-0.4286	1.8635	0.6591	7.4646	-	5.6921
Q3 1997	0.2455	0.3783	5.1084	-0.4218	1.9129	0.7183	7.5042	-	5.6744
Q4 1997	0.3053	0.3917	5.1686	-0.4413	1.8785	0.6847	7.4835	-	5.6817
Q1 1998	0.3443	0.4092	5.1843	-0.4376	1.9126	0.7201	7.5283	-	5.6051
Q2 1998	0.4023	0.4177	5.2421	-0.4364	1.8974	0.7030	7.5151	-	5.5912
Q3 1998	0.4494	0.4609	5.2631	-0.4395	1.8742	0.6842	7.4944	-	5.5911
Q4 1998	0.4094	0.4774	5.1132	-0.4529	1.8114	0.6179	7.4400	-	5.5445
Q1 1999	0.3893	0.4546	5.0717	-0.4326	-	-	-	-0.0689	5.4605
Q2 1999	0.3538	0.4308	5.1025	-0.4145	-	-	-	-0.0103	5.4174
Q3 1999	0.3597	0.4395	5.0305	-0.4197	-	-	-	-0.0063	5.4029
Q4 1999	0.3693	0.4276	4.9408	-0.4414	-	-	-	0.0007	5.4514
Q4 1999	0.3693	0.4276	4.9408	-0.4414	-	-	-	0.0007	5.4514
Q1 2000	0.3878	0.4105	4.9498	-0.4388	-	-	-	0.0488	5.4246
Q2 2000	0.4528	0.4259	4.9360	-0.3943	-	-	-	0.0989	5.4281
Q3 2000	0.5084	0.4286	4.9355	-0.3662	-	-	-	0.1292	5.4101
Q4 2000	0.5832	0.4606	4.9492	-0.3441	-	-	-	0.1701	5.4112
Q1 2001	0.5861	0.4542	5.0089	-0.3678	-	-	-	0.1036	5.4116
Q2 2001	0.6186	0.4699	5.0358	-0.3362	-	-	-	0.1629	5.4153
Q3 2001	0.6198	0.4719	5.0243	-0.3495	-	-	-	0.1432	5.4526
Q4 2001	0.6333	0.4880	5.0384	-0.3491	-	-	-	0.1432	5.3807

Table A2.1 (Continued)

YR/QTR	AU	CN	JP	UK	FR	DM	IT	EU	CMD
Q1 2002	0.6265	0.4991	5.0926	-0.3425	-	-	-	0.1682	5.3571
Q2 2002	0.5611	0.4778	5.0489	-0.3692	-	-	-	0.1197	5.3967
Q3 2002	0.5700	0.4905	4.9791	-0.4297	-	-	-	0.0487	5.4552
Q4 2002	0.5555	0.4929	5.0055	-0.4404	-	-	-	0.0365	5.4672
Q1 2003	0.4989	0.4608	4.9581	-0.4717	-	-	-	-0.0401	5.4984
Q2 2003	0.4192	0.3795	4.9553	-0.4790	-	-	-	-0.0924	5.5130
Q3 2003	0.3909	0.3651	4.9422	-0.4759	-	-	-	-0.0855	5.5179
Q4 2003	0.3109	0.3183	4.8625	-0.5297	-	-	-	-0.1380	5.5918
Q1 2004	0.2450	0.3161	4.8368	-0.6148	-	-	-	-0.1934	5.6475
Q2 2004	0.3045	0.3451	4.8481	-0.6022	-	-	-	-0.1572	5.7278
Q3 2004	0.3110	0.3034	4.8459	-0.6137	-	-	-	-0.1754	5.6810
Q4 2004	0.2494	0.2311	4.8069	-0.6374	-	-	-	-0.2318	5.6860
Q1 2005	0.2235	0.2369	4.7830	-0.6561	-	-	-	-0.2523	5.6830
Q2 2005	0.2268	0.2449	4.7981	-0.6401	-	-	-	-0.2103	5.6942
Q3 2005	0.2354	0.2069	4.8177	-0.6078	-	-	-	-0.1873	5.6842
Q4 2005	0.2493	0.1792	4.8663	-0.5875	-	-	-	-0.1595	5.6976
Q1 2006	0.2662	0.1641	4.8563	-0.5956	-	-	-	-0.1752	5.7146
Q2 2006	0.2556	0.1279	4.8216	-0.6413	-	-	-	-0.2235	5.7497
Q3 2006	0.2446	0.1219	4.8345	-0.6664	-	-	-	-0.2422	5.8203
Q4 2006	0.2346	0.1439	4.8532	-0.6732	-	-	-	-0.2436	5.8430
Q1 2007	0.2059	0.1708	4.8530	-0.7005	-	-	-	-0.2671	5.8926
Q2 2007	0.1436	0.1032	4.8488	-0.7259	-	-	-	-0.3008	5.9505
Q3 2007	0.1275	0.0496	4.8228	-0.7468	-	-	-	-0.3232	6.0067
Q4 2007	0.0807	-0.0196	4.7787	-0.7571	-	-	-	-0.3711	6.0388
Q1 2008	0.0640	-0.0058	4.6942	-0.7309	-	-	-	-0.4097	6.0244
Q2 2008	0.0172	-0.0018	4.6751	-0.7276	-	-	-	-0.4560	6.1153
Q3 2008	0.0703	0.0279	4.7021	-0.6949	-	-	-	-0.4254	6.1939
Q4 2008	0.3812	0.1946	4.6115	-0.4668	-	-	-	-0.2702	6.0303
Q1 2009	0.4008	0.2284	4.5787	-0.3757	-	-	-	-0.2576	5.7461
Q2 2009	0.2628	0.1549	4.6047	-0.4528	-	-	-	-0.3046	5.7522
Q3 2009	0.1714	0.0885	4.5572	-0.5127	-	-	-	-0.3639	5.8743
Q4 2009	0.0859	0.0497	4.5073	-0.5028	-	-	-	-0.3924	5.9281
Q1 2010	0.0971	0.0361	4.5130	-0.4527	-	-	-	-0.3312	6.0429
Q2 2010	0.1225	0.0242	4.5250	-0.3966	-	-	-	-0.2374	6.0730
Q3 2010	0.1054	0.0404	4.4487	-0.4425	-	-	-	-0.2565	6.0434
Q4 2010	0.0165	0.0180	4.4089	-0.4500	-	-	-	-0.3013	6.1816
Q1 2011	0.0023	-0.0137	4.3895	-0.4562	-	-	-	-0.3161	6.2607
Q2 2011	-0.0616	-0.0348	4.3677	-0.4826	-	-	-	-0.3680	6.3570
Q3 2011	-0.0487	-0.0256	4.3141	-0.4660	-	-	-	-0.3559	6.3063
Q4 2011	-0.0094	0.0215	4.3086	-0.4312	-	-	-	-0.2974	6.2204
Q1 2012	-0.0582	-0.0026	4.3278	-0.4347	-	-	-	-0.2745	6.1780
Q2 2012	-0.0178	0.0033	4.3317	-0.4420	-	-	-	-0.2475	6.2085
Q3 2012	-0.0340	-0.0147	4.3040	-0.4398	-	-	-	-0.2257	6.1693
Q4 2012	-0.0336	-0.0197	4.3344	-0.4316	-	-	-	-0.2555	6.2099
Q1 2013	-0.0347	-0.0033	4.4577	-0.4102	-	-	-	-0.2806	6.1822
Q2 2013	0.0121	0.0092	4.5234	-0.4010	-	-	-	-0.2664	6.1712
Q3 2013	0.0967	0.0234	4.5274	-0.4105	-	-	-	-0.2857	6.1511

Table A2.1 (Continued)

YR/QTR	AU	CN	JP	UK	FR	DM	IT	EU	CMD
Q4 2013	0.0950	0.0341	4.5489	-0.4438	-	-	-	-0.3073	6.1484
Q1 2014	0.1276	0.0864	4.5655	-0.4679	-	-	-	-0.3248	6.1233

**Table A2.2: Real interest rates (in logarithm): 1960(Q1)-2014(Q2)**

Name	AUI	CNI	JPI	UKI	USI	FRI	DMI	ITI	EUI
Q1 1960	-0.2414	5.4300	-0.4577	5.3063	4.4900	-1.6134	4.8295	5.2200	-
Q2 1960	-5.1971	5.1700	3.9257	3.2925	1.3080	6.1400	6.4600	4.9800	-
Q3 1960	4.9700	4.9000	1.8039	5.3579	3.8300	2.3252	9.7473	4.5100	-
Q4 1960	0.1810	-0.7403	3.9600	1.7844	0.9596	2.2822	1.4486	-4.3290	-
Q1 1961	0.4520	8.1440	-0.2173	3.8851	3.7900	6.1300	1.2748	4.7600	-
Q2 1961	5.3600	5.1100	1.9369	1.1915	3.7900	6.0400	4.0605	5.0800	-
Q3 1961	5.3400	4.9800	-2.0815	1.5941	3.9800	2.2485	7.4195	5.4000	-
Q4 1961	5.0300	1.9460	-5.8592	1.8761	1.0609	-5.0835	-0.2117	-3.9222	-
Q1 1962	9.8480	4.9200	0.2425	2.2999	4.0200	2.3670	-0.3870	5.5600	-
Q2 1962	4.9300	2.0780	0.3265	-2.1881	0.9819	2.5101	2.7411	-3.4858	-
Q3 1962	0.0120	2.4796	4.1818	7.4992	3.9900	2.3925	10.4969	5.8200	-
Q4 1962	4.8800	5.1000	2.3084	5.5106	3.9000	2.3744	0.1221	-2.9491	-
Q1 1963	4.8500	5.0800	-12.2698	-0.1853	1.0226	-1.0477	-2.8993	-11.5840	-
Q2 1963	4.5600	2.0609	0.3647	3.0445	3.9600	2.5868	6.0600	5.9000	-
Q3 1963	4.4800	2.2819	2.1857	8.0407	1.1830	-0.9678	10.5099	-2.2914	-
Q4 1963	4.4400	5.1400	3.9595	2.5058	4.1200	2.5345	-1.3197	-1.6977	-
Q1 1964	-0.3985	2.3326	3.9671	2.1788	1.3531	2.6327	0.1437	6.9800	-
Q2 1964	4.6500	2.3730	-1.1867	-1.3781	4.2000	2.8905	6.2600	-0.2511	-
Q3 1964	0.1195	2.3931	4.0042	2.9046	1.3830	6.0400	7.7563	-0.3811	-
Q4 1964	0.1562	5.1000	-4.3746	2.6532	4.1700	2.7978	0.6756	7.2800	-
Q1 1965	0.4116	2.2130	-2.5038	2.7936	4.2000	3.0247	3.6331	-0.7772	-
Q2 1965	0.6257	2.325	-2.3386	-3.1259	1.4225	3.1611	2.6568	7.0400	-
Q3 1965	0.6885	2.551	7.3068	4.8235	1.4818	3.1171	5.8987	-0.6093	-
Q4 1965	0.7302	2.6408	-2.2111	3.8559	1.7208	6.2200	0.6651	6.7000	-
Q1 1966	5.2500	0.0877	-2.0572	3.7089	2.0396	3.1527	3.5453	-0.9969	-
Q2 1966	0.7807	2.9264	1.1210	-0.7376	2.0681	3.2479	2.8208	6.5400	-
Q3 1966	5.2500	0.4766	5.7100	6.0727	-0.2292	3.3627	12.5701	6.5500	-
Q4 1966	0.8301	3.1497	1.1731	3.7250	2.3422	3.4771	2.7387	6.5900	-
Q1 1967	5.2500	5.5700	-1.7390	4.4282	4.5800	3.5412	4.7010	6.5600	-
Q2 1967	0.8784	0.4912	5.7100	3.1082	2.1797	6.9200	4.2584	-0.7197	-
Q3 1967	-3.3525	-1.6973	4.2367	9.0432	0.0212	3.7449	10.7439	6.6100	-
Q4 1967	5.2500	6.4400	-7.3110	2.2269	3.0510	0.6993	4.1197	6.6600	-
Q1 1968	5.2500	1.6566	0.0562	1.6633	0.4817	0.9897	1.4612	6.7000	-
Q2 1968	1.0172	1.7399	4.4949	-1.9661	0.6766	4.0780	5.1634	6.7300	-
Q3 1968	5.2500	1.5717	2.9225	5.6296	2.9522	1.2305	8.9174	6.6900	-
Q4 1968	0.9115	4.5835	-2.5377	3.1122	0.8010	1.2545	2.4002	6.6600	-
Q1 1969	1.2649	4.7584	4.3518	0.5695	1.2720	-1.0709	2.4676	-0.5574	-
Q2 1969	1.4674	0.2126	-1.0128	2.9576	-0.9010	2.1744	4.0122	-0.3898	-
Q3 1969	5.8000	2.8862	-3.2941	8.5134	2.0980	4.9508	10.8178	6.8300	-
Q4 1969	1.8191	5.7540	0.7539	4.0822	0.2617	2.5177	2.3544	0.3033	-
Q1 1970	1.9699	3.4688	-6.7273	1.3596	2.7457	0.3230	0.2963	1.3722	-
Q2 1970	2.8999	3.5222	0.9784	-0.1690	0.8722	2.9568	4.6805	9.1300	-
Q3 1970	2.9391	7.9300	4.7031	4.8160	2.9656	2.7351	9.7527	2.7172	-
Q4 1970	-0.9272	7.4800	-5.0893	1.1945	0.2016	2.8617	3.5820	2.6383	-
Q1 1971	3.0222	4.4808	-0.2490	-1.4094	3.8282	2.7266	-3.0777	8.3400	-
Q2 1971	-0.7174	2.7002	-1.5743	-4.8584	1.9021	2.8099	2.1289	1.9058	-

Table A2.2 (Continued)

Name	AUI	CNI	JPI	UKI	USI	FRI	DMI	ITI	EUI
3 1971	-0.6076	0.5146	0.5702	3.4444	2.1789	2.8117	8.2200	2.1399	-
Q4 1971	-0.9029	4.4061	0.6225	3.1838	3.7567	0.5150	2.1144	1.7907	-
Q1 1972	2.3525	0.4203	2.4065	1.8595	3.9080	2.9195	-0.5689	7.8000	-
Q2 1972	2.2944	5.1937	-3.6358	1.2832	1.9294	2.5462	3.2956	1.1283	-
Q3 1972	-1.2477	-1.0510	-0.2306	2.8762	2.1233	0.2627	4.5820	-4.7621	-
Q4 1972	2.3068	2.9615	-1.2598	-0.1284	4.3028	-1.7433	-0.4475	1.4740	-
Q1 1973	-4.4633	1.0183	-5.6967	2.7964	0.4618	3.3056	-0.0594	-4.1950	-
Q2 1973	-6.8743	-2.5071	-13.9913	-2.5349	-1.2305	1.4616	0.9207	-9.3757	-
Q3 1973	-5.5211	-2.1170	-6.2455	5.1230	-2.6185	-2.2808	8.7824	1.9677	-
Q4 1973	-7.0959	-0.0797	-11.2612	-1.6451	-2.8428	-1.7047	-0.6507	-3.2073	-
Q1 1974	-0.6291	-1.5667	-28.6750	-2.8965	-4.1657	-4.5038	0.9609	-12.9473	-
Q2 1974	-5.7671	-3.8147	-10.6232	-8.9811	-3.3698	-5.2256	3.6955	-15.0198	-
Q3 1974	-12.7279	-2.7632	-7.5478	5.1129	-2.6601	-2.2829	9.7103	-7.5340	-
Q4 1974	-3.7903	-1.4402	-9.3155	-0.9836	-4.3739	-2.0247	1.6569	-14.2862	-
Q1 1975	-5.9165	-0.1470	-1.3766	-8.7163	0.8172	-0.2849	2.3394	-0.9362	-
Q2 1975	-2.8849	0.5981	-4.6057	-21.8432	1.4383	1.2051	0.0452	-0.4312	-
Q3 1975	5.1515	-5.0085	1.7732	-3.3342	0.1861	0.5509	8.2500	3.6166	-
Q4 1975	-11.1193	1.6420	-4.8407	1.2133	1.6854	0.7590	2.0079	0.0760	-
Q1 1976	-1.2684	4.6957	-3.2199	-0.4583	3.0348	-0.6764	1.6068	-2.9265	-
Q2 1976	1.2084	3.2562	-6.3239	-0.5511	3.1098	-0.3622	3.3895	-11.5574	-
Q3 1976	-0.7345	3.2674	0.4567	5.3248	1.5996	0.1011	9.7744	-0.1066	-
Q4 1976	-12.4981	2.8858	-4.5636	-2.2451	2.6531	-0.8068	2.2498	-8.5259	-
Q1 1977	2.4789	-0.0360	-2.5816	-5.7297	-0.0990	3.8819	0.8919	-3.8538	-
Q2 1977	0.7243	-1.1320	-6.0791	-4.4576	-1.3895	-1.6372	1.0944	0.2363	-
Q3 1977	2.7468	0.3252	2.9500	6.6135	1.6251	0.0780	7.4813	3.3017	-
Q4 1977	0.4888	0.6041	-0.0293	5.3367	3.3522	2.9974	1.4750	0.7129	-
Q1 1978	3.7829	1.1563	1.0226	4.7383	1.0290	3.1655	0.3599	3.4127	-
Q2 1978	0.1711	0.1239	-4.7944	1.8659	-1.2531	-0.9673	2.0910	3.4098	-
Q3 1978	2.0123	-0.9993	0.5091	5.7537	-0.8593	-1.0202	8.4617	3.3029	-
Q4 1978	0.2275	3.3490	2.2452	6.3972	0.9766	0.3648	2.0490	1.1613	-
Q1 1979	2.3188	1.3501	3.9665	1.0712	-1.1142	-0.0325	0.1990	-0.5672	-
Q2 1979	-1.7672	-1.0409	-4.9254	-2.3166	-4.5347	-1.7033	1.8555	-2.1280	-
Q3 1979	2.0214	1.9683	1.2601	-13.5432	-4.0946	-2.3633	5.2161	0.8391	-
Q4 1979	-2.4700	2.0228	-1.4808	3.0437	-0.0309	0.8484	1.6576	-6.6990	-
Q1 1980	1.5693	3.9160	-1.8908	-3.9875	-3.7867	-2.6215	1.6801	-11.6843	-
Q2 1980	1.3311	0.6998	-5.8243	-8.5893	-3.6327	0.1489	1.8981	-0.1277	-
Q3 1980	4.5038	1.9874	2.3129	4.8695	3.5522	0.5959	7.9900	-0.8232	-
Q4 1980	3.7382	1.6436	0.8299	5.9698	2.0835	2.6679	1.9422	-4.7443	-
Q1 1981	3.3264	0.2851	2.3989	4.4576	1.8901	2.4618	0.8505	-3.2588	-
Q2 1981	4.9086	3.3969	-0.8029	-4.8687	4.9153	3.6413	3.1442	1.5603	-
Q3 1981	6.6030	4.9481	4.1964	8.3923	3.3660	1.3152	7.0295	8.5418	-
Q4 1981	-1.8582	5.3623	1.0139	5.9922	8.4693	3.1784	2.3009	3.6248	-
Q1 1982	8.7807	5.5290	5.4230	8.0781	11.5090	4.9863	4.8713	5.1123	-
Q2 1982	6.1230	3.0216	1.0620	1.1449	7.5152	4.2868	4.2382	8.4249	-
Q3 1982	2.8354	5.8930	3.4999	10.4596	5.9026	9.8431	6.3054	4.3003	-
Q4 1982	2.7513	6.3547	2.0797	7.9100	9.7781	7.8026	2.2448	1.9771	-
Q1 1983	4.6045	8.6446	6.3754	9.3257	10.5600	3.0504	4.9827	4.5869	-

Table A2.2 (Continued)

Name	AUI	CNI	JPI	UKI	USI	FRI	DMI	ITI	EUI
Q2 1983	5.1054	6.4719	1.1550	2.4583	5.2302	3.0427	5.8108	6.6033	-
Q3 1983	8.0281	5.6270	6.3675	5.7780	7.2584	4.3277	7.0592	8.9928	-
Q4 1983	4.8363	8.6817	0.6812	5.9480	8.2268	6.0938	3.1686	4.4024	-
Q1 1984	14.9268	6.9751	3.0470	8.3202	7.6527	6.6140	5.0476	4.4971	-
Q2 1984	12.8732	10.5792	1.6676	3.2483	8.9582	5.2401	6.2867	7.3027	-
Q3 1984	7.7775	9.1375	4.9140	8.0890	8.6727	6.2469	11.2571	9.2002	-
Q4 1984	8.1053	9.5921	0.3215	5.9580	8.4136	5.3222	1.5892	5.9602	-
Q1 1985	7.4074	7.3331	3.4426	6.4069	9.1032	6.1508	3.0715	1.5655	-
Q2 1985	4.7384	6.5640	3.4426	-2.4312	5.9020	3.8731	4.7094	4.2202	-
Q3 1985	4.9069	6.4537	2.4890	9.7304	7.9084	7.8100	10.9712	9.2896	-
Q4 1985	7.1459	7.4396	1.0862	8.7073	5.7399	8.1810	2.8075	5.3860	-
Q1 1986	4.0799	4.9229	3.8990	7.7468	7.7608	9.0354	4.8635	7.1935	-
Q2 1986	6.1757	6.5475	3.8990	3.9641	8.3992	5.4918	6.8965	7.7525	-
Q3 1986	3.2385	4.3422	5.1908	9.4414	4.1227	5.3082	10.7145	8.1004	-
Q4 1986	2.1382	5.1220	2.8880	5.8457	5.6758	6.0343	4.2135	5.7998	-
Q1 1987	6.0492	4.8360	4.6426	4.9675	2.4748	3.8964	3.4317	3.7863	-
Q2 1987	7.0614	4.3416	-2.5682	2.8928	2.9083	5.2033	4.4216	5.9335	-
Q3 1987	6.1746	6.5253	3.2799	8.9651	4.2822	7.9496	9.5332	6.9192	-
Q4 1987	6.7525	7.6564	1.4881	5.3836	6.0839	8.4181	4.0655	4.5812	-
Q1 1988	4.9926	6.4883	4.1777	7.8019	6.1580	6.9672	3.2359	5.6113	-
Q2 1988	4.8402	5.0007	-0.3036	1.2932	3.6812	5.4936	4.6509	6.7142	-
Q3 1988	4.9433	5.9385	1.9378	7.0154	3.9386	5.4464	9.1740	7.0655	-
Q4 1988	4.0585	7.6810	-0.7254	4.9177	4.5884	6.3555	2.1453	3.9313	-
Q1 1989	9.7951	5.2817	4.6025	6.1541	4.8856	5.3497	0.7576	4.7579	-
Q2 1989	3.3242	2.9343	-6.0953	1.4063	2.3699	4.0947	3.2779	5.6501	-
Q3 1989	4.7175	4.1255	2.2724	7.5000	4.5981	5.6093	9.7429	9.9782	-
Q4 1989	5.4537	6.6054	1.0514	4.4098	4.4287	6.1202	1.8168	6.9793	-
Q1 1990	6.2833	5.0546	2.8620	6.6894	1.5470	6.4314	3.5410	5.8791	-
Q2 1990	7.4530	7.4310	0.0452	-0.0472	4.6122	6.2405	6.4210	8.4029	-
Q3 1990	10.7454	6.8802	4.2795	6.4489	2.0109	7.2490	10.0228	7.4954	-
Q4 1990	1.9883	4.9075	-0.3263	3.8155	1.8209	5.7131	2.6061	6.4076	-
Q1 1991	12.1320	-1.5116	3.0578	8.7118	4.7706	6.5695	14.3621	6.8594	-
Q2 1991	10.3180	7.2331	1.4305	-7.1105	5.5493	6.2184	4.3408	7.0622	-
Q3 1991	8.0626	7.6628	5.4230	6.8807	4.7374	6.3170	2.2586	8.5680	-
Q4 1991	6.4368	9.6506	0.0260	4.7766	4.8063	5.5667	1.0116	7.5731	-
Q1 1992	10.0100	7.3805	6.0287	7.9579	4.1429	6.3823	2.4451	6.7327	-
Q2 1992	9.7926	6.9516	-1.6039	1.9976	4.2476	5.4700	3.6943	7.6286	-
Q3 1992	8.7400	6.6468	4.7490	9.8638	3.5120	8.9000	5.8049	11.2541	-
Q4 1992	7.0554	6.8537	1.5330	6.0719	3.6559	6.1308	6.3118	8.7866	-
Q1 1993	4.3083	5.6346	2.3840	7.6554	3.2195	4.5121	-3.7048	8.7515	-
Q2 1993	6.2742	7.5732	-1.2106	0.5562	2.9528	4.4773	3.6368	7.4640	-
Q3 1993	4.8987	5.9440	-0.3541	6.6031	3.8087	5.8795	3.3012	6.4402	-
Q4 1993	6.0316	5.1390	2.8177	5.7719	3.2076	3.8548	5.9400	4.8507	-
Q1 1994	5.2406	9.6510	1.2324	6.3671	3.0871	4.4406	0.9417	4.1695	-
Q2 1994	6.4578	9.7599	0.0464	2.5266	4.7096	4.4809	3.6843	6.6648	-
Q3 1994	7.2732	7.5062	2.4195	9.0073	3.8006	7.1882	5.1523	8.4466	-
Q4 1994	6.6533	7.6029	-0.3444	7.5601	6.0869	6.5884	8.0035	7.4352	-



Table A2.2 (Continued)

Name	AUI	CNI	JPI	UKI	USI	FRI	DMI	ITI	EUI
Q1 1995	3.5381	5.2189	3.6024	5.3483	3.9967	6.0570	3.4199	6.9845	-
Q2 1995	4.4667	4.9857	0.0855	2.6262	3.1667	5.5772	5.9137	5.3296	-
Q3 1995	4.2332	7.2176	1.1645	7.3364	4.6045	5.8596	5.2402	7.3369	-
Q4 1995	4.9112	7.6600	0.7698	5.9397	4.1818	5.0850	6.8260	7.1762	-
Q1 1996	7.2272	6.1216	1.5639	5.4488	1.9524	3.5712	2.7211	6.7274	-
Q2 1996	5.9877	4.8321	-2.3969	3.2048	2.8011	3.5334	4.9867	5.5456	-
Q3 1996	7.0689	7.1261	0.7687	7.6990	4.5578	6.8329	5.3608	8.2862	-
Q4 1996	6.7657	4.0607	-0.4150	5.1603	3.5795	4.3731	5.8900	5.6910	-
Q1 1997	7.0065	4.8648	1.1630	7.4000	3.8184	3.6392	0.8297	4.8822	-
Q2 1997	8.7278	5.2506	-8.2201	3.7322	5.0640	4.7332	5.2972	5.2664	-
Q3 1997	7.6811	5.1304	0.3740	5.5046	4.6107	5.0325	1.7584	5.9833	-
Q4 1997	5.5440	6.3045	-0.7837	4.4301	4.8275	4.5168	5.9682	3.3970	-
Q1 1998	4.7006	3.5461	1.9184	6.7882	4.5104	4.5443	4.0442	2.7341	-
Q2 1998	3.3410	4.5070	-1.5556	1.2652	3.4495	3.4863	3.9365	3.0775	-
Q3 1998	4.3604	4.9895	2.4916	5.8121	3.5946	4.9840	3.4388	4.2435	-
Q4 1998	3.2767	4.2109	-3.6786	2.4881	3.0711	4.5746	5.4377	2.7446	-
Q1 1999	5.3200	4.7214	3.9276	4.8960	3.3874	3.4554	3.3835	2.5405	3.4840
Q2 1999	4.1139	0.9516	-1.1180	0.8365	1.8485	2.2676	2.1698	2.2966	1.2373
Q3 1999	2.8992	3.2753	1.1810	6.5094	3.2639	5.0000	2.9787	3.0870	4.0475
Q4 1999	4.3985	4.7547	0.4100	3.6573	3.5409	3.3569	5.6320	2.8531	3.8209
Q1 2000	3.5759	4.1149	2.4451	7.3384	2.8694	3.6561	2.6365	3.1790	3.1340
Q2 2000	3.0033	2.5096	-0.6862	2.0037	1.5852	3.0005	4.7913	2.5575	2.9493
Q3 2000	-8.3280	1.9128	1.1242	5.6062	2.8559	3.9690	2.9149	3.1132	2.9845
Q4 2000	4.3000	2.7644	1.5267	2.6519	3.5599	3.8141	3.6855	3.0185	2.8295
Q1 2001	1.1070	4.7261	1.2324	6.9318	1.0599	4.9000	2.4365	1.7391	3.5328
Q2 2001	2.7012	-0.6827	0.4116	-0.8783	1.3194	-0.0293	1.2860	1.9881	-0.1081
Q3 2001	4.2646	5.8600	1.1850	5.2010	4.4889	4.5452	3.9668	3.8351	4.6418
Q4 2001	2.4870	8.9074	1.6078	4.2159	5.7528	4.7200	5.0564	3.5003	3.3789
Q1 2002	2.4844	3.4205	3.1703	5.1613	3.6067	2.2722	0.8914	1.9107	2.2930
Q2 2002	3.1473	-0.3314	-2.3666	1.6916	0.7124	1.9834	4.2071	2.5198	1.4953
Q3 2002	3.1484	1.3563	0.7933	4.6104	2.8081	3.7857	4.6100	2.9676	4.2919
Q4 2002	2.5386	3.6646	0.4012	2.2428	2.5633	2.6677	4.4200	1.8730	2.6730
Q1 2003	-0.1688	-0.0358	1.6049	4.4488	0.0876	0.4901	0.4485	0.9898	1.3658
Q2 2003	5.0600	5.5643	-1.5819	1.6395	2.1923	2.5809	4.3072	1.2950	1.1950
Q3 2003	3.4712	3.9487	0.4306	3.8911	2.3343	3.2331	2.7500	1.9504	3.2526
Q4 2003	3.8106	4.3350	0.7974	2.8991	3.8175	1.6614	4.2900	2.6277	2.5414
Q1 2004	1.7292	3.2162	0.8080	5.1811	0.7278	1.8915	1.3933	2.4659	2.7840
Q2 2004	3.9584	0.7757	-0.7810	1.8115	-0.9815	0.7757	1.1312	1.3051	-0.6090
Q3 2004	4.1423	4.2611	-0.3894	4.8741	2.4567	3.7216	2.7935	2.5283	3.7613
Q4 2004	2.0283	3.1281	-1.5827	1.9489	1.8777	1.6454	2.8747	3.0771	1.1684
Q1 2005	2.6531	3.3962	2.7872	3.8303	2.0208	3.2045	2.2907	1.5165	3.2248
Q2 2005	2.9676	0.9012	-0.3982	0.4156	-1.2577	-0.0970	1.5609	0.8881	-1.4546
Q3 2005	1.4963	0.7317	0.3982	2.4161	-0.6926	1.5077	0.5754	1.1934	1.9435
Q4 2005	3.0925	3.7773	0.0030	2.5664	2.7220	2.5316	2.4789	1.8014	0.7999
Q1 2006	2.0755	2.0637	0.4676	4.0478	2.3710	2.2259	1.7633	1.9790	3.1250
Q2 2006	-0.6235	0.3219	-1.2520	-0.5140	-1.8867	0.1622	1.8044	1.2413	-1.1337
Q3 2006	2.1765	4.2500	-0.8519	2.0174	2.7506	3.4769	2.6041	2.0206	3.5410

Table A2.2 (Continued)

Name	AUI	CNI	JPI	UKI	USI	FRI	DMI	ITI	EUI
Q4 2006	6.0937	4.9820	1.6089	1.7467	8.0746	4.2131	3.7600	4.0300	3.0035
Q1 2007	5.3663	0.7830	2.5770	4.2166	0.8069	3.6369	0.6173	2.5288	3.2253
Q2 2007	1.1615	-1.8827	-0.9606	1.1165	-2.7854	0.1839	0.9757	1.9868	-1.0815
Q3 2007	3.3999	4.4900	-0.2454	5.6895	3.4715	3.6041	2.2577	2.5247	4.4800
Q4 2007	2.2418	4.6764	-1.0312	0.7329	1.3388	0.5897	0.8808	1.5873	-0.6810
Q1 2008	1.0107	2.8219	1.0185	2.7581	-0.8879	1.1949	1.0567	-0.2010	1.6529
Q2 2008	0.4565	-4.1723	-2.9481	-3.0481	-4.6512	-1.2386	0.9913	0.2509	-2.0475
Q3 2008	1.3742	0.0614	-3.2635	-0.2363	-0.9401	3.6711	1.4303	1.2321	3.3823
Q4 2008	6.0355	9.5996	3.0847	3.6643	14.9503	5.9253	5.9242	6.2860	4.9814
Q1 2009	3.8044	5.3277	5.3877	5.1216	4.7923	5.6756	3.4755	5.3555	7.0028
Q2 2009	2.9485	0.2546	0.1580	-0.9056	-1.1913	1.3485	2.5095	2.4244	0.9313
Q3 2009	1.7482	3.5737	1.3409	1.3260	1.0859	4.0459	2.4911	3.3786	5.1689
Q4 2009	3.4181	3.5641	2.1120	0.7556	2.6519	2.3136	2.7862	3.6549	1.4059
Q1 2010	1.9007	1.9367	0.5184	1.0973	2.1087	1.4608	1.9709	2.0108	4.0600
Q2 2010	3.1155	1.3055	-0.6824	-1.3513	1.4850	-0.4290	0.7730	1.6204	-1.3736
Q3 2010	2.2414	1.0500	2.5100	2.2127	2.3902	3.1794	1.6200	2.3016	4.3192
Q4 2010	3.7495	1.1143	-0.6716	-0.7383	1.6630	1.8230	1.0048	2.9954	0.1261
Q1 2011	-0.7793	0.5310	1.3170	-2.1697	-1.6860	0.7708	-0.0315	1.2174	2.7174
Q2 2011	1.8297	-1.9488	-0.7104	-2.5357	-3.4211	-1.1798	0.7378	0.8884	-2.1870
Q3 2011	2.2534	2.2348	0.0940	0.4004	0.5004	3.4012	0.6929	3.1554	5.4467
Q4 2011	4.0900	1.4900	0.9024	-1.5357	2.8207	0.4596	0.3690	3.5182	-0.0615
Q1 2012	3.5852	0.6041	-1.1010	0.8832	-1.0340	0.7244	-1.2738	2.2601	2.4956
Q2 2012	1.0789	0.0311	-0.3012	-1.2049	-1.6102	-0.3099	0.2623	1.6134	-1.9036
Q3 2012	-2.2582	2.6022	2.5052	0.4761	0.8817	2.5937	-0.9455	3.8059	3.2793
Q4 2012	2.3560	2.2500	0.0940	-3.0571	1.3314	0.9600	-0.1596	4.7800	-0.8046
Q1 2013	1.9662	0.8733	0.4446	0.4706	-0.3142	1.7774	0.3266	2.9491	3.5140
Q2 2013	1.4682	0.6198	-1.9150	-0.8582	-0.2514	0.0525	0.1999	3.0880	-0.8859
Q3 2013	-0.5869	1.8242	-1.9760	1.6074	1.2161	1.9896	-0.9178	2.5969	3.9484
Q4 2013	1.1661	4.1258	-1.9321	0.3152	3.8699	2.7104	1.3732	5.6398	2.0880
Q1 2014	1.5817	-0.9636	0.0330	2.5306	-0.2195	1.4995	1.2335	2.8944	4.5567

## Chapter 3

### Nonlinearity in Exchange Rates

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#### 3.1 Introduction

Exchange rate behavior is still as mysterious as it has historically been in the past. It is now widely accepted that the exchange rates follow a random walk, whereby successive changes in the rates are serially uncorrelated. Unfortunately, empirical testing of the random walk model of exchange rate is controversial because it is possible for exchange rate changes to be linearly uncorrelated, but nonlinearly dependent. This possibility has led to extensive research in the area of nonlinearity in exchange rate. Many of these studies utilize the Multiple Regime Smooth Transition Autoregressive model to evaluate the non-linear relationship between the exchange rate and its fundamentals. Other studies have applied Markov-switching model to the foreign exchange markets and found evidence of frequent shifts of regimes in the relation between the exchange rate and its fundamentals (see, for a review, Taylor and Manzur, 2013). Existing literature tends to provide support to some nonlinear structures that appear consistent with the presence of conditional heteroskedasticity. However, adequate representation of the nonlinear dependence in exchange rate returns continues to remain a puzzle (see, Ballie and Bollerslev, 1989, 2002; Lundbergh et al., 2003; Sollis, 2008). There is widespread controversy surrounding the appropriateness of the model specification, the choice of numeraire currency, the issues of structural change and outliers and so on (see, such as, Giordani et al., 2007).

This chapter contains a systematic analysis of the time series properties of a mixed bundle of currencies since major currencies returned to the floating system in the early 1970s. Our sample includes four major currencies, namely, Canadian dollar, Japanese yen, Swiss franc and the U.S. dollar exchange rate series, all denominated in British pound-sterling, and eight other mixed relatively less-liquid currencies, namely, Chilean peso, Indonesian rupee, Malaysian ringgit, Pilipino peso, Singapore dollar, South African rand, South Korean won and Thai baht. As discussed later (in Section 3.3), the purpose of including these relatively less liquid currencies is to compare and check if nonlinearity is more of a phenomenon for the currencies of less-developed countries. Tests are employed on this sample based on the residuals of

the basic purchasing power parity (PPP) and simple autoregressive moving average (ARMA) equations to empirically determine the presence of nonlinearity, structural change and outliers. The purpose here is to provide further evidence on the properties of the series, rather than designing a statistically adequate empirical model of exchange rate returns. Note that using PPP as a base model puts the focus on real exchange rates, while ARMA describes the behavior of nominal exchange rates. Overall, the results are insightful and provide further evidence to nonlinear dependence in exchange rates.

The significance and innovations of this chapter are attractive. First, it provides updated evidence on the time series properties of representative exchange rates over the current floating rate system spanning last four decades. This is a useful work since further evidence will have important implications for previous work, as well as new work in future research. Second, for nonlinearity test purposes, a more general approach is introduced to specify the PPP equation in which the existence of cointegrating vectors between exchange rates and prices is first verified and confirmed before the check for nonlinearity in an error correction framework. Third, the British pound-sterling, rather than the U.S. dollar, serves as the base currency in this study. Previous literature has shown that the results can be sensitive to the choice of the numeraire currency (see Papell and Theodoridis, 2001). Finally, unlike most empirical research, I have provided tests for structural change and outliers, together with the direct test for the presence of nonlinearity. A clear-cut understanding of the time series properties of exchange rates is pivotal to resolving several outstanding puzzles, including the tests for market efficiency, predictability, forecasting model selection, and more fundamentally, the deviations from PPP.

The chapter is organized as follows. Section 3.2 provides a selective review of the existing literature, followed by a brief reference to analytical considerations in Section 3.3. The description of data and preliminary analysis are contained in Sections 3.4 and 3.5, respectively, while Section 3.6 contains the empirical results. The last section concludes the chapter. This chapter is based on Wali et al. (2014).

### 3.2 A Reference to Literature

Existing literature points to at least three major sources of nonlinearity in exchange rates. The first and most prominent of these sources is the role of transaction costs and other frictions like tariffs and nontariff barriers to trade. This source of nonlinearity in exchange rates has attracted considerable attention in the literature (see Heckscher, 1916; Benninga and Protopapadakis, 1988; Dixit, 1989; Williams and Wright, 1991; Dumas, 1992; Coleman, 1995; Sercu et al., 1995; Rogoff, 1996, Ohanian and Stockman, 1997; O'Connell, 1997; O'Connell and Wei, 2002). It is argued that due to the presence of transaction cost, arbitrage profit from mispricing of currencies would no longer exist unless the mispricing reaches a certain level, thus showing up as a discontinuity in the behaviour of deviations from the equilibrium exchange rate. A second potential source of nonlinearity, as suggested by Kilian and Taylor (2003), arises from the interaction of heterogeneous agents in the foreign exchange market at the microstructural level giving rise to different beliefs of different market participants regarding the equilibrium exchange rate. A third potential source of nonlinearity, suggested by Sarno and Taylor (2001b) and Taylor (2002, 2003) arises from the types of official interventions in the foreign exchange market. In an effort to contain inflation and manipulate trade flows, some governments or central banks intervene in the foreign exchange market directly or indirectly, causing nonlinearity in the adjustment of the nominal and real exchange rates. It is argued that these interventions may solve a coordination problem in the foreign exchange market. When the exchange rate is grossly misaligned because fundamental traders have lost liquidity (or confidence), they need a coordinating signal in order to enter the market at the same time and correct the misalignment. This coordinating signal is provided by official intervention and is more likely to be successful, the greater the degree of misalignment. These issues relating to nonlinearity are under intense scrutiny by the recently developed literature known as 'new open economy macroeconomics' (NOEM), pioneered by Obstfeld and Rogoff (1995).

The empirical literature has extensively employed the test proposed by Brock, Dechert, Scheinkman (1987), referred to as BDS test, to uncover nonlinear dependence in exchange rates. This procedure tests the null hypothesis that the

residuals are independently and identically distributed (*iid*) against an unspecified alternative. The test has power against both deterministic chaos and nonlinear stochastic systems. The ability of this test to deal with stochastic time series makes its application in applied economics quite appealing. The test is developed on the concept of correlation integral, briefly described as follows.

Let  $\{x_t\}$  be a scalar time series generated randomly according to a density function  $f$ . Arrange  $m$ -dimensional vectors, called  $m$ -histories,  $x_t^m = (x_t, x_{t+1}, \dots, x_{t+m-1})$ . The correlation integral at embedding dimension  $m$  is computed as

$$C_{m,T}(\varepsilon) = 2 \sum_{t=1}^{T_m-1} \sum_{s=t+1}^{T_m} I_\varepsilon(x_t^m, x_s^m) / (T_m(T_m - 1)) \quad (3.1)$$

where  $T_m = T - m + 1$ , and  $I_\varepsilon(x_t^m, x_s^m)$  is an indicator function of the event  $\|x_t^m - x_s^m\| = \max_{i=0,1,\dots,m-1} |x_{t+i} - x_{s+i}| < \varepsilon$ . Thus, the correlation integral measures the fraction of pairs that lie within the tolerance distance  $\varepsilon$  for the particular embedding dimension  $m$ . The BDS statistic, for the time series of length  $T$  is then defined as

$$BDS_{m,T}(\varepsilon) = T^{1/2} \left[ C_{m,T}(\varepsilon) - C_{1,T}(\varepsilon)^m \right] / \sigma_{m,T}(\varepsilon), \quad (3.2)$$

where  $T$  is the sample size,  $\varepsilon$  is the arbitrarily chosen proximity parameter, and  $\sigma_{m,T}(\varepsilon)$  is the standard sample deviation of the statistic's numerator that varies with dimension  $m$ . The idea is for BDS test to use pairs of  $m$ -histories that too often cluster together within a specific distance  $\varepsilon$ , and thus reveal hidden patterns that should not occur in truly randomly distributed data. Note that the values of two parameters,  $m$  and  $\varepsilon$  are typically determined ex ante.<sup>4</sup> Under certain conditions, the BDS test statistic is asymptotically normal (see Brock et al., 1987). Simulation studies have reported that the test has power against a large class of alternatives, including auto-

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<sup>4</sup> Kočenda (2001) and Kočenda and Briatka (2005) extends the BDS test by specifying the intervals of the proximity parameter  $\varepsilon$ , but the question regarding the choice of embedding dimension,  $m$ , remains unresolved.

regressive conditional heteroskedastic (ARCH) models (see Bollerslev, Engle and Nelson, 1994). However, the interpretation of this test is not all that clear-cut, and consequently, a rejection of the null hypothesis do not suggest the type of alternative models one should consider (see Granger and Terasvirta, 1993). Studies using BDS test include Scheinkman et al (1989), Hsieh (1989, 1991), DeGrauwe et al. (1993), Brooks (1996), Mahajan and Wagner (1999), Clarida et al. (2003), Rahman and Saadi (2008), Emekter et al. (2009), among others. Most of these studies using different base currencies report evidence in support of nonlinear dependencies in exchange rates. This chapter contributes to the literature by confirming that similar results can be obtained when using GBP as based currency.

The literature includes several other statistical tests for detecting nonlinear dependence in exchange rates. McLeod and Li (1983) show that the autocorrelation coefficients and Box-Pierce Q-statistics of the squared residuals of an ARMA model can be used to test for nonlinear dependence. Tsay (1986) proposes a generalised version of Keenan's (1985) test by adopting a three-stage estimation routine. Both Tsay and Keenan Tests are directly designed to test for departures of linearity in mean. Another approach is to use the bi-spectrum, which is the double Fourier transform of the third order cumulant function, and this forms the basis of the test for Gaussianity and linearity as suggested by Hinich (1982), following Subba Rao and Gabr (1980). For a fuller exposition and comparative analysis of these and similar other tests, see Lee et al. (1993) and Brooks (1996). An important conclusion of these comparative studies is that no single test is uniformly superior to the others. More recently, significant efforts have also been directed to nonparametric entropy-based tests of independence in exchange rates. These tests rely on kernel-based estimation techniques in which kernels and bandwidths are typically selected by the researcher. Besides, the finite sample level of these tests differs from the asymptotic one, and the constructs lose certain amount of detailed information (see, Granger et al., 2004; Racine and Maasoumi, 2007; Martilla-Garcia and Marin (2008); Fernandes and Neri, 2009; Yoon, 2010, among others). In traditional applications (eg Mann-Whitney and Wilcoxon) if the test assumptions hold, parametric tests have greater power than non-parametric tests. The value of non-parametric tests is when the assumptions do not hold.

The potential nonlinearity in exchange rates adds a new dimension to testing the empirical validity of PPP. Note that PPP is arguably the oldest and most durable workhorse in exchange rate economics (see Manzur, 2008). In its simplest form, PPP implies that for there to be no unexploited profits, arbitrage ensures equalisation of national price levels when expressed in a common currency. Thus, we have:

$$S_t = \beta_0 + \beta_1 P_t - \beta_2 P_t^* + \varepsilon_t \quad (3.3)$$

where  $S_t$  is the logarithm of the domestic currency cost of one unit of a foreign currency at time  $t$ ,  $P_t$  and  $P_t^*$  are the logarithms of the domestic and foreign price levels, respectively, and  $\varepsilon_t$  is the disturbance term capturing deviations from PPP. Note that the term  $\varepsilon_t$  in equation (3.3) identically coincides with a measure of the real exchange rate under PPP so that, we have

$$d_t = \beta_0 + \varepsilon_t = S_t - P_t + P_t^* . \quad (3.4)$$

Earlier tests of PPP focused on  $d_t$  using conventional linear unit root tests, and a vast majority of them rejected PPP (see, for a survey, Taylor, 2006). However, the well-known PPP puzzle raised by Rogoff (1996) has seen a new wave of literature unraveling the low power of the linear autoregressive models and accounting for nonlinearity in exchange rates.<sup>5</sup> Prominent nonlinear approaches include the threshold autoregressive (TAR) model of Tong (1978) and smooth transition model can be defined as follows:

$$d_t = \beta_0 + \sum_{i=1}^p \phi_i d_{t-i} + \left( \sum_{i=1}^q \theta_i d_{t-i} \right) F(x_t; c) + u_t \quad (3.5)$$

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<sup>5</sup> Rogoff (1996) highlights the puzzle that existing models seem inadequate to explain the ‘excessive’ persistence in the real exchange rate and its huge short-term volatility. More specifically, if nominal price distortions are really responsible for short-term PPP deviations, ‘one would expect substantial convergence to PPP over one to two years, as wages and prices adjust to shock’ (p.654). The consensus estimate of convergence to PPP is between 3 and 5 years.



where  $x_t$  is the transition variable, it could be the lagged value of  $d_t$  or any other exogenous variables,  $c$  is the threshold value and  $F(x_t; c)$  is an indicator function such that

$$F(x_t; c) = \begin{cases} 0, & x_t < c \\ 1, & x_t \geq c. \end{cases}$$

Equation (3.5) is usually estimated via a grid search on the thresholds, and the restrictions are tested accordingly. In the case of STAR model, the indicator function  $F(x_t, c)$  is replaced by a transition function, which can be any continuous and twice differentiable function that ranges from 0 to 1. In the STAR literature, the logistic function (LSTAR) and the exponential function (ESTAR) are among the popular specifications of  $F(x_t, c)$  (see Terasvirta, 1994). For a survey on the developments of STAR modeling, see van Dijk et al. (2002). Studies using an ESTAR framework include Michael et al. (1997), Baum et al. (2001), Taylor et al. (2001), O'Connell and Wei (2002), Kilian and Taylor (2003), among others, and provide evidence in support of nonlinear mean reversion of real exchange rates. Their findings generally support the existence of two regimes in exchange rates. While the speed of adjustment and the threshold values varied between exchange rates and the period used for estimation. Overall, they provide some evidence supporting that (i) exchange rates follow different regimes and (ii) the transition between regimes is smooth rather than abrupt.

Overall, the evidence, as above, is at best mixed. The performance of the class of nonlinear models in out-of-sample forecasting has not been encouraging (see, Clarida et al. 2003; Rapach and Wohar, 2006, among others). Empirical studies have typically considered nonlinearity, structural change and outliers in isolation, rather than all of these properties simultaneously. It is argued that the apparent nonlinearity in exchange rates could simply be due to structural breaks or outliers in the series (see, for example, Villavicencio, 2008). Thus, the need for further work on these issues cannot be underestimated.

### 3.3 Econometric Issues

A problem with specification such as equation (3.5) is that it focuses on the deviation from PPP, namely,  $d_t$ . Given the strong empirical evidence suggesting that  $S_t$ ,  $P_t$  and  $P_t^*$  are  $I(1)$ , the specification relies heavily on the assumption that  $(1, -1, 1)'$  is a cointegrating vector, that is,  $S_t - P_t + P_t^*$  is stationary (or  $I(0)$ ). However, if this is not true, then  $d_t$  will be non-stationary and standard approaches in estimating nonlinear models, such as those specified in equation (3.5) will not be appropriate.

I propose to resolve this issue by tackling the problem in a slightly more general form, which allows proper testing on (i) the existence of cointegrating vectors between exchange rates and prices, and (ii) the existence of non-linearity in the vector error correction model (VECM). Under the assumption that there is a cointegrating vector between the three variables, then by the Granger's representation theorem (Engle and Granger, 1987), there must exist a vector error correction representation for exchange rate, that is:

$$\Delta S_t = \alpha (S_{t-1} - \beta_1 P_{t-1} - \beta_2 P_{t-1}^*) + \sum_{i=1}^K (\delta_{si} \Delta S_{t-i} + \delta_{pi} \Delta P_{t-i} + \delta_{p^*i} \Delta P_{t-i}^*) + \varepsilon_t \quad (3.6)$$

where  $\Delta$  is the change operator, and  $\varepsilon_t$  is an error term which does not have to be iid.

Equation (3.6) is general enough to cover all previous cases as special cases. For example, Equation (3.6) reduces to Equation (3.5) by setting  $\beta_1 = 1$  and  $\beta_2 = -1$  along with the restrictions that  $\delta_{si} = \delta_{pi} = \delta_{p^*i} = 0$  for all  $i$ . Obviously, if cointegrating vector does not exist, it is equivalent to  $\alpha = 0$ . In such a case, equation (3.6) with an appropriate serial correlation structure is ensured by the Wold's decomposition on the stationary variable,  $\Delta S_t$ , and consequently, no long run relationships exist between the three variables. Furthermore, equation (3.6) specifies that the exchange rate change is a linear function to the past values of all three variables as well as the error correction term. Therefore, any potential nonlinearity will be embedded in the estimated residuals,  $\hat{\varepsilon}_t$ . That is, detecting potential nonlinearity in the exchange rate

can be achieved by testing the existence of nonlinearity in the estimated residuals in (3.6). Thus, equation (3.6) provides a more complete platform to examine nonlinearity in exchange rates. Equation (3.6) also nests an ARMA representation of delta S. Under the assumption  $\alpha = 0$  and epsilon follows an AR(q) process then delta S follows an ARMA-X process.

Under the null of  $\varepsilon_t$  being a sequence of iid random variable, the Johansen's (1988) trace and max tests can be used to determine the number of cointegrating vectors among  $(S_t, P_t, P_t^*)$ . Once the number of cointegrating vectors has been determined then the coefficients in equation (3.6) can be estimated by reduced-rank regression algorithm as proposed in Johansen (1988). The estimated residuals,  $\hat{\varepsilon}_t$  can then be obtained in a natural way and can be used for purposes of analyzing the potential nonlinear structure in  $\Delta S_t$ . These procedures are adopted in the empirical analysis section of this chapter.

### 3.4 Data

Exchange rate data series are all monthly and denominated in British pound-sterling (domestic currency cost of GBP 1). Our sample consists of two sets of currencies. In the first set, we have four major exchange rates of the Canadian dollar (CAD), Japanese yen (Y), Swiss franc (CHF), US dollar (USD), all denominated in British pound sterling (GBP). Euro is not included in this study as it has a relatively shorter period of existence. The data for these four currencies start from 1973(1) to 2013(4). For comparison purposes, included is a mixed bundle of eight globally-representative currencies of economies with a sufficiently long history of exchange rates, namely, Chile (CLP), Indonesia (IDR), Malaysia (MYR), Philippines (PHP), Singapore (SGD), South Africa (ZAR), South Korea (KRW) and Thailand (THB). The idea is to consider whether there is any difference in the extent of nonlinearity between the most-traded currencies in large volumes, such as the major ones listed above, and those which are less frequently traded in considerably smaller volumes, such as those in our mixed bundle. Possibility of this difference arises from the notion that the most-traded currencies are subject to closer market scrutiny (by analysts, traders and regulators), and hence any autoregressive dependencies in their returns are likely to be arbitrated away instantaneously (see, Brooks, 1996). The data for Chile are for the

period from 1976(1) to 2013(4), and for the remaining countries in this group, from 1979(1) to 2013(4). Consumer price index (CPI) is used as the measure of inflation. All data are from the International Financial Statistics (IFS) through DataStream and appended at the end of this chapter.

### 3.5 Basic Statistics and Preliminary Analysis

Descriptive statistics of the exchange rate series are provided in Table 3.1. All the data are in log change form. The statistics are presented separately for the two sets of currencies. As can be seen, the kurtosis measures for all exchange rates are larger than the standard normal distribution measure 3.0. The Jarque-Bera test statistics indicate departure from normality in the exchange rate returns of all the countries.

**Table 3.1: Summary statistics of the exchange rate series (log-change): 1973(M1)-2013(M4)**

Highly Liquid Currencies						
Exchange rate	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
CAD	-0.0009	-0.0019	0.0303	-0.0247	4.39957	38.65 (0.00)
JPY	-0.0031	0.0010	0.0354	-0.8339	5.7670	205.72(0.00)
CHF	-0.0035	-0.0014	0.0292	-0.9294	7.8167	525.34(0.00)
USD	-0.0009	-0.0007	0.0297	-0.2237	4.8406	70.71 (0.00)
Relatively less liquid currencies						
	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
CLP	0.0075	0.0051	0.0463	0.8625	8.2724	560.35(0.00)
IDR	0.0060	0.0033	0.0679	2.9896	30.5875	13313.45(0.00)
KRW	0.0012	-0.0006	0.0431	1.3075	16.8813	3333.78(0.00)
MYR	0.0002	-0.0015	0.03667	1.6308	22.4558	6502.30(0.00)
PHP	0.0035	0.0008	0.0414	0.9137	9.0032	657.94(0.00)
ZAR	0.0051	0.0036	0.0433	0.2836	5.8325	139.42(0.00)
SGD	-0.0023	-0.0022	0.0266	-0.3630	5.2190	91.08(0.00)
THB	0.0001	-0.0019	0.0358	0.4160	8.8664	586.58(0.00)

Note: See text for definitions of currencies. The p-values of the Jarque-Bera test are in parenthesis.

**Table 3.2: Unit root test results: exchange rates and price levels**

Variable	ADF test				PP Test			
	Level		First Difference		Level		First Difference	
	Intercept	Intercept and trend	intercept	Intercept and trend	intercept	Intercept and trend	intercept	Intercept and trend
UKI	-3.72 (0.00)	-4.44 (0.00)	-2.55 (0.10)	-3.24 (0.08)	-10.35 (0.00)	-5.88 (0.00)	-13.42 (0.00)	-15.65 (0.00)
CN	-2.10 (0.25)	-2.31 (0.43)	-21.94 (0.00)	-21.93 (0.00)	-2.32 (0.17)	-2.54 (0.31)	-21.97 (0.00)	-21.95 (0.00)
CNI	-10.56 (0.00)	-4.58 (0.07)	-2.01 (0.28)	-18.28 (0.00)	-11.35 (0.00)	-4.21 (0.04)	-18.55 (0.00)	-19.22 (0.00)
JP	-1.94 (0.32)	-1.86 (0.68)	-20.15 (0.00)	-20.16 (0.00)	-1.91 (0.33)	-2.10 (0.54)	-20.29 (0.00)	-20.28 (0.00)
JPI	-3.60 (0.01)	-3.10 (0.11)	-4.99 (0.00)	-4.86 (0.00)	-15.85 (0.00)	-10.51 (0.00)	-18.35 (0.00)	-18.62 (0.00)
CH	-2.86 (0.05)	-3.29 (0.07)	-21.23 (0.00)	-21.26 (0.00)	-2.84 (0.05)	-3.30 (0.07)	-21.24 (0.00)	-21.27 (0.00)
CHI	-1.86 (0.35)	-0.23 (0.99)	-4.14 (0.01)	-4.42 (0.00)	-6.45 (0.00)	-1.67 (0.76)	-17.70 (0.00)	-18.41 (0.00)
US	-2.60 (.09)	-2.60 (0.28)	-20.32 (0.00)	-20.32 (0.00)	-2.80 (0.06)	-2.85 (0.18)	-20.36 (0.00)	-20.36 (0.00)
USI	-6.54 (0.00)	-3.33 (0.06)	-10.99 (0.00)	-12.74 (0.00)	-8.25 (0.00)	-3.71 (0.03)	-11.36 (0.00)	-12.69 (0.00)
ID	-1.07 (0.73)	-1.96 (0.62)	-17.96 (0.00)	-17.95 (0.00)	-1.12 (0.71)	-2.06 (0.57)	-17.98 (0.00)	-17.97 (0.00)
IDI	-0.81 (0.82)	-1.94 (0.63)	-17.96 (0.00)	-7.18 (0.00)	-1.04 (0.74)	-1.75 (0.73)	-12.22 (0.00)	-12.25 (0.00)
MY	-1.62 (.47)	-1.78 (0.71)	-19.62 (0.00)	-19.60 (0.00)	-1.81 (0.38)	-2.06 (0.57)	-19.67 (0.00)	-19.66 (0.00)
MYI	-2.78 (0.06)	-3.09 (0.11)	-15.47 (0.00)	-15.75 (0.00)	-2.95 (0.04)	-2.98 (0.14)	-15.45 (0.00)	-15.73 (0.00)
SG	-1.27 (0.65)	-1.79 (0.71)	-18.88 (0.00)	-18.86 (0.00)	-1.34 (0.61)	-1.93 (0.64)	-18.87 (0.00)	-18.86 (0.00)
SIG	-1.38 (0.59)	-3.62 (0.03)	-4.92 (0.00)	-4.96 (0.00)	-1.72 (0.42)	-3.22 (0.08)	-20.57 (0.00)	-20.58 (0.00)
PH	-1.86 (0.35)	-0.95 (0.95)	-19.68 (0.00)	-19.77 (0.00)	-18.53 (0.35)	-0.99 (0.94)	-19.68 (0.00)	-19.78 (0.00)
PHI	-2.78 (0.06)	-1.80 (0.70)	-3.85 (0.00)	-5.04 (0.00)	-3.97 (0.00)	-1.89 (0.65)	-9.86 (0.00)	-10.79 (0.00)
TH	-1.56 (0.49)	-1.52 (0.82)	-18.37 (0.00)	-18.37 (0.00)	-1.64 (0.46)	-1.72 (0.74)	-18.35 (0.00)	-18.35 (0.00)

Table 3.2 (Continued)

Variable	ADF test				PP Test			
	Level		First Difference		Level		First Difference	
	Intercept	Intercept and trend	intercept	Intercept and trend	intercept	Intercept and trend	intercept	Intercept and trend
THI	-3.88 (0.03)	-4.59 (0.08)	-14.24 (0.00)	-14.76 (0.00)	-3.63 (0.04)	-4.40 (0.07)	-15.21 (0.00)	-15.38 (0.00)
SA	-1.28 (0.64)	-1.59 (0.79)	-20.13 (0.00)	-20.15 (0.00)	-1.28 (0.64)	-1.52 (0.82)	-20.15 (0.00)	-20.17 (0.00)
SAI	-9.26 (0.00)	-1.32 (0.88)	-4.77 (0.00)	-12.32 (0.00)	-7.45 (0.00)	-1.20 (0.91)	-20.17 (0.00)	-20.13 (0.00)
KR	-2.35 (0.16)	-2.96 (0.15)	-19.77 (0.00)	-19.76 (0.00)	-2.39 (0.14)	-3.03 (0.13)	-19.77 (0.00)	-19.76 (0.00)
KRI	-1.14 (0.70)	-2.59 (0.29)	-3.97 (0.00)	-3.79 (0.02)	-4.95 (0.00)	-5.40 (0.00)	-11.35 (0.00)	-12.12 (0.00)
CL	-4.60 (0.00)	-1.86 (0.67)	-20.27 (0.00)	-21.03 (0.00)	-4.63 (0.00)	-1.86 (0.67)	-20.30 (0.00)	-21.03 (0.00)
CLI	-6.52 (0.00)	-4.53 (0.00)	-8.12 (0.00)	-8.93 (0.00)	-9.29 (0.00)	-5.74 (0.00)	-6.97 (0.00)	-8.39 (0.00)

Note: Figures in parenthesis are the p-values. The variables in two digits are the respective exchange rates of the respective countries against British pound sterling and the three-digit variables are the respective price levels.

Next, standard tests have been employed to check for the stationarity of the series of both exchange rates and price levels. Table 3.2 contains the unit root test results of both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests (with and without trend). The results in this table indicate that both ADF and PP tests cannot reject the null of a unit root in levels, but the series tend to be stationary in their first differences for all countries except for UK and Chile. For these two countries the series in question tend to be stationary in both levels and first differences. This presents a problem for our subsequent cointegration analysis, as the test for a cointegrating vector requires the series to be I(1) in levels. This problem is addressed by treating the UK CPI as an exogenous variable, and dropping Chile from our subsequent analysis.

### 3.6 Empirical Results

As indicated in Section 3.3, Johansen's (1988) trace and max tests has been conducted first to determine the number of cointegrating vectors among  $(S_t, P_t, P_t^*)$ <sup>6</sup>. The UK is the numeraire country for both exchange rate and relative inflation and treated as an exogenous variable. As the data are monthly, lags specified are 1 to 12. The critical values for the test have been computed using

**Table 3.3: Cointegration results: exchange rates and prices (in logarithm)**

	Data Trend	None	None	Linear	Linear	Quadratic	
		Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
			No Trend	No Trend	No Trend	Trend	Trend
United States	Trace	2	1	1	1	2	
	Max Eig	2	1	1	1	2	
Canada	Trace	2	1	2	0	2	
	Max Eig	0	1	2	0	0	
Japan	Trace	1	2	2	1	2	
	Max Eig	1	2	0	1	2	
Switzerland	Trace	0	1	2	0	0	
	Max Eig	1	1	0	0	0	
Indonesia	Trace	0	0	0	0	0	
	Max Eig	0	0	0	0	0	
Malaysia	Trace	0	0	0	0	0	
	Max Eig	0	0	0	0	0	
Singapore	Trace	0	0	0	1	2	
	Max Eig	0	0	0	1	2	
Philippines	Trace	1	1	2	1	2	
	Max Eig	1	1	2	1	2	
Thailand	Trace	0	0	0	0	0	
	Max Eig	0	0	0	0	0	
South Africa	Trace	2	1	2	0	0	
	Max Eig	2	1	0	0	0	
South Korea	Trace	1	2	2	1	2	
	Max Eig	0	0	0	0	2	

MacKinnon-Haug-Michelis (1999) p-values. The results are presented in Table 3.3. The focus here is on the column with linear trend and tests with both intercept and

<sup>6</sup> Eviews 8 is used for this and other tests in this section.

trend, which is considered appropriate when the data tend to be trend stationary<sup>7</sup>. As can be seen, no integrating relationship is present between exchange rates and price levels for Indonesia, Malaysia, Thailand and South Korea, while there is at least one cointegrating vector for the remainder of the countries. Consequently, we discuss the empirical results of these four countries first, followed by those for the rest of our sample.

### 3.6.1 Non-cointegrating currencies

For Indonesia, Malaysia, Thailand and South Korea, we estimate equation (3.3) using OLS in the following form:

$$\Delta S_t = \alpha_0 + \beta(\Delta P_t - \Delta P_t^*) + \varepsilon_t \quad (3.7)$$

where  $\varepsilon_t \sim iid(0, \sigma_\eta^2)$  are assumed to be iid random variables with zero means and finite variances. Note that estimating equation (3.7) is tantamount to testing PPP. For PPP to hold,  $\beta$  in the above equation needs to be unity. As can be seen from Table 3.4,  $\beta$  is not statistically significant for any of the pairs of currencies.

**Table 3.4: PPP estimation results: non-cointegrating countries**

$y_t = \alpha + \beta(\pi_t - \pi_t^*) + \eta_t$					
$y_t$	$\alpha$	$\beta$	Std. Error	R <sup>2</sup>	DW
IDR/GBP	0.0040	0.4811	0.0671	0.0090	1.8124
KRW/GBP	0.0015	-0.1025	0.0429	0.0003	1.9508
MYR/GBP	0.0001	-0.1213	0.0365	0.0005	1.9417
THB/GBP	0.0004	0.0204	0.0358	-0.0011	1.8223

Note: None of the above values are significant even at 10%

Next, the BDS test is conducted on the residuals of the estimated series for these four countries. Note that the currencies of these four countries are relatively less liquid. The BDS test results are given in Table 3.5. Note that, for the BDS tests

<sup>7</sup> In practice the test without any intercept and trend in no trend assumption is hardly used because of its extreme assumptions. For the same reason test with intercept and trend for quadratic trend is rarely used. As a rough guide, it is advisable to use test with intercept and no trend if none of the series appear to have a trend. For liner trending series, test with intercept and no trend is advisable to use.



statistics of the residuals reported, embedding dimensions (m) are 6. The distance measure  $\varepsilon$  approximately equals to 0.5. This is used by default in Eviews. For comparison purposes, also reported are the results of the Breusch-Godfrey Lagrange multiplier (LM) test for serial correlation. Under the alternative of the LM test, the residuals are linearly related to its past values and therefore it is a test of linear dependence in the residuals against the null hypothesis of independence. As can be seen, the reported p-values for the LM test indicate that the null hypothesis of no serial correlation cannot be rejected for all currencies except IDR/GBP. In the case of the BDS test, the null of iid is rejected for all four currencies.

**Table 3.5: LM and BDS test on PPP residuals: non-cointegrating countries**

Exchange rate	LM	BDS
IDR	0.0142	0.0000
KRW	0.7554	0.0000
MYR	0.1570	0.0002
THB	0.1449	0.0000

Note: The numbers reported in the table are the associated p-values for each test, with dimension set equals to 2. Other dimensions were also tried with similar results.

We double-check these results with those using an ARMA of the following form:

$$\Delta S_t = \alpha_0 + \sum_{i=1}^p \theta_i S_{t-1} + \sum_{j=1}^q \phi_j \varepsilon_{t-1} + \varepsilon_t \quad (3.8)$$

where  $\varepsilon_t \sim iid(0, \sigma_\varepsilon^2)$ . The optimal lags are based on the lowest Schwarz Information Criterion (SIC), and the results are reported in Table 3.6. As reported, none of the

**Table 3.6: ARMA estimation results: non-cointegrating countries**

$$y_t = \alpha_0 + \sum_{i=1}^p \theta_i y_{t-1} + \sum_{j=1}^q \phi_j \varepsilon_{t-1} + \varepsilon_t$$

$y_t$	Lag	$\alpha_0$	$\theta_i$	$\phi_j$	$R^2$	DW
	Length					
IDR/GBP	0,1	0.0060			0.0166	2.0184
KRW/GBP	2,0	0.0012	0.0306		0.0011	2.0003
			0.0253			
MYR/GBP	0,1	0.0001		0.0232	0.0006	1.9950
THB/GBP	0,1	0.0001		0.0963	0.0085	2.0004

Note: None of the above values are significant even at 10%

ARMA coefficients are significant, not even at 10% level. As with the PPP model, the LM and BDS tests are conducted on the residuals of the estimated series for these four countries. As can be seen, both LM and BDS test results on ARMA residuals in Table 3.7 are qualitatively similar to those in Table 3.5. For the BDS tests statistics of the residuals reported, embedding dimensions ( $m$ ) and distance measure  $\epsilon$  approximately equals to 6 and 0.5 respectively. Please note, in our case variation of ( $m$ ) or  $\epsilon$  will not have impact on the result we are reporting or looking at. The LM test cannot reject the null of no serial correlation for all exchange rates except KRW/GBP. In the case of the BDS test, null of iid is rejected in all four cases. Overall, the results of Table 3.4 and Table 3.5 provide evidence rejecting iid and serial independence for these four less-liquid currencies. This result is consistent with the notion alluded to in Section 3.4, but at variance with the earlier literature (see, such as, Brooks, 1996). In what follows, we provide further investigations of these results.

**Table 3.7: LM and BDS test on ARMA residuals: non-cointegrating countries**

Exchange rate	LM	BDS
IDR	0.2873	0.0000
KRW	0.0023	0.0000
MYR	0.1077	0.0005
THB	0.0824	0.0000

See notes to Table 3.5

We employ the Andrews (1993) test to detect the existence of structural instability in the PPP model over the sample period. Structural instability in the series can adversely affect various diagnostic tests, including the BDS test (see, such as, Sibbertsen, 2004 and Banergee and Urga, 2005). The Andrews test has two attractions: (i) the potential break point, if exists, is estimated, rather than assumed exogenous, and (ii) the asymptotic distribution is nonstandard. Standard tests, such as the classical Chow test does not accommodate these problems.

Equation (3.7) is used for the Andrews test and the results are given in Table 3.8. For purposes of comparison, we have also included the results from the three variants of the Chow test by assuming the break date to be January 1999 (introduction of euro). The idea of the breakpoint Chow test is to fit the equation separately for each subsample and to see whether there are significant differences in the estimated

equations. A significant difference indicates a structural change in the relationship. The software 'Eviews' reports three test statistics for the Chow breakpoint test. The F-statistic, the log likelihood ratio statistic and the Wald statistic. To know the details process please see Chow, Gregory C. (1960). Also note that Andrews test applies the Chow test recursively and select the potential break date based on the test statistics with the highest probability to reject the null hypothesis of no break. As can be seen, the results are mixed; there is no evidence of structural instability for KRW and MYR, while IDR and THB seem to have experienced structural breaks in their series. Note that the Chow test has failed to identify the presence of structural instability for all four countries. This indicates the impacts of unknown break date and non-normal errors. While it is well known that the Chow test required normality, the fact that both Andrews and Chow tests provided similar results suggest that non-normality is not the underlying cause on the non-rejection of a structural break. Please note, Andrews test does not require the identification of the break date in prior. While the Chow test does require such information, the results have been robust with different break dates. Given both Andrews and Chow tests provided qualitatively similar results, it is clear that non-normality is not the cause since the Andrews test does not require any distributional assumption.

**Table 3.8: Breakpoint test results: non-cointegrating countries**

Exchange rate	Inflation differential	Andrews	Chow (F-sts)	Chow's (L-L)	Chow (Wald sts)
IDR	IDI-UKI	0.0001	0.1541	0.1513	0.1528
KRW	KWI-UKI	0.5750	0.4311	0.4276	0.4304
MYR	MYI-UKI	0.7377	0.1689	0.1660	0.1676
THB	THI-UKI	0.0043	0.3473	0.3437	0.3463

Note: Andrews Maximum LR / minimum Wald F statistics is reported. F-sts, L-L and wald sts are the F-statistic, Log-likelihood ratio statistic and Wald statistic respectively. Chow tests have been conducted for the periods before and after January 1999.

The presence of influential observations, such as outliers and extreme observations may also bias the BDS test to reject the null. Consequently, it is important to examine the importance of these aberrant observations on the BDS test statistics. To identify the contribution of outliers, we employ a crude, but simple and sensible technique, whereby we re-estimate the BDS test statistics after reducing the

size of aberrant observations by a sample-trimming algorithm. The trimming algorithm can be summarized as follows:

Step 1: Let  $s$  be the estimated standard deviation of the residuals.

Step 2: Set  $n = 1$ .

Step 3: Let  $|a(n)|$  be the  $n^{\text{th}}$  observation and let  $abs(x)$  denotes the absolute value of  $x$ . If  $|a(n)| > 3$  then set  $a(n) = 3s$ ; else if  $2.5 < |a(n)| \leq 3$  then set  $|a(n)| = 2.5s$ ; else if  $2 < |a(n)| \leq 2.5$  then set  $|a(n)| = 2s$ ; else keep  $|a(n)|$ .

Step 4: Set  $n = n + 1$  and repeat Step 3 until  $n = T$  where  $T$  is the total number of observations. Note that the above sample trimming procedure does not involve omission or removal of outliers but rather reduce their impacts on estimation and testing.

Table 3.9 contains the LM and BDS test results before and after adjusting for outliers using the above algorithm. P-values have been reported here. As can be seen, the test results before and after outlier adjustments are very similar. This seems to suggest that our test results are unaffected by outliers and extreme observations. Thus, these results, along with the results from the structural stability tests, provide evidence in support of the presence of nonlinearity in exchange rates for this sample.

**Table 3.9: LM and BDS test statistic before and after adjusting outliers: non-cointegrating countries**

Exchange rates	Before Adjusting Outliers		After Adjusting Outliers	
	LM	BDS	LM	BDS
IDR	0.2873	0.0000	0.9999	0.0000
KRW	0.0023	0.0000	0.9999	0.0000
MYR	0.1077	0.0005	0.1723	0.0024
THB	0.0824	0.0000	0.7935	0.0000

See notes to Table 3.5

### 3.6.2 Currencies with At Least One Cointegrating Vector

Based on the results as reported in Table 3.3, we now turn to the countries in our sample that have at least one integrating vector among the variables  $(S_t, P_t, P_t^*)$ . These countries are the USA, Canada, Japan, Switzerland, Singapore, Philippines, South Africa and Chile. As before, equation (3.7) is estimated for these countries, followed by employing BDS and LM tests on the residuals of the estimated series. The BDS and LM test results are given in last two columns of Table 3.10. Note that the regressing results of equation (3.7) for these countries are not reported here for brevity. As can be seen, the reported p-values for the LM test indicate that the null hypothesis of no serial correlation cannot be rejected for all currencies except JPY/GBP. In the case of the BDS test, the null of iid is rejected for all currencies except for the Canadian dollar, yen and Singapore dollar. First two columns of Table 3.10 is the ARMA counterpart of last two columns. As can be seen, the results on ARMA residuals are qualitatively similar to those of PPP residuals. The LM test cannot reject the null of no serial correlation for all exchange rates. In the case of the BDS test, the results indicate that the null of iid is rejected for all other currencies except the Canadian dollar, Japanese yen and Singapore dollar, as in Table 3.8. The results of these two tables indicate that the data tend to support nonlinear dependence in exchange rates, but the evidence for the major currencies is not all that clear-cut.

**Table 3.10: LM and BDS on ARMA and PPP residuals: cointegrating countries**

Exchange rate	ARMA		PPP	
	LM	BDS	LM	BDS
CAD	0.9365	0.1940	0.9990	0.1576
JPY	0.1254	0.4424	0.0705	0.6001
CHF	0.9905	0.0001	0.4795	0.0000
USD	0.4969	0.0338	0.1609	0.0051
PHP	0.8749	0.0065	0.7921	0.0076
ZAR	0.9115	0.0000	0.9459	0.0000
SGD	0.9168	0.1383	0.5970	0.1211

See notes to Table 3.5

Next, as discussed in Section 3.3, we test these currencies for cointegration via the Johansen (1988) procedure. Specifically, the coefficients in equation (3.6) are estimated by reduced-rank regression algorithm as proposed in Johansen (1988). The

estimated residuals are then subjected to the BDS test to identify the potential nonlinear structure in exchange rates. The alpha value is set following the convention of the literature and set at 5%. The VECM coefficient and BDS test results are presented below in Table 3.11. In this table the BDS test results of ARMA residuals from Table 3.10 are reproduced for comparison purpose. As can be seen, test results are not different at all qualitatively. This seems to provide confirmation to the results reported in our previous two tables.

**Table 3.11: VECM and BDS results: cointegrating countries**

$$S_t = C + \beta_0 P_t + \frac{\beta_1}{\alpha_1} P_t^*$$

Exchange rate	$\beta_0$	$\frac{\beta_1}{\alpha_1}$	BDS Before	BDS After
CAD	-6.6514	39.2593	0.1940	0.3140
JPY	28.1166	-14.3568	0.4424	0.4265
CHF	-6.2998	3.043478	0.0001	0.0092
USD	-1.3475	1.017195	0.0338	0.0739
PHP	-6.6928	17.46073	0.0065	0.0217
ZAR	-19.1617	38.22785	0.0000	0.0000
SGD	4.6342	0.069854	0.1383	0.6712

Notes: VECM coefficient and p values of BDS test are reported.

Breakpoint test and the effect of outliers for these currencies have been tested. Table 3.12 reports the Andrew's breakpoint test results also been checked with no difference in the results. As can be seen, the results do not indicate the presence of structural instability for all eight countries.

Table 3.13 reports and compares the BDS and LM test results conducted on the ARMA residuals before and after adjusting the outliers. As can be seen, the results are not significantly different from each other, thus confirming that impact of outlier is not an issue in the case of linearity or otherwise for these data.

**Table 3.12: Breakpoint test results: Quandt-Andrews test and Chow's test for cointegrating countries**

Exchange rate	Inflation differential	Quandt-Andrews	Chow's test (F-stat)	Chow's test (Log-Like)	Chow's test (Wald stat)
CAD	CNI-UKI	0.9496	0.5251	0.5223	0.5247
JPY	JPI-UKI	0.1806	0.1066	0.1046	0.1055
CHF	SWI-UKI	0.1461	0.4646	0.4617	0.4641
USD	USI-UKI	0.3709	0.2875	0.2846	0.2866
CLP	CPI-UKI	0.4463	0.1040	0.1019	0.1028
PHP	PHI-UKI	0.2937	0.2360	0.2327	0.2348
SGD	SPI-UKI	0.3164	0.7917	0.7899	0.7916
ZAR	SAI-UKI	0.5106	0.2774	0.2740	0.2763

Note: F-sts, Log-like and wald stat are the F-statistic, Log-likelihood ratio statistic and Wald statistic respectively. Chow tests have been conducted for the periods before and after January 1999. Quandt-Andrews Maximum LR / minimum Wald F statistics is reported.

**Table 3.13: A comparison of LM and BDS test statistic before and after adjusting outliers: cointegrating countries.**

Exchange rates	Before Adjusting Outliers		After Adjusting Outliers	
	LM	BDS	LM	BDS
CAD	0.9365	0.1940	0.9736	0.1436
JPY	0.1254	0.4424	0.0792	0.3067
CHF	0.9905	0.0001	0.3273	0.0000
USD	0.4969	0.0338	0.5951	0.0235
CLP	0.4355	0.0002	0.9999	0.0000
PHP	0.8749	0.0065	0.9999	0.0035
ZAR	0.9115	0.0000	0.9999	0.0000
SGD	0.9168	0.1383	0.8260	0.0921

See notes to table 3.5

### 3.7 Conclusion

This chapter has focused on the time series properties of major currencies since their return to floating rates in the early 1970s. The major currencies included here are the U.S. dollar, Canadian dollar, Japanese yen and Swiss franc exchange rate

series, all denominated in British pound-sterling. We also include in our sample a mixed bundle of eight other relatively less-liquid currencies for comparison purposes. Alternative specifications and test procedures have been employed for this purpose. We provide direct tests for the presence of nonlinearity, structural change and outliers. The results are quite instructive. The BDS test results reject iid for the less-liquid currencies. This result is consistent with the notion that the less-liquid currencies are subject to lesser scrutiny by the market agents and consequently, any autoregressive dependencies in their returns tend not to be arbitrated away instantaneously. However, the results for the major currencies are not all that clear-cut. Unlike most other studies, we find that the Canadian dollar, yen and Singapore dollar returns tend to be iid. In future research, it may be worthwhile to dig further whether this result is attributable to the choice of the numeraire currency.

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### Appendix to Chapter 3

Table A3.1 lists Canadian dollar (CN), Chilean peso (CP), Indonesian rupiah (ID), Japanese yen (JP), Malaysian ringgit (MY), Pilipino peso (PH), Singapore dollar (SG), South African rand (SA), South Korean won (KO), Swiss franc (CH), Thai baht (TH), and U.S. dollar (US), all denominated in British pound sterling (UK). These are monthly exchange rates data for the period Jan-1973 to May-2014. Note that the data in this chapter cuts-off in April 2013. Next chapter uses the same sample countries and data, and the additional data listed in Table 3.1 are used in the next chapter. Also the CPI data used in this chapter are appended at the end of Chapter 4. Soft versions of these data are available on request.

**Table A3.1: Log of nominal exchange rates (GBP numeraire) 12 countries, 1973 (M1) - 2014 (M5)**

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Jan-73	0.868	6.576	2.154	0.867	-	-	-	-	-	-	-	-
Feb-73	0.903	6.492	2.054	0.909	-	-	-	-	-	-	-	-
Mar-73	0.906	6.487	2.082	0.908	-	-	-	-	-	-	-	-
Apr-73	0.915	6.496	2.088	0.912	-	-	-	-	-	-	-	-
May-73	0.938	6.521	2.071	0.942	-	-	-	-	-	-	-	-
Jun-73	0.947	6.516	2.020	0.948	-	-	-	-	-	-	-	-
Jul-73	0.918	6.493	1.963	0.917	-	-	-	-	-	-	-	-
Aug-73	0.905	6.479	2.008	0.900	-	-	-	-	-	-	-	-
Sep-73	0.887	6.462	1.989	0.881	-	-	-	-	-	-	-	-
Oct-73	0.890	6.476	2.023	0.892	-	-	-	-	-	-	-	-
Nov-73	0.852	6.485	2.018	0.852	-	-	-	-	-	-	-	-
Dec-73	0.839	6.476	2.020	0.843	-	-	-	-	-	-	-	-
Jan-74	0.814	6.521	2.003	0.825	-	-	-	-	-	-	-	-
Feb-74	0.803	6.498	1.977	0.835	-	-	-	-	-	-	-	-
Mar-74	0.845	6.491	1.978	0.873	-	-	-	-	-	-	-	-
Apr-74	0.849	6.521	1.960	0.889	-	-	-	-	-	-	-	-
May-74	0.836	6.516	1.966	0.874	-	-	-	-	-	-	-	-
Jun-74	0.842	6.521	1.969	0.870	-	-	-	-	-	-	-	-
Jul-74	0.845	6.568	1.956	0.867	-	-	-	-	-	-	-	-
Aug-74	0.828	6.554	1.942	0.841	-	-	-	-	-	-	-	-
Sep-74	0.833	6.545	1.929	0.847	-	-	-	-	-	-	-	-
Oct-74	0.832	6.553	1.904	0.848	-	-	-	-	-	-	-	-
Nov-74	0.831	6.548	1.842	0.844	-	-	-	-	-	-	-	-
Dec-74	0.845	6.560	1.782	0.854	-	-	-	-	-	-	-	-
Jan-75	0.865	6.566	1.783	0.867	-	-	-	-	-	-	-	-
Feb-75	0.886	6.545	1.765	0.888	-	-	-	-	-	-	-	-
Mar-75	0.879	6.554	1.808	0.876	-	-	-	-	-	-	-	-
Apr-75	0.875	6.534	1.794	0.857	-	-	-	-	-	-	-	-
May-75	0.862	6.515	1.756	0.838	-	-	-	-	-	-	-	-

Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Jun-75	0.806	6.474	1.702	0.776	-	-	-	-	-	-	-	-
Jul-75	0.796	6.464	1.760	0.764	-	-	-	-	-	-	-	-
Aug-75	0.779	6.444	1.735	0.747	-	-	-	-	-	-	-	-
Sep-75	0.739	6.428	1.724	0.714	-	-	-	-	-	-	-	-
Oct-75	0.749	6.442	1.696	0.731	-	-	-	-	-	-	-	-
Nov-75	0.711	6.418	1.689	0.702	-	-	-	-	-	-	-	-
Dec-75	0.721	6.425	1.668	0.705	-	-	-	-	-	-	-	-
Jan-76	0.709	6.425	1.664	0.708	-	-	-	-	-	-	-	3.010
Feb-76	0.690	6.418	1.650	0.706	-	-	-	-	-	-	-	3.039
Mar-76	0.634	6.354	1.585	0.651	-	-	-	-	-	-	-	3.062
Apr-76	0.589	6.313	1.533	0.610	-	-	-	-	-	-	-	3.080
May-76	0.544	6.270	1.461	0.565	-	-	-	-	-	-	-	3.133
Jun-76	0.547	6.277	1.483	0.579	-	-	-	-	-	-	-	3.103
Jul-76	0.554	6.262	1.490	0.580	-	-	-	-	-	-	-	3.153
Aug-76	0.556	6.240	1.483	0.575	-	-	-	-	-	-	-	3.207
Sep-76	0.480	6.169	1.402	0.507	-	-	-	-	-	-	-	3.205
Oct-76	0.432	6.147	1.349	0.461	-	-	-	-	-	-	-	3.224
Nov-76	0.537	6.196	1.397	0.502	-	-	-	-	-	-	-	3.309
Dec-76	0.542	6.213	1.427	0.532	-	-	-	-	-	-	-	3.390
Jan-77	0.560	6.205	1.460	0.539	-	-	-	-	-	-	-	3.456
Feb-77	0.585	6.184	1.478	0.539	-	-	-	-	-	-	-	3.511
Mar-77	0.599	6.170	1.478	0.542	-	-	-	-	-	-	-	3.455
Apr-77	0.588	6.170	1.464	0.542	-	-	-	-	-	-	-	3.485
May-77	0.591	6.168	1.461	0.542	-	-	-	-	-	-	-	3.528
Jun-77	0.601	6.132	1.445	0.542	-	-	-	-	-	-	-	3.567
Jul-77	0.619	6.140	1.431	0.552	-	-	-	-	-	-	-	3.611
Aug-77	0.627	6.144	1.429	0.556	-	-	-	-	-	-	-	3.710
Sep-77	0.629	6.135	1.411	0.558	-	-	-	-	-	-	-	3.746
Oct-77	0.712	6.129	1.413	0.610	-	-	-	-	-	-	-	3.831
Nov-77	0.699	6.096	1.369	0.597	-	-	-	-	-	-	-	3.861
Dec-77	0.741	6.130	1.338	0.651	-	-	-	-	-	-	-	3.976
Jan-78	0.770	6.156	1.351	0.668	-	-	-	-	-	-	-	4.027
Feb-78	0.772	6.138	1.266	0.664	-	-	-	-	-	-	-	4.044
Mar-78	0.746	6.021	1.249	0.624	-	-	-	-	-	-	-	4.027
Apr-78	0.726	6.015	1.263	0.604	-	-	-	-	-	-	-	4.038
May-78	0.721	6.008	1.245	0.606	-	-	-	-	-	-	-	4.053
Jun-78	0.737	5.938	1.236	0.621	-	-	-	-	-	-	-	4.088
Jul-78	0.781	5.899	1.209	0.658	-	-	-	-	-	-	-	4.141
Aug-78	0.805	5.914	1.159	0.665	-	-	-	-	-	-	-	4.157
Sep-78	0.850	5.924	1.119	0.681	-	-	-	-	-	-	-	4.182
Oct-78	0.883	5.919	1.133	0.730	-	-	-	-	-	-	-	4.248
Nov-78	0.823	5.961	1.216	0.665	-	-	-	-	-	-	-	4.185
Dec-78	0.883	5.983	1.195	0.714	-	-	-	-	-	-	-	4.229
Jan-79	0.869	5.999	1.219	0.688	7.128	1.481	1.463	3.695	2.689	0.552	6.873	4.216
Feb-79	0.881	6.016	1.217	0.705	7.141	1.489	1.477	3.707	2.702	0.536	6.887	4.250
Mar-79	0.875	6.072	1.253	0.726	7.157	1.517	1.509	3.726	2.718	0.557	6.909	4.269
Apr-79	0.860	6.130	1.270	0.725	7.165	1.528	1.519	3.725	2.726	0.562	6.904	4.309

Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
May-79	0.876	6.122	1.273	0.727	7.156	1.520	1.525	3.726	2.717	0.557	6.908	4.302
Jun-79	0.934	6.162	1.284	0.779	7.182	1.552	1.551	3.766	2.757	0.606	6.956	4.372
Jul-79	0.966	6.188	1.318	0.810	7.276	1.586	1.586	3.846	2.833	0.639	7.007	4.505
Aug-79	0.965	6.207	1.317	0.812	7.241	1.581	1.579	3.819	2.798	0.632	6.993	4.463
Sep-79	0.938	6.203	1.230	0.790	7.206	1.553	1.549	3.780	2.763	0.596	6.969	4.431
Oct-79	0.899	6.202	1.238	0.730	7.178	1.514	1.512	3.754	2.734	0.545	6.913	4.408
Nov-79	0.945	6.308	1.258	0.788	7.219	1.567	1.565	3.774	2.776	0.600	6.968	4.552
Dec-79	0.952	6.277	1.264	0.798	7.225	1.583	1.568	3.809	2.794	0.609	6.980	4.462
Jan-80	0.966	6.296	1.312	0.818	7.266	1.600	1.586	3.844	2.830	0.617	7.181	4.493
Feb-80	0.956	6.349	1.353	0.821	7.260	1.603	1.597	3.835	2.811	0.607	7.185	4.623
Mar-80	0.947	6.293	1.388	0.772	7.218	1.600	1.596	3.792	2.773	0.561	7.145	4.443
Apr-80	0.986	6.292	1.326	0.815	7.268	1.615	1.597	3.842	2.812	0.591	7.196	4.494
May-80	0.999	6.259	1.357	0.852	7.265	1.620	1.607	3.838	2.815	0.608	7.243	4.647
Jun-80	0.998	6.249	1.345	0.857	7.296	1.619	1.606	3.869	2.842	0.595	7.259	4.521
Jul-80	1.002	6.279	1.352	0.851	7.310	1.625	1.612	3.882	2.859	0.581	7.269	4.534
Aug-80	1.020	6.263	1.374	0.874	7.299	1.633	1.626	3.875	2.851	0.596	7.298	4.525
Sep-80	1.027	6.222	1.373	0.870	7.309	1.627	1.615	3.884	2.871	0.587	7.308	4.534
Oct-80	1.053	6.243	1.428	0.891	7.332	1.653	1.625	3.908	2.895	0.603	7.370	4.556
Nov-80	1.031	6.235	1.412	0.858	7.288	1.642	1.598	3.873	2.859	0.571	7.348	4.519
Dec-80	1.049	6.186	1.447	0.872	7.307	1.666	1.609	3.887	2.870	0.577	7.364	4.535
Jan-81	1.039	6.193	1.520	0.862	7.317	1.669	1.599	3.903	2.896	0.587	7.362	4.542
Feb-81	0.974	6.137	1.466	0.791	7.258	1.622	1.532	3.839	2.827	0.546	7.299	4.483
Mar-81	0.979	6.161	1.462	0.808	7.241	1.631	1.543	3.823	2.821	0.584	7.320	4.468
Apr-81	0.941	6.135	1.464	0.761	7.218	1.602	1.513	3.795	2.797	0.562	7.282	4.436
May-81	0.913	6.139	1.457	0.728	7.168	1.581	1.494	3.764	2.763	0.561	7.255	4.386
Jun-81	0.840	6.082	1.374	0.658	7.112	1.498	1.413	3.699	2.719	0.537	7.187	4.329
Jul-81	0.821	6.092	1.375	0.611	7.074	1.474	1.384	3.754	2.678	0.563	7.143	4.293
Aug-81	0.798	6.050	1.371	0.615	7.054	1.472	1.381	3.742	2.667	0.558	7.143	4.276
Sep-81	0.778	6.039	1.271	0.591	7.017	1.434	1.342	3.704	2.635	0.544	7.121	4.240
Oct-81	0.805	6.072	1.225	0.621	7.036	1.437	1.345	3.720	2.657	0.583	7.140	4.254
Nov-81	0.833	6.037	1.241	0.670	7.124	1.479	1.390	3.804	2.754	0.630	7.207	4.342
Dec-81	0.819	6.039	1.234	0.647	7.082	1.453	1.360	3.770	2.723	0.603	7.198	4.301
Jan-82	0.811	6.063	1.246	0.632	7.064	1.455	1.364	3.747	2.715	0.603	7.195	4.281
Feb-82	0.805	6.066	1.238	0.600	7.089	1.439	1.344	3.746	2.716	0.579	7.168	4.280
Mar-82	0.784	6.091	1.237	0.578	7.051	1.428	1.335	3.712	2.690	0.631	7.155	4.241
Apr-82	0.781	6.047	1.257	0.584	7.049	1.416	1.330	3.705	2.684	0.628	7.166	4.235
May-82	0.800	6.078	1.277	0.582	7.063	1.413	1.321	3.716	2.698	0.660	7.180	4.246
Jun-82	0.808	6.095	1.294	0.556	7.024	1.415	1.322	3.672	2.657	0.678	7.164	4.368
Jul-82	0.780	6.104	1.291	0.553	7.058	1.409	1.317	3.701	2.693	0.691	7.161	4.394
Aug-82	0.755	6.107	1.298	0.541	7.044	1.409	1.307	3.683	2.682	0.677	7.161	4.697
Sep-82	0.739	6.119	1.303	0.527	7.038	1.392	1.310	3.661	2.669	0.672	7.138	4.675
Oct-82	0.720	6.141	1.308	0.517	7.041	1.375	1.314	3.651	2.674	0.674	7.130	4.664
Nov-82	0.698	6.006	1.237	0.485	7.002	1.338	1.266	3.605	2.643	0.585	7.098	4.693
Dec-82	0.687	5.940	1.177	0.481	7.019	1.321	1.225	3.609	2.675	0.554	7.099	4.757
Jan-83	0.631	5.900	1.119	0.419	6.971	1.246	1.151	3.551	2.632	0.490	7.099	4.702
Feb-83	0.622	5.886	1.138	0.415	6.967	1.237	1.145	3.547	2.646	0.500	7.040	4.697
Mar-83	0.604	5.871	1.129	0.394	6.930	1.222	1.127	3.520	2.646	0.486	7.032	4.670

Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Apr-83	0.649	5.917	1.172	0.445	7.321	1.282	1.187	3.576	2.721	0.532	7.089	4.722
May-83	0.680	5.950	1.214	0.473	7.348	1.309	1.215	3.598	2.760	0.543	7.121	4.780
Jun-83	0.634	5.898	1.165	0.425	7.318	1.274	1.183	3.564	2.814	0.517	7.080	4.745
Jul-83	0.629	5.907	1.176	0.419	7.309	1.272	1.179	3.558	2.804	0.515	7.082	4.736
Aug-83	0.611	5.908	1.184	0.401	7.298	1.259	1.166	3.537	2.788	0.520	7.074	4.787
Sep-83	0.612	5.866	1.156	0.403	7.300	1.256	1.162	3.541	2.788	0.502	7.075	4.810
Oct-83	0.611	5.858	1.164	0.402	7.294	1.255	1.161	3.534	3.028	0.559	7.078	4.831
Nov-83	0.594	5.830	1.153	0.383	7.277	1.233	1.138	3.511	3.004	0.555	7.063	4.824
Dec-83	0.591	5.819	1.152	0.373	7.277	1.219	1.123	3.500	2.991	0.574	7.052	4.841
Jan-84	0.560	5.797	1.151	0.338	7.244	1.187	1.094	3.474	2.979	0.575	7.021	4.818
Feb-84	0.624	5.852	1.173	0.399	7.285	1.246	1.151	3.515	3.008	0.580	7.075	4.863
Mar-84	0.611	5.781	1.133	0.366	7.273	1.195	1.102	3.500	3.005	0.578	7.041	4.846
Apr-84	0.585	5.760	1.145	0.335	7.247	1.164	1.071	3.466	2.959	0.562	7.017	4.827
May-84	0.584	5.771	1.142	0.326	7.241	1.165	1.071	3.460	2.964	0.573	7.009	4.817
Jun-84	0.581	5.775	1.151	0.305	7.221	1.146	1.062	3.428	3.159	0.609	6.994	4.793
Jul-84	0.541	5.771	1.168	0.268	7.198	1.122	1.037	3.398	3.139	0.780	6.967	4.799
Aug-84	0.529	5.757	1.148	0.269	7.219	1.115	1.037	3.400	3.144	0.721	6.964	4.799
Sep-84	0.486	5.715	1.135	0.211	7.190	1.076	0.984	3.361	3.103	0.724	6.915	4.977
Oct-84	0.471	5.704	1.114	0.200	7.156	1.072	0.967	3.321	3.140	0.841	6.906	4.952
Nov-84	0.462	5.692	1.118	0.181	7.154	1.065	0.959	3.466	3.153	0.800	6.891	4.968
Dec-84	0.426	5.675	1.104	0.148	7.127	1.034	0.926	3.428	3.096	0.832	6.866	5.002
Jan-85	0.406	5.663	1.107	0.123	7.095	1.034	0.913	3.405	2.939	0.804	6.845	4.966
Feb-85	0.403	5.637	1.127	0.077	7.056	1.026	0.894	3.393	2.910	0.782	6.814	4.946
Mar-85	0.523	5.737	1.168	0.213	7.165	1.130	1.000	3.464	3.011	0.841	6.959	5.041
Apr-85	0.528	5.745	1.172	0.217	7.218	1.123	1.016	3.512	3.061	0.880	6.981	5.196
May-85	0.569	5.778	1.198	0.252	7.250	1.153	1.051	3.538	3.093	0.940	7.022	5.249
Jun-85	0.577	5.785	1.202	0.270	7.270	1.178	1.069	3.558	3.114	0.943	7.043	5.290
Jul-85	0.646	5.810	1.177	0.343	7.371	1.250	1.131	3.631	3.244	1.123	7.118	5.496
Aug-85	0.642	5.807	1.168	0.331	7.358	1.241	1.148	3.610	3.209	1.148	7.119	5.492
Sep-85	0.655	5.719	1.129	0.343	7.362	1.234	1.098	3.589	3.215	1.279	7.136	5.520
Oct-85	0.677	5.719	1.131	0.365	7.377	1.262	1.124	3.627	3.250	1.317	7.159	5.544
Nov-85	0.722	5.706	1.131	0.398	7.402	1.278	1.134	3.628	3.277	1.392	7.188	5.573
Dec-85	0.704	5.668	1.091	0.368	7.390	1.250	1.118	3.640	3.270	1.317	7.160	5.567
Jan-86	0.696	5.608	1.053	0.346	7.355	1.248	1.104	3.591	3.245	1.170	7.124	5.528
Feb-86	0.721	5.565	1.005	0.369	7.407	1.289	1.143	3.636	3.472	1.063	7.158	5.602
Mar-86	0.728	5.584	1.061	0.395	7.421	1.338	1.169	3.653	3.384	1.135	7.176	5.617
Apr-86	0.757	5.556	1.033	0.439	7.466	1.381	1.222	3.689	3.426	1.161	7.226	5.668
May-86	0.709	5.549	1.046	0.387	7.428	1.363	1.200	3.664	3.401	1.240	7.189	5.641
Jun-86	0.754	5.524	1.012	0.427	7.460	1.390	1.209	3.689	3.434	1.340	7.214	5.681
Jul-86	0.721	5.436	0.917	0.400	7.418	1.364	1.176	3.639	3.379	1.337	7.177	5.637
Aug-86	0.724	5.438	0.894	0.398	7.436	1.349	1.160	3.656	3.403	1.335	7.185	5.667
Sep-86	0.698	5.409	0.868	0.369	7.769	1.334	1.145	3.614	3.361	1.169	7.140	5.634
Oct-86	0.670	5.436	0.879	0.340	7.747	1.303	1.123	3.604	3.345	1.168	7.119	5.621
Nov-86	0.687	5.448	0.857	0.360	7.763	1.318	1.148	3.603	3.343	1.162	7.118	5.641
Dec-86	0.717	5.457	0.871	0.394	7.782	1.348	1.168	3.631	3.381	1.172	7.143	5.685
Jan-87	0.708	5.449	0.849	0.414	7.819	1.341	1.173	3.673	3.424	1.149	7.182	5.735
Feb-87	0.723	5.467	0.865	0.436	7.831	1.359	1.194	3.683	3.436	1.166	7.186	5.754



Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Mar-87	0.740	5.456	0.885	0.473	7.885	1.388	1.226	3.720	3.481	1.174	7.215	5.821
Apr-87	0.797	5.453	0.897	0.507	7.914	1.413	1.262	3.744	3.509	1.202	7.235	5.866
May-87	0.781	5.459	0.902	0.489	7.927	1.401	1.238	3.750	3.484	1.190	7.200	5.886
Jun-87	0.763	5.467	0.894	0.478	7.886	1.405	1.228	3.726	3.481	1.195	7.166	5.861
Jul-87	0.747	5.474	0.896	0.465	7.880	1.399	1.214	3.741	3.464	1.197	7.160	5.884
Aug-87	0.768	5.447	0.891	0.491	7.893	1.411	1.233	3.729	3.489	1.198	7.183	5.914
Sep-87	0.754	5.472	0.914	0.486	7.903	1.418	1.226	3.731	3.490	1.217	7.179	5.913
Oct-87	0.817	5.471	0.901	0.543	7.929	1.462	1.268	3.759	3.544	1.244	7.224	5.974
Nov-87	0.871	5.488	0.898	0.602	7.991	1.516	1.310	3.818	3.597	1.268	7.276	6.038
Dec-87	0.894	5.429	0.873	0.630	8.012	1.543	1.321	3.824	3.634	1.289	7.295	6.057
Jan-88	0.814	5.422	0.884	0.571	7.996	1.507	1.272	3.807	3.589	1.258	7.238	6.118
Feb-88	0.805	5.428	0.903	0.573	7.990	1.520	1.271	3.791	3.589	1.307	7.206	6.070
Mar-88	0.844	5.456	0.946	0.636	8.046	1.574	1.327	3.871	3.666	1.384	7.244	6.134
Apr-88	0.837	5.459	0.963	0.631	8.050	1.578	1.328	3.850	3.651	1.397	7.234	6.139
May-88	0.819	5.438	0.976	0.609	8.046	1.562	1.315	3.835	3.615	1.418	7.215	6.129
Jun-88	0.728	5.429	0.946	0.535	7.972	1.495	1.251	3.773	3.547	1.377	7.130	6.045
Jul-88	0.728	5.427	0.982	0.537	7.993	1.508	1.253	3.764	3.561	1.435	7.128	6.067
Aug-88	0.736	5.437	0.982	0.521	7.968	1.502	1.234	3.761	3.548	1.412	7.105	6.029
Sep-88	0.722	5.423	0.985	0.525	7.954	1.510	1.235	3.764	3.541	1.438	7.098	6.013
Oct-88	0.768	5.403	0.976	0.570	8.021	1.556	1.266	3.795	3.616	1.480	7.125	6.089
Nov-88	0.787	5.418	0.990	0.615	8.066	1.597	1.280	3.835	3.640	1.447	7.145	6.165
Dec-88	0.767	5.421	1.000	0.593	8.041	1.589	1.257	3.812	3.624	1.460	7.111	6.117
Jan-89	0.728	5.432	1.030	0.560	8.028	1.567	1.221	3.794	3.592	1.440	7.089	6.096
Feb-89	0.738	5.399	0.998	0.556	8.030	1.561	1.213	3.788	3.578	1.466	7.065	6.095
Mar-89	0.701	5.409	1.031	0.524	8.018	1.534	1.196	3.759	3.548	1.464	7.035	6.080
Apr-89	0.696	5.413	1.039	0.524	7.999	1.514	1.191	3.760	3.555	1.463	7.023	6.060
May-89	0.640	5.411	0.987	0.453	7.945	1.453	1.121	3.701	3.487	1.466	6.946	6.011
Jun-89	0.618	5.407	0.956	0.438	7.923	1.433	1.113	3.690	3.509	1.460	6.937	5.981
Jul-89	0.674	5.430	0.985	0.511	7.986	1.487	1.176	3.744	3.555	1.482	7.006	6.079
Aug-89	0.615	5.427	0.977	0.453	7.941	1.444	1.130	3.707	3.506	1.472	6.961	6.033
Sep-89	0.644	5.418	0.963	0.479	7.956	1.471	1.155	3.731	3.541	1.472	6.984	6.069
Oct-89	0.615	5.417	0.935	0.456	7.947	1.449	1.129	3.707	3.512	1.426	6.969	6.058
Nov-89	0.602	5.413	0.914	0.450	7.941	1.444	1.115	3.696	3.519	1.408	6.961	6.069
Dec-89	0.625	5.446	0.911	0.478	7.971	1.471	1.120	3.704	3.541	1.413	6.993	6.122
Jan-90	0.689	5.492	0.926	0.519	8.012	1.512	1.142	3.761	3.595	1.459	7.044	6.170
Feb-90	0.700	5.527	0.924	0.525	8.039	1.518	1.148	3.773	3.608	1.462	7.065	6.194
Mar-90	0.656	5.558	0.901	0.499	7.979	1.500	1.132	3.750	3.582	1.474	7.048	6.168
Apr-90	0.647	5.562	0.867	0.494	8.002	1.491	1.120	3.747	3.597	1.470	7.049	6.193
May-90	0.677	5.545	0.877	0.517	8.040	1.512	1.134	3.766	3.618	1.497	7.095	6.237
Jun-90	0.710	5.582	0.904	0.556	8.067	1.553	1.165	3.807	3.664	1.534	7.126	6.270
Jul-90	0.764	5.605	0.919	0.621	8.135	1.612	1.210	3.859	3.750	1.571	7.186	6.364
Aug-90	0.782	5.607	0.906	0.638	8.182	1.626	1.204	3.872	3.827	1.581	7.221	6.424
Sep-90	0.771	5.557	0.889	0.628	8.144	1.619	1.194	3.858	3.835	1.568	7.199	6.368
Oct-90	0.820	5.531	0.916	0.665	8.225	1.659	1.200	3.886	3.875	1.598	7.241	6.406
Nov-90	0.817	5.554	0.907	0.662	8.216	1.656	1.204	3.884	3.950	1.584	7.232	6.465
Dec-90	0.806	5.567	0.900	0.658	8.208	1.650	1.210	3.862	3.938	1.597	7.230	6.460
Jan-91	0.827	5.554	0.904	0.675	8.228	1.667	1.223	3.896	3.970	1.608	7.252	6.489

Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Feb-91	0.788	5.537	0.929	0.647	8.224	1.649	1.195	3.874	3.952	1.590	7.236	6.473
Mar-91	0.699	5.503	0.928	0.553	8.143	1.578	1.137	3.798	3.847	1.559	7.142	6.393
Apr-91	0.686	5.460	0.915	0.545	8.091	1.551	1.110	3.786	3.824	1.565	7.115	6.364
May-91	0.666	5.461	0.923	0.530	8.120	1.552	1.106	3.771	3.830	1.574	7.123	6.373
Jun-91	0.615	5.408	0.925	0.482	8.060	1.510	1.053	3.729	3.775	1.542	7.077	6.368
Jul-91	0.664	5.445	0.944	0.522	8.101	1.548	1.077	3.767	3.812	1.576	7.104	6.375
Aug-91	0.651	5.438	0.943	0.519	8.110	1.547	1.067	3.769	3.783	1.579	7.119	6.386
Sep-91	0.684	5.450	0.932	0.561	8.146	1.566	1.081	3.799	3.827	1.591	7.167	6.438
Oct-91	0.671	5.427	0.937	0.555	8.128	1.564	1.078	3.792	3.818	1.594	7.176	6.441
Nov-91	0.694	5.436	0.930	0.568	8.179	1.579	1.077	3.802	3.821	1.595	7.197	6.479
Dec-91	0.771	5.454	0.930	0.626	8.227	1.627	1.109	3.855	3.885	1.635	7.258	6.552
Jan-92	0.742	5.415	0.939	0.582	8.183	1.546	1.075	3.819	3.823	1.614	7.212	6.453
Feb-92	0.731	5.425	0.958	0.564	8.175	1.516	1.064	3.801	3.786	1.612	7.209	6.425
Mar-92	0.726	5.442	0.957	0.551	8.163	1.501	1.056	3.792	3.734	1.610	7.205	6.424
Apr-92	0.752	5.467	0.990	0.574	8.187	1.496	1.076	3.814	3.794	1.626	7.229	6.438
May-92	0.791	5.453	0.980	0.604	8.208	1.524	1.091	3.841	3.837	1.646	7.258	6.466
Jun-92	0.823	5.480	0.962	0.644	8.263	1.561	1.125	3.874	3.844	1.663	7.316	6.526
Jul-92	0.823	5.499	0.929	0.652	8.276	1.570	1.131	3.882	3.835	1.669	7.324	6.555
Aug-92	0.864	5.498	0.914	0.684	8.311	1.597	1.152	3.912	3.858	1.692	7.351	6.633
Sep-92	0.799	5.365	0.788	0.577	8.203	1.486	1.036	3.798	3.776	1.604	7.249	6.517
Oct-92	0.662	5.260	0.768	0.446	8.081	1.368	0.930	3.679	3.618	1.532	7.112	6.375
Nov-92	0.666	5.238	0.777	0.414	8.046	1.340	0.904	3.655	3.620	1.516	7.080	6.352
Dec-92	0.659	5.242	0.796	0.415	8.045	1.377	0.910	3.647	3.576	1.532	7.083	6.359
Jan-93	0.635	5.223	0.793	0.397	8.051	1.365	0.897	3.635	3.608	1.521	7.090	6.350
Feb-93	0.575	5.124	0.776	0.353	7.995	1.319	0.850	3.592	3.564	1.496	7.039	6.334
Mar-93	0.638	5.153	0.811	0.409	8.039	1.361	0.904	3.641	3.640	1.565	7.077	6.413
Apr-93	0.691	5.162	0.811	0.450	8.093	1.396	0.934	3.678	3.699	1.603	7.130	6.483
May-93	0.685	5.119	0.794	0.445	8.085	1.385	0.920	3.665	3.717	1.601	7.123	6.482
Jun-93	0.650	5.072	0.813	0.401	8.060	1.357	0.895	3.632	3.692	1.615	7.101	6.430
Jul-93	0.644	5.048	0.815	0.395	8.044	1.333	0.873	3.621	3.710	1.609	7.087	6.399
Aug-93	0.675	5.048	0.790	0.397	8.054	1.332	0.870	3.624	3.709	1.615	7.095	6.409
Sep-93	0.692	5.067	0.760	0.402	8.069	1.343	0.868	3.640	3.774	1.644	7.106	6.421
Oct-93	0.676	5.083	0.792	0.396	8.052	1.336	0.859	3.629	3.744	1.607	7.092	6.419
Nov-93	0.687	5.088	0.801	0.395	8.053	1.337	0.868	3.630	3.701	1.612	7.093	6.432
Dec-93	0.672	5.107	0.787	0.392	8.047	1.383	0.867	3.632	3.711	1.615	7.085	6.452
Jan-94	0.687	5.096	0.788	0.405	8.062	1.422	0.870	3.641	3.726	1.635	7.099	6.472
Feb-94	0.698	5.042	0.753	0.396	8.067	1.399	0.854	3.628	3.718	1.641	7.091	6.458
Mar-94	0.719	5.027	0.738	0.395	8.071	1.383	0.846	3.623	3.712	1.642	7.089	6.451
Apr-94	0.739	5.036	0.758	0.416	8.093	1.402	0.858	3.642	3.732	1.675	7.110	6.471
May-94	0.740	5.064	0.752	0.413	8.093	1.361	0.841	3.640	3.705	1.703	7.105	6.458
Jun-94	0.757	5.026	0.725	0.434	8.116	1.391	0.856	3.654	3.730	1.729	7.125	6.470
Jul-94	0.753	5.036	0.726	0.430	8.110	1.383	0.842	3.650	3.697	1.732	7.118	6.479
Aug-94	0.745	5.036	0.715	0.430	8.114	1.369	0.835	3.650	3.705	1.707	7.115	6.467
Sep-94	0.749	5.050	0.708	0.456	8.141	1.397	0.849	3.673	3.717	1.727	7.139	6.477
Oct-94	0.791	5.063	0.718	0.489	8.172	1.428	0.874	3.705	3.703	1.742	7.170	6.507
Nov-94	0.767	5.043	0.732	0.448	8.134	1.387	0.829	3.669	3.620	1.716	7.126	6.446
Dec-94	0.786	5.050	0.717	0.448	8.143	1.385	0.825	3.671	3.642	1.713	7.118	6.442

Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Jan-95	0.808	5.057	0.706	0.462	8.166	1.401	0.836	3.683	3.663	1.724	7.133	6.480
Feb-95	0.788	5.029	0.674	0.458	8.161	1.395	0.829	3.674	3.704	1.739	7.129	6.475
Mar-95	0.826	4.947	0.607	0.488	8.201	1.417	0.833	3.693	3.742	1.762	7.137	6.488
Apr-95	0.784	4.907	0.609	0.476	8.187	1.380	0.808	3.678	3.736	1.761	7.112	6.436
May-95	0.777	4.901	0.618	0.463	8.171	1.365	0.795	3.669	3.713	1.766	7.093	6.397
Jun-95	0.782	4.906	0.606	0.464	8.173	1.355	0.799	3.670	3.705	1.755	7.095	6.389
Jul-95	0.787	4.948	0.607	0.470	8.182	1.369	0.802	3.679	3.714	1.756	7.099	6.413
Aug-95	0.733	5.022	0.625	0.438	8.164	1.352	0.789	3.659	3.693	1.735	7.088	6.412
Sep-95	0.757	5.051	0.598	0.459	8.185	1.380	0.810	3.681	3.719	1.754	7.103	6.448
Oct-95	0.753	5.083	0.584	0.456	8.184	1.389	0.803	3.681	3.715	1.750	7.096	6.484
Nov-95	0.731	5.045	0.585	0.425	8.158	1.356	0.769	3.650	3.690	1.724	7.072	6.448
Dec-95	0.750	5.076	0.580	0.440	8.175	1.372	0.787	3.666	3.707	1.733	7.094	6.448
Jan-96	0.732	5.085	0.603	0.413	8.150	1.353	0.763	3.645	3.678	1.707	7.079	6.433
Feb-96	0.742	5.081	0.607	0.426	8.174	1.361	0.771	3.653	3.690	1.779	7.088	6.448
Mar-96	0.732	5.094	0.597	0.423	8.180	1.351	0.765	3.651	3.688	1.804	7.085	6.443
Apr-96	0.714	5.057	0.625	0.406	8.159	1.320	0.747	3.635	3.670	1.870	7.063	6.415
May-96	0.753	5.121	0.663	0.438	8.193	1.354	0.781	3.669	3.703	1.910	7.107	6.451
Jun-96	0.752	5.138	0.665	0.441	8.193	1.355	0.785	3.675	3.706	1.906	7.139	6.459
Jul-96	0.761	5.113	0.623	0.443	8.206	1.357	0.789	3.672	3.709	1.949	7.143	6.461
Aug-96	0.760	5.134	0.627	0.447	8.205	1.360	0.788	3.678	3.712	1.948	7.155	6.464
Sep-96	0.756	5.160	0.673	0.447	8.197	1.366	0.789	3.682	3.714	1.959	7.163	6.471
Oct-96	0.781	5.222	0.718	0.488	8.241	1.414	0.830	3.726	3.756	2.034	7.205	6.529
Nov-96	0.817	5.253	0.783	0.519	8.279	1.446	0.857	3.759	3.788	2.047	7.239	6.561
Dec-96	0.853	5.291	0.832	0.537	8.305	1.464	0.873	3.781	3.807	2.080	7.277	6.588
Jan-97	0.770	5.271	0.824	0.472	8.245	1.382	0.814	3.726	3.743	1.990	7.233	6.512
Feb-97	0.802	5.283	0.878	0.489	8.272	1.399	0.844	3.744	3.760	1.989	7.251	6.514
Mar-97	0.819	5.315	0.861	0.496	8.280	1.404	0.864	3.753	3.768	1.982	7.293	6.523
Apr-97	0.819	5.328	0.872	0.484	8.280	1.404	0.853	3.747	3.756	1.976	7.277	6.523
May-97	0.814	5.250	0.839	0.492	8.289	1.414	0.850	3.708	3.765	1.989	7.285	6.529
Jun-97	0.831	5.249	0.886	0.509	8.306	1.435	0.867	3.764	3.782	2.021	7.298	6.541
Jul-97	0.817	5.267	0.907	0.493	8.362	1.463	0.879	3.955	3.860	2.022	7.284	6.525
Aug-97	0.812	5.273	0.878	0.484	8.473	1.554	0.897	4.015	3.898	2.029	7.289	6.512
Sep-97	0.804	5.273	0.853	0.480	8.572	1.656	0.905	4.071	4.016	2.019	7.298	6.506
Oct-97	0.860	5.307	0.851	0.517	8.707	1.726	0.970	4.231	4.083	2.088	7.389	6.562
Nov-97	0.875	5.371	0.876	0.522	8.723	1.772	0.987	4.217	4.072	2.102	7.586	6.603
Dec-97	0.856	5.366	0.875	0.498	9.110	1.857	1.020	4.372	4.184	2.080	7.933	6.581
Jan-98	0.871	5.334	0.881	0.492	9.751	1.922	1.032	4.457	4.245	2.088	7.821	6.612
Feb-98	0.852	5.338	0.882	0.499	9.587	1.800	0.982	4.262	4.185	2.096	7.897	6.607
Mar-98	0.868	5.409	0.937	0.516	9.581	1.808	0.995	4.185	4.150	2.133	7.749	6.633
Apr-98	0.872	5.398	0.919	0.514	9.511	1.833	0.974	4.169	4.207	2.135	7.712	6.629
May-98	0.864	5.420	0.880	0.489	9.822	1.835	1.004	4.188	4.151	2.129	7.739	6.609
Jun-98	0.898	5.445	0.929	0.512	10.114	1.934	1.036	4.257	4.242	2.285	7.737	6.657
Jul-98	0.903	5.465	0.891	0.492	9.976	1.907	1.038	4.202	4.232	2.307	7.607	6.636
Aug-98	0.963	5.466	0.885	0.516	9.839	1.947	1.090	4.251	4.295	2.376	7.724	6.674
Sep-98	0.953	5.444	0.855	0.530	9.808	1.865	1.052	4.207	4.309	2.302	7.768	6.677
Oct-98	0.952	5.274	0.819	0.516	9.452	2.208	1.003	4.120	4.213	2.240	7.701	6.652
Nov-98	0.926	5.313	0.832	0.501	9.414	2.193	1.000	4.087	4.175	2.240	7.629	6.650

Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Dec-98	0.938	5.235	0.826	0.509	9.490	2.201	1.010	4.102	4.170	2.281	7.601	6.669
Jan-99	0.909	5.252	0.847	0.496	9.596	2.188	1.022	4.106	4.147	2.297	7.565	6.689
Feb-99	0.883	5.247	0.842	0.471	9.558	2.163	1.015	4.091	4.134	2.295	7.581	6.690
Mar-99	0.893	5.253	0.871	0.479	9.547	2.037	1.026	4.105	4.136	2.301	7.591	6.663
Apr-99	0.852	5.258	0.897	0.476	9.474	2.034	1.003	4.090	4.115	2.285	7.557	6.658
May-99	0.862	5.274	0.894	0.472	9.469	1.912	1.018	4.086	4.109	2.297	7.551	6.668
Jun-99	0.847	5.251	0.896	0.455	9.292	1.895	0.987	4.063	4.094	2.253	7.509	6.704
Jul-99	0.888	5.225	0.883	0.482	9.313	1.922	1.003	4.099	4.133	2.301	7.575	6.723
Aug-99	0.875	5.172	0.890	0.475	9.421	1.810	0.996	4.122	4.156	2.280	7.549	6.724
Sep-99	0.884	5.167	0.905	0.499	9.529	1.834	1.030	4.211	4.210	2.291	7.603	6.775
Oct-99	0.881	5.143	0.916	0.495	9.324	1.830	1.004	4.148	4.188	2.311	7.585	6.803
Nov-99	0.853	5.092	0.930	0.465	9.362	1.800	0.984	4.129	4.179	2.286	7.521	6.767
Dec-99	0.850	5.106	0.948	0.477	9.338	1.812	0.988	4.104	4.174	2.295	7.510	6.750
Jan-00	0.854	5.156	0.980	0.483	9.395	1.818	1.014	4.106	4.185	2.325	7.507	6.732
Feb-00	0.829	5.156	0.968	0.457	9.369	1.792	1.001	4.097	4.170	2.304	7.488	6.675
Mar-00	0.840	5.098	0.976	0.467	9.399	1.802	1.004	4.100	4.184	2.346	7.475	6.685
Apr-00	0.841	5.131	0.990	0.448	9.426	1.783	0.983	4.088	4.168	2.362	7.460	6.693
May-00	0.806	5.081	0.930	0.402	9.460	1.737	0.952	4.071	4.155	2.343	7.431	6.663
Jun-00	0.808	5.076	0.901	0.415	9.492	1.750	0.962	4.084	4.181	2.329	7.431	6.702
Jul-00	0.800	5.101	0.916	0.404	9.498	1.739	0.954	4.125	4.209	2.344	7.422	6.728
Aug-00	0.763	5.044	0.930	0.375	9.401	1.710	0.918	4.085	4.184	2.317	7.386	6.709
Sep-00	0.800	5.074	0.938	0.391	9.471	1.726	0.945	4.133	4.224	2.368	7.408	6.725
Oct-00	0.796	5.066	0.960	0.373	9.517	1.708	0.936	4.157	4.308	2.396	7.410	6.719
Nov-00	0.779	5.056	0.900	0.349	9.512	1.684	0.911	4.129	4.253	2.396	7.452	6.709
Dec-00	0.808	5.139	0.884	0.401	9.579	1.736	0.952	4.171	4.313	2.426	7.544	6.754
Jan-01	0.786	5.135	0.876	0.379	9.533	1.714	0.935	4.129	4.269	2.430	7.516	6.711
Feb-01	0.792	5.131	0.882	0.366	9.562	1.701	0.923	4.129	4.244	2.411	7.500	6.719
Mar-01	0.806	5.183	0.898	0.352	9.603	1.687	0.943	4.158	4.254	2.433	7.546	6.740
Apr-01	0.788	5.175	0.909	0.358	9.717	1.693	0.958	4.178	4.298	2.440	7.541	6.752
May-01	0.787	5.129	0.936	0.351	9.668	1.686	0.944	4.166	4.273	2.434	7.506	6.767
Jun-01	0.758	5.167	0.927	0.341	9.681	1.676	0.941	4.154	4.300	2.428	7.512	6.784
Jul-01	0.778	5.182	0.901	0.354	9.513	1.689	0.943	4.176	4.335	2.467	7.523	6.859
Aug-01	0.810	5.151	0.884	0.372	9.461	1.707	0.927	4.158	4.304	2.504	7.525	6.868
Sep-01	0.842	5.165	0.865	0.385	9.566	1.720	0.954	4.180	4.324	2.583	7.562	6.929
Oct-01	0.836	5.182	0.865	0.375	9.631	1.710	0.976	4.175	4.325	2.618	7.541	6.943
Nov-01	0.807	5.168	0.854	0.355	9.611	1.690	0.960	4.137	4.305	2.685	7.504	6.887
Dec-01	0.843	5.251	0.882	0.375	9.625	1.710	0.989	4.165	4.319	2.860	7.556	6.869
Jan-02	0.810	5.242	0.883	0.346	9.587	1.681	0.954	4.131	4.282	2.781	7.527	6.865
Feb-02	0.820	5.243	0.880	0.347	9.572	1.682	0.952	4.124	4.283	2.783	7.535	6.857
Mar-02	0.821	5.240	0.873	0.353	9.546	1.688	0.965	4.127	4.286	2.784	7.544	6.837
Apr-02	0.827	5.232	0.859	0.377	9.518	1.712	0.971	4.144	4.301	2.741	7.542	6.848
May-02	0.805	5.202	0.830	0.381	9.451	1.716	0.961	4.126	4.296	2.660	7.492	6.867
Jun-02	0.841	5.208	0.819	0.422	9.494	1.757	0.991	4.148	4.340	2.755	7.514	6.956
Jul-02	0.906	5.232	0.839	0.446	9.558	1.781	1.013	4.184	4.383	2.772	7.526	7.004
Aug-02	0.881	5.212	0.842	0.436	9.525	1.771	0.996	4.178	4.385	2.789	7.528	7.002
Sep-02	0.914	5.255	0.840	0.453	9.557	1.788	1.028	4.220	4.412	2.808	7.566	7.071
Oct-02	0.896	5.256	0.837	0.448	9.578	1.783	1.016	4.215	4.420	2.752	7.553	7.036

Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Nov-02	0.891	5.250	0.836	0.442	9.545	1.777	1.011	4.215	4.422	2.669	7.539	6.999
Dec-02	0.933	5.253	0.800	0.476	9.576	1.811	1.027	4.240	4.454	2.626	7.555	7.056
Jan-03	0.923	5.284	0.810	0.497	9.587	1.832	1.050	4.253	4.483	2.641	7.557	7.097
Feb-03	0.853	5.227	0.759	0.454	9.546	1.789	1.008	4.211	4.453	2.542	7.539	7.073
Mar-03	0.844	5.233	0.759	0.458	9.552	1.793	1.026	4.216	4.438	2.521	7.592	7.052
Apr-03	0.830	5.250	0.774	0.469	9.537	1.804	1.043	4.227	4.429	2.454	7.571	7.027
May-03	0.811	5.278	0.758	0.494	9.519	1.829	1.044	4.225	4.469	2.579	7.589	7.064
Jun-03	0.807	5.289	0.804	0.501	9.519	1.836	1.067	4.239	4.480	2.517	7.586	7.053
Jul-03	0.817	5.267	0.792	0.475	9.524	1.810	1.039	4.212	4.477	2.478	7.548	7.034
Aug-03	0.786	5.218	0.795	0.459	9.505	1.794	1.020	4.174	4.465	2.451	7.530	7.006
Sep-03	0.807	5.224	0.786	0.508	9.543	1.843	1.055	4.195	4.513	2.449	7.555	7.001
Oct-03	0.805	5.229	0.818	0.529	9.576	1.864	1.083	4.215	4.542	2.460	7.605	6.968
Nov-03	0.805	5.238	0.799	0.542	9.591	1.877	1.087	4.229	4.563	2.397	7.634	6.975
Dec-03	0.839	5.257	0.795	0.582	9.621	1.917	1.112	4.262	4.599	2.481	7.665	6.967
Jan-04	0.884	5.261	0.830	0.599	9.642	1.934	1.127	4.269	4.622	2.555	7.667	6.967
Feb-04	0.912	5.312	0.857	0.618	9.661	1.953	1.150	4.289	4.649	2.513	7.688	7.001
Mar-04	0.882	5.253	0.845	0.609	9.664	1.944	1.125	4.280	4.637	2.450	7.653	7.033
Apr-04	0.892	5.277	0.833	0.573	9.653	1.908	1.104	4.262	4.598	2.513	7.640	7.013
May-04	0.917	5.311	0.833	0.606	9.741	1.941	1.137	4.309	4.630	2.480	7.667	7.055
Jun-04	0.888	5.288	0.820	0.595	9.744	1.930	1.139	4.306	4.623	2.422	7.648	7.051
Jul-04	0.882	5.312	0.844	0.598	9.718	1.933	1.141	4.319	4.623	2.433	7.662	7.063
Aug-04	0.863	5.285	0.825	0.587	9.733	1.922	1.125	4.317	4.616	2.483	7.636	7.024
Sep-04	0.829	5.296	0.815	0.593	9.716	1.928	1.114	4.317	4.624	2.461	7.642	7.008
Oct-04	0.804	5.271	0.789	0.606	9.722	1.941	1.116	4.321	4.637	2.423	7.626	7.026
Nov-04	0.821	5.281	0.777	0.648	9.753	1.983	1.141	4.322	4.677	2.405	7.603	7.025
Dec-04	0.833	5.282	0.781	0.652	9.788	1.987	1.142	4.312	4.680	2.381	7.595	6.973
Jan-05	0.850	5.274	0.807	0.635	9.758	1.970	1.127	4.287	4.643	2.419	7.567	7.001
Feb-05	0.862	5.302	0.802	0.655	9.788	1.990	1.140	4.300	4.657	2.412	7.570	7.006
Mar-05	0.827	5.309	0.812	0.636	9.792	1.971	1.137	4.303	4.642	2.465	7.560	7.009
Apr-05	0.874	5.300	0.821	0.647	9.812	1.982	1.138	4.322	4.639	2.452	7.552	7.016
May-05	0.827	5.280	0.819	0.600	9.760	1.935	1.109	4.304	4.599	2.510	7.516	6.967
Jun-05	0.786	5.291	0.831	0.584	9.770	1.919	1.107	4.305	4.608	2.482	7.524	6.945
Jul-05	0.769	5.285	0.817	0.566	9.756	1.888	1.073	4.294	4.593	2.448	7.500	6.896
Aug-05	0.759	5.298	0.817	0.587	9.827	1.915	1.109	4.308	4.618	2.451	7.534	6.881
Sep-05	0.719	5.301	0.825	0.570	9.809	1.897	1.095	4.286	4.597	2.420	7.519	6.841
Oct-05	0.736	5.328	0.827	0.571	9.793	1.900	1.099	4.280	4.576	2.473	7.518	6.871
Nov-05	0.704	5.333	0.822	0.548	9.762	1.878	1.074	4.268	4.537	2.413	7.489	6.793
Dec-05	0.696	5.311	0.817	0.540	9.735	1.870	1.049	4.254	4.511	2.388	7.459	6.779
Jan-06	0.709	5.338	0.823	0.575	9.722	1.897	1.059	4.237	4.529	2.381	7.447	6.841
Feb-06	0.690	5.312	0.832	0.560	9.685	1.873	1.043	4.228	4.505	2.380	7.439	6.809
Mar-06	0.705	5.321	0.818	0.551	9.665	1.855	1.032	4.212	4.486	2.370	7.430	6.814
Apr-06	0.711	5.335	0.816	0.598	9.679	1.885	1.056	4.224	4.544	2.399	7.447	6.842
May-06	0.723	5.346	0.821	0.627	9.760	1.916	1.081	4.269	4.594	2.528	7.479	6.902
Jun-06	0.721	5.354	0.818	0.615	9.749	1.916	1.073	4.257	4.588	2.580	7.470	6.906
Jul-06	0.747	5.364	0.832	0.624	9.737	1.921	1.080	4.258	4.565	2.561	7.487	6.915
Aug-06	0.747	5.408	0.852	0.643	9.759	1.946	1.096	4.270	4.571	2.618	7.511	6.935
Sep-06	0.734	5.396	0.851	0.625	9.755	1.930	1.086	4.251	4.541	2.675	7.478	6.912

Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Oct-06	0.759	5.409	0.864	0.646	9.763	1.941	1.089	4.249	4.554	2.645	7.494	6.909
Nov-06	0.809	5.427	0.857	0.677	9.800	1.962	1.109	4.257	4.582	2.647	7.511	6.944
Dec-06	0.823	5.452	0.871	0.671	9.776	1.932	1.100	4.259	4.564	2.625	7.507	6.949
Jan-07	0.837	5.467	0.893	0.672	9.788	1.925	1.101	4.220	4.561	2.653	7.519	6.971
Feb-07	0.832	5.448	0.873	0.673	9.792	1.926	1.098	4.198	4.555	2.657	7.521	6.963
Mar-07	0.817	5.445	0.873	0.674	9.792	1.914	1.091	4.229	4.550	2.655	7.520	6.963
Apr-07	0.793	5.476	0.881	0.693	9.807	1.923	1.112	4.242	4.556	2.644	7.529	6.957
May-07	0.749	5.485	0.885	0.682	9.768	1.905	1.107	4.227	4.517	2.644	7.516	6.946
Jun-07	0.758	5.513	0.900	0.696	9.805	1.935	1.121	4.238	4.530	2.650	7.525	6.963
Jul-07	0.775	5.489	0.894	0.709	9.839	1.949	1.126	4.229	4.523	2.670	7.533	6.967
Aug-07	0.758	5.454	0.891	0.702	9.849	1.955	1.123	4.237	4.542	2.672	7.546	6.962
Sep-07	0.705	5.457	0.867	0.712	9.833	1.938	1.107	4.246	4.519	2.643	7.531	6.949
Oct-07	0.680	5.479	0.879	0.731	9.847	1.936	1.102	4.257	4.508	2.609	7.534	6.933
Nov-07	0.720	5.430	0.842	0.721	9.866	1.934	1.090	4.243	4.477	2.637	7.546	6.945
Dec-07	0.675	5.404	0.813	0.688	9.836	1.884	1.053	4.205	4.409	2.610	7.530	6.899
Jan-08	0.695	5.354	0.768	0.687	9.819	1.861	1.036	4.184	4.390	2.702	7.537	6.829
Feb-08	0.667	5.333	0.731	0.688	9.800	1.849	1.020	4.137	4.388	2.738	7.533	6.808
Mar-08	0.713	5.287	0.676	0.687	9.814	1.850	1.008	4.136	4.419	2.782	7.585	6.766
Apr-08	0.690	5.333	0.724	0.683	9.813	1.834	0.989	4.140	4.427	2.705	7.594	6.815
May-08	0.675	5.341	0.725	0.681	9.821	1.857	0.991	4.162	4.460	2.714	7.619	6.854
Jun-08	0.703	5.352	0.707	0.688	9.817	1.872	0.995	4.198	4.493	2.746	7.641	6.955
Jul-08	0.709	5.366	0.730	0.684	9.799	1.864	0.997	4.195	4.471	2.672	7.603	6.910
Aug-08	0.659	5.288	0.695	0.601	9.723	1.823	0.948	4.134	4.428	2.640	7.594	6.840
Sep-08	0.639	5.243	0.692	0.578	9.730	1.814	0.935	4.100	4.429	2.692	7.674	6.890
Oct-08	0.675	5.068	0.635	0.480	9.776	1.747	0.874	4.037	4.370	2.767	7.643	6.988
Nov-08	0.644	4.985	0.623	0.428	9.823	1.716	0.839	3.998	4.319	2.737	7.721	6.925
Dec-08	0.574	4.870	0.425	0.363	9.660	1.604	0.728	3.912	4.225	2.587	7.502	6.820
Jan-09	0.581	4.864	0.515	0.366	9.705	1.649	0.778	3.920	4.224	2.688	7.595	6.791
Feb-09	0.593	4.938	0.507	0.354	9.745	1.665	0.790	3.943	4.242	2.661	7.690	6.744
Mar-09	0.590	4.953	0.488	0.360	9.715	1.654	0.779	3.929	4.238	2.612	7.592	6.727
Apr-09	0.566	4.982	0.523	0.393	9.660	1.663	0.783	3.956	4.272	2.531	7.550	6.755
May-09	0.569	5.036	0.542	0.478	9.717	1.729	0.846	4.014	4.335	2.562	7.613	6.806
Jun-09	0.648	5.068	0.583	0.499	9.730	1.756	0.869	4.027	4.373	2.543	7.649	6.774
Jul-09	0.583	5.061	0.579	0.506	9.708	1.765	0.872	4.033	4.378	2.565	7.619	6.799
Aug-09	0.582	5.019	0.544	0.488	9.707	1.747	0.854	4.015	4.376	2.541	7.618	6.804
Sep-09	0.540	4.964	0.507	0.470	9.646	1.711	0.813	3.978	4.328	2.495	7.541	6.780
Oct-09	0.574	5.005	0.524	0.500	9.664	1.727	0.835	4.009	4.363	2.557	7.575	6.776
Nov-09	0.548	4.951	0.500	0.495	9.650	1.717	0.821	3.999	4.350	2.501	7.554	6.703
Dec-09	0.526	5.013	0.512	0.479	9.627	1.710	0.819	3.986	4.313	2.476	7.539	6.708
Jan-10	0.535	4.979	0.524	0.472	9.615	1.699	0.811	3.974	4.311	2.492	7.529	6.734
Feb-10	0.476	4.907	0.491	0.420	9.562	1.646	0.761	3.919	4.252	2.457	7.476	6.688
Mar-10	0.431	4.954	0.468	0.417	9.533	1.599	0.752	3.893	4.228	2.411	7.448	6.680
Apr-10	0.438	4.969	0.501	0.426	9.532	1.584	0.741	3.902	4.220	2.422	7.436	6.673
May-10	0.422	4.885	0.518	0.374	9.498	1.556	0.710	3.855	4.208	2.414	7.465	6.648
Jun-10	0.464	4.886	0.478	0.403	9.515	1.578	0.737	3.881	4.239	2.440	7.511	6.709
Jul-10	0.478	4.911	0.494	0.449	9.548	1.606	0.756	3.923	4.267	2.437	7.524	6.706
Aug-10	0.494	4.860	0.444	0.430	9.539	1.573	0.733	3.873	4.244	2.428	7.519	6.650

Table A3.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Sep-10	0.480	4.880	0.431	0.455	9.551	1.582	0.729	3.868	4.236	2.397	7.494	6.635
Oct-10	0.487	4.858	0.453	0.469	9.567	1.604	0.727	3.870	4.231	2.409	7.495	6.662
Nov-10	0.470	4.871	0.440	0.443	9.552	1.596	0.722	3.852	4.227	2.402	7.499	6.633
Dec-10	0.442	4.844	0.378	0.448	9.554	1.574	0.696	3.854	4.228	2.338	7.483	6.597
Jan-11	0.471	4.877	0.409	0.471	9.581	1.590	0.718	3.902	4.262	2.442	7.493	6.652
Feb-11	0.461	4.892	0.413	0.486	9.571	1.602	0.726	3.907	4.261	2.424	7.515	6.653
Mar-11	0.444	4.889	0.383	0.472	9.544	1.580	0.703	3.881	4.242	2.383	7.472	6.644
Apr-11	0.459	4.908	0.371	0.512	9.567	1.597	0.712	3.908	4.268	2.397	7.489	6.643
May-11	0.467	4.896	0.339	0.498	9.550	1.600	0.709	3.909	4.266	2.419	7.482	6.641
Jun-11	0.438	4.865	0.301	0.473	9.530	1.578	0.678	3.898	4.242	2.387	7.447	6.623
Jul-11	0.449	4.842	0.258	0.496	9.544	1.583	0.681	3.891	4.237	2.399	7.456	6.621
Aug-11	0.465	4.824	0.272	0.488	9.539	1.580	0.672	3.888	4.232	2.433	7.460	6.627
Sep-11	0.484	4.788	0.347	0.443	9.525	1.604	0.708	3.880	4.221	2.528	7.515	6.704
Oct-11	0.472	4.835	0.340	0.479	9.567	1.600	0.703	3.905	4.231	2.545	7.489	6.673
Nov-11	0.469	4.805	0.359	0.453	9.570	1.609	0.701	3.892	4.228	2.545	7.494	6.698
Dec-11	0.459	4.784	0.374	0.441	9.553	1.595	0.701	3.892	4.222	2.529	7.490	6.694
Jan-12	0.459	4.790	0.372	0.456	9.560	1.569	0.684	3.888	4.215	2.510	7.480	6.653
Feb-12	0.453	4.862	0.364	0.468	9.576	1.566	0.689	3.878	4.224	2.477	7.488	6.638
Mar-12	0.468	4.879	0.368	0.469	9.589	1.588	0.698	3.898	4.228	2.507	7.501	6.659
Apr-12	0.473	4.865	0.388	0.485	9.611	1.592	0.698	3.911	4.228	2.533	7.515	6.668
May-12	0.466	4.793	0.403	0.431	9.580	1.586	0.685	3.891	4.204	2.578	7.505	6.687
Jun-12	0.469	4.829	0.395	0.450	9.598	1.606	0.687	3.908	4.191	2.552	7.494	6.669
Jul-12	0.451	4.807	0.424	0.449	9.604	1.590	0.668	3.898	4.181	2.555	7.480	6.626
Aug-12	0.449	4.823	0.414	0.463	9.625	1.602	0.684	3.907	4.202	2.594	7.497	6.637
Sep-12	0.463	4.833	0.417	0.479	9.646	1.596	0.684	3.906	4.210	2.590	7.493	6.642
Oct-12	0.476	4.858	0.406	0.477	9.647	1.591	0.676	3.900	4.195	2.640	7.471	6.654
Nov-12	0.465	4.884	0.395	0.472	9.640	1.583	0.671	3.896	4.183	2.656	7.459	6.647
Dec-12	0.481	4.946	0.397	0.486	9.659	1.604	0.686	3.906	4.201	2.624	7.462	6.657
Jan-13	0.460	4.975	0.367	0.461	9.645	1.595	0.674	3.856	4.167	2.651	7.454	6.616
Feb-13	0.445	4.942	0.348	0.417	9.593	1.546	0.631	3.810	4.123	2.612	7.405	6.577
Mar-13	0.434	4.961	0.363	0.418	9.599	1.548	0.633	3.795	4.127	2.634	7.432	6.574
Apr-13	0.448	5.021	0.369	0.442	9.625	1.555	0.651	3.822	4.160	2.638	7.447	6.598
May-13	0.449	5.031	0.375	0.416	9.606	1.547	0.651	3.826	4.160	2.725	7.446	6.630
Jun-13	0.470	5.015	0.361	0.417	9.619	1.567	0.654	3.851	4.182	2.712	7.457	6.643
Jul-13	0.444	5.005	0.343	0.416	9.654	1.593	0.658	3.860	4.187	2.710	7.440	6.661
Aug-13	0.490	5.022	0.366	0.436	9.735	1.626	0.681	3.908	4.234	2.763	7.448	6.670
Sep-13	0.510	5.068	0.381	0.482	9.839	1.664	0.709	3.925	4.256	2.791	7.462	6.703
Oct-13	0.516	5.060	0.375	0.474	9.804	1.623	0.690	3.912	4.240	2.777	7.441	6.712
Nov-13	0.551	5.122	0.392	0.494	9.883	1.664	0.720	3.963	4.273	2.813	7.458	6.769
Dec-13	0.565	5.160	0.387	0.505	9.911	1.691	0.738	3.997	4.297	2.853	7.466	6.769
Jan-14	0.606	5.122	0.398	0.497	9.907	1.705	0.742	3.994	4.311	2.910	7.473	6.818
Feb-14	0.618	5.142	0.389	0.516	9.876	1.703	0.753	4.001	4.315	2.890	7.489	6.841
Mar-14	0.610	5.146	0.387	0.511	9.849	1.695	0.740	3.991	4.314	2.864	7.481	6.822
Apr-14	0.617	5.150	0.397	0.524	9.879	1.707	0.751	4.001	4.321	2.878	7.464	6.860
May-14	0.600	5.140	0.405	0.517	9.882	1.684	0.743	4.009	4.296	2.877	7.445	6.829

## Chapter 4

### Purchasing Power Parity and Panel Data Tests

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#### 4.1 Introduction

Purchasing power parity (PPP) is perhaps the oldest and most controversial theory of exchange rate determination. Absolute PPP states that the exchange rate is given by the ratio of domestic to foreign price levels. The relative version implies that the change in the exchange rate is approximately equal to the inflation differential. Under PPP, prices of goods and services are internationally arbitrated so that they are the same in all locations when expressed in a common currency. Note that PPP is more of an empirical proposition and the real exchange rate is constant under this proposition. Despite its long and chequered history, PPP continues to occupy the centre stage of research in exchange rate economics for two important business implications. First, PPP serves as the benchmark to judge the level of an exchange rate. This implies that PPP enables us to have meaningful discussions about over- or undervaluation of a currency. Second, PPP serves as a simple prediction model for exchange rates.

Empirical research on PPP is arguably the most voluminous in the exchange rate literature (see for surveys, among others, Rogoff, 1996, Taylor, 2003, Manzur, 2003, Manzur, 2008, Taylor and Manzur, 2013). While the content of PPP has historically been tested using several procedures, the focus has recently concentrated on time series econometrics involving unit root and cointegration properties of variables in panel frameworks. The test of PPP for a panel of countries is grounded on the idea that this framework enlarges the size of the sample (which is relevant for focusing on long-run PPP) and hence increases the statistical power of the test. In a panel framework, both unit root and cointegration procedures have gained popularity. The unit root procedure tests for a unit root in real exchange rates, while the cointegration procedure tests for a cointegrating relationship between various measures of domestic and foreign prices as well as nominal exchange rates. While the panel approach has made significant advances in the PPP literature, many questions remain.



This chapter systematically provides a re-examination of the empirical content of PPP for the same sample as in the previous chapter using panel data techniques. Alternative panel unit root tests are employed with the British pound sterling (GBP) as the numeraire currency. Results are then compared with a U.S. dollar-based panel. The purpose is to provide evidence if the results are sensitive to the choice of the numeraire currency (see Papell and Theodoridis, 2001). Panel unit root results are further analysed using alternative panel cointegration tests. The reason for this cointegration test is that, non-rejection of unit roots in real exchange rate do not necessarily imply a rejection of PPP. If nominal exchange rates and relative price levels are integrated of order one (in levels), then it is possible that these two variables may be cointegrated, implying a close relationship in the long run. Overall, the results are not encouraging for PPP. The sample of 12 countries is then divided into 3 sub-groups to check if the results are sensitive to country characteristics. Again, the data tend to reject PPP. Note that this chapter uses the same sample countries and data as those in the previous chapter with slightly updated cut-off period.

The study in this chapter makes two contributions. First, it represents empirical applications of recent methodological developments in the PPP literature thereby providing updated evidence using the most recent data. Second the results of this chapter are expected to contribute to the understanding of the role of numeraire or base currency in PPP analysis. The chapter is organized as follows. The next section provides a brief reference to literature, followed by analytical considerations in Section 4.3. The data are discussed in Section 4.4 and empirical results are contained in Section 4.5. The last section concludes the chapter.

## **4.2 Brief Review of Literature**

Efficient market version of PPP is empirically tested in the early literature in two ways. The first is to test for the stationarity of the real exchange rates using classical univariate procedures, such as the one proposed by Dicky and Fuller (1979). Studies using this approach include, among others, Mark (1990), Grilli and Kaminsky (1991), Flynn and Boucher (1994), Yazgan (2003) and Narayan (2005, 2006). A second approach, pioneered by Engle and Granger (1987), and subsequently, Johansen and Juselius (1990), is to test for cointegration between nominal exchange rates vis-a-vis some common currency, such as the US dollar, and relative prices. For

PPP studies along this line, see such as, Corbae and Ouliaris (1991), Enders (1988), Taylor (1988), Fisher and Park (1991), Cheung and Lai (1993) and Thacker (1995). In general, empirical studies employing classical unit root and cointegration procedures have rejected PPP.

As classical tests have low statistical power, the authors have developed what is now known as the multivariate panel data test, whereby PPP is tested by pooling the time series data across a panel of members or countries. For panel unit root tests, Im et al. (2003) [hereafter IPS], Levin et al. (2002) [hereafter LLC], Maddala and Wu (1999) [hereafter MW] and Pesaran (2007) are among the leading exponents. Ghoshroy-Saha and Berg (1996), O'Connell (1998), Papell and Theodoridis (1998) Fleissig and Strauss (2000), Ho (2002), Taylor (2002), Huseyin (2005), and Chang et al. (2006), among others, employ this methodology for PPP and provide mixed evidence. A parallel development has been the panel cointegration tests, proposed by Pedroni (1999, 2004) and Westerlund (2007), among others. Studies such as Azali et al. (2001), Nagayasu (2002), Basher and Mohsin (2004), and Jenkins and Snaith (2005) examine PPP using the Pedroni panel methodology with mixed results.

Panel frameworks exploit both time-series and cross-section information and have the advantage that their asymptotic distribution is standard normal (see Baltagi et al. 2007). However, several issues remain unresolved in panel data methods. For example, homogeneity in panels as required by some of these tests such as LLC and IPS, is hard to observe in the real world. Consequently, the authors resort to the assumption of cross-sectional independence, thereby making the results restrictive and difficult to interpret. Several studies have proposed to model cross-sectional dependence using nonlinear IV (instrumental variable) and GLS-demeaning procedures (see such as, Chang, 2002; 2004). Given the restrictive nature of these approaches, authors have introduced dynamic factor models that involve two steps: first, use orthogonalisation type methods to asymptotically eliminate cross section dependence of the series; and second, apply standard unit root tests to the transformed series (see such as, Bai and Ng , 2004; Moon and Perron 2004; Phillips and Sul, 2003). Pesaran (2007) proposes an alternative to the factor based tests, whereby standard panel unit root tests are based on the simple averages of the individual cross-sectionally augmented ADF statistics (CADF). By comparison to panel unit root tests,

the cointegration analysis in panels is still at an early stage of its development. In panel cointegration framework, testing of hypothesis and estimation procedures are further complicated by the presence of cross section cointegration. These and other issues are currently the subject of extensive research (see Breitung and Pesaran, 2008 for a review).

### 4.3 Analytical Framework

This study employs MW and CADF methods for panel unit tests of PPP. MW test has several attractions in that it allows for the flexibility in the size and dimension of the time series and cross sections, and that the alternative hypothesis allows some members to have unit roots while others may not (see Baltagi et al., 2007). CADF is a simpler procedure to get rid of cross-sectional dependence. Similarly, two separate cointegration tests are employed, namely, the one proposed by Pedroni (2004) and the other one proposed by Westerlund (2007). In what follows, these tests are briefly discussed.

#### 4.3.1 MW and CIPS Tests

MW test is implemented using the Augmented Dicky-Fuller (ADF) which follows Fisher (1932) unit root test. This test can also be implemented using the Phillips-Perron's (PP) unit root test (Phillips and Perron, 1988). Consider the following ADF regressions for each cross section:

$$\Delta y_{it} = \rho_i y_{it-1} + \sum_{j=1}^{\rho_i} \beta_{it} \Delta y_{it-j} + X_{it} \delta + \varepsilon_{it} \quad (4.1)$$

where  $i = 1, 2, \dots, N$  represents cross-section units that are observed over periods  $t = 1, 2, \dots, T$ .  $X_{i,t}$  represents the exogenous variables including any fixed or individual trend,  $\rho_i$  is the autoregressive coefficient and  $\varepsilon_{i,t}$  is idiosyncratic disturbance. If  $|\rho_i| < 1$ ,  $y_i$  is said to be weakly stationary and if  $|\rho_i| = 1$ , then  $y_i$  is said to contain a unit root. The null hypothesis is  $H_0 : \rho_i = 0$  for all  $i$  and the alternative hypothesis is that not all of the individual series have a unit root:

$$H_0 : \rho_i = 0$$

$$H_1 : \left\{ \begin{array}{l} \rho_i < 0 \text{ for } i = 1, 2, \dots, N_1, \\ \rho_i = 0 \text{ for } i = N_1 + 1, N_1 + 2, \dots, N \end{array} \right\}.$$

Hence, MW uses Fisher's (1932) result to derive tests that combine the p-values from the individual unit root in each cross-sectional unit. If the p-value from individual unit root test for cross-section  $i$  is defined as  $\pi_i$ , then under the null hypothesis of unit root for all  $N$  cross-sections, the test statistic is given by

$$P = -2 \sum_{i=1}^N \log(\pi_i) \rightarrow \chi_{2N}^2. \quad (4.2)$$

Pesaran (2007)'s cross section dependence IPS (CIPS) panel unit root test is based on a CADF regression, which filters out the cross-sectional dependence by augmenting the ADF regressions with the lagged cross-section mean and the lagged first differences of the cross sectional mean. Instead of basing the unit root tests on deviations from the estimated factors, Pesaran (2007) augmented the standard DF (or ADF) regressions with the cross-section averages of lagged levels and first-differences of the individual series. Panel unit root tests are then based on the simple averages of the individual cross-sectionally augmented ADF statistics or suitable transformations of the associated rejection probabilities. The individual CADF statistics or the rejection probabilities are then used to develop, for example, modified versions of the t-bar test in IPS, the P test in MW, and the Z test suggested by Choi (2001). The CADF regression estimates a dynamic linear heterogenous panel data model:

$$\Delta y_{it} = \alpha_{i0} + \alpha_{i1}t + \alpha_{i2}y_{i,t-1} + \alpha_{i3}\bar{y}_{t-1} + \sum_{j=0}^p d_{ij}\Delta\bar{y}_{t-j} + \sum_{j=1}^p \delta_{ij}\Delta y_{i,t-j} + \varepsilon_{it}. \quad (4.3)$$

The error term in equation (4.3) is assumed to have an unobserved one-common-factor structure accounting for cross sectional correlation and an idiosyncratic component. Let,  $\tilde{t}_i$  denote the t-ratio for  $\alpha_{i2}$  in the above regression. Then the CIPS test statistic is derived as:

$$CIPS = N^{-1} \sum_{i=1}^N \tilde{t}_i \quad (4.4)$$

See Pesaran (2007) for full derivation. The null and alternative hypothesis for CIPS test are

$$H_0 : \alpha_{i2} = 0 \text{ for } i = 1, 2, \dots, N,$$

and

$$H_1 : \left\{ \begin{array}{l} \alpha_{i2} < 0 \text{ for } i = 1, 2, \dots, N_1, \\ \alpha_{i2} = 0 \text{ for } i = N_1 + 1, N_2 + 2, \dots, N. \end{array} \right\}$$

### 4.3.2 Pedroni and Westerlund Tests

In panel cointegration literature residual-based and system approaches have been suggested. Residual-based tests typically employ non-parametric procedures to model the residual serial correlation in the error correction terms, while vector autoregressions (VAR) are employed in the development of system approaches. Two widely used residual-based panel cointegration tests are those suggested by Pedroni (1999, 2004) and Kao (1999) and the system approach is suggested by Larsson et al. (2001). Monte Carlo comparison by Gutierrez (2003) shows that in homogeneous panels, Kao's (1999) test have higher (lower) power than Pedroni's (1999) test when a small-T (high-T) are included in the panel. Gutierrez (2003) also shows that both these tests outperform Larsson et al.'s (2001) test. This study uses 37 years of monthly data and thus employs Pedroni's residual-based panel cointegration technique.

Pedroni's (1999, 2004) test is the extension of Engle and Granger's (1987) cointegration test for a single cross-section unit. The Engle and Granger cointegration test is based on the examination of the residual of a spurious regression performed using variables integrated of order one,  $I(1)$ . If the variables are cointegrated, then the residual will be  $I(0)$  and if the variables are not cointegrated, then residual will be  $I(1)$ . Pedroni proposes tests for cointegration that allows for heterogeneous intercepts and trend across cross-section units. For two  $I(1)$  variables  $x$  and  $y$ , consider the following regression

$$y_{it} = \alpha_i + \delta_i t + \beta_{1i} x_{1it} + \beta_{2i} x_{2it} + \dots + \beta_{Mi} x_{Mit} + e_{it} \quad \text{for} \quad (4.5)$$

$$t = 1, 2, \dots, T; \quad i = 1, 2, \dots, N; \quad m = 1, 2, \dots, M.$$

The parameters  $\alpha_i$  and  $\delta_i$  allow for the possibility of member specific fixed effects and deterministic trends, respectively. The slope coefficients  $\beta_i$  are also permitted to vary by individual, so that in general the cointegrating vectors may be heterogeneous across members of the panel. To test whether the residuals are stationary, the following auxiliary regressions are estimated for each cross-section unit:

$$e_{it} = \rho_i e_{it-1} + u_{it} \quad (4.6)$$

$$e_{it} = \rho_i e_{it-1} + \sum_{j=1}^{\rho_i} \psi_{ij} \Delta e_{it-j} + v_{it} \quad (4.7)$$

Against the null hypothesis of no cointegration ( $H_0 : \rho_i = 0$ ), there are two alternative hypotheses, (i) the homogeneous alternative  $[H_1 : (\rho_i = \rho) < 1, \text{ for all } i]$ , also called within-dimension test or panel statistic test and, (ii) the heterogeneous alternative ( $H_1 : \rho_i < 1, \text{ for all } i$ ), also called between-dimension or groups mean panel statistic test. The within dimension tests consist of four statistics, namely, panel v-statistic, panel  $\rho$ -statistic, panel PP-statistic, and panel ADF-statistic. These tests take into account common time factors and allow for heterogeneity across panel members. The between-dimension tests include three statistics: group  $\rho$ -statistic, group PP-statistic, and group ADF-statistic. All seven tests are distributed asymptotically as standard normal. Among the seven tests, only the panel v-statistic is a right-sided test where large positive values reject the null of no cointegration. Conversely, large negative values reject the null hypothesis of no cointegration for the remaining tests. The panel cointegration test statistic  $\aleph_{N,T}$  is constructed from the residuals from any of the auxiliary regressions as in equations (4.6) and (4.7). A total of 11 statistics are generated with varying degrees of size and power for different  $N$  and  $T$  values. Pedroni shows that the standardized statistic is asymptotically normally distributed,  $\frac{\aleph_{N,T} - \mu\sqrt{N}}{\sqrt{v}} \Rightarrow N(0,1)$ , where  $\mu$  and  $v$  are Monte-Carlo generated adjustment terms.

For comparison purposes, a relatively new cointegration test proposed by Westerlund (2007) is employed on the data. One attraction of this new cointegration test is that it handles the problem of cross-sectional dependence by bootstrapping the critical values of the test statistics. Using an error correction setup, this framework proposes four test statistics: two are designed to test the alternative that the panel is cointegrated as a whole, while the other two are designed to test the alternative that variables in at least one cross-section unit are cointegrated. The former two statistics are referred to as group mean statistics, while the latter two are referred to as panel

statistics. The group mean statistics are constructed using three steps. The first step is to estimate a conditional error correction model:

$$\Delta y_{it} = \delta_i' d_t + \alpha_i y_{it-1} + \lambda_i' x_{it-1} + \sum_{j=1}^{p_i} \alpha_{ij} \Delta y_{it-j} + \sum_{j=0}^{p_i} \gamma_{ij} \Delta x_{it-j} + e_{it} \quad (4.8)$$

The second step involves estimating the error correction parameter  $\alpha_i(1)$  and the third step is to compute the group mean statistics as follows:

$$G_\tau = \frac{1}{N} \sum_{i=1}^N \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \quad \text{and} \quad G_\alpha = \frac{1}{N} \sum_{i=1}^N \frac{T \hat{\alpha}_i}{\hat{\alpha}_i(1)}. \quad (4.9)$$

A three-step procedure is also involved to implement the panel statistics. In this part, the first step is the same as for the group mean statistics. The common error correction parameter and its standard error are estimated in the second step. The final step is to compute the panel statistics:

$$P_\tau = \frac{\hat{\alpha}}{SE(\hat{\alpha})} \quad \text{and} \quad P_\alpha = T \hat{\alpha}. \quad (4.10)$$

See Westerlund (2007) for full derivation.

#### 4.4 Data and Basic Statistics

This study uses two different panels of 12 countries. The first panel (Panel 1) has the British pound sterling (GBP) as the numeraire currency, while the second is the U.S dollar-based panel (Panel 2). Nominal exchange rates and the price levels are all monthly observations transformed in natural logarithms. All data are from the International Monetary Fund's International Financial Statistics through datastream. The euro is excluded from this analysis for its limited period of existence. For the first panel, the sample consists of the Canadian dollar (CND), Chilean peso (CLP), Indonesian rupiah (IDR), Japanese yen (JPY), Malaysian ringgit (MYR), Pilipino peso (PHP), South African rand (ZAR), South Korean won (KRW), Singapore dollar (SGD), Swiss franc (CHF), Thai baht (THB) and U.S. dollar (USD), all denominated in British pound sterling (GBP). The countries were chosen for purposes of comparison with results from earlier chapters. Consumer price index (CPI) is used as the measure of inflation. The U.S. dollar-base replaces GBP in the second panel. All data are appended at the end of this chapter.

## 4.5 Empirical Results

Log real exchange rates are calculated as  $y_{it} = s_{it} - p_{it} + p_{gbpt,ust}$ , where  $s_{it}$  is the log of exchange rate of country  $i$ th currency in terms of GBP (for the first panel) and U.S. dollar (for the second panel),  $p_{it}$  are logarithms of consumer prices indices in country  $i$ , and  $p_{gbpt,ust}$  are logarithms of consumer price indices of the UK and the USA, respectively (used as foreign price levels for the two panels). MW test results on real exchange rate along with CIPS test results for both panels are reported in the first two rows of Table 4.1. Note that MW test is carried out using both ADF and PP procedures. In the case of ADF, the optimum lag length is chosen on the basis of Schwartz Information Criteria (SIC) and in case of PP, Newey-West bandwidth is selected using Bartlett kernel. The null hypothesis is that all of the series contain unit roots and the alternative hypothesis is that all of the series are stationary. As can be seen, the results of both MW and CIPS tests indicate that the null hypothesis of a unit root cannot be rejected for both panels. This result is consistent with Pesaran (2007) and others. Pesaran (2007) found unit root in their test. While discouraging for PPP, this result is not overly surprising as the data used here are monthly, and that the panels are relatively smaller in size and a mixed bundle of countries from across the world.

The full-sample results may be sensitive to the selection of the countries in the panels. As a further check, panels are divided into three subgroups based on country characteristics such as their geographic locations and the levels of economic development. Accordingly, for Panel 1, Canada, Japan, Switzerland and the USA are put into the first subgroup; Indonesia, Malaysia, Philippines, Singapore, South Korea and Thailand constitute the second subgroup; and the remaining two outlying countries, namely, Chile and South Africa make up for the third subgroup. For Panel 2, everything remains the same except that the USA is substituted for the UK.

Table 4.1 also presents the unit root test results of panels in sub-groups. As can be seen, the full-sample and sub-sample results are very similar. None of the test statistics are significant at conventional levels, implying a rejection of stationarity of the real exchange rates in panels. Consequently, these results do not lend support to PPP.



As the tests for unit roots in real exchange rates may not be adequate for the empirical test of PPP, the two panel cointegration tests as discussed above are implemented. Before testing for cointegration, the first step is to check the order of integration of both the nominal exchange rate and the relative price level, as they need to be I(1) in levels for cointegration purposes. This is done using the same two panel unit root tests already employed as above (namely, MW and CIPS tests). The results reported in Table 4.2 show that the nominal exchange rate and relative price level appear non-stationary for both panels under MW and CIPS tests. Consequently, we can proceed to test for cointegration between these variables. Note that these variables are found to be stationary at 1 percent level when conducted the tests on their first differences (results not reported here for brevity).

**Table 4.1: Panel unit root tests on real exchange rates: sub-samples**

Panel/sub-group	ADF based MW	PP based MW	CIPS
Panel 1: Full Sample	12.37 (0.97)	14.38 (0.94)	1.40 (0.92)
Panel 2: Full Sample	10.04 (0.99)	11.57 (0.98)	0.35 (0.64)
Panel 1: 1 <sup>st</sup> sub-group	5.54 (0.69)	6.07 (0.64)	0.27 (0.61)
Panel 2: 1 <sup>st</sup> sub-group	3.73 (0.88)	4.27 (0.83)	1.13 (0.87)
Panel 1: 2 <sup>nd</sup> sub-group	9.16 (0.69)	7.43 (0.83)	-0.80 (0.21)
Panel 2: 2 <sup>nd</sup> sub-group	7.21 (0.84)	7.45 (0.83)	-1.25 (0.11)
Panel 1: 3 <sup>rd</sup> sub-group	0.29 (0.99)	0.31 (0.99)	0.91 (0.82)
Panel 2: 3 <sup>rd</sup> sub-group	0.35 (0.99)	0.39 (0.98)	1.28 (0.90)

Notes: The numbers in parenthesis are p values. The reported test statistics are given by equations (4.2) and (4.4) for MW and CIPS tests, respectively, with intercept and trend included in all cases.

**Table 4.2: Panel unit root tests on nominal exchange rate and relative price level: full sample**

Variables (Panels)	ADF based MW	PP based MW	CIPS
NER (Panel 1)	14.94 (0.92)	16.39 (0.87)	0.45 (0.67)
RPL (Panel 1)	22.47 (0.55)	48.27 (0.00)	1.27 (0.90)
NER (Panel 2)	11.66 (0.98)	11.66 (0.98)	-1.31 (0.10)
RPL (Panel 2)	16.83 (0.86)	25.40 (0.38)	1.96 (0.97)

Notes: NER = Nominal exchange rate; RPL = Relative price level. See notes to Table 4.1

Pedroni's panel cointegration test is first conducted. As discussed in Section 4.3, this procedure tests for the null of no cointegration using seven test statistics. The results of these seven test statistics are reported in Table 4.3. As can be seen, the panel rho-statistics for full sample and 1<sup>st</sup> sub-sample in Panel 1 are significant at 10% and 5% respectively. However, the group rho-statistics for Panel 1 is not significant at any

level. None of the test statistics are significant for Panel 2. Thus, these results indicate that the Pedroni test has rejected panel cointegration between the exchange rate and inflation differential, indicating a rejection of PPP.

**Table 4.3: Pedroni's panel cointegration tests**

Panel 1				
	Full Sample	First Sub-group	Second Sub-group	Third Sub-group
Panel v-statistic	2.31**	1.15	1.45*	1.60*
Panel rho-statistic	-1.62*	-1.65**	-0.67	-1.06
Panel PP-statistic	-1.37*	-1.49*	-0.52	-0.84
Panel ADF-statistic	-1.09	-0.69	-0.02	-0.99
Group rho-statistic	-0.43	-0.49	-0.01	-0.35
Group PP-statistic	-0.72	-0.85	-0.05	-0.48
Group ADF-statistic	-0.41	-0.12	0.48	-0.63
Panel 2				
	Full Sample	First Sub-group	Second Sub-group	Third Sub-group
Panel v-statistic	1.17	0.58	0.53	1.02
Panel rho-statistic	0.02	0.07	0.29	-0.48
Panel PP-statistic	0.03	0.03	0.32	-0.42
Panel ADF-statistic	0.28	0.22	0.37	-0.19
Group rho-statistic	1.69	0.91	1.52	0.23
Group PP-statistic	1.46	0.72	1.45	0.04
Group ADF-statistic	1.76	0.91	1.60	0.28

Note: \*, \*\*, \*\*\* represents the significance level at 10%, 5% and 1% respectively.

To check if the nominal exchange rate and relative price level are cross-sectionally independent or not, Pesaran's (2004) cross-section dependence (CD) test is done and the results are presented in Table 4.4. As can be seen, the p-values are close to zero, which implies that the null hypothesis of no cross-sectional dependence is strongly rejected. As there is evidence of cross-sectional dependence, it may be worthwhile to take this into account in examining the long-run relationship between the exchange rate and relative price level.

The panel cointegration test proposed by Westerlund (2007) accommodates the issue of cross dependence. As already mentioned, this test handles the problem of cross-sectional dependence by bootstrapping the critical values of the test statistics. The null hypothesis of this test is no cointegration. If the null is rejected, then there is evidence of long-run or cointegrating relation between the variables in question, which will provide evidence of weak form of PPP to hold. Tables 4.5 and 4.6 report

**Table 4.4: Average correlation coefficients and Pesaran's CD test**

Panel 1						
	Nominal Exchange Rate			Relative Price Level		
	CD test	p-value	Correlation	CD test	p-value	Correlation
Full Sample	34.51	0.00	0.56	-6.35	0.00	0.78
1st Sub-group	27.37	0.00	0.54	48.05	0.00	0.95
2nd Sub-group	36.86	0.00	0.66	-1.21	0.22	0.65
3rd Sub-group	19.17	0.00	0.95	19.89	0.00	0.97

Panel 2						
Full sample	30.1	0.00	0.58	-4.24	0.00	0.79
1st Sub-group	17.14	0.00	0.38	1.77	0.07	0.72
2nd Sub-group	33.17	0.00	0.77	3.11	0.02	0.77
3rd Sub-group	19.25	0.00	0.97	20.05	0.00	0.97

Note: Under the null hypothesis of cross-section independence  $CD \sim N(0,1)$

the results of this cointegration test for Panel 1 and Panel 2, respectively. Information criterion AIC is set to be used to choose optimal lag and lead lengths for each series and the Bartlett kernel window width is set according to  $4(T/100)^{\frac{2}{5}}$  (See, Westlund, 2008) Column (4) of the table reports the p-value and column (5) reports the bootstrapped p-values with 1000 replications. Test results show that, even with bootstrapping, the null of no cointegration between nominal exchange rate and relative price level cannot be rejected at conventional significance levels. Given these results, it may not be worthwhile to pursue the usual next step in using fully modified OLS (FMOLS) or dynamic OLS (DOLS).

**Table 4.5: Results of Westerlund panel cointegration test: Panel 1**

Statistic	Value	Z-value	P-value	Robust P-value	Value	Z-value	P-value	Bootstrap P-value
(1)	(2)	(3)	(4)	(5)	(2)	(3)	(4)	(5)
	<b>All countries</b>				<b>2<sup>nd</sup> Sub-group</b>			
Gt	-2.586	-0.993	0.160	0.300	-2.010	1.055	0.854	0.789
Ga	-12.610	-0.371	0.355	0.376	-9.779	0.773	0.780	0.673
Pt	-8.726	-1.639	0.051	0.195	-4.492	0.795	0.787	0.798
Pa	-11.853	-1.682	0.046	0.194	-8.624	0.135	0.554	0.609
	<b>1<sup>st</sup> Sub-group</b>				<b>3<sup>rd</sup> Sub-group Remaining 3</b>			
Gt	-2.767	-1.023	0.153	0.213	-2.217	-0.245	0.597	0.616
Ga	-12.953	-0.317	0.376	0.349	-12.803	-0.192	0.424	0.377
Pt	-5.480	-1.461	0.072*	0.128	-3.118	-0.151	0.440	0.551
Pa	-12.453	-1.172	0.121	0.217	-12.730	-0.894	0.186	0.259

Note: \* represents significance at 1%.

As a final check, conventional unit root tests on real exchange rates are conducted on an individual country basis and the results are presented in Tables 4.7. As can be seen from Table 4.7, in both panels the statistics for only Switzerland and Chile tend to be significant, while the rest of the sample fails the stationarity tests.

**Table 4.6: Results of Westerlund panel cointegration test: Panel 2**

Statistic	Value	Z-value	P-value	Robust P-value	Value	Z-value	P-value	Bootstrap P-value
(1)	(2)	(3)	(4)	(5)	(2)	(3)	(4)	(5)
	<b>All countries</b>				<b>2<sup>nd</sup> Sub-group</b>			
Gt	-2.116	1.066	0.857	0.808	-1.882	1.629	0.948	0.901
Ga	-9.136	1.465	0.928	0.858	-8.029	1.425	0.923	0.869
Pt	-7.741	-0.484	0.314	0.425	-4.465	0.827	0.796	0.798
Pa	-9.517	-0.330	0.371	0.439	-8.339	0.252	0.600	0.655
	<b>1<sup>st</sup> Sub-group</b>				<b>3<sup>rd</sup> Sub-group Remaining 3</b>			
Gt	-2.362	-0.015	0.494	0.499	-1.683	1.185	0.882	0.876
Ga	-10.762	0.341	0.634	0.576	-8.276	0.770	0.779	0.745
Pt	-4.781	-0.647	0.259	0.369	-2.387	0.700	0.758	0.819
Pa	-10.656	-0.570	0.284	0.399	-8.318	0.150	0.560	0.640

**Table 4.7: Unit root results of individual countries: real exchange rate**

	Panel 1		Panel 2	
	ADF	PP	ADF	PP
Canada	-2.74(0.22)	-2.95(0.15)	-1.49(0.83)	-1.53(0.82)
Japan	-1.33(0.88)	-1.52(0.82)	-1.81(0.70)	-2.10(0.54)
UK			-1.71(0.75)	-1.73(0.74)
US	-2.59(0.29)	-2.69(0.24)		
Switzerland	-3.79(0.02)	-3.79(0.02)	-3.05(0.12)	-3.11(0.10)
Indonesia	-1.87(0.67)	-2.04(0.58)	-2.16(0.52)	-2.40(0.38)
Malaysia	-2.22(0.48)	-2.37(0.40)	-1.78(0.71)	-2.10(0.55)
Singapore	-2.10(0.54)	-2.11(0.53)	-1.91(0.65)	-1.80(0.70)
Thailand	-1.96(0.62)	-1.92(0.64)	-1.80(0.70)	-1.75(0.73)
Philippines	-0.70(0.97)	-0.86(0.96)	-0.88(0.96)	-1.07(0.93)
South Africa	-1.12(0.92)	-1.15(0.92)	-1.08(0.93)	-1.20(0.91)
South Korea	-2.47(0.34)	-2.55(0.30)	-2.49(0.33)	-2.66(0.25)
Chile	-4.18(0.01)	-3.72(0.02)	-4.07(0.01)	-3.81(0.02)

As a pre-requisite to cointegration test, the unit root for nominal exchange rates and relative prices in levels are tested and the results are presented in Table 4.8. As can be seen, the results are very mixed. For Panel 1, 5 out of 13 countries' CPI differential are stationary at level. The countries are Canada, the USA, Switzerland,

Malaysia and Chile. For Panel 2, CPI differential of Japan, UK, Switzerland, Malaysia and Chile are  $I(0)$ . In such scenario conducting a cointegration test will lead to spurious results, hence the usual next step of testing for cointegrating relationship is dropped.

Overall, the results in this section tend not to provide support to PPP. While this evidence is at variance with several studies employing panel techniques (for example, Alba and Papell, 2007), it is consistent with a set of other studies (for example, Papell and Theodoridis, 2001). It is to be noted that the number of countries included in the panel for this chapter is relatively small and very mixed. Thus, the evidence here may lend support to the notion that panel unit root tests are sensitive to the selection of series included in the panel (Chortareas and Kapetanios, 2009).

**Table 4.8: Unit root results of individual countries: nominal exchange rates and inflation differentials**

	Panel 1				Panel 2			
	Exchange Rate		CPI Differential		Exchange Rate		CPI Differential	
	ADF	PP	ADF	PP	ADF	PP	ADF	pp
Canada	-2.53	-2.95	-5.02***	-3.86**	-1.61	-1.62	-1.70	-1.73
Japan	-1.66	-1.93	-0.87	-1.23	-1.83	-2.12	-3.64**	-6.14***
UK					-2.59	-2.85	-5.42***	-4.29***
US	-2.60	-2.86	-5.23***	-4.14***				
Switzerland	-3.33*	-3.34*	-5.41***	-4.29***	-3.15*	-3.29*	-4.16***	-2.07
Indonesia	-2.14	-2.23	-1.90	-1.86	-1.82	-2.09	-1.75	-1.87
Malaysia	-1.99	-2.26	-2.09	-3.78**	-1.59	-1.83	-3.23*	-3.53**
Singapore	-1.91	-2.05	-1.37	-2.61	-1.79	-1.72	-0.89	-0.82
Thailand	-1.88	-2.08	-2.04	-1.62	-1.91	-1.82	-1.51	-1.63
Philippines	-1.28	-1.31	-1.66	-1.19	-0.89	-1.09	-1.94	-1.34
South Africa	-1.88	-1.84	-1.24	-0.01	-1.72	-1.82	-0.24	-0.22
South Korea	-2.96	-2.96	-2.43	-1.89	-2.50	-2.62	-3.12	-3.05
Chile	-2.54	-2.41	-0.67	-4.79***	-4.07	-3.81	-4.21***	-5.14***

Note: p-values has been reporteds. \*,\*\* and \*\*\* represents significance at 1%, 5% and 10% respectively.

### Conclusion:

As far as I am aware, this chapter is the first comprehensive investigation on PPP using more than one the panel data approach simultaneously, specifically, it focused on the potentially non-stationary nature of the panel. USD is chosen, as it is the most popular currency base. We also conducted the same analysis using GBP as base currency to examine the robustness of results. This chapter has systematically

provided a re-examination of the empirical content of PPP for a mixed bundle of 12 currencies using panel data techniques. Both panel unit root tests and panel cointegration tests have been employed. For panel unit root tests, MW and CADF, and for panel cointegration tests, Pedroni and Westurlund frameworks have been used with the British pound sterling (GBP) as the numeraire currency. Results are then compared with a U.S. dollar-based panel. Overall, results do not lend empirical support to PPP which is consistent with the previous chapter. Results also indicate that alternative methodologies and numeraire currencies do not tend to make any difference in the results. These results may be attributable to the issues arising out the selection of series included in the panel, cross section dependence, cross integration and so on which are currently the focus of intense research in the literature.

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#### Appendix to Chapter 4

This appendix contains the log of nominal exchange rates (US dollar as numeraire) and consumer price index (CPI) data used in this chapter. The exchange rate and CPI are for the period 1979(M1) – 2014(M5) and 1973(M1)-2014(M4) respectively. As mentioned earlier, same CPI data have been used in previous chapter with slightly lesser cut-off (1973 M1 – 2013 M4). Table A4.1 contains the log of nominal exchange rate data for 12 countries. Table A4.2 contains the log of CPI data of all the 13 countries (including numeraire country).

**A4.1: Nominal exchange rates (USD as numeraire, in logarithm): 12 countries 1979(M1) – 2014(M5)**

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Jan-79	0.183	5.305	0.525	-0.691	6.438	0.792	0.773	3.015	1.998	-0.140	6.182	3.540
Feb-79	0.177	5.309	0.511	-0.705	6.433	0.783	0.773	3.017	1.998	-0.167	6.182	3.555
Mar-79	0.149	5.344	0.525	-0.727	6.435	0.789	0.780	3.017	1.999	-0.167	6.182	3.570
Apr-79	0.133	5.387	0.544	-0.722	6.438	0.803	0.794	3.017	1.999	-0.163	6.182	3.584
May-79	0.149	5.393	0.544	-0.726	6.440	0.799	0.790	3.017	1.998	-0.169	6.182	3.596
Jun-79	0.155	5.380	0.508	-0.774	6.439	0.778	0.777	3.017	1.995	-0.165	6.182	3.664
Jul-79	0.157	5.381	0.509	-0.825	6.439	0.771	0.771	3.017	1.998	-0.177	6.182	3.664
Aug-79	0.154	5.394	0.504	-0.811	6.439	0.771	0.767	3.017	1.998	-0.178	6.182	3.664
Sep-79	0.149	5.409	0.443	-0.787	6.439	0.764	0.761	3.016	1.998	-0.188	6.182	3.664
Oct-79	0.169	5.471	0.507	-0.730	6.441	0.787	0.785	3.017	1.998	-0.187	6.182	3.664
Nov-79	0.157	5.517	0.479	-0.786	6.441	0.781	0.779	3.017	2.000	-0.187	6.182	3.664
Dec-79	0.155	5.479	0.457	-0.799	6.441	0.783	0.770	3.017	2.004	-0.190	6.182	3.664
Jan-80	0.147	5.476	0.486	-0.819	6.441	0.782	0.766	3.017	2.004	-0.201	6.363	3.664
Feb-80	0.135	5.521	0.523	-0.824	6.443	0.780	0.775	3.017	2.004	-0.214	6.364	3.664
Mar-80	0.175	5.520	0.605	-0.773	6.444	0.822	0.820	3.017	2.005	-0.211	6.373	3.664
Apr-80	0.172	5.476	0.512	-0.818	6.443	0.804	0.786	3.017	2.014	-0.223	6.381	3.664
May-80	0.147	5.413	0.509	-0.846	6.440	0.773	0.761	3.016	2.018	-0.245	6.391	3.664
Jun-80	0.141	5.383	0.481	-0.860	6.438	0.763	0.750	3.016	2.019	-0.262	6.402	3.664
Jul-80	0.150	5.425	0.504	-0.849	6.440	0.771	0.758	3.018	2.022	-0.271	6.418	3.664

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Aug-80	0.146	5.389	0.501	-0.872	6.439	0.761	0.754	3.020	2.023	-0.278	6.424	3.664
Sep-80	0.157	5.358	0.502	-0.871	6.439	0.757	0.745	3.020	2.023	-0.283	6.438	3.664
Oct-80	0.162	5.354	0.542	-0.891	6.440	0.766	0.738	3.024	2.024	-0.288	6.479	3.664
Nov-80	0.174	5.379	0.554	-0.858	6.442	0.784	0.741	3.025	2.027	-0.287	6.490	3.664
Dec-80	0.178	5.313	0.567	-0.869	6.441	0.799	0.739	3.027	2.028	-0.294	6.492	3.664
Jan-81	0.177	5.322	0.656	-0.870	6.443	0.800	0.731	3.029	2.035	-0.276	6.501	3.664
Feb-81	0.183	5.341	0.675	-0.790	6.443	0.831	0.741	3.029	2.042	-0.246	6.508	3.664
Mar-81	0.171	5.352	0.650	-0.808	6.443	0.827	0.736	3.030	2.050	-0.225	6.511	3.664
Apr-81	0.179	5.371	0.704	-0.761	6.444	0.840	0.753	3.034	2.057	-0.199	6.520	3.664
May-81	0.185	5.412	0.729	-0.727	6.446	0.855	0.769	3.045	2.066	-0.166	6.528	3.664
Jun-81	0.183	5.420	0.709	-0.664	6.448	0.840	0.757	3.045	2.073	-0.124	6.530	3.664
Jul-81	0.211	5.478	0.760	-0.618	6.451	0.860	0.769	3.135	2.073	-0.049	6.532	3.664
Aug-81	0.184	5.429	0.752	-0.608	6.450	0.861	0.770	3.135	2.074	-0.061	6.530	3.664
Sep-81	0.188	5.450	0.679	-0.588	6.452	0.842	0.749	3.135	2.082	-0.046	6.530	3.664
Oct-81	0.185	5.454	0.614	-0.612	6.453	0.827	0.736	3.135	2.090	-0.036	6.519	3.664
Nov-81	0.163	5.367	0.568	-0.678	6.453	0.810	0.719	3.135	2.093	-0.041	6.537	3.664
Dec-81	0.171	5.393	0.587	-0.646	6.468	0.808	0.717	3.135	2.104	-0.044	6.552	3.664
Jan-82	0.180	5.440	0.612	-0.633	6.472	0.823	0.731	3.135	2.113	-0.029	6.563	3.664
Feb-82	0.207	5.468	0.638	-0.596	6.477	0.837	0.746	3.135	2.117	-0.019	6.568	3.664
Mar-82	0.207	5.507	0.660	-0.578	6.480	0.849	0.756	3.135	2.122	0.051	6.577	3.664
Apr-82	0.198	5.460	0.671	-0.581	6.480	0.834	0.741	3.135	2.128	0.044	6.581	3.664
May-82	0.218	5.495	0.691	-0.583	6.483	0.829	0.741	3.135	2.132	0.078	6.597	3.664
Jun-82	0.257	5.537	0.744	-0.553	6.488	0.858	0.765	3.135	2.137	0.134	6.608	3.839
Jul-82	0.228	5.551	0.738	-0.554	6.492	0.857	0.766	3.135	2.140	0.137	6.608	3.847
Aug-82	0.215	5.567	0.751	-0.543	6.500	0.855	0.772	3.135	2.150	0.141	6.609	3.919
Sep-82	0.212	5.597	0.774	-0.526	6.509	0.866	0.786	3.135	2.162	0.143	6.611	3.947
Oct-82	0.204	5.625	0.795	-0.515	6.524	0.857	0.793	3.135	2.178	0.157	6.613	3.986
Nov-82	0.213	5.534	0.760	-0.477	6.528	0.861	0.790	3.135	2.189	0.102	6.613	4.031
Dec-82	0.207	5.460	0.690	-0.479	6.540	0.842	0.746	3.135	2.216	0.074	6.618	4.069

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Jan-83	0.213	5.472	0.693	-0.426	6.546	0.822	0.727	3.135	2.240	0.067	6.622	4.086
Feb-83	0.206	5.461	0.715	-0.419	6.552	0.820	0.725	3.135	2.253	0.082	6.624	4.102
Mar-83	0.210	5.478	0.733	-0.391	6.555	0.834	0.738	3.135	2.276	0.090	6.638	4.108
Apr-83	0.204	5.468	0.724	-0.446	6.875	0.837	0.743	3.135	2.295	0.087	6.644	4.122
May-83	0.207	5.474	0.738	-0.475	6.876	0.835	0.741	3.135	2.311	0.071	6.648	4.149
Jun-83	0.205	5.479	0.744	-0.426	6.881	0.847	0.757	3.135	2.398	0.089	6.655	4.167
Jul-83	0.210	5.488	0.756	-0.419	6.889	0.853	0.759	3.135	2.398	0.094	6.663	4.182
Aug-83	0.210	5.508	0.785	-0.401	6.892	0.857	0.764	3.135	2.398	0.118	6.672	4.200
Sep-83	0.209	5.464	0.756	-0.403	6.890	0.854	0.761	3.135	2.398	0.098	6.671	4.224
Oct-83	0.209	5.454	0.759	-0.402	6.892	0.853	0.759	3.135	2.639	0.154	6.676	4.248
Nov-83	0.214	5.455	0.771	-0.382	6.899	0.852	0.757	3.135	2.639	0.177	6.681	4.272
Dec-83	0.219	5.448	0.779	-0.372	6.902	0.849	0.755	3.135	2.639	0.200	6.679	4.288
Jan-84	0.223	5.459	0.808	-0.339	6.903	0.850	0.756	3.135	2.639	0.237	6.684	4.296
Feb-84	0.225	5.453	0.772	-0.398	6.901	0.847	0.753	3.135	2.639	0.181	6.676	4.298
Mar-84	0.244	5.415	0.767	-0.366	6.908	0.830	0.736	3.135	2.639	0.212	6.674	4.297
Apr-84	0.250	5.420	0.808	-0.334	6.913	0.829	0.736	3.135	2.639	0.226	6.682	4.314
May-84	0.258	5.445	0.815	-0.326	6.917	0.839	0.745	3.135	2.639	0.249	6.682	4.332
Jun-84	0.277	5.470	0.846	-0.302	6.922	0.841	0.757	3.135	2.890	0.304	6.689	4.345
Jul-84	0.271	5.503	0.902	-0.267	6.934	0.852	0.767	3.135	2.890	0.499	6.699	4.357
Aug-84	0.260	5.486	0.878	-0.271	6.955	0.846	0.768	3.135	2.890	0.453	6.695	4.367
Sep-84	0.276	5.503	0.915	-0.222	6.965	0.863	0.771	3.135	2.890	0.513	6.703	4.372
Oct-84	0.274	5.502	0.913	-0.197	6.967	0.878	0.771	3.135	2.995	0.632	6.706	4.393
Nov-84	0.281	5.507	0.934	-0.182	6.973	0.880	0.775	3.298	2.992	0.618	6.711	4.457
Dec-84	0.279	5.526	0.950	-0.145	6.979	0.886	0.778	3.301	2.984	0.686	6.718	4.489
Jan-85	0.283	5.540	0.985	-0.120	6.987	0.913	0.793	3.310	2.912	0.682	6.722	4.502
Feb-85	0.324	5.559	1.041	-0.086	6.996	0.949	0.816	3.334	2.910	0.707	6.737	4.527
Mar-85	0.313	5.531	0.962	-0.218	7.005	0.925	0.792	3.316	2.916	0.644	6.746	4.551
Apr-85	0.312	5.530	0.950	-0.219	7.011	0.908	0.796	3.314	2.917	0.663	6.764	4.576
May-85	0.317	5.529	0.958	-0.242	7.018	0.905	0.800	3.315	2.917	0.692	6.770	4.600

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Jun-85	0.307	5.517	0.941	-0.259	7.019	0.912	0.804	3.311	2.916	0.677	6.773	4.621
Jul-85	0.303	5.467	0.824	-0.357	7.018	0.901	0.783	3.287	2.927	0.778	6.776	5.147
Aug-85	0.312	5.469	0.825	-0.336	7.020	0.909	0.819	3.290	2.923	1.020	6.788	5.159
Sep-85	0.316	5.380	0.780	-0.337	7.022	0.893	0.758	3.270	2.925	0.940	6.793	5.166
Oct-85	0.312	5.354	0.764	-0.367	7.024	0.895	0.756	3.278	2.931	0.947	6.794	5.174
Nov-85	0.325	5.308	0.733	-0.394	7.023	0.886	0.739	3.263	2.932	0.993	6.790	5.183
Dec-85	0.335	5.301	0.731	-0.368	7.026	0.886	0.744	3.283	2.946	0.939	6.791	5.213
Jan-86	0.353	5.256	0.707	-0.345	7.027	0.907	0.755	3.279	2.950	0.826	6.790	5.224
Feb-86	0.351	5.191	0.627	-0.384	7.028	0.910	0.763	3.271	3.090	0.684	6.784	5.238
Mar-86	0.335	5.191	0.663	-0.396	7.026	0.948	0.777	3.276	3.025	0.744	6.786	5.247
Apr-86	0.318	5.126	0.603	-0.435	7.025	0.950	0.786	3.269	3.020	0.721	6.786	5.238
May-86	0.322	5.146	0.651	-0.393	7.030	0.969	0.802	3.276	3.021	0.854	6.791	5.237
Jun-86	0.327	5.106	0.585	-0.425	7.031	0.967	0.784	3.270	3.024	0.905	6.787	5.258
Jul-86	0.322	5.039	0.520	-0.399	7.031	0.964	0.777	3.263	3.017	0.939	6.786	5.260
Aug-86	0.328	5.050	0.504	-0.391	7.032	0.959	0.771	3.263	3.019	0.938	6.780	5.286
Sep-86	0.328	5.034	0.494	-0.372	7.398	0.965	0.775	3.261	3.018	0.800	6.777	5.292
Oct-86	0.329	5.085	0.540	-0.336	7.402	0.965	0.783	3.268	3.017	0.827	6.772	5.302
Nov-86	0.325	5.090	0.499	-0.362	7.409	0.956	0.788	3.267	3.017	0.795	6.763	5.313
Dec-86	0.322	5.070	0.485	-0.388	7.403	0.957	0.777	3.263	3.022	0.781	6.759	5.323
Jan-87	0.292	5.027	0.420	-0.425	7.398	0.932	0.756	3.253	3.019	0.727	6.754	5.329
Feb-87	0.288	5.031	0.430	-0.435	7.405	0.925	0.757	3.255	3.022	0.730	6.751	5.325
Mar-87	0.266	4.982	0.409	-0.473	7.405	0.919	0.758	3.253	3.023	0.702	6.742	5.359
Apr-87	0.290	4.938	0.381	-0.510	7.403	0.907	0.752	3.241	3.020	0.694	6.726	5.358
May-87	0.292	4.970	0.414	-0.486	7.408	0.915	0.751	3.248	3.019	0.702	6.713	5.370
Jun-87	0.286	4.990	0.419	-0.476	7.407	0.926	0.752	3.252	3.018	0.716	6.696	5.403
Jul-87	0.283	5.006	0.430	-0.466	7.402	0.934	0.747	3.256	3.017	0.727	6.695	5.414
Aug-87	0.277	4.959	0.403	-0.486	7.402	0.924	0.744	3.248	3.018	0.712	6.694	5.418
Sep-87	0.269	4.986	0.425	-0.488	7.409	0.930	0.740	3.252	3.025	0.731	6.692	5.418
Oct-87	0.275	4.932	0.364	-0.539	7.407	0.921	0.727	3.243	3.031	0.699	6.686	5.449

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Nov-87	0.268	4.887	0.293	-0.605	7.409	0.913	0.709	3.233	3.039	0.666	6.680	5.460
Dec-87	0.262	4.816	0.245	-0.627	7.409	0.913	0.692	3.222	3.035	0.657	6.675	5.473
Jan-88	0.243	4.846	0.310	-0.571	7.416	0.937	0.702	3.228	3.038	0.688	6.661	5.485
Feb-88	0.231	4.852	0.329	-0.571	7.415	0.950	0.699	3.230	3.045	0.738	6.634	5.485
Mar-88	0.210	4.832	0.314	-0.631	7.415	0.942	0.695	3.225	3.045	0.754	6.615	5.499
Apr-88	0.206	4.827	0.327	-0.634	7.420	0.946	0.694	3.224	3.045	0.767	6.607	5.497
May-88	0.210	4.830	0.365	-0.612	7.422	0.951	0.703	3.225	3.040	0.807	6.597	5.514
Jun-88	0.193	4.886	0.412	-0.536	7.431	0.958	0.714	3.238	3.047	0.845	6.591	5.525
Jul-88	0.191	4.887	0.447	-0.535	7.434	0.969	0.712	3.238	3.046	0.892	6.585	5.500
Aug-88	0.215	4.905	0.459	-0.520	7.438	0.981	0.713	3.241	3.048	0.896	6.582	5.505
Sep-88	0.196	4.902	0.463	-0.522	7.442	0.985	0.713	3.241	3.060	0.915	6.578	5.507
Oct-88	0.199	4.834	0.398	-0.577	7.447	0.983	0.693	3.228	3.063	0.913	6.553	5.513
Nov-88	0.173	4.802	0.374	-0.614	7.451	0.984	0.664	3.221	3.062	0.832	6.533	5.503
Dec-88	0.176	4.835	0.408	-0.593	7.456	0.999	0.666	3.228	3.060	0.866	6.528	5.511
Jan-89	0.168	4.861	0.461	-0.566	7.462	1.004	0.658	3.234	3.061	0.876	6.523	5.505
Feb-89	0.181	4.844	0.445	-0.554	7.465	1.006	0.657	3.233	3.061	0.912	6.512	5.505
Mar-89	0.177	4.883	0.507	-0.524	7.471	1.013	0.672	3.240	3.060	0.940	6.510	5.540
Apr-89	0.171	4.886	0.512	-0.525	7.473	0.993	0.667	3.240	3.071	0.941	6.502	5.530
May-89	0.187	4.961	0.539	-0.453	7.479	0.999	0.672	3.254	3.073	1.024	6.502	5.539
Jun-89	0.181	4.971	0.515	-0.438	7.480	0.995	0.676	3.256	3.082	1.022	6.503	5.597
Jul-89	0.166	4.930	0.475	-0.509	7.481	0.979	0.671	3.248	3.086	0.983	6.503	5.616
Aug-89	0.162	4.972	0.525	-0.451	7.487	0.992	0.676	3.257	3.086	1.019	6.506	5.630
Sep-89	0.164	4.937	0.481	-0.486	7.486	0.990	0.673	3.250	3.089	0.990	6.507	5.638
Oct-89	0.161	4.958	0.477	-0.456	7.491	0.992	0.671	3.252	3.096	0.969	6.510	5.654
Nov-89	0.151	4.962	0.467	-0.450	7.491	0.993	0.668	3.250	3.102	0.959	6.511	5.675
Dec-89	0.147	4.966	0.436	-0.473	7.494	0.994	0.639	3.246	3.111	0.931	6.522	5.692
Jan-90	0.171	4.971	0.400	-0.520	7.498	0.993	0.625	3.247	3.115	0.940	6.531	5.688
Feb-90	0.176	5.000	0.397	-0.522	7.502	0.994	0.625	3.250	3.125	0.939	6.542	5.689
Mar-90	0.157	5.058	0.403	-0.496	7.508	1.003	0.634	3.257	3.125	0.976	6.554	5.696

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Apr-90	0.153	5.071	0.377	-0.492	7.512	1.000	0.630	3.258	3.127	0.980	6.561	5.694
May-90	0.161	5.022	0.352	-0.520	7.515	0.994	0.615	3.252	3.134	0.976	6.568	5.694
Jun-90	0.154	5.030	0.349	-0.555	7.520	0.997	0.610	3.250	3.147	0.978	6.574	5.695
Jul-90	0.142	4.993	0.303	-0.617	7.522	0.995	0.593	3.243	3.172	0.952	6.572	5.698
Aug-90	0.144	4.972	0.257	-0.642	7.527	0.989	0.568	3.238	3.219	0.945	6.571	5.718
Sep-90	0.145	4.926	0.262	-0.628	7.530	0.994	0.567	3.232	3.248	0.942	6.569	5.728
Oct-90	0.155	4.863	0.253	-0.666	7.535	0.993	0.533	3.222	3.248	0.934	6.571	5.766
Nov-90	0.153	4.893	0.249	-0.661	7.541	0.991	0.541	3.226	3.332	0.925	6.570	5.803
Dec-90	0.149	4.901	0.259	-0.656	7.550	0.994	0.556	3.230	3.332	0.941	6.574	5.820
Jan-91	0.151	4.877	0.235	-0.674	7.556	0.993	0.549	3.225	3.332	0.932	6.578	5.821
Feb-91	0.140	4.883	0.275	-0.652	7.560	0.999	0.546	3.228	3.332	0.942	6.585	5.822
Mar-91	0.147	4.949	0.378	-0.551	7.566	1.020	0.584	3.245	3.332	1.005	6.586	5.842
Apr-91	0.141	4.923	0.381	-0.536	7.570	1.015	0.571	3.245	3.327	1.025	6.586	5.826
May-91	0.136	4.927	0.385	-0.537	7.574	1.015	0.568	3.244	3.325	1.032	6.583	5.835
Jun-91	0.133	4.927	0.445	-0.483	7.578	1.023	0.568	3.247	3.323	1.061	6.584	5.852
Jul-91	0.141	4.926	0.421	-0.521	7.580	1.026	0.558	3.248	3.323	1.053	6.588	5.853
Aug-91	0.133	4.921	0.420	-0.523	7.583	1.024	0.542	3.247	3.296	1.056	6.601	5.867
Sep-91	0.124	4.889	0.371	-0.561	7.585	1.008	0.524	3.240	3.296	1.031	6.609	5.878
Oct-91	0.116	4.874	0.386	-0.555	7.589	1.010	0.524	3.241	3.296	1.042	6.620	5.887
Nov-91	0.126	4.868	0.363	-0.565	7.593	1.012	0.509	3.238	3.285	1.030	6.626	5.909
Dec-91	0.145	4.830	0.304	-0.626	7.597	1.002	0.489	3.230	3.283	1.009	6.634	5.927
Jan-92	0.161	4.834	0.361	-0.579	7.603	0.991	0.492	3.235	3.278	1.030	6.636	5.869
Feb-92	0.167	4.862	0.397	-0.565	7.606	0.951	0.497	3.239	3.260	1.046	6.644	5.850
Mar-92	0.174	4.892	0.404	-0.553	7.609	0.950	0.507	3.243	3.234	1.056	6.653	5.857
Apr-92	0.179	4.894	0.422	-0.569	7.612	0.927	0.504	3.244	3.251	1.056	6.658	5.849
May-92	0.186	4.854	0.381	-0.599	7.614	0.928	0.491	3.238	3.268	1.040	6.664	5.851
Jun-92	0.180	4.832	0.320	-0.641	7.617	0.919	0.481	3.230	3.242	1.020	6.672	5.886
Jul-92	0.169	4.846	0.276	-0.652	7.618	0.917	0.478	3.231	3.215	1.018	6.670	5.898
Aug-92	0.178	4.811	0.230	-0.684	7.618	0.913	0.469	3.224	3.148	1.007	6.669	5.927

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Sep-92	0.222	4.781	0.207	-0.578	7.620	0.916	0.465	3.222	3.224	1.034	6.668	5.929
Oct-92	0.215	4.814	0.316	-0.450	7.626	0.920	0.482	3.233	3.204	1.085	6.662	5.923
Nov-92	0.251	4.826	0.369	-0.409	7.630	0.930	0.493	3.239	3.238	1.106	6.666	5.944
Dec-92	0.240	4.826	0.376	-0.413	7.631	0.960	0.498	3.239	3.223	1.116	6.670	5.946
Jan-93	0.239	4.825	0.385	-0.407	7.633	0.965	0.496	3.238	3.233	1.123	6.677	5.953
Feb-93	0.226	4.768	0.421	-0.355	7.634	0.968	0.498	3.236	3.230	1.145	6.678	5.968
Mar-93	0.229	4.757	0.402	-0.408	7.636	0.953	0.495	3.233	3.239	1.155	6.677	5.994
Apr-93	0.239	4.711	0.356	-0.454	7.637	0.944	0.479	3.227	3.273	1.150	6.679	6.003
May-93	0.240	4.668	0.355	-0.444	7.639	0.939	0.474	3.224	3.299	1.156	6.686	6.005
Jun-93	0.249	4.670	0.412	-0.411	7.644	0.948	0.484	3.229	3.306	1.202	6.689	6.001
Jul-93	0.250	4.662	0.422	-0.393	7.648	0.943	0.481	3.230	3.321	1.218	6.693	6.002
Aug-93	0.278	4.646	0.383	-0.404	7.651	0.936	0.474	3.226	3.334	1.218	6.695	6.014
Sep-93	0.290	4.655	0.349	-0.413	7.653	0.936	0.462	3.227	3.395	1.234	6.696	6.016
Oct-93	0.279	4.684	0.392	-0.397	7.653	0.939	0.456	3.232	3.361	1.210	6.695	6.021
Nov-93	0.290	4.691	0.400	-0.396	7.653	0.939	0.471	3.236	3.331	1.214	6.694	6.041
Dec-93	0.281	4.717	0.392	-0.393	7.654	0.994	0.475	3.240	3.321	1.223	6.695	6.066
Jan-94	0.283	4.700	0.381	-0.404	7.660	1.016	0.467	3.238	3.321	1.230	6.695	6.065
Feb-94	0.302	4.646	0.357	-0.397	7.667	1.004	0.459	3.230	3.321	1.245	6.688	6.063
Mar-94	0.325	4.636	0.344	-0.394	7.670	0.983	0.451	3.228	3.317	1.247	6.693	6.057
Apr-94	0.323	4.630	0.347	-0.412	7.673	0.989	0.441	3.225	3.306	1.258	6.694	6.057
May-94	0.325	4.649	0.336	-0.412	7.676	0.947	0.427	3.227	3.291	1.293	6.692	6.047
Jun-94	0.324	4.596	0.296	-0.432	7.678	0.957	0.421	3.218	3.292	1.295	6.691	6.038
Jul-94	0.324	4.603	0.303	-0.423	7.682	0.953	0.414	3.220	3.267	1.301	6.688	6.047
Aug-94	0.316	4.601	0.287	-0.428	7.685	0.937	0.405	3.220	3.277	1.277	6.686	6.038
Sep-94	0.293	4.590	0.252	-0.457	7.688	0.942	0.395	3.218	3.258	1.271	6.683	6.022
Oct-94	0.302	4.579	0.232	-0.484	7.690	0.937	0.386	3.216	3.216	1.253	6.681	6.015
Nov-94	0.319	4.594	0.285	-0.446	7.693	0.939	0.381	3.221	3.173	1.268	6.677	6.032
Dec-94	0.338	4.603	0.271	-0.446	7.696	0.940	0.379	3.222	3.195	1.265	6.670	6.002
Jan-95	0.343	4.591	0.243	-0.466	7.699	0.939	0.373	3.220	3.202	1.263	6.668	6.016



Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Feb-95	0.332	4.575	0.215	-0.457	7.702	0.938	0.371	3.217	3.248	1.281	6.667	6.018
Mar-95	0.336	4.493	0.130	-0.478	7.705	0.931	0.350	3.208	3.258	1.278	6.648	6.004
Apr-95	0.307	4.428	0.131	-0.478	7.708	0.905	0.331	3.202	3.259	1.286	6.636	5.962
May-95	0.315	4.421	0.135	-0.473	7.712	0.902	0.329	3.204	3.250	1.303	6.633	5.930
Jun-95	0.317	4.438	0.141	-0.466	7.717	0.892	0.334	3.205	3.242	1.291	6.631	5.926
Jul-95	0.315	4.482	0.136	-0.472	7.721	0.899	0.333	3.209	3.242	1.286	6.629	5.950
Aug-95	0.295	4.596	0.185	-0.440	7.726	0.916	0.353	3.222	3.254	1.297	6.648	5.980
Sep-95	0.296	4.588	0.134	-0.457	7.730	0.919	0.351	3.222	3.261	1.295	6.644	5.983
Oct-95	0.292	4.622	0.132	-0.454	7.734	0.934	0.348	3.224	3.258	1.294	6.641	6.031
Nov-95	0.306	4.621	0.153	-0.428	7.739	0.933	0.345	3.225	3.265	1.298	6.645	6.026
Dec-95	0.311	4.633	0.140	-0.438	7.744	0.933	0.347	3.226	3.266	1.294	6.652	6.009
Jan-96	0.318	4.675	0.197	-0.410	7.745	0.941	0.350	3.233	3.265	1.295	6.665	6.023
Feb-96	0.316	4.651	0.179	-0.427	7.750	0.936	0.345	3.226	3.265	1.351	6.660	6.022
Mar-96	0.310	4.666	0.174	-0.422	7.757	0.931	0.342	3.228	3.266	1.381	6.663	6.020
Apr-96	0.309	4.652	0.214	-0.411	7.759	0.913	0.341	3.228	3.265	1.469	6.658	6.008
May-96	0.315	4.684	0.231	-0.431	7.764	0.916	0.343	3.232	3.267	1.474	6.669	6.011
Jun-96	0.311	4.695	0.224	-0.437	7.759	0.914	0.344	3.233	3.266	1.467	6.698	6.015
Jul-96	0.318	4.681	0.174	-0.443	7.763	0.914	0.346	3.230	3.267	1.505	6.701	6.018
Aug-96	0.314	4.686	0.182	-0.443	7.768	0.914	0.342	3.230	3.266	1.501	6.709	6.018
Sep-96	0.309	4.709	0.229	-0.446	7.758	0.920	0.342	3.236	3.268	1.511	6.711	6.023
Oct-96	0.293	4.734	0.228	-0.487	7.763	0.930	0.343	3.238	3.269	1.548	6.723	6.042
Nov-96	0.299	4.734	0.261	-0.520	7.770	0.927	0.338	3.239	3.269	1.527	6.720	6.042
Dec-96	0.315	4.754	0.297	-0.529	7.776	0.928	0.336	3.243	3.269	1.544	6.738	6.052
Jan-97	0.298	4.804	0.349	-0.471	7.782	0.911	0.343	3.253	3.271	1.519	6.758	6.039
Feb-97	0.312	4.794	0.390	-0.488	7.786	0.909	0.354	3.254	3.271	1.499	6.761	6.022
Mar-97	0.325	4.821	0.372	-0.488	7.791	0.908	0.368	3.257	3.272	1.487	6.799	6.028
Apr-97	0.334	4.843	0.385	-0.488	7.797	0.921	0.368	3.262	3.272	1.492	6.794	6.038
May-97	0.323	4.757	0.344	-0.494	7.800	0.921	0.358	3.250	3.272	1.498	6.793	6.038
Jun-97	0.323	4.740	0.378	-0.509	7.804	0.926	0.358	3.250	3.273	1.511	6.789	6.032

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Jul-97	0.323	4.773	0.415	-0.492	7.863	0.967	0.386	3.468	3.366	1.528	6.793	6.033
Aug-97	0.328	4.782	0.394	-0.484	8.018	1.085	0.424	3.536	3.407	1.546	6.805	6.028
Sep-97	0.324	4.796	0.373	-0.478	8.094	1.161	0.425	3.598	3.523	1.539	6.819	6.029
Oct-97	0.343	4.787	0.336	-0.515	8.208	1.233	0.463	3.682	3.554	1.572	6.872	6.042
Nov-97	0.354	4.849	0.355	-0.517	8.202	1.254	0.465	3.692	3.545	1.580	7.059	6.076
Dec-97	0.357	4.867	0.375	-0.503	8.445	1.359	0.516	3.855	3.688	1.583	7.435	6.086
Jan-98	0.376	4.843	0.387	-0.494	9.247	1.519	0.562	4.006	3.747	1.597	7.330	6.113
Feb-98	0.353	4.846	0.384	-0.497	9.077	1.301	0.482	3.759	3.698	1.597	7.398	6.115
Mar-98	0.348	4.883	0.419	-0.519	9.027	1.294	0.474	3.659	3.613	1.616	7.232	6.118
Apr-98	0.358	4.885	0.405	-0.513	8.923	1.317	0.460	3.656	3.688	1.620	7.197	6.115
May-98	0.376	4.935	0.393	-0.489	9.262	1.359	0.517	3.694	3.661	1.640	7.249	6.119
Jun-98	0.386	4.948	0.421	-0.508	9.609	1.428	0.535	3.745	3.740	1.769	7.225	6.143
Jul-98	0.413	4.968	0.401	-0.493	9.473	1.420	0.545	3.709	3.738	1.814	7.115	6.142
Aug-98	0.452	4.952	0.377	-0.502	9.312	1.437	0.577	3.737	3.781	1.858	7.208	6.162
Sep-98	0.423	4.907	0.327	-0.528	9.278	1.335	0.522	3.671	3.780	1.770	7.238	6.145
Oct-98	0.433	4.757	0.297	-0.517	8.929	1.335	0.484	3.605	3.709	1.733	7.185	6.137
Nov-98	0.421	4.817	0.340	-0.502	8.896	1.334	0.504	3.586	3.675	1.738	7.128	6.145
Dec-98	0.426	4.750	0.320	-0.509	8.990	1.335	0.507	3.603	3.665	1.768	7.093	6.161
Jan-99	0.410	4.755	0.349	-0.499	9.099	1.335	0.525	3.607	3.656	1.801	7.069	6.181
Feb-99	0.410	4.782	0.367	-0.471	9.075	1.335	0.545	3.623	3.666	1.821	7.109	6.212
Mar-99	0.412	4.791	0.397	-0.477	9.069	1.335	0.549	3.628	3.658	1.823	7.112	6.182
Apr-99	0.377	4.782	0.419	-0.478	9.019	1.335	0.531	3.617	3.638	1.809	7.080	6.187
May-99	0.390	4.799	0.421	-0.473	9.000	1.335	0.547	3.612	3.640	1.827	7.079	6.201
Jun-99	0.387	4.797	0.440	-0.454	8.814	1.335	0.531	3.607	3.638	1.798	7.054	6.252
Jul-99	0.410	4.747	0.402	-0.482	8.836	1.335	0.523	3.613	3.644	1.817	7.093	6.246
Aug-99	0.403	4.708	0.417	-0.472	8.931	1.335	0.521	3.645	3.681	1.805	7.077	6.248
Sep-99	0.385	4.671	0.404	-0.499	9.034	1.335	0.532	3.713	3.716	1.793	7.104	6.275
Oct-99	0.386	4.653	0.427	-0.491	8.839	1.335	0.513	3.656	3.693	1.815	7.090	6.307
Nov-99	0.387	4.630	0.465	-0.467	8.913	1.335	0.521	3.664	3.708	1.820	7.055	6.304

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Dec-99	0.367	4.627	0.470	-0.480	8.866	1.335	0.510	3.624	3.697	1.817	7.037	6.273
Jan-00	0.372	4.671	0.495	-0.485	8.913	1.335	0.534	3.624	3.699	1.842	7.024	6.250
Feb-00	0.371	4.702	0.500	-0.465	8.923	1.335	0.539	3.636	3.710	1.848	7.031	6.223
Mar-00	0.374	4.662	0.512	-0.467	8.935	1.335	0.542	3.632	3.715	1.881	7.009	6.226
Apr-00	0.393	4.669	0.550	-0.450	8.980	1.335	0.534	3.638	3.720	1.920	7.011	6.245
May-00	0.404	4.670	0.524	-0.402	9.062	1.335	0.548	3.666	3.757	1.940	7.029	6.263
Jun-00	0.392	4.658	0.486	-0.414	9.075	1.335	0.548	3.667	3.765	1.913	7.017	6.289
Jul-00	0.397	4.696	0.515	-0.404	9.105	1.335	0.550	3.724	3.805	1.940	7.018	6.321
Aug-00	0.387	4.667	0.550	-0.375	9.023	1.335	0.543	3.711	3.808	1.942	7.011	6.322
Sep-00	0.410	4.681	0.552	-0.385	9.080	1.335	0.554	3.743	3.835	1.982	7.017	6.337
Oct-00	0.423	4.692	0.592	-0.371	9.148	1.335	0.564	3.783	3.940	2.025	7.038	6.349
Nov-00	0.429	4.711	0.551	-0.351	9.162	1.335	0.564	3.781	3.900	2.044	7.102	6.364
Dec-00	0.406	4.744	0.493	-0.400	9.169	1.335	0.549	3.767	3.912	2.024	7.142	6.350
Jan-01	0.405	4.755	0.498	-0.381	9.154	1.335	0.556	3.751	3.900	2.063	7.138	6.334
Feb-01	0.423	4.757	0.512	-0.370	9.194	1.335	0.554	3.758	3.877	2.047	7.132	6.341
Mar-01	0.456	4.825	0.549	-0.355	9.250	1.335	0.588	3.802	3.900	2.081	7.191	6.385
Apr-01	0.429	4.816	0.550	-0.359	9.365	1.335	0.598	3.819	3.936	2.080	7.185	6.397
May-01	0.435	4.781	0.584	-0.349	9.311	1.335	0.592	3.813	3.924	2.082	7.157	6.414
Jun-01	0.417	4.821	0.585	-0.339	9.345	1.335	0.599	3.811	3.958	2.087	7.168	6.440
Jul-01	0.425	4.827	0.545	-0.355	9.162	1.335	0.589	3.822	3.981	2.112	7.170	6.499
Aug-01	0.437	4.779	0.503	-0.378	9.090	1.335	0.553	3.786	3.936	2.129	7.153	6.493
Sep-01	0.457	4.782	0.477	-0.385	9.177	1.335	0.568	3.793	3.939	2.197	7.177	6.546
Oct-01	0.462	4.803	0.485	-0.375	9.253	1.335	0.601	3.798	3.950	2.238	7.167	6.575
Nov-01	0.452	4.820	0.503	-0.355	9.252	1.335	0.605	3.784	3.952	2.334	7.149	6.525
Dec-01	0.465	4.881	0.517	-0.372	9.250	1.335	0.616	3.789	3.940	2.495	7.180	6.486
Jan-02	0.465	4.890	0.530	-0.346	9.242	1.335	0.605	3.782	3.936	2.444	7.181	6.519
Feb-02	0.473	4.897	0.534	-0.348	9.229	1.335	0.607	3.777	3.939	2.435	7.188	6.515
Mar-02	0.466	4.892	0.521	-0.353	9.175	1.335	0.611	3.772	3.935	2.432	7.190	6.499
Apr-02	0.450	4.852	0.484	-0.376	9.139	1.335	0.593	3.766	3.927	2.369	7.165	6.476

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
May-02	0.424	4.824	0.445	-0.383	9.081	1.335	0.580	3.747	3.911	2.282	7.112	6.484
Jun-02	0.418	4.783	0.389	-0.430	9.075	1.335	0.568	3.726	3.920	2.327	7.091	6.548
Jul-02	0.460	4.786	0.397	-0.448	9.117	1.335	0.567	3.737	3.937	2.321	7.080	6.552
Aug-02	0.444	4.770	0.399	-0.440	9.090	1.335	0.559	3.742	3.948	2.353	7.092	6.573
Sep-02	0.461	4.800	0.394	-0.447	9.107	1.335	0.575	3.769	3.960	2.355	7.113	6.617
Oct-02	0.445	4.808	0.395	-0.445	9.131	1.335	0.569	3.768	3.971	2.311	7.108	6.597
Nov-02	0.448	4.806	0.396	-0.440	9.102	1.335	0.567	3.769	3.981	2.229	7.097	6.558
Dec-02	0.457	4.787	0.327	-0.477	9.098	1.335	0.552	3.765	3.972	2.156	7.079	6.569
Jan-03	0.425	4.779	0.305	-0.501	9.091	1.335	0.553	3.755	3.985	2.147	7.065	6.599
Feb-03	0.397	4.769	0.304	-0.459	9.094	1.335	0.553	3.752	3.995	2.097	7.085	6.625
Mar-03	0.385	4.789	0.303	-0.457	9.095	1.335	0.568	3.758	3.980	2.069	7.135	6.589
Apr-03	0.360	4.784	0.308	-0.468	9.068	1.335	0.573	3.757	3.967	1.982	7.103	6.559
May-03	0.315	4.774	0.255	-0.499	9.021	1.335	0.548	3.730	3.957	2.093	7.095	6.565
Jun-03	0.304	4.786	0.306	-0.501	9.022	1.335	0.563	3.737	3.984	2.022	7.084	6.547
Jul-03	0.342	4.788	0.314	-0.477	9.048	1.335	0.565	3.737	4.002	2.008	7.073	6.559
Aug-03	0.326	4.763	0.343	-0.457	9.052	1.335	0.564	3.717	4.009	1.992	7.072	6.550
Sep-03	0.300	4.711	0.274	-0.515	9.035	1.335	0.547	3.688	4.006	1.935	7.048	6.500
Oct-03	0.277	4.689	0.287	-0.526	9.047	1.335	0.552	3.686	4.012	1.932	7.076	6.443
Nov-03	0.260	4.696	0.255	-0.542	9.052	1.335	0.546	3.686	4.021	1.858	7.092	6.437
Dec-03	0.257	4.674	0.213	-0.579	9.044	1.335	0.531	3.679	4.018	1.893	7.084	6.396
Jan-04	0.282	4.663	0.233	-0.594	9.041	1.335	0.532	3.670	4.027	1.946	7.068	6.392
Feb-04	0.293	4.691	0.242	-0.615	9.042	1.335	0.533	3.671	4.030	1.895	7.070	6.387
Mar-04	0.270	4.647	0.244	-0.607	9.058	1.335	0.518	3.674	4.032	1.852	7.045	6.435
Apr-04	0.315	4.702	0.260	-0.573	9.067	1.335	0.533	3.688	4.023	1.925	7.068	6.437
May-04	0.312	4.705	0.222	-0.607	9.128	1.335	0.530	3.701	4.022	1.875	7.056	6.449
Jun-04	0.293	4.686	0.226	-0.594	9.150	1.335	0.540	3.711	4.029	1.836	7.052	6.456
Jul-04	0.285	4.719	0.245	-0.597	9.123	1.335	0.545	3.721	4.026	1.832	7.065	6.459
Aug-04	0.275	4.697	0.241	-0.584	9.141	1.335	0.538	3.728	4.029	1.899	7.050	6.444
Sep-04	0.234	4.710	0.231	-0.587	9.124	1.335	0.525	3.724	4.031	1.864	7.049	6.408

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Oct-04	0.199	4.665	0.182	-0.605	9.115	1.335	0.508	3.714	4.032	1.821	7.021	6.422
Nov-04	0.170	4.636	0.128	-0.646	9.107	1.335	0.496	3.677	4.029	1.755	6.955	6.377
Dec-04	0.185	4.646	0.124	-0.658	9.137	1.335	0.491	3.665	4.030	1.728	6.942	6.328
Jan-05	0.195	4.644	0.161	-0.631	9.123	1.335	0.495	3.651	4.009	1.783	6.933	6.374
Feb-05	0.208	4.651	0.150	-0.653	9.133	1.335	0.486	3.645	4.002	1.766	6.914	6.359
Mar-05	0.190	4.676	0.178	-0.633	9.157	1.335	0.501	3.666	4.004	1.830	6.923	6.374
Apr-05	0.229	4.662	0.171	-0.648	9.166	1.335	0.499	3.678	3.996	1.808	6.905	6.368
May-05	0.224	4.683	0.222	-0.598	9.159	1.335	0.509	3.701	3.996	1.904	6.915	6.363
Jun-05	0.203	4.704	0.251	-0.584	9.181	1.335	0.521	3.720	4.024	1.895	6.933	6.361
Jul-05	0.204	4.720	0.255	-0.563	9.192	1.322	0.508	3.730	4.027	1.890	6.934	6.334
Aug-05	0.173	4.712	0.239	-0.578	9.234	1.327	0.521	3.721	4.028	1.873	6.946	6.301
Sep-05	0.149	4.729	0.255	-0.569	9.241	1.327	0.524	3.713	4.026	1.850	6.948	6.280
Oct-05	0.166	4.751	0.250	-0.575	9.219	1.328	0.526	3.707	4.008	1.901	6.947	6.298
Nov-05	0.155	4.784	0.274	-0.546	9.214	1.329	0.526	3.718	3.989	1.866	6.941	6.252
Dec-05	0.152	4.770	0.273	-0.543	9.193	1.330	0.509	3.714	3.972	1.845	6.919	6.243
Jan-06	0.134	4.768	0.250	-0.572	9.148	1.322	0.485	3.665	3.958	1.807	6.872	6.263
Feb-06	0.129	4.756	0.276	-0.558	9.130	1.312	0.485	3.670	3.953	1.813	6.878	6.250
Mar-06	0.155	4.766	0.267	-0.551	9.113	1.305	0.481	3.658	3.937	1.825	6.879	6.269
Apr-06	0.114	4.739	0.225	-0.592	9.080	1.288	0.459	3.624	3.948	1.816	6.849	6.251
May-06	0.095	4.721	0.191	-0.631	9.129	1.289	0.455	3.640	3.964	1.893	6.852	6.275
Jun-06	0.109	4.744	0.209	-0.607	9.138	1.302	0.463	3.642	3.981	1.970	6.867	6.305
Jul-06	0.123	4.743	0.210	-0.623	9.113	1.296	0.456	3.633	3.944	1.928	6.862	6.290
Aug-06	0.101	4.765	0.203	-0.646	9.116	1.302	0.453	3.625	3.931	1.963	6.868	6.287
Sep-06	0.109	4.769	0.226	-0.626	9.131	1.304	0.462	3.624	3.920	2.050	6.852	6.288
Oct-06	0.116	4.768	0.224	-0.641	9.117	1.294	0.446	3.604	3.908	2.008	6.848	6.265
Nov-06	0.128	4.757	0.188	-0.671	9.123	1.286	0.435	3.583	3.907	1.964	6.835	6.272
Dec-06	0.153	4.779	0.199	-0.674	9.107	1.262	0.428	3.585	3.895	1.942	6.835	6.281
Jan-07	0.165	4.801	0.226	-0.669	9.115	1.253	0.430	3.577	3.892	1.967	6.847	6.301
Feb-07	0.157	4.775	0.201	-0.671	9.123	1.254	0.426	3.567	3.877	1.984	6.848	6.289

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Mar-07	0.142	4.768	0.200	-0.672	9.118	1.240	0.417	3.554	3.877	1.984	6.847	6.290
Apr-07	0.109	4.784	0.188	-0.690	9.114	1.231	0.419	3.548	3.861	1.955	6.836	6.267
May-07	0.068	4.801	0.204	-0.682	9.084	1.225	0.424	3.544	3.834	1.963	6.833	6.268
Jun-07	0.061	4.814	0.204	-0.696	9.111	1.240	0.427	3.541	3.836	1.962	6.832	6.268
Jul-07	0.064	4.779	0.187	-0.709	9.125	1.240	0.413	3.519	3.820	1.959	6.824	6.260
Aug-07	0.055	4.755	0.187	-0.703	9.150	1.254	0.420	3.535	3.844	1.965	6.844	6.263
Sep-07	-0.004	4.745	0.157	-0.709	9.120	1.229	0.399	3.538	3.808	1.927	6.819	6.238
Oct-07	-0.051	4.743	0.148	-0.729	9.116	1.206	0.371	3.525	3.783	1.878	6.803	6.204
Nov-07	0.001	4.703	0.114	-0.726	9.146	1.211	0.369	3.521	3.756	1.909	6.826	6.231
Dec-07	-0.012	4.736	0.118	-0.695	9.150	1.196	0.365	3.518	3.723	1.918	6.842	6.206
Jan-08	0.002	4.667	0.077	-0.690	9.137	1.174	0.350	3.496	3.705	2.006	6.850	6.143
Feb-08	-0.020	4.651	0.045	-0.685	9.111	1.160	0.331	3.461	3.698	2.044	6.845	6.127
Mar-08	0.028	4.606	-0.006	-0.687	9.129	1.159	0.322	3.449	3.735	2.092	6.898	6.085
Apr-08	0.009	4.645	0.038	-0.676	9.131	1.150	0.309	3.456	3.742	2.027	6.910	6.129
May-08	-0.006	4.660	0.048	-0.680	9.140	1.177	0.311	3.478	3.782	2.029	6.937	6.173
Jun-08	0.018	4.667	0.018	-0.689	9.130	1.184	0.309	3.511	3.801	2.056	6.953	6.254
Jul-08	0.025	4.682	0.047	-0.683	9.118	1.183	0.313	3.511	3.787	1.992	6.920	6.220
Aug-08	0.061	4.692	0.093	-0.604	9.122	1.221	0.348	3.530	3.822	2.042	6.993	6.247
Sep-08	0.058	4.647	0.097	-0.588	9.146	1.241	0.359	3.526	3.822	2.113	7.096	6.314
Oct-08	0.196	4.588	0.143	-0.481	9.305	1.270	0.393	3.553	3.887	2.314	7.163	6.500
Nov-08	0.213	4.557	0.190	-0.428	9.405	1.277	0.410	3.566	3.889	2.316	7.292	6.491
Dec-08	0.203	4.508	0.062	-0.377	9.301	1.242	0.364	3.552	3.860	2.231	7.138	6.444
Jan-09	0.212	4.495	0.150	-0.358	9.337	1.283	0.411	3.552	3.852	2.322	7.229	6.417
Feb-09	0.240	4.580	0.161	-0.350	9.391	1.306	0.433	3.584	3.860	2.308	7.336	6.390
Mar-09	0.231	4.586	0.130	-0.360	9.357	1.294	0.418	3.569	3.880	2.251	7.232	6.367
Apr-09	0.177	4.581	0.127	-0.394	9.279	1.270	0.391	3.563	3.886	2.136	7.156	6.378
May-09	0.092	4.570	0.071	-0.480	9.244	1.255	0.372	3.536	3.862	2.073	7.135	6.336
Jun-09	0.147	4.564	0.077	-0.504	9.233	1.259	0.371	3.526	3.878	2.039	7.150	6.271
Jul-09	0.076	4.557	0.081	-0.505	9.202	1.258	0.365	3.526	3.874	2.055	7.114	6.295

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Aug-09	0.092	4.529	0.061	-0.490	9.216	1.259	0.366	3.525	3.890	2.052	7.130	6.311
Sep-09	0.070	4.497	0.029	-0.477	9.178	1.245	0.346	3.512	3.858	2.007	7.072	6.303
Oct-09	0.075	4.515	0.023	-0.502	9.164	1.226	0.334	3.508	3.866	2.043	7.075	6.276
Nov-09	0.056	4.463	0.003	-0.499	9.157	1.220	0.324	3.501	3.845	2.006	7.059	6.206
Dec-09	0.046	4.522	0.030	-0.482	9.148	1.231	0.339	3.506	3.836	1.999	7.060	6.227
Jan-10	0.063	4.498	0.049	-0.479	9.145	1.228	0.340	3.500	3.845	2.022	7.058	6.276
Feb-10	0.051	4.491	0.074	-0.420	9.142	1.226	0.343	3.498	3.834	2.043	7.056	6.272
Mar-10	0.015	4.535	0.058	-0.415	9.118	1.186	0.338	3.476	3.821	1.993	7.031	6.266
Apr-10	0.012	4.544	0.075	-0.427	9.106	1.160	0.313	3.474	3.799	1.992	7.011	6.256
May-10	0.049	4.514	0.139	-0.377	9.125	1.180	0.338	3.481	3.833	2.027	7.092	6.271
Jun-10	0.059	4.484	0.078	-0.407	9.114	1.181	0.337	3.478	3.835	2.033	7.099	6.297
Jul-10	0.029	4.460	0.039	-0.443	9.100	1.159	0.309	3.473	3.825	1.993	7.076	6.258
Aug-10	0.062	4.434	0.021	-0.432	9.110	1.143	0.304	3.442	3.811	2.004	7.081	6.213
Sep-10	0.029	4.424	-0.027	-0.465	9.096	1.127	0.276	3.413	3.782	1.943	7.039	6.185
Oct-10	0.019	4.389	-0.011	-0.465	9.097	1.134	0.261	3.399	3.765	1.941	7.026	6.198
Nov-10	0.026	4.433	-0.002	-0.440	9.106	1.150	0.277	3.408	3.790	1.964	7.056	6.187
Dec-10	0.001	4.400	-0.062	-0.448	9.104	1.126	0.253	3.406	3.782	1.892	7.034	6.149
Jan-11	0.002	4.407	-0.059	-0.463	9.111	1.118	0.252	3.439	3.786	1.971	7.022	6.181
Feb-11	-0.019	4.403	-0.074	-0.485	9.085	1.116	0.242	3.421	3.780	1.941	7.029	6.165
Mar-11	-0.029	4.420	-0.089	-0.476	9.072	1.107	0.232	3.411	3.771	1.916	7.000	6.178
Apr-11	-0.053	4.407	-0.143	-0.510	9.056	1.090	0.205	3.399	3.762	1.886	6.977	6.131
May-11	-0.023	4.393	-0.159	-0.501	9.052	1.102	0.209	3.411	3.768	1.926	6.984	6.147
Jun-11	-0.036	4.391	-0.181	-0.471	9.059	1.105	0.206	3.426	3.773	1.919	6.973	6.155
Jul-11	-0.047	4.351	-0.222	-0.487	9.049	1.084	0.186	3.393	3.743	1.907	6.961	6.122
Aug-11	-0.022	4.338	-0.211	-0.488	9.057	1.092	0.186	3.402	3.750	1.951	6.972	6.143
Sep-11	0.038	4.339	-0.104	-0.444	9.085	1.160	0.263	3.439	3.776	2.090	7.072	6.244
Oct-11	-0.004	4.372	-0.139	-0.472	9.086	1.123	0.223	3.423	3.762	2.058	7.012	6.199
Nov-11	0.020	4.357	-0.082	-0.445	9.124	1.155	0.259	3.441	3.780	2.120	7.041	6.262
Dec-11	0.021	4.353	-0.061	-0.436	9.113	1.156	0.263	3.456	3.783	2.097	7.049	6.257

Table A4.1 (Continued)

Name	CN	JP	CH	US	IN	MY	SG	TH	PH	SA	KR	CL
Jan-12	0.005	4.335	-0.090	-0.457	9.105	1.114	0.227	3.435	3.760	2.052	7.024	6.192
Feb-12	-0.013	4.390	-0.109	-0.466	9.114	1.099	0.221	3.414	3.758	2.006	7.020	6.168
Mar-12	-0.001	4.409	-0.102	-0.471	9.125	1.121	0.229	3.429	3.761	2.038	7.033	6.194
Apr-12	-0.012	4.396	-0.095	-0.486	9.126	1.110	0.213	3.425	3.748	2.047	7.030	6.181
May-12	0.034	4.367	-0.031	-0.439	9.166	1.158	0.253	3.462	3.772	2.144	7.074	6.250
Jun-12	0.019	4.373	-0.046	-0.445	9.157	1.160	0.242	3.460	3.744	2.104	7.044	6.234
Jul-12	0.001	4.359	-0.022	-0.450	9.157	1.145	0.219	3.452	3.735	2.102	7.031	6.180
Aug-12	-0.014	4.362	-0.047	-0.460	9.165	1.142	0.225	3.446	3.745	2.130	7.034	6.176
Sep-12	-0.019	4.351	-0.067	-0.482	9.168	1.120	0.203	3.428	3.735	2.117	7.013	6.154
Oct-12	0.000	4.378	-0.074	-0.477	9.171	1.117	0.199	3.424	3.720	2.161	6.995	6.174
Nov-12	-0.007	4.412	-0.078	-0.474	9.170	1.113	0.200	3.424	3.711	2.177	6.987	6.173
Dec-12	-0.005	4.461	-0.087	-0.456	9.177	1.118	0.202	3.422	3.718	2.140	6.976	6.171
Jan-13	-0.001	4.512	-0.093	-0.456	9.180	1.131	0.214	3.394	3.705	2.192	6.993	6.156
Feb-13	0.028	4.527	-0.072	-0.418	9.176	1.129	0.212	3.395	3.707	2.191	6.987	6.160
Mar-13	0.015	4.545	-0.049	-0.414	9.182	1.128	0.218	3.378	3.712	2.219	7.013	6.158
Apr-13	0.014	4.593	-0.063	-0.440	9.182	1.109	0.210	3.378	3.717	2.194	7.004	6.156
May-13	0.033	4.615	-0.048	-0.420	9.190	1.127	0.232	3.406	3.747	2.317	7.030	6.200
Jun-13	0.046	4.586	-0.061	-0.429	9.203	1.156	0.235	3.438	3.768	2.311	7.041	6.222
Jul-13	0.029	4.586	-0.073	-0.426	9.238	1.178	0.242	3.445	3.771	2.289	7.012	6.234
Aug-13	0.054	4.588	-0.072	-0.438	9.299	1.194	0.243	3.468	3.799	2.334	7.012	6.238
Sep-13	0.030	4.582	-0.100	-0.480	9.360	1.181	0.229	3.447	3.768	2.307	6.980	6.221
Oct-13	0.045	4.587	-0.108	-0.474	9.327	1.150	0.215	3.437	3.765	2.289	6.967	6.232
Nov-13	0.058	4.619	-0.100	-0.490	9.391	1.171	0.228	3.469	3.778	2.319	6.964	6.269
Dec-13	0.062	4.657	-0.115	-0.499	9.408	1.188	0.235	3.491	3.794	2.350	6.962	6.261
Jan-14	0.106	4.633	-0.103	-0.498	9.411	1.208	0.244	3.496	3.810	2.423	6.976	6.305
Feb-14	0.108	4.623	-0.126	-0.512	9.362	1.187	0.237	3.485	3.799	2.371	6.973	6.334
Mar-14	0.100	4.633	-0.123	-0.509	9.342	1.184	0.232	3.479	3.807	2.359	6.970	6.311
Apr-14	0.091	4.631	-0.125	-0.520	9.353	1.184	0.228	3.475	3.795	2.356	6.940	6.329
May-14	0.083	4.624	-0.110	-0.520	9.360	1.168	0.227	3.490	3.783	2.345	6.928	6.317



**Table A4.2: 13 Country's consumer price index (in logarithm): 1973(M1) to 2014(M5)**

Name	CN	JP	US	UK	CH	IN	MY	SG	TH	PH	SA	KR	CL
Jan-73	3.054	3.624	3.082	2.469	3.723	-	-	-	-	-	-	-	-
Feb-73	3.059	3.632	3.091	2.475	3.731	-	-	-	-	-	-	-	-
Mar-73	3.059	3.656	3.100	2.481	3.740	-	-	-	-	-	-	-	-
Apr-73	3.073	3.674	3.105	2.498	3.742	-	-	-	-	-	-	-	-
May-73	3.077	3.691	3.114	2.507	3.750	-	-	-	-	-	-	-	-
Jun-73	3.086	3.694	3.118	2.513	3.757	-	-	-	-	-	-	-	-
Jul-73	3.096	3.701	3.122	2.515	3.757	-	-	-	-	-	-	-	-
Aug-73	3.109	3.709	3.140	2.518	3.761	-	-	-	-	-	-	-	-
Sep-73	3.118	3.738	3.144	2.529	3.770	-	-	-	-	-	-	-	-
Oct-73	3.118	3.742	3.153	2.549	3.791	-	-	-	-	-	-	-	-
Nov-73	3.127	3.750	3.157	2.554	3.811	-	-	-	-	-	-	-	-
Dec-73	3.131	3.782	3.165	2.562	3.826	-	-	-	-	-	-	-	-
Jan-74	3.140	3.824	3.174	2.579	3.833	-	-	-	-	-	-	-	-
Feb-74	3.148	3.857	3.186	2.598	3.826	-	-	-	-	-	-	-	-
Mar-74	3.157	3.861	3.199	2.606	3.831	-	-	-	-	-	-	-	-
Apr-74	3.165	3.888	3.203	2.640	3.824	-	-	-	-	-	-	-	-
May-74	3.182	3.892	3.215	2.655	3.842	-	-	-	-	-	-	-	-
Jun-74	3.195	3.896	3.223	2.666	3.848	-	-	-	-	-	-	-	-
Jul-74	3.203	3.916	3.231	2.673	3.850	-	-	-	-	-	-	-	-
Aug-74	3.211	3.926	3.243	2.673	3.861	-	-	-	-	-	-	-	-
Sep-74	3.219	3.940	3.254	2.684	3.877	-	-	-	-	-	-	-	-
Oct-74	3.227	3.963	3.266	2.705	3.884	-	-	-	-	-	-	-	-
Nov-74	3.239	3.970	3.273	2.722	3.898	-	-	-	-	-	-	-	-
Dec-74	3.250	3.974	3.281	2.736	3.898	-	-	-	-	-	-	-	-
Jan-75	3.254	3.985	3.285	2.762	3.904	-	-	-	-	-	-	-	-

Table A4.2 (Continued)

Name	CN	JP	US	UK	CH	IN	MY	SG	TH	PH	SA	KR	CL
Feb-75	3.262	3.987	3.292	2.779	3.908	-	-	-	-	-	-	-	-
Mar-75	3.266	3.996	3.296	2.798	3.912	-	-	-	-	-	-	-	-
Apr-75	3.270	4.013	3.300	2.835	3.914	-	-	-	-	-	-	-	-
May-75	3.281	4.018	3.303	2.877	3.920	-	-	-	-	-	-	-	-
Jun-75	3.292	4.018	3.314	2.897	3.924	-	-	-	-	-	-	-	-
Jul-75	3.307	4.022	3.321	2.906	3.922	-	-	-	-	-	-	-	-
Aug-75	3.318	4.018	3.325	2.912	3.926	-	-	-	-	-	-	-	-
Sep-75	3.321	4.040	3.332	2.920	3.930	-	-	-	-	-	-	-	-
Oct-75	3.329	4.055	3.336	2.934	3.930	-	-	-	-	-	-	-	-
Nov-75	3.339	4.052	3.343	2.948	3.934	-	-	-	-	-	-	-	-
Dec-75	3.339	4.052	3.346	2.959	3.932	-	-	-	-	-	-	-	-
Jan-76	3.346	4.069	3.350	2.972	3.938	-	-	-	-	-	-	-	-0.580
Feb-76	3.350	4.078	3.353	2.985	3.938	-	-	-	-	-	-	-	-0.478
Mar-76	3.353	4.079	3.353	2.991	3.936	-	-	-	-	-	-	-	-0.357
Apr-76	3.357	4.101	3.360	3.009	3.936	-	-	-	-	-	-	-	-0.248
May-76	3.364	4.106	3.364	3.019	3.934	-	-	-	-	-	-	-	-0.151
Jun-76	3.371	4.108	3.371	3.024	3.936	-	-	-	-	-	-	-	-0.030
Jul-76	3.374	4.114	3.374	3.027	3.938	-	-	-	-	-	-	-	0.049
Aug-76	3.378	4.108	3.381	3.042	3.942	-	-	-	-	-	-	-	0.104
Sep-76	3.384	4.132	3.384	3.054	3.938	-	-	-	-	-	-	-	0.182
Oct-76	3.388	4.138	3.388	3.071	3.942	-	-	-	-	-	-	-	0.247
Nov-76	3.391	4.138	3.391	3.085	3.944	-	-	-	-	-	-	-	0.278
Dec-76	3.395	4.151	3.395	3.100	3.945	-	-	-	-	-	-	-	0.329
Jan-77	3.405	4.159	3.401	3.125	3.947	-	-	-	-	-	-	-	0.392
Feb-77	3.414	4.164	3.411	3.134	3.947	-	-	-	-	-	-	-	0.445
Mar-77	3.424	4.170	3.418	3.146	3.945	-	-	-	-	-	-	-	0.507

Apr-77	3.431	4.187	3.424	3.170	3.947	-	-	-	-	-	-	-	0.548
May-77	3.437	4.196	3.431	3.179	3.945	-	-	-	-	-	-	-	0.588
Jun-77	3.444	4.191	3.437	3.187	3.953	-	-	-	-	-	-	-	0.621
Jul-77	3.453	4.188	3.440	3.189	3.953	-	-	-	-	-	-	-	0.658
Aug-77	3.459	4.190	3.444	3.194	3.953	-	-	-	-	-	-	-	0.693
Sep-77	3.463	4.206	3.450	3.200	3.955	-	-	-	-	-	-	-	0.728
Oct-77	3.472	4.212	3.450	3.204	3.957	-	-	-	-	-	-	-	0.770
Nov-77	3.481	4.202	3.456	3.209	3.955	-	-	-	-	-	-	-	0.793
Dec-77	3.487	4.199	3.459	3.215	3.957	-	-	-	-	-	-	-	0.824
Jan-78	3.490	4.203	3.466	3.219	3.957	-	-	-	-	-	-	-	0.842
Feb-78	3.497	4.209	3.472	3.225	3.959	-	-	-	-	-	-	-	0.863
Mar-78	3.509	4.218	3.478	3.231	3.959	-	-	-	-	-	-	-	0.892
Apr-78	3.512	4.228	3.487	3.246	3.961	-	-	-	-	-	-	-	0.920
May-78	3.523	4.234	3.497	3.252	3.963	-	-	-	-	-	-	-	0.940
Jun-78	3.532	4.230	3.509	3.260	3.965	-	-	-	-	-	-	-	0.959
Jul-78	3.547	4.233	3.515	3.264	3.965	-	-	-	-	-	-	-	0.986
Aug-78	3.547	4.236	3.520	3.270	3.965	-	-	-	-	-	-	-	1.012
Sep-78	3.547	4.246	3.529	3.274	3.963	-	-	-	-	-	-	-	1.040
Oct-78	3.555	4.248	3.535	3.280	3.961	-	-	-	-	-	-	-	1.058
Nov-78	3.564	4.238	3.541	3.285	3.963	-	-	-	-	-	-	-	1.072
Dec-78	3.567	4.237	3.547	3.295	3.965	-	-	-	-	-	-	-	1.089
Jan-79	3.490	4.243	3.444	3.156	3.924	1.442	3.638	3.945	3.227	1.841	1.609	2.830	1.012
Feb-79	3.500	4.240	3.456	3.166	3.936	1.463	3.640	3.944	3.235	1.841	1.609	2.864	1.030
Mar-79	3.512	4.248	3.466	3.173	3.940	1.466	3.643	3.940	3.246	1.856	1.629	2.882	1.058
Apr-79	3.517	4.261	3.478	3.190	3.944	1.495	3.643	3.942	3.254	1.887	1.629	2.907	1.082
May-79	3.529	4.270	3.490	3.197	3.947	1.524	3.651	3.945	3.270	1.917	1.629	2.938	1.105
Jun-79	3.532	4.271	3.503	3.215	3.961	1.548	3.651	3.953	3.277	1.932	1.649	2.947	1.131
Jul-79	3.541	4.279	3.512	3.258	3.963	1.573	3.656	3.967	3.303	1.946	1.686	2.951	1.166

Aug-79	3.544	4.270	3.523	3.265	3.961	1.595	3.666	3.983	3.318	1.960	1.705	2.955	1.212
Sep-79	3.552	4.282	3.532	3.275	3.967	1.603	3.671	3.996	3.339	1.974	1.705	2.968	1.253
Oct-79	3.561	4.295	3.541	3.285	3.965	1.611	3.669	4.002	3.357	1.988	1.723	2.975	1.275
Nov-79	3.570	4.290	3.550	3.295	3.968	1.617	3.674	4.007	3.360	2.001	1.723	2.990	1.297
Dec-79	3.575	4.297	3.561	3.301	3.970	1.625	3.691	4.013	3.367	2.015	1.740	3.014	1.319
Jan-80	3.581	4.307	3.575	3.326	3.974	1.637	3.699	4.016	3.391	2.028	1.740	3.047	1.340
Feb-80	3.589	4.315	3.589	3.340	3.976	1.652	3.701	4.032	3.421	2.041	1.740	3.090	1.358
Mar-80	3.600	4.320	3.603	3.353	3.978	1.654	3.704	4.043	3.437	2.054	1.758	3.129	1.386
Apr-80	3.605	4.339	3.614	3.387	3.983	1.664	3.701	4.045	3.453	2.067	1.758	3.137	1.411
May-80	3.619	4.346	3.624	3.396	3.989	1.701	3.709	4.040	3.487	2.079	1.775	3.170	1.435
Jun-80	3.630	4.350	3.635	3.406	3.993	1.716	3.716	4.048	3.490	2.092	1.792	3.182	1.454
Jul-80	3.638	4.352	3.635	3.414	3.996	1.728	3.726	4.057	3.484	2.104	1.808	3.189	1.475
Aug-80	3.645	4.349	3.643	3.416	4.002	1.739	3.735	4.064	3.500	2.116	1.808	3.210	1.495
Sep-80	3.656	4.366	3.651	3.422	4.004	1.742	3.733	4.064	3.500	2.128	1.841	3.232	1.517
Oct-80	3.664	4.368	3.661	3.428	4.002	1.760	3.738	4.069	3.512	2.140	1.856	3.258	1.545
Nov-80	3.676	4.371	3.669	3.437	4.011	1.782	3.752	4.071	3.526	2.152	1.856	3.278	1.571
Dec-80	3.681	4.367	3.679	3.443	4.015	1.783	3.759	4.071	3.517	2.163	1.872	3.311	1.591
Jan-81	3.696	4.377	3.686	3.448	4.024	1.797	3.777	4.076	3.538	2.186	1.872	3.309	1.607
Feb-81	3.706	4.376	3.696	3.457	4.034	1.803	3.789	4.088	3.550	2.186	1.902	3.317	1.609
Mar-81	3.718	4.380	3.704	3.472	4.040	1.812	3.795	4.091	3.578	2.197	1.902	3.336	1.617
Apr-81	3.726	4.387	3.709	3.501	4.038	1.820	3.800	4.109	3.589	2.197	1.902	3.345	1.629
May-81	3.733	4.396	3.718	3.508	4.047	1.821	3.809	4.117	3.595	2.208	1.917	3.367	1.643
Jun-81	3.750	4.398	3.726	3.513	4.054	1.826	3.816	4.130	3.600	2.208	1.917	3.394	1.645
Jul-81	3.757	4.394	3.738	3.517	4.059	1.837	3.824	4.145	3.600	2.230	1.946	3.404	1.651
Aug-81	3.766	4.389	3.745	3.525	4.074	1.844	3.831	4.159	3.605	2.230	1.960	3.414	1.662
Sep-81	3.773	4.405	3.757	3.530	4.076	1.841	3.833	4.156	3.616	2.241	1.988	3.427	1.671
Oct-81	3.782	4.408	3.759	3.539	4.072	1.853	3.833	4.159	3.624	2.241	1.988	3.425	1.675
Nov-81	3.791	4.408	3.761	3.550	4.078	1.850	3.835	4.162	3.630	2.251	2.001	3.416	1.677

Dec-81	3.795	4.408	3.764	3.556	4.078	1.855	3.842	4.170	3.635	2.262	2.001	3.422	1.683
Jan-82	3.802	4.408	3.768	3.561	4.083	1.901	3.852	4.181	3.632	2.282	2.001	3.426	1.688
Feb-82	3.816	4.408	3.770	3.562	4.084	1.907	3.857	4.174	3.635	2.293	2.028	3.431	1.681
Mar-82	3.826	4.408	3.768	3.570	4.086	1.908	3.861	4.164	3.640	2.293	2.041	3.440	1.685
Apr-82	3.833	4.416	3.773	3.590	4.091	1.907	3.861	4.160	3.638	2.303	2.054	3.442	1.685
May-82	3.846	4.420	3.784	3.597	4.104	1.910	3.867	4.159	3.648	2.303	2.067	3.450	1.679
Jun-82	3.857	4.420	3.795	3.601	4.113	1.913	3.871	4.167	3.651	2.313	2.067	3.456	1.686
Jul-82	3.861	4.414	3.800	3.601	4.117	1.923	3.877	4.164	3.645	2.332	2.079	3.458	1.705
Aug-82	3.865	4.421	3.802	3.601	4.124	1.918	3.877	4.168	3.643	2.332	2.092	3.461	1.737
Sep-82	3.871	4.436	3.804	3.601	4.129	1.927	3.879	4.168	3.656	2.342	2.104	3.466	1.780
Oct-82	3.877	4.439	3.807	3.606	4.130	1.940	3.875	4.170	3.658	2.342	2.116	3.464	1.826
Nov-82	3.884	4.430	3.807	3.611	4.134	1.944	3.890	4.173	3.669	2.342	2.128	3.457	1.859
Dec-82	3.884	4.428	3.802	3.608	4.132	1.950	3.894	4.177	3.658	2.342	2.128	3.469	1.870
Jan-83	3.882	4.430	3.804	3.610	4.130	1.995	3.900	4.177	3.653	2.351	2.140	3.476	1.887
Feb-83	3.888	4.426	3.804	3.614	4.132	1.996	3.896	4.181	3.661	2.351	2.163	3.483	1.889
Mar-83	3.898	4.432	3.804	3.616	4.134	1.991	3.898	4.177	3.664	2.361	2.163	3.487	1.908
Apr-83	3.898	4.436	3.811	3.630	4.135	2.015	3.898	4.176	3.671	2.361	2.175	3.484	1.937
May-83	3.900	4.446	3.818	3.633	4.137	2.023	3.904	4.179	3.684	2.370	2.186	3.487	1.950
Jun-83	3.910	4.440	3.820	3.636	4.142	2.039	3.906	4.174	3.686	2.380	2.186	3.486	1.966
Jul-83	3.914	4.436	3.824	3.642	4.138	2.046	3.908	4.177	3.689	2.407	2.197	3.486	1.985
Aug-83	3.920	4.434	3.829	3.646	4.142	2.046	3.910	4.179	3.696	2.425	2.208	3.487	2.012
Sep-83	3.920	4.445	3.833	3.651	4.143	2.054	3.914	4.184	3.701	2.425	2.219	3.488	2.035
Oct-83	3.926	4.453	3.835	3.654	4.146	2.054	3.918	4.182	3.704	2.442	2.219	3.487	2.059
Nov-83	3.926	4.449	3.837	3.658	4.151	2.057	3.918	4.191	3.706	2.493	2.230	3.485	2.072
Dec-83	3.928	4.445	3.839	3.660	4.151	2.063	3.924	4.193	3.696	2.573	2.230	3.488	2.078
Jan-84	3.934	4.449	3.844	3.659	4.156	2.097	3.944	4.202	3.691	2.639	2.241	3.494	2.078
Feb-84	3.940	4.454	3.848	3.664	4.159	2.114	3.957	4.217	3.689	2.667	2.251	3.503	2.077
Mar-84	3.942	4.457	3.850	3.667	4.167	2.115	3.942	4.205	3.689	2.688	2.262	3.507	2.102

Apr-84	3.945	4.459	3.857	3.680	4.168	2.128	3.944	4.205	3.696	2.701	2.282	3.509	2.117
May-84	3.945	4.466	3.859	3.684	4.165	2.135	3.945	4.202	3.699	2.721	2.293	3.508	2.129
Jun-84	3.951	4.459	3.863	3.686	4.168	2.138	3.944	4.206	3.694	2.779	2.303	3.503	2.141
Jul-84	3.957	4.461	3.865	3.685	4.167	2.141	3.949	4.209	3.691	2.868	2.313	3.503	2.151
Aug-84	3.957	4.453	3.869	3.694	4.170	2.140	3.951	4.214	3.694	2.896	2.322	3.508	2.153
Sep-84	3.957	4.468	3.875	3.696	4.170	2.139	3.949	4.206	3.694	2.918	2.322	3.520	2.182
Oct-84	3.959	4.475	3.877	3.703	4.176	2.139	3.947	4.206	3.696	2.934	2.342	3.515	2.261
Nov-84	3.967	4.470	3.877	3.706	4.182	2.140	3.944	4.203	3.691	2.970	2.351	3.512	2.272
Dec-84	3.967	4.472	3.877	3.705	4.181	2.151	3.942	4.202	3.694	2.986	2.361	3.512	2.285
Jan-85	3.970	4.475	3.879	3.709	4.190	2.155	3.942	4.206	3.696	3.011	2.370	3.517	2.316
Feb-85	3.976	4.472	3.884	3.716	4.199	2.149	3.944	4.211	3.706	3.020	2.407	3.525	2.336
Mar-85	3.978	4.475	3.888	3.726	4.203	2.152	3.947	4.212	3.709	3.025	2.407	3.524	2.364
Apr-85	3.983	4.481	3.892	3.747	4.203	2.177	3.945	4.209	3.711	3.020	2.434	3.526	2.387
May-85	3.985	4.483	3.896	3.751	4.202	2.180	3.947	4.209	3.718	3.020	2.442	3.530	2.406
Jun-85	3.991	4.483	3.898	3.754	4.202	2.189	3.951	4.212	3.718	3.025	2.451	3.530	2.442
Jul-85	3.995	4.485	3.900	3.751	4.200	2.188	3.957	4.217	3.718	3.040	2.460	3.530	2.455
Aug-85	3.995	4.483	3.902	3.755	4.200	2.187	3.961	4.218	3.721	3.040	2.468	3.534	2.465
Sep-85	3.996	4.484	3.906	3.754	4.202	2.186	3.953	4.211	3.726	3.040	2.485	3.542	2.477
Oct-85	4.000	4.493	3.908	3.756	4.205	2.186	3.949	4.211	3.731	3.035	2.493	3.540	2.492
Nov-85	4.004	4.485	3.912	3.759	4.212	2.189	3.949	4.209	3.728	3.035	2.510	3.544	2.507
Dec-85	4.009	4.486	3.914	3.760	4.214	2.193	3.953	4.209	3.726	3.040	2.526	3.544	2.520
Jan-86	4.013	4.490	3.918	3.762	4.212	2.205	3.957	4.208	3.723	3.049	2.557	3.549	2.546
Feb-86	4.016	4.489	3.914	3.766	4.212	2.213	3.957	4.206	3.723	3.054	2.565	3.552	2.556
Mar-86	4.020	4.489	3.910	3.767	4.214	2.208	3.955	4.200	3.731	3.059	2.580	3.551	2.570
Apr-86	4.020	4.491	3.908	3.777	4.214	2.209	3.951	4.196	3.731	3.040	2.595	3.551	2.584
May-86	4.025	4.494	3.912	3.778	4.209	2.221	3.955	4.194	3.735	3.035	2.595	3.554	2.591
Jun-86	4.027	4.489	3.916	3.778	4.209	2.225	3.953	4.193	3.735	3.025	2.610	3.556	2.604
Jul-86	4.034	4.486	3.916	3.775	4.205	2.222	3.955	4.193	3.735	3.025	2.632	3.558	2.614

Aug-86	4.038	4.484	3.918	3.778	4.206	2.224	3.955	4.193	3.738	3.025	2.639	3.558	2.620
Sep-86	4.038	4.489	3.924	3.784	4.208	2.251	3.957	4.196	3.742	3.025	2.660	3.561	2.635
Oct-86	4.043	4.490	3.924	3.786	4.209	2.272	3.961	4.199	3.745	3.030	2.674	3.558	2.651
Nov-86	4.048	4.485	3.924	3.794	4.211	2.277	3.963	4.196	3.745	3.035	2.688	3.556	2.664
Dec-86	4.050	4.483	3.926	3.797	4.214	2.280	3.967	4.196	3.742	3.035	2.695	3.557	2.680
Jan-87	4.052	4.480	3.932	3.801	4.218	2.284	3.965	4.200	3.745	3.045	2.708	3.560	2.699
Feb-87	4.057	4.480	3.936	3.805	4.221	2.299	3.965	4.196	3.742	3.049	2.721	3.562	2.717
Mar-87	4.060	4.483	3.940	3.807	4.222	2.296	3.961	4.194	3.745	3.049	2.734	3.570	2.733
Apr-87	4.066	4.492	3.945	3.819	4.224	2.297	3.965	4.196	3.750	3.049	2.754	3.575	2.756
May-87	4.071	4.494	3.949	3.819	4.218	2.315	3.967	4.199	3.754	3.059	2.760	3.591	2.771
Jun-87	4.074	4.492	3.953	3.819	4.222	2.317	3.968	4.200	3.759	3.068	2.766	3.590	2.778
Jul-87	4.081	4.488	3.955	3.819	4.222	2.321	3.967	4.206	3.761	3.082	2.779	3.587	2.795
Aug-87	4.081	4.489	3.961	3.821	4.227	2.327	3.968	4.206	3.766	3.086	2.791	3.601	2.809
Sep-87	4.081	4.498	3.965	3.824	4.224	2.334	3.970	4.206	3.773	3.091	2.809	3.608	2.828
Oct-87	4.086	4.498	3.968	3.829	4.228	2.348	3.963	4.206	3.770	3.096	2.815	3.608	2.852
Nov-87	4.089	4.492	3.968	3.834	4.233	2.366	3.965	4.209	3.780	3.100	2.827	3.607	2.871
Dec-87	4.089	4.491	3.968	3.833	4.233	2.369	3.970	4.211	3.780	3.109	2.833	3.615	2.874
Jan-88	4.093	4.489	3.972	3.833	4.234	2.372	3.972	4.208	3.775	3.127	2.839	3.621	2.881
Feb-88	4.096	4.486	3.974	3.837	4.240	2.378	3.974	4.217	3.784	3.135	2.845	3.637	2.885
Mar-88	4.101	4.490	3.978	3.841	4.241	2.378	3.974	4.212	3.789	3.140	2.862	3.651	2.904
Apr-88	4.104	4.495	3.983	3.857	4.244	2.385	3.974	4.211	3.791	3.140	2.874	3.649	2.912
May-88	4.111	4.496	3.987	3.861	4.241	2.394	3.976	4.215	3.793	3.144	2.879	3.655	2.916
Jun-88	4.113	4.494	3.991	3.865	4.243	2.398	3.985	4.215	3.795	3.157	2.885	3.661	2.922
Jul-88	4.117	4.492	3.995	3.866	4.240	2.410	3.991	4.221	3.795	3.161	2.896	3.663	2.924
Aug-88	4.121	4.495	4.000	3.877	4.244	2.413	3.991	4.221	3.802	3.165	2.912	3.668	2.932
Sep-88	4.122	4.503	4.006	3.881	4.244	2.413	3.995	4.221	3.811	3.165	2.923	3.670	2.941
Oct-88	4.126	4.508	4.009	3.891	4.246	2.417	3.993	4.221	3.813	3.170	2.934	3.668	2.956
Nov-88	4.129	4.504	4.011	3.896	4.248	2.421	3.998	4.222	3.811	3.186	2.944	3.676	2.975

Dec-88	4.129	4.501	4.013	3.899	4.251	2.423	4.006	4.225	3.809	3.195	2.950	3.684	2.994
Jan-89	4.134	4.499	4.016	3.905	4.257	2.428	4.006	4.224	3.818	3.211	2.965	3.686	3.005
Feb-89	4.140	4.496	4.022	3.912	4.263	2.441	4.007	4.225	3.829	3.215	2.976	3.689	3.006
Mar-89	4.146	4.501	4.027	3.917	4.264	2.443	4.007	4.225	3.829	3.215	2.991	3.696	3.025
Apr-89	4.148	4.519	4.034	3.934	4.270	2.459	4.007	4.231	3.829	3.219	3.006	3.701	3.035
May-89	4.159	4.524	4.040	3.940	4.270	2.466	4.011	4.238	3.837	3.231	3.020	3.713	3.054
Jun-89	4.165	4.523	4.041	3.944	4.272	2.463	4.011	4.243	3.842	3.250	3.030	3.715	3.072
Jul-89	4.171	4.522	4.043	3.945	4.270	2.467	4.015	4.246	3.854	3.262	3.040	3.714	3.090
Aug-89	4.171	4.521	4.045	3.947	4.274	2.468	4.015	4.247	3.865	3.277	3.054	3.721	3.100
Sep-89	4.173	4.529	4.048	3.954	4.278	2.471	4.016	4.246	3.871	3.285	3.063	3.731	3.121
Oct-89	4.176	4.537	4.054	3.962	4.281	2.478	4.018	4.251	3.877	3.296	3.068	3.733	3.150
Nov-89	4.181	4.526	4.055	3.970	4.292	2.483	4.024	4.256	3.875	3.307	3.082	3.735	3.167
Dec-89	4.179	4.527	4.057	3.973	4.300	2.482	4.025	4.257	3.871	3.329	3.096	3.734	3.188
Jan-90	4.188	4.532	4.067	3.979	4.307	2.492	4.025	4.263	3.875	3.332	3.109	3.744	3.212
Feb-90	4.194	4.533	4.072	3.985	4.308	2.501	4.032	4.265	3.884	3.336	3.114	3.752	3.215
Mar-90	4.197	4.537	4.078	3.995	4.312	2.497	4.032	4.261	3.888	3.339	3.131	3.765	3.239
Apr-90	4.197	4.544	4.079	4.025	4.315	2.509	4.038	4.267	3.896	3.346	3.140	3.780	3.257
May-90	4.202	4.550	4.083	4.033	4.320	2.518	4.040	4.270	3.902	3.353	3.148	3.799	3.272
Jun-90	4.206	4.545	4.088	4.037	4.321	2.531	4.038	4.271	3.904	3.364	3.157	3.805	3.294
Jul-90	4.212	4.544	4.091	4.038	4.321	2.552	4.034	4.271	3.906	3.378	3.165	3.809	3.310
Aug-90	4.212	4.548	4.101	4.048	4.332	2.558	4.034	4.274	3.908	3.381	3.182	3.812	3.330
Sep-90	4.215	4.556	4.109	4.058	4.336	2.563	4.040	4.282	3.914	3.391	3.199	3.820	3.378
Oct-90	4.222	4.566	4.114	4.065	4.343	2.573	4.045	4.289	3.932	3.411	3.203	3.822	3.415
Nov-90	4.228	4.564	4.117	4.063	4.352	2.576	4.052	4.289	3.938	3.428	3.223	3.821	3.424
Dec-90	4.228	4.563	4.117	4.062	4.352	2.577	4.059	4.293	3.932	3.459	3.231	3.824	3.429
Jan-91	4.254	4.571	4.122	4.065	4.361	2.585	4.062	4.295	3.934	3.490	3.243	3.844	3.433
Feb-91	4.254	4.567	4.124	4.070	4.369	2.588	4.067	4.303	3.942	3.512	3.254	3.858	3.435
Mar-91	4.258	4.573	4.126	4.074	4.369	2.589	4.069	4.299	3.942	3.520	3.262	3.871	3.446



Apr-91	4.258	4.579	4.127	4.087	4.372	2.607	4.076	4.304	3.953	3.526	3.277	3.876	3.464
May-91	4.263	4.583	4.130	4.090	4.381	2.609	4.081	4.307	3.963	3.532	3.292	3.882	3.489
Jun-91	4.267	4.580	4.134	4.094	4.385	2.613	4.088	4.309	3.963	3.544	3.300	3.883	3.507
Jul-91	4.268	4.579	4.135	4.092	4.385	2.632	4.084	4.311	3.959	3.552	3.311	3.890	3.525
Aug-91	4.270	4.581	4.137	4.094	4.389	2.651	4.088	4.311	3.968	3.567	3.325	3.898	3.537
Sep-91	4.267	4.582	4.142	4.098	4.392	2.652	4.084	4.312	3.978	3.575	3.339	3.903	3.550
Oct-91	4.265	4.593	4.143	4.102	4.393	2.660	4.088	4.312	3.983	3.575	3.357	3.905	3.579
Nov-91	4.270	4.595	4.146	4.105	4.404	2.671	4.093	4.315	3.982	3.581	3.367	3.910	3.588
Dec-91	4.265	4.590	4.146	4.106	4.403	2.672	4.099	4.323	3.978	3.586	3.381	3.912	3.600
Jan-92	4.270	4.588	4.148	4.105	4.407	2.677	4.106	4.323	3.983	3.592	3.391	3.919	3.611
Feb-92	4.271	4.587	4.153	4.110	4.415	2.680	4.109	4.321	3.985	3.597	3.401	3.925	3.605
Mar-92	4.274	4.592	4.157	4.113	4.416	2.686	4.111	4.320	3.983	3.603	3.408	3.935	3.612
Apr-92	4.274	4.602	4.159	4.129	4.419	2.695	4.119	4.325	3.987	3.608	3.421	3.941	3.625
May-92	4.277	4.603	4.160	4.132	4.421	2.696	4.129	4.331	4.002	3.619	3.428	3.947	3.636
Jun-92	4.278	4.602	4.164	4.132	4.426	2.703	4.130	4.331	4.007	3.630	3.440	3.949	3.643
Jul-92	4.281	4.595	4.165	4.129	4.422	2.705	4.132	4.335	4.009	3.638	3.447	3.953	3.654
Aug-92	4.281	4.598	4.168	4.129	4.425	2.706	4.137	4.333	4.018	3.645	3.459	3.955	3.668
Sep-92	4.279	4.602	4.171	4.133	4.426	2.708	4.137	4.335	4.018	3.653	3.466	3.959	3.691
Oct-92	4.282	4.603	4.174	4.136	4.428	2.713	4.135	4.337	4.018	3.653	3.469	3.958	3.705
Nov-92	4.286	4.601	4.176	4.135	4.438	2.715	4.145	4.339	4.013	3.656	3.472	3.953	3.719
Dec-92	4.286	4.601	4.176	4.131	4.437	2.721	4.148	4.340	4.009	3.658	3.472	3.955	3.720
Jan-93	4.290	4.600	4.181	4.122	4.441	2.750	4.149	4.348	4.013	3.666	3.484	3.963	3.722
Feb-93	4.293	4.601	4.184	4.129	4.447	2.771	4.153	4.344	4.018	3.669	3.487	3.970	3.725
Mar-93	4.292	4.604	4.188	4.132	4.453	2.785	4.154	4.345	4.018	3.671	3.500	3.982	3.731
Apr-93	4.292	4.611	4.190	4.141	4.456	2.787	4.157	4.348	4.027	3.674	3.526	3.988	3.745
May-93	4.295	4.612	4.191	4.145	4.457	2.788	4.160	4.352	4.029	3.676	3.529	3.991	3.760
Jun-93	4.295	4.611	4.193	4.144	4.456	2.791	4.164	4.352	4.032	3.686	3.535	3.996	3.764
Jul-93	4.297	4.614	4.193	4.142	4.456	2.797	4.168	4.357	4.041	3.699	3.544	3.995	3.774

Aug-93	4.297	4.616	4.196	4.146	4.460	2.800	4.165	4.355	4.043	3.706	3.547	3.999	3.795
Sep-93	4.299	4.617	4.197	4.151	4.460	2.803	4.165	4.355	4.052	3.718	3.552	4.004	3.807
Oct-93	4.300	4.616	4.202	4.150	4.461	2.809	4.168	4.359	4.052	3.726	3.558	4.008	3.832
Nov-93	4.304	4.611	4.203	4.149	4.459	2.813	4.174	4.362	4.048	3.728	3.561	4.006	3.833
Dec-93	4.303	4.612	4.203	4.151	4.460	2.818	4.182	4.366	4.052	3.731	3.564	4.012	3.835
Jan-94	4.303	4.613	4.205	4.146	4.462	2.831	4.185	4.369	4.059	3.752	3.578	4.024	3.846
Feb-94	4.296	4.613	4.209	4.152	4.466	2.848	4.196	4.374	4.062	3.764	3.581	4.035	3.849
Mar-94	4.295	4.617	4.212	4.155	4.466	2.855	4.193	4.369	4.067	3.764	3.586	4.044	3.860
Apr-94	4.295	4.619	4.214	4.167	4.466	2.858	4.193	4.376	4.069	3.764	3.595	4.046	3.865
May-94	4.292	4.620	4.214	4.170	4.460	2.863	4.194	4.382	4.081	3.770	3.600	4.046	3.879
Jun-94	4.295	4.616	4.218	4.170	4.462	2.864	4.193	4.387	4.088	3.775	3.605	4.053	3.884
Jul-94	4.299	4.612	4.221	4.165	4.461	2.878	4.199	4.388	4.089	3.782	3.622	4.062	3.890
Aug-94	4.299	4.616	4.224	4.170	4.466	2.886	4.200	4.389	4.093	3.789	3.635	4.070	3.901
Sep-94	4.300	4.619	4.227	4.172	4.466	2.892	4.206	4.389	4.104	3.791	3.648	4.066	3.906
Oct-94	4.299	4.624	4.228	4.174	4.466	2.901	4.208	4.393	4.108	3.791	3.653	4.063	3.912
Nov-94	4.304	4.621	4.230	4.174	4.466	2.905	4.212	4.397	4.101	3.791	3.656	4.065	3.918
Dec-94	4.305	4.618	4.230	4.179	4.465	2.911	4.215	4.394	4.098	3.791	3.658	4.066	3.921
Jan-95	4.309	4.618	4.233	4.179	4.472	2.922	4.220	4.396	4.108	3.816	3.671	4.075	3.927
Feb-95	4.313	4.615	4.237	4.185	4.481	2.935	4.227	4.397	4.109	3.820	3.674	4.079	3.932
Mar-95	4.316	4.614	4.240	4.189	4.481	2.941	4.225	4.394	4.114	3.824	3.686	4.089	3.938
Apr-95	4.319	4.617	4.244	4.199	4.482	2.958	4.225	4.399	4.122	3.826	3.699	4.095	3.944
May-95	4.321	4.619	4.246	4.203	4.480	2.962	4.231	4.403	4.134	3.837	3.704	4.097	3.950
Jun-95	4.321	4.618	4.247	4.205	4.482	2.964	4.231	4.404	4.140	3.846	3.701	4.094	3.958
Jul-95	4.324	4.613	4.247	4.200	4.482	2.971	4.233	4.403	4.143	3.852	3.706	4.097	3.966
Aug-95	4.321	4.614	4.250	4.205	4.485	2.974	4.236	4.403	4.149	3.867	3.709	4.103	3.982
Sep-95	4.323	4.620	4.253	4.210	4.485	2.978	4.238	4.403	4.162	3.888	3.711	4.112	3.988
Oct-95	4.321	4.617	4.256	4.205	4.484	2.984	4.241	4.403	4.170	3.890	3.714	4.107	3.996
Nov-95	4.325	4.614	4.254	4.205	4.484	2.989	4.246	4.405	4.170	3.888	3.716	4.105	3.997

Dec-95	4.323	4.614	4.254	4.211	4.484	2.997	4.247	4.403	4.170	3.890	3.726	4.112	4.000
Jan-96	4.325	4.613	4.260	4.207	4.488	3.027	4.253	4.404	4.176	3.918	3.738	4.122	4.002
Feb-96	4.325	4.611	4.263	4.212	4.489	3.040	4.260	4.413	4.182	3.926	3.738	4.126	4.008
Mar-96	4.331	4.613	4.268	4.216	4.490	3.034	4.257	4.408	4.185	3.928	3.747	4.133	4.015
Apr-96	4.333	4.619	4.272	4.223	4.491	3.036	4.261	4.410	4.190	3.932	3.752	4.139	4.025
May-96	4.336	4.621	4.274	4.225	4.488	3.043	4.267	4.415	4.193	3.934	3.759	4.145	4.033
Jun-96	4.336	4.618	4.275	4.226	4.490	3.035	4.268	4.416	4.193	3.940	3.768	4.145	4.037
Jul-96	4.336	4.617	4.277	4.222	4.489	3.042	4.270	4.416	4.196	3.942	3.775	4.150	4.040
Aug-96	4.336	4.616	4.278	4.227	4.490	3.042	4.270	4.416	4.206	3.951	3.782	4.155	4.044
Sep-96	4.337	4.620	4.282	4.231	4.491	3.044	4.274	4.418	4.208	3.949	3.791	4.157	4.049
Oct-96	4.340	4.622	4.285	4.231	4.493	3.048	4.274	4.418	4.212	3.951	3.800	4.157	4.056
Nov-96	4.344	4.619	4.286	4.232	4.491	3.052	4.278	4.420	4.217	3.951	3.804	4.157	4.060
Dec-96	4.344	4.620	4.286	4.235	4.492	3.055	4.281	4.422	4.217	3.959	3.813	4.160	4.064
Jan-97	4.346	4.619	4.290	4.235	4.495	3.072	4.285	4.424	4.220	3.972	3.826	4.168	4.069
Feb-97	4.349	4.617	4.293	4.239	4.498	3.080	4.290	4.428	4.225	3.976	3.833	4.173	4.077
Mar-97	4.349	4.618	4.296	4.242	4.495	3.080	4.289	4.424	4.230	3.980	3.837	4.177	4.080
Apr-97	4.349	4.639	4.297	4.247	4.496	3.084	4.286	4.428	4.231	3.982	3.846	4.182	4.084
May-97	4.350	4.641	4.296	4.251	4.493	3.087	4.292	4.431	4.234	3.983	3.850	4.183	4.086
Jun-97	4.353	4.641	4.297	4.255	4.494	3.086	4.290	4.432	4.237	3.996	3.852	4.184	4.088
Jul-97	4.353	4.637	4.299	4.255	4.493	3.095	4.292	4.437	4.244	3.998	3.863	4.186	4.094
Aug-97	4.354	4.638	4.300	4.261	4.495	3.104	4.295	4.440	4.270	4.004	3.865	4.194	4.099
Sep-97	4.354	4.644	4.303	4.266	4.495	3.114	4.297	4.441	4.274	4.013	3.869	4.198	4.108
Oct-97	4.354	4.647	4.305	4.268	4.495	3.129	4.300	4.443	4.282	4.016	3.873	4.198	4.120
Nov-97	4.353	4.641	4.305	4.268	4.495	3.136	4.304	4.444	4.290	4.024	3.871	4.199	4.121
Dec-97	4.352	4.639	4.304	4.271	4.495	3.153	4.308	4.443	4.290	4.029	3.873	4.224	4.123
Jan-98	4.357	4.638	4.305	4.268	4.495	3.220	4.319	4.439	4.301	4.040	3.882	4.247	4.130
Feb-98	4.358	4.637	4.307	4.273	4.496	3.340	4.333	4.439	4.309	4.054	3.884	4.265	4.128
Mar-98	4.359	4.641	4.309	4.276	4.495	3.393	4.339	4.433	4.319	4.062	3.892	4.263	4.132

Apr-98	4.358	4.642	4.311	4.287	4.496	3.438	4.341	4.433	4.327	4.067	3.896	4.266	4.136
May-98	4.362	4.645	4.313	4.292	4.494	3.490	4.344	4.432	4.332	4.079	3.900	4.261	4.138
Jun-98	4.363	4.642	4.315	4.292	4.495	3.535	4.350	4.431	4.337	4.098	3.904	4.257	4.141
Jul-98	4.363	4.636	4.315	4.289	4.494	3.618	4.348	4.432	4.339	4.099	3.926	4.257	4.146
Aug-98	4.363	4.635	4.316	4.294	4.496	3.679	4.349	4.431	4.343	4.104	3.938	4.260	4.149
Sep-98	4.361	4.642	4.317	4.298	4.496	3.716	4.350	4.430	4.340	4.108	3.955	4.265	4.154
Oct-98	4.364	4.649	4.320	4.298	4.495	3.713	4.352	4.427	4.339	4.114	3.959	4.268	4.162
Nov-98	4.364	4.648	4.320	4.298	4.494	3.714	4.358	4.430	4.335	4.129	3.959	4.265	4.163
Dec-98	4.362	4.644	4.320	4.298	4.494	3.728	4.361	4.427	4.332	4.127	3.959	4.263	4.168
Jan-99	4.364	4.640	4.321	4.292	4.496	3.757	4.368	4.430	4.335	4.148	3.967	4.262	4.165
Feb-99	4.364	4.636	4.323	4.294	4.500	3.770	4.371	4.432	4.336	4.148	3.967	4.266	4.166
Mar-99	4.369	4.637	4.327	4.296	4.501	3.767	4.368	4.428	4.333	4.145	3.967	4.268	4.172
Apr-99	4.374	4.642	4.333	4.303	4.502	3.761	4.369	4.431	4.331	4.145	3.968	4.270	4.176
May-99	4.377	4.642	4.333	4.305	4.500	3.758	4.373	4.432	4.327	4.145	3.968	4.269	4.177
Jun-99	4.380	4.639	4.333	4.305	4.502	3.755	4.372	4.432	4.325	4.153	3.974	4.263	4.178
Jul-99	4.381	4.635	4.336	4.302	4.502	3.744	4.373	4.433	4.328	4.154	3.974	4.259	4.179
Aug-99	4.383	4.638	4.339	4.304	4.506	3.735	4.372	4.433	4.332	4.157	3.970	4.270	4.181
Sep-99	4.387	4.641	4.344	4.309	4.509	3.726	4.372	4.433	4.332	4.162	3.974	4.272	4.183
Oct-99	4.388	4.642	4.345	4.310	4.509	3.727	4.372	4.432	4.333	4.165	3.976	4.280	4.187
Nov-99	4.387	4.637	4.346	4.312	4.508	3.730	4.374	4.433	4.335	4.167	3.978	4.278	4.188
Dec-99	4.388	4.634	4.346	4.315	4.511	3.747	4.385	4.434	4.339	4.168	3.982	4.276	4.191
Jan-00	4.386	4.633	4.349	4.311	4.512	3.760	4.385	4.439	4.341	4.135	3.993	4.278	4.193
Feb-00	4.392	4.630	4.355	4.316	4.515	3.761	4.386	4.444	4.346	4.138	3.991	4.280	4.198
Mar-00	4.399	4.632	4.363	4.322	4.515	3.756	4.385	4.440	4.346	4.138	4.000	4.284	4.206
Apr-00	4.396	4.634	4.364	4.332	4.516	3.762	4.385	4.441	4.343	4.140	4.013	4.280	4.210
May-00	4.401	4.635	4.364	4.335	4.515	3.770	4.386	4.439	4.344	4.143	4.018	4.280	4.213
Jun-00	4.407	4.633	4.371	4.338	4.520	3.775	4.386	4.439	4.346	4.146	4.024	4.285	4.215
Jul-00	4.410	4.630	4.372	4.334	4.520	3.788	4.387	4.445	4.346	4.153	4.032	4.288	4.216

Aug-00	4.409	4.633	4.372	4.334	4.517	3.793	4.387	4.451	4.353	4.156	4.036	4.296	4.219
Sep-00	4.413	4.632	4.378	4.341	4.523	3.792	4.387	4.451	4.357	4.159	4.041	4.311	4.225
Oct-00	4.415	4.632	4.380	4.341	4.522	3.804	4.391	4.452	4.352	4.165	4.045	4.308	4.231
Nov-00	4.418	4.629	4.380	4.344	4.526	3.817	4.393	4.453	4.353	4.176	4.047	4.304	4.234
Dec-00	4.419	4.630	4.380	4.344	4.525	3.836	4.397	4.456	4.353	4.184	4.050	4.308	4.235
Jan-01	4.415	4.630	4.386	4.338	4.525	3.839	4.399	4.458	4.354	4.191	4.062	4.310	4.239
Feb-01	4.420	4.626	4.389	4.343	4.523	3.848	4.402	4.457	4.361	4.194	4.064	4.319	4.236
Mar-01	4.424	4.624	4.392	4.344	4.525	3.857	4.399	4.458	4.361	4.194	4.071	4.328	4.240
Apr-01	4.431	4.626	4.396	4.349	4.528	3.862	4.401	4.461	4.367	4.194	4.076	4.332	4.245
May-01	4.439	4.627	4.401	4.356	4.534	3.873	4.402	4.458	4.371	4.197	4.079	4.331	4.249
Jun-01	4.439	4.624	4.402	4.357	4.535	3.889	4.401	4.452	4.367	4.205	4.084	4.334	4.250
Jul-01	4.437	4.621	4.399	4.351	4.534	3.910	4.401	4.458	4.367	4.211	4.084	4.336	4.248
Aug-01	4.437	4.625	4.399	4.355	4.528	3.908	4.399	4.458	4.367	4.212	4.083	4.340	4.256
Sep-01	4.439	4.623	4.404	4.358	4.529	3.915	4.401	4.456	4.369	4.214	4.084	4.339	4.263
Oct-01	4.433	4.623	4.401	4.356	4.528	3.921	4.399	4.453	4.364	4.215	4.084	4.339	4.265
Nov-01	4.425	4.618	4.399	4.352	4.529	3.938	4.408	4.452	4.363	4.218	4.088	4.333	4.265
Dec-01	4.426	4.617	4.394	4.351	4.528	3.954	4.409	4.450	4.361	4.220	4.094	4.335	4.261
Jan-02	4.428	4.611	4.397	4.351	4.530	3.974	4.410	4.447	4.363	4.224	4.111	4.341	4.261
Feb-02	4.434	4.610	4.401	4.353	4.530	3.989	4.414	4.451	4.363	4.222	4.122	4.345	4.261
Mar-02	4.441	4.612	4.407	4.357	4.530	3.989	4.420	4.450	4.366	4.227	4.132	4.351	4.266
Apr-02	4.447	4.615	4.413	4.364	4.539	3.986	4.419	4.451	4.372	4.227	4.148	4.357	4.270
May-02	4.450	4.618	4.413	4.367	4.540	3.994	4.420	4.453	4.373	4.228	4.154	4.360	4.271
Jun-02	4.452	4.617	4.413	4.367	4.538	3.998	4.421	4.453	4.371	4.230	4.162	4.360	4.269
Jul-02	4.458	4.613	4.414	4.365	4.533	4.006	4.421	4.453	4.369	4.234	4.176	4.357	4.274
Aug-02	4.461	4.616	4.418	4.368	4.533	4.009	4.420	4.452	4.371	4.238	4.181	4.363	4.277
Sep-02	4.461	4.616	4.419	4.375	4.535	4.014	4.421	4.452	4.374	4.238	4.191	4.369	4.286
Oct-02	4.465	4.614	4.420	4.377	4.540	4.020	4.420	4.452	4.380	4.238	4.206	4.366	4.295
Nov-02	4.467	4.614	4.420	4.378	4.538	4.038	4.424	4.453	4.376	4.238	4.209	4.367	4.294

Dec-02	4.464	4.614	4.419	4.380	4.538	4.050	4.425	4.453	4.377	4.241	4.211	4.372	4.289
Jan-03	4.473	4.611	4.422	4.380	4.538	4.058	4.427	4.457	4.385	4.243	4.220	4.378	4.290
Feb-03	4.481	4.608	4.431	4.385	4.539	4.060	4.428	4.454	4.383	4.246	4.220	4.384	4.298
Mar-03	4.483	4.611	4.437	4.388	4.543	4.058	4.427	4.458	4.383	4.247	4.230	4.395	4.310
Apr-03	4.476	4.614	4.434	4.395	4.545	4.059	4.428	4.459	4.387	4.248	4.233	4.393	4.309
May-03	4.477	4.616	4.433	4.397	4.543	4.061	4.430	4.453	4.392	4.250	4.230	4.392	4.305
Jun-03	4.477	4.613	4.433	4.396	4.543	4.062	4.428	4.451	4.387	4.257	4.227	4.389	4.305
Jul-03	4.478	4.611	4.434	4.396	4.536	4.062	4.431	4.457	4.387	4.257	4.227	4.388	4.304
Aug-03	4.482	4.613	4.439	4.397	4.538	4.071	4.430	4.458	4.393	4.260	4.231	4.393	4.306
Sep-03	4.483	4.614	4.441	4.402	4.539	4.074	4.432	4.458	4.392	4.260	4.227	4.402	4.308
Oct-03	4.481	4.614	4.440	4.403	4.544	4.080	4.428	4.458	4.393	4.261	4.221	4.402	4.306
Nov-03	4.483	4.609	4.438	4.403	4.543	4.090	4.434	4.459	4.394	4.263	4.214	4.401	4.303
Dec-03	4.484	4.610	4.437	4.408	4.543	4.099	4.428	4.461	4.394	4.265	4.214	4.405	4.300
Jan-04	4.485	4.608	4.441	4.406	4.540	4.105	4.437	4.464	4.397	4.271	4.222	4.411	4.298
Feb-04	4.488	4.608	4.447	4.409	4.540	4.105	4.438	4.475	4.405	4.274	4.227	4.416	4.298
Mar-04	4.491	4.610	4.453	4.414	4.542	4.109	4.437	4.467	4.407	4.277	4.233	4.425	4.302
Apr-04	4.493	4.610	4.457	4.420	4.551	4.118	4.439	4.474	4.412	4.281	4.234	4.425	4.306
May-04	4.502	4.611	4.462	4.424	4.553	4.127	4.441	4.476	4.415	4.285	4.236	4.425	4.311
Jun-04	4.502	4.613	4.466	4.426	4.555	4.132	4.443	4.468	4.418	4.297	4.238	4.425	4.315
Jul-04	4.502	4.610	4.465	4.426	4.544	4.136	4.444	4.476	4.419	4.311	4.241	4.431	4.318
Aug-04	4.500	4.611	4.465	4.429	4.548	4.137	4.444	4.475	4.424	4.316	4.240	4.439	4.322
Sep-04	4.502	4.614	4.467	4.432	4.549	4.137	4.449	4.477	4.426	4.320	4.240	4.439	4.322
Oct-04	4.503	4.619	4.472	4.435	4.557	4.142	4.453	4.476	4.426	4.323	4.244	4.439	4.325
Nov-04	4.508	4.617	4.473	4.437	4.558	4.151	4.456	4.476	4.424	4.328	4.250	4.433	4.328
Dec-04	4.505	4.612	4.469	4.442	4.557	4.162	4.458	4.474	4.424	4.335	4.247	4.435	4.324
Jan-05	4.504	4.610	4.472	4.437	4.552	4.176	4.460	4.466	4.425	4.341	4.251	4.442	4.321
Feb-05	4.509	4.607	4.477	4.440	4.554	4.174	4.461	4.475	4.430	4.344	4.253	4.448	4.320
Mar-05	4.514	4.610	4.484	4.445	4.557	4.192	4.461	4.472	4.439	4.346	4.263	4.456	4.326

Apr-05	4.516	4.611	4.491	4.451	4.565	4.196	4.464	4.477	4.446	4.350	4.268	4.456	4.335
May-05	4.517	4.612	4.491	4.453	4.564	4.198	4.472	4.475	4.452	4.355	4.268	4.455	4.338
Jun-05	4.520	4.608	4.491	4.454	4.561	4.203	4.473	4.466	4.454	4.362	4.267	4.451	4.342
Jul-05	4.522	4.607	4.495	4.454	4.556	4.211	4.473	4.477	4.470	4.369	4.275	4.456	4.348
Aug-05	4.525	4.608	4.501	4.456	4.558	4.217	4.480	4.482	4.477	4.374	4.279	4.459	4.351
Sep-05	4.534	4.611	4.513	4.459	4.562	4.223	4.482	4.483	4.484	4.378	4.284	4.466	4.361
Oct-05	4.528	4.611	4.515	4.460	4.571	4.307	4.484	4.488	4.488	4.382	4.284	4.464	4.366
Nov-05	4.527	4.607	4.506	4.461	4.567	4.320	4.488	4.486	4.481	4.388	4.284	4.457	4.363
Dec-05	4.526	4.608	4.503	4.464	4.566	4.319	4.489	4.486	4.480	4.391	4.284	4.461	4.360
Jan-06	4.532	4.609	4.510	4.460	4.565	4.333	4.492	4.484	4.482	4.399	4.290	4.467	4.361
Feb-06	4.529	4.606	4.512	4.464	4.569	4.339	4.493	4.486	4.483	4.407	4.290	4.469	4.360
Mar-06	4.535	4.608	4.517	4.468	4.567	4.339	4.508	4.483	4.494	4.409	4.296	4.475	4.366
Apr-06	4.541	4.610	4.526	4.476	4.576	4.340	4.508	4.489	4.505	4.412	4.300	4.476	4.372
May-06	4.545	4.613	4.532	4.482	4.578	4.343	4.510	4.486	4.512	4.414	4.307	4.478	4.374
Jun-06	4.543	4.613	4.533	4.486	4.577	4.348	4.512	4.481	4.512	4.420	4.315	4.476	4.380
Jul-06	4.544	4.610	4.536	4.486	4.571	4.352	4.513	4.489	4.513	4.422	4.324	4.480	4.386
Aug-06	4.546	4.617	4.538	4.490	4.572	4.355	4.512	4.489	4.514	4.426	4.332	4.485	4.388
Sep-06	4.541	4.617	4.533	4.494	4.570	4.359	4.514	4.488	4.512	4.426	4.335	4.488	4.389
Oct-06	4.539	4.615	4.527	4.496	4.574	4.368	4.514	4.491	4.515	4.427	4.336	4.484	4.386
Nov-06	4.541	4.610	4.526	4.499	4.573	4.371	4.517	4.491	4.514	4.430	4.336	4.479	4.384
Dec-06	4.542	4.611	4.527	4.507	4.573	4.383	4.520	4.494	4.513	4.432	4.340	4.482	4.385
Jan-07	4.542	4.609	4.530	4.502	4.566	4.397	4.524	4.486	4.512	4.437	4.348	4.484	4.388
Feb-07	4.550	4.604	4.536	4.509	4.567	4.401	4.524	4.492	4.508	4.436	4.346	4.490	4.387
Mar-07	4.558	4.607	4.545	4.516	4.569	4.403	4.523	4.491	4.513	4.436	4.355	4.496	4.391
Apr-07	4.562	4.610	4.552	4.520	4.580	4.403	4.523	4.494	4.524	4.438	4.368	4.500	4.397
May-07	4.567	4.613	4.558	4.524	4.582	4.404	4.524	4.498	4.532	4.440	4.373	4.501	4.403
Jun-07	4.565	4.611	4.560	4.530	4.583	4.406	4.526	4.493	4.532	4.445	4.382	4.501	4.412
Jul-07	4.566	4.610	4.559	4.524	4.578	4.412	4.529	4.514	4.532	4.451	4.392	4.505	4.423

Aug-07	4.563	4.615	4.558	4.530	4.577	4.418	4.532	4.517	4.525	4.452	4.397	4.506	4.434
Sep-07	4.565	4.615	4.560	4.533	4.578	4.425	4.533	4.514	4.532	4.454	4.403	4.511	4.445
Oct-07	4.562	4.618	4.562	4.537	4.586	4.432	4.534	4.527	4.540	4.456	4.413	4.513	4.448
Nov-07	4.565	4.616	4.569	4.541	4.590	4.435	4.540	4.533	4.544	4.460	4.416	4.513	4.456
Dec-07	4.566	4.618	4.567	4.547	4.593	4.440	4.542	4.537	4.545	4.467	4.425	4.517	4.460
Jan-08	4.564	4.616	4.573	4.542	4.590	4.456	4.546	4.551	4.553	4.482	4.447	4.522	4.460
Feb-08	4.567	4.614	4.576	4.549	4.591	4.463	4.550	4.556	4.560	4.485	4.453	4.525	4.464
Mar-08	4.572	4.619	4.584	4.553	4.595	4.472	4.550	4.555	4.565	4.493	4.468	4.535	4.472
Apr-08	4.580	4.618	4.590	4.561	4.602	4.475	4.553	4.567	4.583	4.508	4.474	4.540	4.476
May-08	4.589	4.626	4.598	4.567	4.610	4.487	4.561	4.569	4.604	4.520	4.482	4.548	4.488
Jun-08	4.596	4.631	4.608	4.574	4.612	4.511	4.600	4.566	4.616	4.536	4.495	4.555	4.503
Jul-08	4.599	4.633	4.614	4.573	4.608	4.525	4.611	4.578	4.619	4.548	4.509	4.562	4.514
Aug-08	4.598	4.636	4.610	4.576	4.605	4.530	4.613	4.580	4.589	4.553	4.514	4.560	4.523
Sep-08	4.598	4.636	4.608	4.582	4.606	4.539	4.611	4.580	4.591	4.551	4.521	4.561	4.534
Oct-08	4.588	4.635	4.598	4.579	4.611	4.544	4.607	4.589	4.578	4.549	4.522	4.560	4.542
Nov-08	4.585	4.626	4.579	4.571	4.605	4.545	4.595	4.587	4.565	4.548	4.523	4.558	4.541
Dec-08	4.578	4.622	4.569	4.556	4.600	4.545	4.586	4.581	4.550	4.542	4.521	4.558	4.529
Jan-09	4.575	4.616	4.573	4.543	4.591	4.544	4.585	4.584	4.550	4.551	4.525	4.558	4.521
Feb-09	4.582	4.613	4.578	4.549	4.594	4.546	4.587	4.580	4.559	4.555	4.537	4.566	4.508
Mar-09	4.584	4.616	4.580	4.549	4.590	4.548	4.585	4.575	4.564	4.557	4.550	4.573	4.509
Apr-09	4.583	4.617	4.583	4.550	4.599	4.545	4.583	4.567	4.574	4.562	4.555	4.575	4.507
May-09	4.590	4.615	4.586	4.556	4.601	4.546	4.585	4.574	4.571	4.562	4.558	4.575	4.505
Jun-09	4.593	4.613	4.594	4.559	4.602	4.547	4.586	4.569	4.575	4.567	4.562	4.575	4.508
Jul-09	4.590	4.610	4.593	4.559	4.596	4.551	4.587	4.578	4.575	4.570	4.574	4.578	4.504
Aug-09	4.590	4.613	4.595	4.563	4.597	4.557	4.588	4.581	4.578	4.570	4.576	4.582	4.499
Sep-09	4.590	4.613	4.595	4.568	4.597	4.567	4.591	4.578	4.580	4.573	4.580	4.583	4.511
Oct-09	4.589	4.609	4.596	4.571	4.603	4.569	4.592	4.584	4.582	4.578	4.580	4.580	4.511
Nov-09	4.594	4.607	4.597	4.571	4.605	4.569	4.594	4.584	4.585	4.582	4.580	4.582	4.507



Dec-09	4.591	4.605	4.595	4.580	4.602	4.572	4.596	4.578	4.584	4.586	4.583	4.585	4.503
Jan-10	4.593	4.606	4.599	4.580	4.602	4.580	4.599	4.586	4.589	4.588	4.585	4.593	4.508
Feb-10	4.598	4.605	4.599	4.585	4.603	4.583	4.599	4.589	4.595	4.593	4.592	4.595	4.511
Mar-10	4.598	4.608	4.603	4.592	4.605	4.582	4.599	4.590	4.597	4.595	4.600	4.597	4.512
Apr-10	4.601	4.609	4.605	4.602	4.613	4.583	4.599	4.599	4.602	4.601	4.601	4.601	4.516
May-10	4.604	4.608	4.606	4.605	4.612	4.586	4.601	4.605	4.604	4.600	4.603	4.602	4.520
Jun-10	4.603	4.606	4.605	4.608	4.608	4.596	4.602	4.595	4.607	4.603	4.603	4.601	4.520
Jul-10	4.608	4.600	4.605	4.605	4.600	4.612	4.605	4.608	4.608	4.606	4.610	4.603	4.526
Aug-10	4.607	4.602	4.606	4.609	4.600	4.619	4.608	4.613	4.611	4.610	4.610	4.608	4.525
Sep-10	4.609	4.604	4.607	4.613	4.600	4.624	4.609	4.613	4.610	4.610	4.611	4.616	4.529
Oct-10	4.613	4.607	4.608	4.615	4.605	4.624	4.611	4.618	4.610	4.609	4.613	4.616	4.530
Nov-10	4.614	4.604	4.608	4.620	4.608	4.630	4.613	4.622	4.612	4.618	4.615	4.611	4.531
Dec-10	4.614	4.601	4.610	4.627	4.608	4.639	4.617	4.623	4.614	4.622	4.617	4.615	4.532
Jan-11	4.616	4.600	4.615	4.629	4.604	4.648	4.623	4.639	4.619	4.627	4.621	4.627	4.535
Feb-11	4.619	4.600	4.620	4.639	4.608	4.650	4.628	4.638	4.623	4.640	4.628	4.634	4.537
Mar-11	4.630	4.603	4.630	4.644	4.615	4.646	4.629	4.640	4.628	4.642	4.641	4.638	4.545
Apr-11	4.634	4.604	4.636	4.653	4.616	4.643	4.631	4.642	4.642	4.646	4.643	4.639	4.548
May-11	4.640	4.604	4.641	4.656	4.616	4.644	4.634	4.649	4.645	4.648	4.648	4.641	4.552
Jun-11	4.634	4.602	4.640	4.656	4.613	4.650	4.637	4.646	4.646	4.654	4.652	4.642	4.554
Jul-11	4.635	4.602	4.641	4.654	4.605	4.657	4.639	4.661	4.648	4.654	4.661	4.647	4.555
Aug-11	4.638	4.604	4.643	4.660	4.602	4.666	4.641	4.668	4.653	4.655	4.662	4.654	4.557
Sep-11	4.640	4.604	4.645	4.667	4.605	4.669	4.642	4.666	4.649	4.656	4.667	4.653	4.562
Oct-11	4.642	4.605	4.642	4.668	4.604	4.667	4.644	4.671	4.651	4.660	4.671	4.651	4.566
Nov-11	4.642	4.599	4.642	4.670	4.602	4.671	4.645	4.677	4.654	4.664	4.675	4.652	4.570
Dec-11	4.637	4.599	4.640	4.674	4.601	4.676	4.646	4.677	4.648	4.662	4.676	4.656	4.576
Jan-12	4.641	4.601	4.643	4.668	4.597	4.687	4.649	4.686	4.653	4.666	4.682	4.660	4.576
Feb-12	4.645	4.603	4.648	4.676	4.599	4.687	4.649	4.683	4.656	4.666	4.688	4.664	4.580
Mar-12	4.649	4.608	4.656	4.679	4.605	4.687	4.649	4.690	4.662	4.669	4.699	4.664	4.582

Apr-12	4.653	4.609	4.659	4.687	4.606	4.689	4.649	4.696	4.666	4.677	4.703	4.664	4.583
May-12	4.652	4.606	4.658	4.686	4.606	4.690	4.651	4.698	4.670	4.678	4.703	4.666	4.583
Jun-12	4.648	4.601	4.656	4.684	4.603	4.695	4.652	4.698	4.672	4.683	4.706	4.664	4.580
Jul-12	4.647	4.598	4.655	4.685	4.598	4.701	4.652	4.700	4.676	4.686	4.709	4.662	4.580
Aug-12	4.650	4.599	4.661	4.689	4.598	4.709	4.654	4.707	4.679	4.692	4.711	4.667	4.582
Sep-12	4.652	4.601	4.664	4.693	4.601	4.709	4.656	4.712	4.683	4.692	4.720	4.674	4.590
Oct-12	4.653	4.601	4.664	4.699	4.602	4.711	4.658	4.710	4.684	4.691	4.727	4.672	4.595
Nov-12	4.651	4.597	4.660	4.699	4.599	4.711	4.659	4.711	4.680	4.691	4.729	4.668	4.591
Dec-12	4.645	4.598	4.657	4.704	4.597	4.715	4.659	4.719	4.684	4.691	4.731	4.670	4.590
Jan-13	4.646	4.598	4.660	4.700	4.594	4.725	4.662	4.721	4.686	4.697	4.734	4.676	4.594
Feb-13	4.658	4.597	4.668	4.707	4.597	4.732	4.664	4.731	4.688	4.700	4.744	4.679	4.595
Mar-13	4.659	4.599	4.670	4.712	4.599	4.736	4.665	4.725	4.689	4.700	4.756	4.678	4.601
Apr-13	4.658	4.602	4.669	4.715	4.599	4.737	4.666	4.710	4.690	4.702	4.760	4.677	4.599
May-13	4.660	4.603	4.671	4.717	4.600	4.738	4.669	4.714	4.693	4.704	4.757	4.677	4.598
Jun-13	4.660	4.603	4.674	4.716	4.601	4.748	4.670	4.716	4.694	4.710	4.760	4.676	4.603
Jul-13	4.661	4.605	4.674	4.716	4.598	4.778	4.672	4.719	4.695	4.710	4.771	4.678	4.603
Aug-13	4.661	4.608	4.676	4.721	4.597	4.787	4.673	4.727	4.695	4.713	4.773	4.681	4.606
Sep-13	4.662	4.611	4.677	4.725	4.600	4.785	4.681	4.728	4.697	4.718	4.778	4.683	4.611
Oct-13	4.660	4.612	4.674	4.725	4.599	4.787	4.685	4.730	4.699	4.720	4.780	4.680	4.614
Nov-13	4.660	4.613	4.672	4.725	4.599	4.788	4.688	4.737	4.700	4.725	4.781	4.680	4.617
Dec-13	4.658	4.614	4.672	4.730	4.597	4.793	4.690	4.734	4.700	4.732	4.784	4.681	4.620
Jan-14	4.661	4.612	4.676	4.727	4.594	4.804	4.696	4.734	4.705	4.739	4.790	4.687	4.622
Feb-14	4.669	4.612	4.679	4.734	4.595	4.806	4.699	4.734	4.708	4.740	4.802	4.689	4.627
Mar-14	4.675	4.615	4.686	4.736	4.599	4.807	4.700	4.737	4.710	4.739	4.815	4.691	4.635
Apr-14	4.677	4.636	4.689	4.740	4.599	4.807	4.700	4.735	4.715	4.743	4.819	4.692	4.641
May-14	4.682	4.640	4.692	4.740	4.603	4.808	4.700	4.741	4.718	4.748	4.821	4.693	4.645

## Chapter 5

### Purchasing Power Parity and Divisia Index Numbers

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#### 5.1 Introduction

This chapter is a follow-up of the previous chapter where alternative panel data methods were employed to test purchasing power parity (PPP). The empirical results as reported in the previous chapter do not provide clear-cut evidence in support of PPP for a mixed bundle of currencies for the period spanning over the last three decades. The purpose of this chapter is to provide a further check on these results, this time using a Divisia index approach. Note that this approach has the similarity with the panel data methods in that it is based on the experience of several countries simultaneously, rather than looking at pairs of countries in isolation from the rest of the world.

Divisia index numbers possess desirable index number properties and are widely used in production and consumption economics (Thiel, 1975/76, Section 3.7). They can be interpreted and estimated as regression coefficients under a plausible error specification (see, Clements and Izan, 1981). Over the last decade or so, a Divisia approach has become quite popular in energy economics for aggregating electricity and fuels, as well as to decompose energy intensity (see, such as, Choi and Ang, 2012). Manzur (1990) introduces a Divisia index approach to the PPP literature. He sets up an analytical framework to show how Divisia index numbers apply to PPP and derives a set of restrictions based on Divisia index numbers to test PPP. The approach is simple and flexible in that it provides a test of PPP for each observation of the sample period, whereas the regression methods provide a test for only the entire period. Applying this methodology to the quarterly data for the Group of Seven (G-7) countries over the 1970s and 1980s with the U.S. dollar as the reference country, Manzur's results indicate that PPP does not hold up in the short run, but it works fairly well as a long-run proposition.

This chapter provides a re-examination of PPP based on Divisia index numbers, using quarterly data spanning over more than three decades for a mixed bundle ten countries. The original intention was to use the same sample with same frequency of

observations (monthly) as those in the previous chapter, but that has not been possible due to GDP data availability issues. While this chapter draws on Manzur (1990), it differs from that paper in respect of sample countries and time periods. The present study also uses the British pound sterling together with the U.S. dollar as base currencies. Overall, consistent with Manzur (1990), the results are very encouraging for PPP as a long-run proposition.

Since PPP is already introduced in the previous chapters, this chapter is relatively shorter, focusing mainly on the results, and organized as follows. In Section 5.2, a skeletal analytical framework abstracted from Manzur (1990) is given. This section also describes the data used in this study. Empirical results are contained in Section 5.3, followed by some additional results in the following section. The last section concludes the chapter.

## 5.2 Test Design and Data

Let  $p_i$  and  $q_i$  be the GBP (British pound sterling) price and quantity of a good purchased from country  $i$ ,  $M = \sum_{i=1}^n p_i q_i$  be the total cost of the bundle of goods purchased from  $n$  countries,  $\omega_i = p_i q_i / M$  be the  $i$ th budget share and let  $\bar{\omega}_i$  be the arithmetic average of  $\omega_i$  over the current and previous periods. If  $p_i^d$  is the domestic currency price and  $s_i$  is the  $i$ th exchange rate (defined as the domestic currency cost of GBP1), then  $p_i = p_i^d$  as  $s_i = 1$ .

The first-order Divisia moments are given by

$$\Pi_t = \sum_{i=1}^n \bar{\omega}_{it} dp_{it} = \sum_{i=1}^n \bar{\omega}_{it} dp'_{it} - \sum_{i=1}^n \bar{\omega}_{it} ds_{it}, \quad \Pi'_t = \sum_{i=1}^n \bar{\omega}_{it} dp'_{it}, \quad \Psi_t = \sum_{i=1}^n \bar{\omega}_{it} ds_{it}, \quad (5.1)$$

where  $d$  is the log-change operator ( $dx_t = \log x_t - \log x_{t-1}$ ),  $\Pi_t, \Pi'_t$  and  $\Psi_t$  are the Divisia indexes of GBP price levels, domestic currency price levels and exchange rates, respectively. Similarly, Divisia variances are given by

$$\sigma_t^p = \sum_{i=1}^n \bar{\omega}_{it} (dp_{it} - \Pi_t)^2, \quad \sigma_t^{p'} = \sum_{i=1}^n \bar{\omega}_{it} (dp'_{it} - \Pi'_t)^2, \quad \sigma_t^s = \sum_{i=1}^n \bar{\omega}_{it} (ds_{it} - \Psi_t)^2 \quad (5.2)$$

where,  $\sigma_t^p$ ,  $\sigma_t^{p'}$  and  $\sigma_t^s$  are the variances of GBP price levels, domestic currency price levels, and exchange rate changes, respectively. Divisia co-variances are defined as

$$\sigma_t^{ps} = \sum_{i=1}^n \bar{\omega}_{it} (dp_{it} - \Pi_t)(ds_{it} - \Psi_t), \quad \sigma_t^{p's} = \sum_{i=1}^n \bar{\omega}_{it} (dp'_{it} - \Pi'_t)(ds_{it} - \Psi_t) \quad (5.3)$$

where  $\sigma_t^{p's}$  and  $\sigma_t^{ps}$  are the co-variances of domestic-currency price levels to exchange rate changes and the GBP price levels to exchange rates changes, respectively.

The relative version of PPP states that the percentage change in the exchange rate is equal to the inflation differential:

$$ds_{it} = dp'_{it} - dp_{it} + \varepsilon_{it}, \quad (5.4)$$

where  $\varepsilon_{it}$  is the deviation from PPP. Under PPP, the deviation  $\varepsilon_{it}$  is zero. Equation (5.4) together with equation (5.1) yields

$$\Psi_t = \Pi'_t - dp_{it} + E_t, \quad (5.5)$$

where  $E_t = \sum_{i=1}^n \bar{\omega}_{it} \varepsilon_{it}$  is the Divisia mean (or weighted mean) of the deviations from PPP. Equation (5.5) states that the  $n$ -country average change in exchange rates is equal to the difference between the  $n$ -country average inflation rate in terms of domestic currencies and the average inflation rate in the UK, plus an average deviation. As  $\varepsilon_{it} = E_t = 0$  under PPP, it implies that

$$ds_{it} - \Psi_t = dp'_{it} - \Pi'_t + \varepsilon_{it} - E_t. \quad (5.6)$$

Under PPP,  $\varepsilon_{it} = E_t = 0$ . Similarly, using equations (5.1)-(5.6), the following conditions obtain:

$$\sigma_t^s = \sigma_t^{p'} = \sigma_t^{p's} \quad (5.7)$$

$$\sigma_t^p = \sigma_t^{ps} = 0. \quad (5.8)$$

and

$$\rho_t^{p's} = 1. \quad (5.9)$$

Equations (5.7) and (5.8) state that under PPP (i) exchange rates and domestic-currency price variances and their co-variance all coincide; and (ii) the variance of GBP prices and the co-variance between exchange rates and GBP prices both vanish. According to equation (5.9) domestic prices and exchange rates are perfectly

correlated under PPP. See Manzur (1990) for a step-by-step derivation of this framework.

The analysis in this chapter is carried out using  $n=10$  countries, namely, Australia, Canada, Japan, the Philippines, Singapore, South Korea, South Africa, Switzerland, and the USA, with the UK as the reference country. Additional results are provided subsequently with the UK substituted by the USA. The data are quarterly, for the period from 1980 (4) to 2014 (1) (as late as available at the time of concluding this chapter). Domestic prices for each country ( $p_i$ ) are measured by consumer prices, and gross domestic product (GDP) shares are used for the weights ( $\omega$ ). All data are from IMF's International Financial Statistics (IFS) through DataStream and appended at the end of this chapter.

### 5.3 Empirical Results

Table 5.1 gives a summary of the data. As the data in this table refer to averages over more than three decades, they can be used for analysing the long run relationship between exchange rates and prices. PPP implies that exchange rate changes should coincide with inflation differentials. It is observed from the second

**Table 5.1: Summary statistics of quarterly exchange rates, inflation rates and GDPs (all in log-changes): 10 countries, 1981(Q1)-2014(Q1)**

Country	Average Exchange rate log-change $ds_i$	Average price log-change $dp_i$	Average inflation differential $Dp_i - Dp_1$	Mean GDP share. $\bar{\omega}$
(1)	(2)	(3)	(4)	(5)
UK		0.97		2.42
Australia	-0.09 (0.06)	1.02	0.04 (1.00)	0.87
Canada	-0.33 (0.05)	0.75	-0.23 (0.81)	5.53
Japan	-0.78 (0.07)	0.18	-0.79 (0.67)	26.73
Switzerland	-0.80 (0.05)	0.44	-0.53 (0.84)	0.52
USA	-0.27 (0.05)	0.76	-0.21 (0.78)	61.84
Singapore	-0.65 (0.05)	0.50	-0.48 (1.00)	0.15
Philippines	1.09 (0.07)	1.95	0.97 (2.47)	0.00
South Korea	0.09 (0.08)	1.06	0.08 (1.06)	0.80
South Africa	1.72 (0.08)	2.20	1.23 (1.24)	1.15

Note: All entries are multiplied by 100. Standard deviation in parenthesis

and fourth column of Table 5.1 that these two variables are quite closely related for the sample countries. This relation can be seen more clearly when we plot the

exchange rate changes against the inflation differentials, as in figure 5.1. As can be seen, the points are scattered around a 45° line, suggesting a fairly close relationship between exchange rates and national price levels over the longer term.

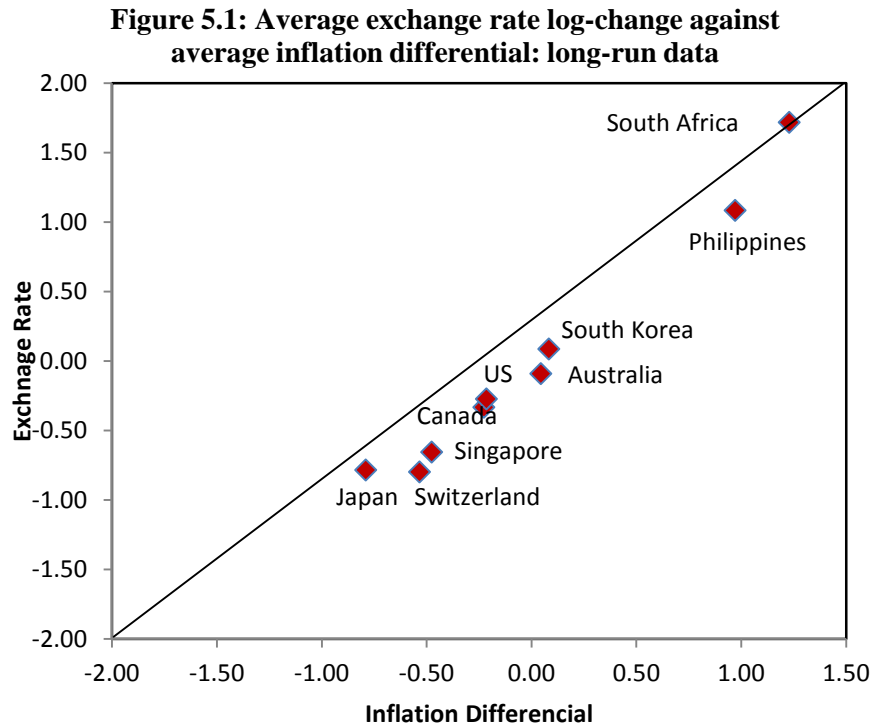


Table 5.2 gives the first- and second-order Divisia moments of exchange rate and prices computed from the data in Table 5.1. The first column of the table gives the Divisia index of exchange rates, defined by equation (5.1). We substitute into this equation the averages of  $ds_{it}$  and the averages of  $\bar{\omega}_{it}$ , given in the second column and the last column, respectively, of Table 5.1. A similar procedure is used for the application of the other measures to the long-run data. The second and third columns of Table 5.2 present the Divisia indexes for prices in domestic currencies and in GBP, defined also by equation (5.1). As can be seen exchange rate appreciated on average by 0.39 per cent per quarter, while prices in domestic currencies and in GBP increased by 0.63 per cent and 1.02 per cent, respectively. Using equation (5.5), we calculate the average deviation from PPP as  $E = \Psi - \Pi + dp_1 = -0.39 - 0.63 + 1.02 = -0.05$  per cent per quarter (see column 5 of Table 5.2), which is not far away from zero (as required under PPP). Columns (6) to (8) give the Divisia variances of exchange rates and prices. The domestic-currency price-exchange rate co-variance and the corresponding correlation coefficient are presented in columns (9) and (10). The results in Table 5.2 reveal the following. First, the figure of 0.000055 for the variance

of prices in GBP, given in column (8), is small in comparison with the two other variances, 0.10 for  $\sigma^{p'}$  and 0.11 for  $\sigma^s$ . This provides support to the prediction contained in equation (5.8) that  $\sigma^p = 0$  under PPP. Second, the figures of 0.11 and 0.10 for the variances of exchange rates and domestic-currency prices, given in columns (6) and (7), are quite close together, again in accordance with the implication for PPP contained as in equation (7). Finally, column (10) reports the value of the domestic-currency price-exchange rate correlation coefficient as 0.98, which is obviously quite close to unity, the value implied by PPP (see equation (9)). In summary, the long-run data in this sample are consistent with the PPP hypothesis. This result is consistent with Manzur (1990) and several other more recent studies using panel data methods (see, Chortareas and Kapetanios, 2009 and Ramajo and Ferré, 2010, among others).

**Table 5.2: Divisia moments of exchange rates and prices:  
long run data**

Price Index			Variance of					price- exchange rate	
$\Psi$	$\Pi'$	$\Pi$	$dp_1$	$E$	$\sigma^\psi$	$\sigma^{\pi'}$	$\sigma^\pi$	$\sigma^{\pi'\psi}$	$\rho^{\pi'\psi}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
-0.39	0.63	1.02	0.97	-0.05	0.11	0.10	0.000055	0.10	0.98

Table 5.3 is the short-run (quarterly) version of columns (1) – (5) of Table 5.2. We present in column (2) the ten-country average exchange rate change and in column (3) the domestic-currency average inflation rate. Column (4) gives UK inflation and the Divisia mean of PPP deviations in column (5). As can be seen, on average exchange rates appreciated (relative to GBP) by about 0.01 per cent per quarter while domestic-currency prices increased by about 0.99 per cent. Prices in GBP rose by 0.98 per cent on average. Consequently, the average deviation from PPP is  $-0.01 - 0.99 + 0.98 = -0.01$  per cent per quarter, as indicated by the last entry in column (5).



**Table 5.3: Divisia indexes of exchange rates and prices: short-run data**

Year/ Quarter	Exchange Rate $\Psi$	Price Index in Domestic currencies $\Pi'$	UK inflation dp1	Deviation E from PPP
(1)	(2)	(3)	(4)	(5)
Q1 1981	-3.48	2.42	2.33	-3.57
Q2 1981	-10.03	2.85	4.81	-8.07
Q3 1981	-5.53	2.67	1.68	-6.51
Q4 1981	3.75	2.03	2.43	4.16
Q1 1982	-1.20	1.61	1.62	-1.19
Q2 1982	0.75	1.87	3.16	2.04
Q3 1982	-0.50	1.75	0.49	-1.75
Q4 1982	-7.18	1.23	0.73	-7.69
Q1 1983	-5.13	0.90	0.48	-5.55
Q2 1983	4.50	1.40	1.99	5.09
Q3 1983	-1.99	1.31	1.33	-1.97
Q4 1983	0.76	1.83	1.12	0.05
Q1 1984	-1.03	2.64	0.58	-3.09
Q2 1984	0.39	1.66	2.01	0.73
Q3 1984	-4.17	2.43	0.86	-5.74
Q4 1984	-2.60	1.59	1.29	-2.89
Q1 1985	6.11	1.67	1.20	5.65
Q2 1985	6.50	1.59	3.39	8.29
Q3 1985	5.89	0.97	0.25	5.16
Q4 1985	1.86	0.99	0.49	1.36
Q1 1986	-0.82	1.27	0.69	-1.40
Q2 1986	3.74	0.34	1.30	4.70
Q3 1986	-7.44	0.83	0.10	-8.17
Q4 1986	1.11	1.11	1.29	1.28
Q1 1987	3.66	1.14	1.20	3.72
Q2 1987	0.08	1.41	1.52	0.18
Q3 1987	0.86	1.21	0.23	-0.12
Q4 1987	7.56	1.15	1.07	7.48
Q1 1988	1.15	1.23	0.48	0.40
Q2 1988	-7.22	1.45	2.38	-6.29
Q3 1988	0.17	1.26	1.37	0.28
Q4 1988	2.51	1.32	2.08	3.28
Q1 1989	-3.50	1.37	1.59	-3.28
Q2 1989	-4.74	2.11	2.82	-4.03
Q3 1989	2.35	1.56	0.92	1.71
Q4 1989	-1.53	1.65	1.96	-1.22
Q1 1990	3.93	1.76	1.76	3.93
Q2 1990	3.98	1.98	4.57	6.57
Q3 1990	4.28	1.55	1.63	4.35
Q4 1990	3.64	2.15	1.55	3.04
Q1 1991	-6.49	2.19	0.59	-8.09
Q2 1991	-5.48	1.50	2.07	-4.91
Q4 1991	4.51	1.21	0.96	3.75
Q1 1992	4.94	1.22	0.54	4.68
Q2 1992	-4.72	0.99	2.13	-5.17
Q3 1992	6.94	1.35	-0.07	7.72
Q4 1992	-6.86	0.75	0.41	-7.69
Q1 1993	-11.02	0.65	-0.67	-11.27
Q2 1993	-0.50	0.84	1.60	-2.01
Q3 1993	1.04	1.21	0.28	1.43
Q4 1993	1.04	0.83	0.33	0.49
Q1 1994	-1.46	0.64	0.14	-1.76
Q2 1994	-0.97	1.02	1.79	-1.85

Table 5.3 continue

Year/ Quarter	Exchange Rate $\Psi$	Price Index in Domestic currencies $\Pi'$	UK inflation dp1	Deviation E from PPP
(1)	(2)	(3)	(4)	(5)
Q3 1994	2.11	0.81	0.02	3.09
Q4 1994	0.23	0.96	0.64	-0.71
Q1 1995	-1.53	0.59	0.89	-1.48
Q2 1995	1.40	1.20	1.80	1.09
Q3 1995	-2.19	1.15	0.27	-1.54
Q4 1995	0.72	0.71	0.16	0.28
Q1 1996	-0.90	0.47	0.51	-1.21
Q2 1996	-0.46	1.05	1.30	-1.00
Q3 1996	3.57	1.00	0.17	3.86
Q4 1996	1.28	0.56	0.61	0.90
Q1 1997	9.76	0.63	0.58	9.73
Q2 1997	-1.80	0.92	1.26	-2.14
Q3 1997	1.05	0.80	0.97	1.51
Q4 1997	2.06	0.65	0.80	2.39
Q1 1998	12.90	0.59	0.31	13.11
Q2 1998	-0.57	0.96	1.84	-1.22
Q3 1998	3.92	0.79	0.33	4.97
Q4 1998	1.92	0.67	0.45	1.58
Q1 1999	-6.98	0.65	-0.43	-7.19
Q2 1999	-0.80	0.27	1.05	-1.50
Q3 1999	-3.29	0.49	0.08	-2.72
Q4 1999	3.53	0.37	0.74	3.23
Q1 2000	-2.65	0.54	0.40	-2.45
Q2 2000	1.07	0.22	1.85	1.25
Q3 2000	-3.27	0.82	0.16	-2.23
Q4 2000	1.24	1.11	0.62	0.29
Q1 2001	3.05	0.68	-0.12	2.99
Q2 2001	0.25	0.74	1.23	-0.60
Q3 2001	-0.89	0.85	0.04	-0.51
Q4 2001	3.80	0.22	-0.12	3.61
Q1 2002	3.47	-0.05	0.06	3.40
Q2 2002	-2.71	0.58	1.24	-3.24
Q3 2002	0.39	1.14	0.34	0.49
Q4 2002	4.50	0.57	0.88	4.27
Q1 2003	-1.64	0.64	0.56	-1.40
Q2 2003	-3.41	0.80	1.18	-3.65
Q3 2003	1.19	0.41	0.26	1.96
Q4 2003	-1.58	0.19	0.62	-1.51
Q1 2004	4.01	0.20	0.49	4.43
Q2 2004	1.37	0.69	1.35	1.18
Q3 2004	0.48	0.93	0.59	0.90
Q4 2004	-0.92	0.59	0.92	-0.92
Q1 2005	-0.47	0.58	0.26	-0.13
Q2 2005	0.39	0.41	1.19	0.24
Q3 2005	-2.12	0.84	0.36	-1.78
Q4 2005	-1.82	0.70	0.53	-2.16
Q1 2006	-2.64	0.50	0.28	-2.61
Q2 2006	-0.20	0.52	1.72	-0.45
Q3 2006	5.29	1.07	0.86	5.94
Q4 2006	1.73	0.62	1.06	1.96
Q1 2007	2.18	0.12	0.81	3.13
Q2 2007	-0.10	0.43	1.60	0.29
Q3 2007	0.42	1.28	0.40	0.74
Q4 2007	-1.79	0.70	1.30	-2.09

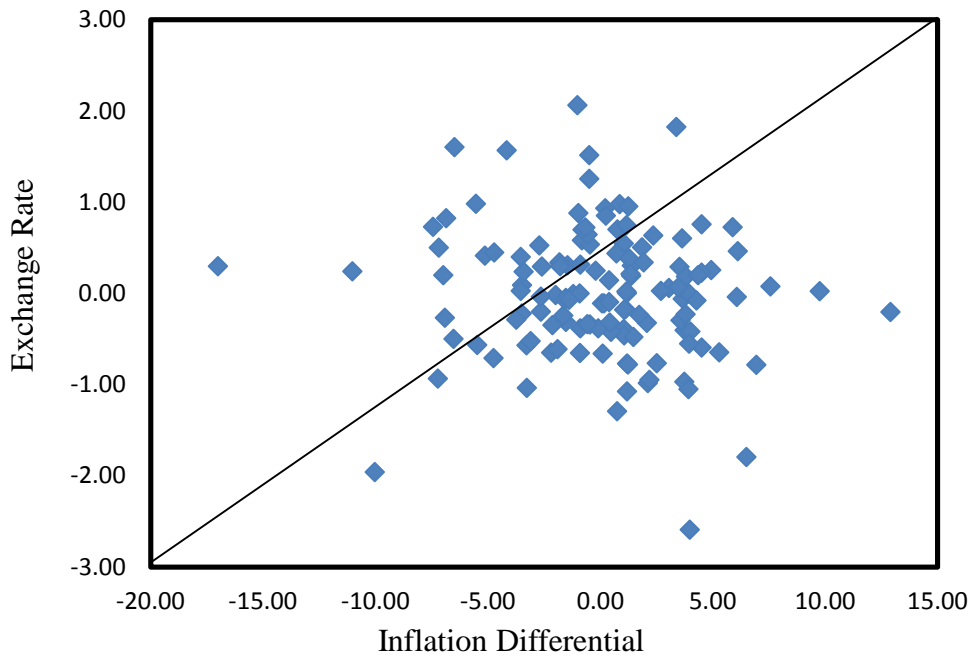
Table 5.3 continue				
Year/ Quarter	Exchange Rate $\Psi$	Price Index in Domestic currencies $\Pi'$	UK inflation dp1	Deviation E from PPP
(1)	(2)	(3)	(4)	(5)
Q1 2008	-3.73	1.01	0.60	-3.45
Q2 2008	-0.67	1.33	1.97	-1.39
Q3 2008	1.18	1.97	0.96	1.18
Q4 2008	-3.54	1.36	-0.85	-3.94
Q1 2009	-17.00	-0.55	-2.16	-17.30
Q2 2009	3.38	-0.33	0.77	1.56
Q3 2009	6.06	0.73	0.84	6.10
Q4 2009	-6.91	0.58	1.07	-6.65
Q1 2010	0.11	0.41	1.19	0.77
Q2 2010	-6.53	0.70	1.91	-6.03
Q3 2010	1.19	0.84	0.43	2.26
Q4 2010	-1.39	0.36	1.12	-1.32
Q1 2011	-3.09	0.60	1.72	-2.57
Q2 2011	1.47	1.24	1.72	1.94
Q3 2011	-1.90	1.10	0.55	-1.28
Q4 2011	2.69	0.58	1.01	2.66
Q1 2012	-0.91	0.36	0.39	-0.26
Q2 2012	1.34	0.60	1.11	1.13
Q3 2012	-0.58	0.77	0.36	-0.24
Q4 2012	1.17	0.38	1.19	1.14
Q1 2013	1.23	0.41	0.55	2.01
Q2 2013	-3.53	0.58	0.95	-3.56
Q3 2013	3.96	0.40	0.45	4.51
Q4 2013	4.35	0.65	0.64	4.15
Q1 2014	3.79	0.41	0.55	4.02
MEAN	-0.0029	0.98	0.97	-0.01

Note: All entries are multiplied by 100

Figure 5.2 is the time-series version of Figure 5.1 with  $\Psi_t$  replacing the average exchange rate change for country  $i$  and similarly for the inflation differentials. As can be seen, there is almost no relation between exchange rates and prices with quarterly data.

Figure 5.3 plots these two variables against time. This figure reveals little (if any) relationship on a quarter-to-quarter basis. Given the stationary nature of the returns. The unconditional mean can be interpreted as the long run change. This long-run, or underlying, change broadly approximates the inflation differential in Figure 5.3.

**Figure 5.2 Average exchange rate log-change against average inflation differential- short-run data**



**Figure 5.3: Time series of average exchange rate log-change and average inflation differential- short-run data**

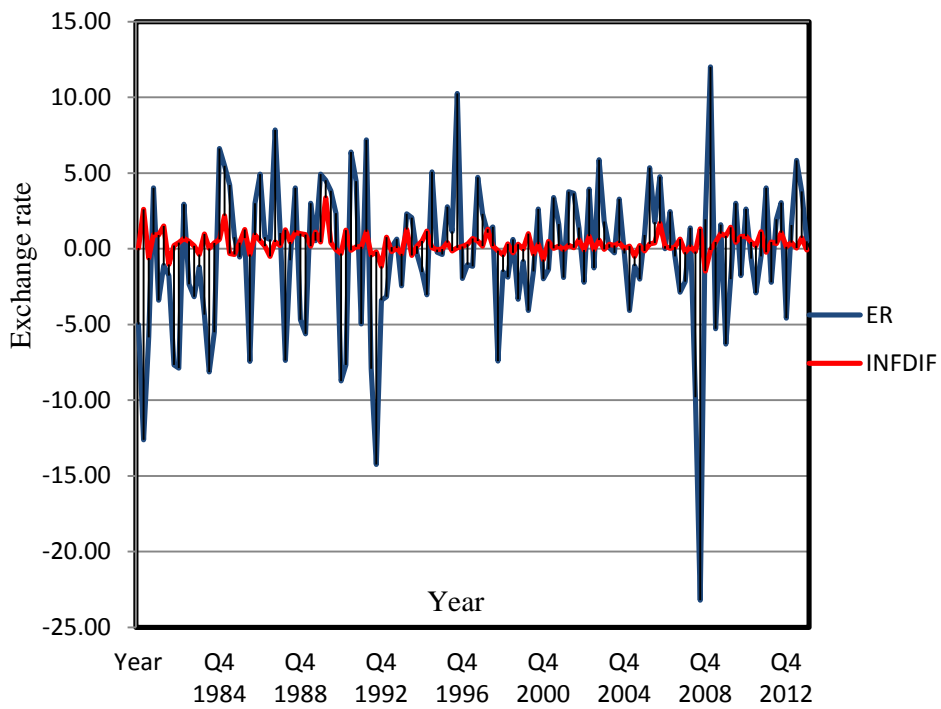


Figure 5.4 plots  $\Psi_t$  against  $E_t$  indicating that most of the deviations from PPP come from the nominal exchange rate changes.

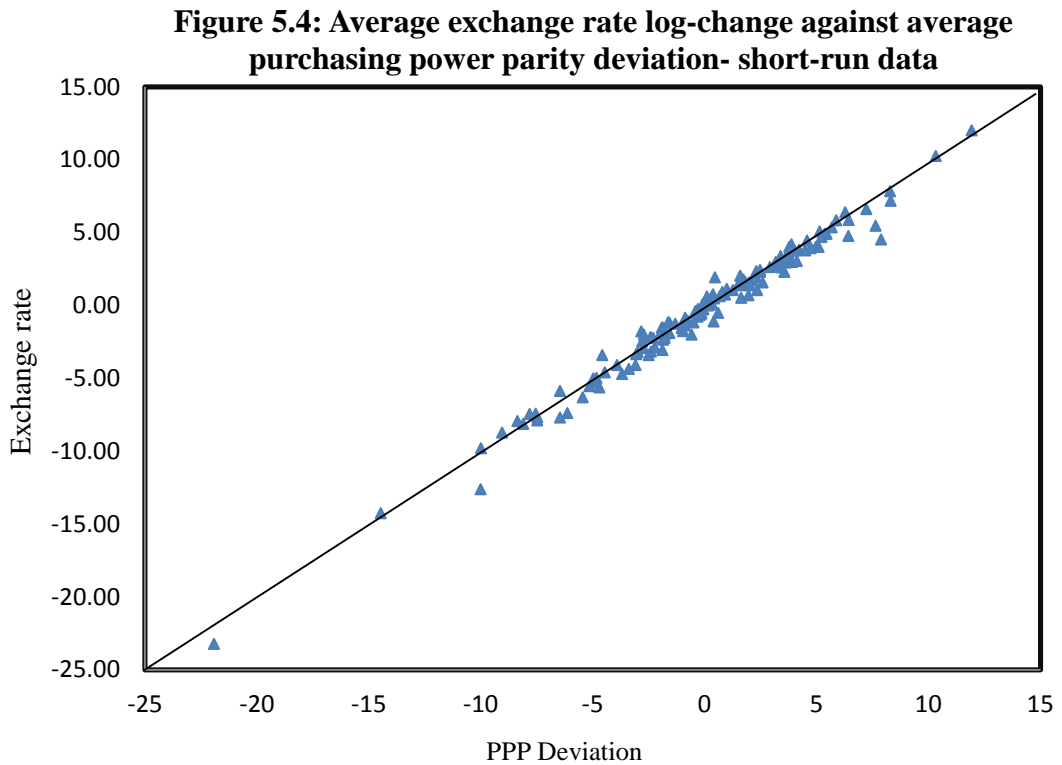


Table 5.4 is the quarterly version of columns (6)-(10) of Table 5.2. As can be seen, on average the  $(\sigma^s)$ ,  $(\sigma^{p'})$  and  $(\sigma^p)$  are far from each other and  $(\rho^{p's})$  is close to zero.

**Table 5.4: Divisia variances and co-variances of exchange rates and prices: short run data**

Year	Variance of			Price-exchange rate	
	$\sigma^s$	$\sigma^{p'}$	$\sigma^p$	$\sigma^{p's}$	$\rho^{p,s}$
(1)	(2)	(3)	(4)	(5)	(6)
Q1 1981	4.48	0.72	0.73	-1.47	-0.82
Q2 1981	14.77	0.33	2.69	0.24	0.11
Q3 1981	2.70	1.21	1.02	-0.91	-0.50
Q4 1981	6.35	0.32	0.61	0.38	0.27
Q1 1982	26.21	0.39	0.16	-1.10	-0.34
Q2 1982	2.82	0.33	0.00	0.39	0.41
Q3 1982	6.67	0.38	0.20	-1.23	-0.77
Q4 1982	31.32	0.34	1.33	-1.34	-0.41
Q1 1983	3.19	0.20	1.24	0.28	0.35
Q2 1983	0.24	0.11	0.28	-0.04	-0.25
Q3 1983	0.36	0.38	0.07	0.25	0.67
Q4 1983	2.55	0.05	0.19	0.15	0.42
Q1 1984	2.51	0.11	0.05	0.46	0.88
Q2 1984	7.06	0.18	0.23	0.12	0.10

Table 5.4 (Continued)

Year	Variance of			Price-exchange rate	
	$\sigma^s$	$\sigma^{p'}$	$\sigma^p$	$\sigma^{p',s}$	$\rho^{p',s}$
(1)	(2)	(3)	(4)	(5)	(6)
Q3 1984	8.60	0.25	1.21	-0.06	-0.04
Q4 1984	4.36	0.07	0.45	0.51	0.91
Q1 1985	3.81	0.19	0.91	0.01	0.01
Q2 1985	1.08	0.32	1.09	0.07	0.12
Q3 1985	42.26	0.10	0.30	1.61	0.76
Q4 1985	11.90	0.15	0.00	0.85	0.63
Q1 1986	25.71	0.43	0.00	-0.37	-0.11
Q2 1986	20.83	0.20	0.08	-0.06	-0.03
Q3 1986	9.56	0.51	1.21	1.30	0.59
Q4 1986	1.86	0.26	0.30	-0.49	-0.72
Q1 1987	14.24	0.71	0.61	2.51	0.79
Q2 1987	0.38	0.09	0.02	0.00	0.01
Q3 1987	0.20	0.46	0.00	0.09	0.30
Q4 1987	77.11	0.17	1.58	2.03	0.56
Q1 1988	4.26	0.33	0.04	-0.58	-0.49
Q2 1988	14.79	0.16	0.89	-0.76	-0.49
Q3 1988	0.66	0.36	0.00	0.07	0.14
Q4 1988	10.79	0.11	0.61	0.26	0.23
Q1 1989	8.38	0.69	0.32	-1.78	-0.74
Q2 1989	15.94	0.20	0.49	1.52	0.85
Q3 1989	2.19	0.21	0.22	0.31	0.47
Q4 1989	2.81	0.10	0.06	-0.32	-0.63
Q1 1990	17.24	0.45	0.68	-2.53	-0.91
Q2 1990	3.04	0.40	1.54	-0.49	-0.44
Q3 1990	19.39	0.43	0.46	2.55	0.88
Q4 1990	1.45	0.07	0.14	0.13	0.42
Q1 1991	6.69	0.39	2.13	-0.20	-0.12
Q2 1991	3.38	0.16	0.99	0.25	0.34
Q3 1991	4.26	0.25	0.93	0.58	0.57
Q4 1991	9.88	0.25	0.52	-0.98	-0.62
Q1 1992	9.48	0.42	0.58	-1.42	-0.71
Q2 1992	8.56	0.16	1.73	-0.92	-0.79
Q3 1992	8.98	0.36	1.73	1.19	0.67
Q4 1992	9.98	0.05	4.63	-0.26	-0.38
Q1 1993	15.55	0.19	0.43	1.41	0.83
Q2 1993	14.39	0.14	0.11	-0.04	-0.03
Q3 1993	1.14	0.02	0.00	0.03	0.18
Q4 1993	6.31	0.19	0.01	-1.06	-0.95
Q1 1994	17.61	0.21	0.15	0.96	0.51
Q2 1994	4.37	0.09	0.25	0.16	0.26
Q3 1994	0.64	0.36	0.05	-0.13	-0.26
Q4 1994	1.06	0.03	0.00	-0.03	-0.14
Q1 1995	48.90	0.49	0.02	4.68	0.96
Q2 1995	1.17	0.17	0.07	0.37	0.83
Q3 1995	54.51	0.10	0.54	-2.25	-0.96
Q4 1995	4.35	0.07	0.00	-0.52	-0.92
Q1 1996	3.57	0.40	0.00	-0.81	-0.68
Q2 1996	2.43	0.05	0.22	-0.08	-0.25
Q3 1996	0.74	0.13	0.02	-0.12	-0.38
Q4 1996	6.26	0.09	2.48	-0.41	-0.55
Q1 1997	9.46	0.22	0.08	-1.29	-0.89
Q2 1997	13.57	0.65	0.01	-2.87	-0.97
Q3 1997	6.05	0.07	0.01	-0.40	-0.63

Table 5.4 (Continued)

Year	Variance of			Price-exchange rate	
	$\sigma^s$	$\sigma^{p'}$	$\sigma^p$	$\sigma^{p',s}$	$\rho^{p',s}$
(1)	(2)	(3)	(4)	(5)	(6)
Q4 1997	38.35	0.03	0.67	0.48	0.47
Q1 1998	4.21	0.25	0.16	-0.93	-0.90
Q2 1998	5.42	0.06	0.14	0.03	0.05
Q3 1998	2.07	0.31	0.07	0.36	0.45
Q4 1998	72.37	0.09	1.46	-2.10	-0.85
Q1 1999	5.53	0.38	0.09	-1.31	-0.91
Q2 1999	1.96	0.09	0.06	-0.26	-0.62
Q3 1999	33.46	0.18	0.00	2.39	0.97
Q4 1999	4.02	0.09	0.22	0.52	0.85
Q1 2000	0.78	0.45	0.02	0.02	0.03
Q2 2000	2.44	0.23	0.22	-0.46	-0.61
Q3 2000	1.85	0.28	0.08	-0.17	-0.24
Q4 2000	7.63	0.11	0.19	-0.74	-0.81
Q1 2001	17.08	0.35	0.17	-2.25	-0.92
Q2 2001	0.82	0.27	0.02	-0.05	-0.10
Q3 2001	6.85	0.04	0.26	0.38	0.77
Q4 2001	21.05	0.03	0.08	-0.11	-0.13
Q1 2002	0.63	0.31	0.09	-0.35	-0.80
Q2 2002	19.54	0.10	0.38	0.71	0.51
Q3 2002	1.49	0.13	0.35	0.01	0.03
Q4 2002	4.43	0.10	0.10	-0.20	-0.30
Q1 2003	3.65	0.37	0.14	-0.25	-0.21
Q2 2003	5.12	0.03	0.59	0.11	0.28
Q3 2003	9.66	0.06	0.05	0.76	0.96
Q4 2003	5.72	0.05	1.13	0.14	0.26
Q1 2004	2.41	0.20	0.09	0.47	0.67
Q2 2004	4.72	0.26	0.00	-1.06	-0.95
Q3 2004	2.35	0.04	0.00	-0.02	-0.06
Q4 2004	13.09	0.02	0.39	0.21	0.45
Q1 2005	4.33	0.30	0.00	-0.92	-0.81
Q2 2005	3.24	0.28	0.44	-0.73	-0.77
Q3 2005	3.14	0.31	0.08	-0.53	-0.53
Q4 2005	3.09	0.04	0.09	-0.25	-0.72
Q1 2006	0.39	0.08	0.02	-0.02	-0.10
Q2 2006	6.61	0.31	0.93	0.74	0.52
Q3 2006	2.47	0.07	0.13	0.01	0.03
Q4 2006	3.44	0.19	1.28	-0.29	-0.36
Q1 2007	0.35	0.35	0.00	0.24	0.69
Q2 2007	8.77	0.36	0.20	-1.04	-0.58
Q3 2007	9.46	0.07	0.01	0.22	0.27
Q4 2007	1.76	0.10	0.16	0.20	0.47
Q1 2008	30.78	0.40	0.19	2.87	0.82
Q2 2008	7.95	0.27	0.07	-1.33	-0.91
Q3 2008	11.52	0.06	3.01	-0.03	-0.04
Q4 2008	81.86	1.16	12.36	-3.11	-0.32
Q1 2009	13.19	0.24	0.01	-0.97	-0.55
Q2 2009	14.96	0.24	3.51	0.17	0.09
Q3 2009	12.95	0.19	0.60	1.26	0.81
Q4 2009	3.62	0.12	0.17	-0.56	-0.86
Q1 2010	1.90	0.09	0.74	0.01	0.01
Q2 2010	9.68	0.07	0.01	0.50	0.59
Q3 2010	9.47	0.15	0.28	0.36	0.30
Q4 2010	2.62	0.03	0.02	0.01	0.03

Table 5.4 (Continued)

Year	Variance of			Price-exchange rate	
	$\sigma^s$	$\sigma^{p'}$	$\sigma^p$	$\sigma^{p',s}$	$\rho^{p',s}$
(1)	(2)	(3)	(4)	(5)	(6)
Q1 2011	1.74	0.48	0.29	-0.66	-0.73
Q2 2011	1.71	0.38	0.00	0.72	0.89
Q3 2011	17.06	0.09	0.18	0.70	0.56
Q4 2011	0.82	0.07	0.01	-0.06	-0.26
Q1 2012	10.06	0.06	0.34	-0.54	-0.67
Q2 2012	3.20	0.11	0.08	0.47	0.78
Q3 2012	1.82	0.15	0.13	0.33	0.63
Q4 2012	19.48	0.07	0.42	-0.25	-0.22
Q1 2013	12.13	0.10	0.49	-0.76	-0.70
Q2 2013	7.57	0.03	0.09	-0.03	-0.06
Q3 2013	2.04	0.03	0.86	0.01	0.06
Q4 2013	7.87	0.13	0.53	0.73	0.73
Q1 2014	1.95	0.12	0.00	0.33	0.68
Mean	10.06	0.23	0.56	-0.06	-0.03

Notes: All entries are multiplied by 10,000 except those in the last column

As shown above, the short-run results indicate that PPP performs poorly. On the other hand, the long-run data are quite consistent with the PPP hypothesis. If PPP holds in the long run only, how long is the long run? Manzur (1990) handles this question by computing multi-period Divisia price-exchange rate correlations. For this purpose, rather than using changes in prices and exchange rates over one quarter as before, changes are used for over two quarters, three quarters and so on, up to the last quarter of the sample time period. Since these changes involve comparisons of periods which become further and further apart, they represent the transition from the short run to the long run. A similar exercise is carried out here and the results are presented in Table 5.5. Note that this table reports multi-period Divisia price-exchange rate correlations for up to 35 quarter-change for brevity. Each entry in this table is a Divisia price-exchange rate correlation for a given length of change. Thus, the entries under the first-quarter change coincide with those in the last column of Table 5.4. As can be seen, the correlations improve as one moves from left to right in Table 5.5. The last row of the table gives the averages of the correlation coefficients for the various lengths of changes. We plot these averages against the length of the change, as in Figure 5.5. It can be seen that the values increase with the length of the change and reach around 0.60 after about 20 quarters. Thus, the results tend to identify five years as being a broad measure of the length of the long run insofar as PPP is concerned.



In summary, the results based on the UK as the reference country indicate that the short-run variability in exchange rates does not reflect at all inflation differentials. This finding is in sharp contrast to the long-run results and is consistent with Manzur (1990).

**Table 5.5a: Divisia price-exchange rate correlation coefficients:  
1- to 18- quarter changes**

	Length of change (quarters)																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Q1 1981	-0.82																	
Q2 1981	0.11	-0.71																
Q3 1981	-0.50	-0.72	-0.82															
Q4 1981	0.27	0.79	-0.30	-0.29														
Q1 1982	-0.34	-0.06	-0.44	-0.34	-0.50													
Q2 1982	0.41	-0.16	0.10	-0.20	-0.21	-0.38												
Q3 1982	-0.77	-0.55	-0.53	-0.31	-0.47	-0.42	-0.53											
Q4 1982	-0.41	0.15	0.32	0.11	0.61	0.28	0.05	-0.15										
Q1 1983	0.35	-0.03	0.16	0.54	0.16	0.49	0.25	0.09	-0.09									
Q2 1983	-0.25	0.35	0.05	0.34	0.60	0.19	0.55	0.31	0.09	-0.06								
Q3 1983	0.67	0.60	0.14	0.43	0.47	0.64	0.15	0.54	0.45	0.12	-0.05							
Q4 1983	0.42	0.68	0.71	0.79	0.52	0.62	0.76	0.40	0.70	0.51	0.28	0.09						
Q1 1984	0.88	0.66	0.77	0.90	0.88	0.60	0.69	0.80	0.55	0.83	0.66	0.40	0.20					
Q2 1984	0.10	0.17	0.58	0.67	0.72	0.65	0.73	0.74	0.75	0.42	0.69	0.50	0.31	0.14				
Q3 1984	-0.04	-0.08	0.02	0.50	0.43	0.50	0.48	0.85	0.76	0.69	0.34	0.56	0.40	0.26	0.11			
Q4 1984	0.91	0.36	0.23	0.37	0.61	0.49	0.54	0.52	0.83	0.68	0.68	0.39	0.57	0.41	0.29	0.15		
Q1 1985	0.01	0.65	0.42	0.33	0.38	0.62	0.55	0.58	0.51	0.89	0.75	0.73	0.43	0.61	0.46	0.33	0.19	
Q2 1985	0.12	0.07	0.63	0.58	0.42	0.50	0.69	0.65	0.65	0.64	0.93	0.83	0.80	0.50	0.67	0.54	0.40	0.26
Q3 1985	0.76	0.82	0.84	0.75	0.95	0.91	0.94	0.96	0.96	0.94	0.95	0.95	0.98	0.98	0.85	0.93	0.85	0.72
Q4 1985	0.63	0.80	0.78	0.70	0.74	0.94	0.94	0.95	0.96	0.97	0.96	0.98	0.92	0.97	0.98	0.94	0.98	0.94
Q1 1986	-0.11	0.22	0.49	0.50	0.51	0.53	0.76	0.83	0.81	0.85	0.90	0.88	0.91	0.78	0.86	0.90	0.97	0.95
Q2 1986	-0.03	0.00	0.23	0.41	0.44	0.48	0.49	0.71	0.79	0.80	0.80	0.86	0.85	0.87	0.76	0.84	0.87	0.95
Q3 1986	0.59	0.61	0.33	0.43	0.54	0.55	0.56	0.57	0.66	0.78	0.79	0.79	0.84	0.84	0.85	0.75	0.82	0.85
Q4 1986	-0.72	0.18	0.57	0.31	0.40	0.52	0.53	0.53	0.60	0.72	0.78	0.79	0.80	0.84	0.83	0.85	0.74	0.81
Q1 1987	0.79	0.35	0.54	0.65	0.47	0.52	0.61	0.59	0.59	0.60	0.73	0.77	0.78	0.79	0.83	0.82	0.83	0.74
Q2 1987	0.01	0.73	0.34	0.50	0.64	0.46	0.51	0.60	0.61	0.58	0.60	0.72	0.77	0.78	0.79	0.82	0.82	0.83
Q3 1987	0.30	0.14	0.80	0.38	0.58	0.73	0.56	0.60	0.67	0.66	0.65	0.67	0.77	0.81	0.82	0.83	0.85	0.85
Q4 1987	0.56	0.84	0.76	0.80	0.69	0.71	0.71	0.59	0.61	0.66	0.64	0.63	0.63	0.72	0.74	0.75	0.76	0.79
Q1 1988	-0.49	0.79	0.88	0.81	0.81	0.71	0.73	0.74	0.70	0.66	0.70	0.68	0.67	0.68	0.76	0.78	0.79	0.80
Q2 1988	-0.49	-0.65	0.78	0.81	0.79	0.79	0.65	0.71	0.83	0.65	0.68	0.72	0.71	0.70	0.71	0.79	0.83	0.84
Q3 1988	0.14	-0.68	-0.63	0.82	0.83	0.82	0.83	0.71	0.77	0.81	0.71	0.73	0.76	0.75	0.74	0.76	0.83	0.86
Q4 1988	0.23	0.80	-0.04	-0.18	0.77	0.82	0.79	0.79	0.74	0.74	0.77	0.68	0.70	0.74	0.72	0.71	0.73	0.80
Q1 1989	-0.74	0.54	0.43	-0.40	-0.44	0.80	0.80	0.79	0.79	0.71	0.77	0.82	0.74	0.76	0.79	0.77	0.77	0.78
Q2 1989	0.85	-0.46	-0.39	-0.28	-0.38	-0.44	0.51	0.48	0.44	0.71	0.53	0.71	0.82	0.72	0.74	0.78	0.77	0.76
Q3 1989	0.47	0.07	-0.56	-0.29	-0.21	-0.39	-0.43	0.62	0.61	0.60	0.72	0.58	0.70	0.79	0.70	0.72	0.76	0.75
Q4 1989	-0.63	-0.63	-0.22	-0.51	-0.51	-0.47	-0.47	-0.49	0.32	0.34	0.32	0.57	0.37	0.56	0.73	0.65	0.68	0.73
Q1 1990	-0.91	-0.85	-0.79	-0.56	-0.68	-0.68	-0.66	-0.63	-0.59	-0.32	-0.31	-0.30	0.07	-0.17	0.19	0.68	0.64	0.70
Q2 1990	-0.44	-0.63	-0.68	-0.78	-0.44	-0.56	-0.60	-0.59	-0.52	-0.54	-0.15	-0.13	-0.13	0.23	-0.01	0.32	0.66	0.61
Q3 1990	0.88	0.70	0.68	-0.32	-0.04	-0.57	-0.65	-0.53	-0.42	-0.52	-0.49	0.43	0.46	0.45	0.58	0.42	0.58	0.71
Q4 1990	0.42	0.81	0.66	0.28	-0.13	0.09	-0.43	-0.60	-0.37	-0.22	-0.46	-0.43	0.53	0.56	0.55	0.62	0.49	0.61
Q1 1991	-0.12	-0.10	0.68	0.60	0.48	-0.38	-0.01	-0.46	-0.40	-0.47	-0.34	-0.42	-0.42	0.48	0.48	0.48	0.62	0.46
Q2 1991	0.34	0.30	0.22	0.69	0.56	0.89	0.63	0.56	-0.09	-0.22	0.08	0.16	-0.15	-0.21	0.69	0.67	0.67	0.72

Table 5.5a (Continued)

	Length of change (quarters)																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Q3 1991	0.57	0.44	0.28	0.62	0.70	0.56	0.73	0.51	0.46	0.18	-0.19	0.32	0.44	-0.07	-0.14	0.71	0.72	0.72
Q4 1991	-0.62	0.06	0.00	0.35	0.34	0.49	0.36	0.54	0.45	0.44	0.43	0.46	0.57	0.73	0.52	0.26	0.75	0.78
Q1 1992	-0.71	-0.04	0.40	0.50	0.72	0.72	0.69	0.59	0.67	0.63	0.58	0.46	-0.02	0.66	0.69	0.06	-0.02	0.84
Q2 1992	-0.79	-0.18	-0.10	0.10	0.15	0.51	0.45	0.50	0.49	0.52	0.41	0.42	0.40	0.38	0.55	0.70	0.52	0.28
Q3 1992	0.67	0.37	0.38	0.27	0.40	0.39	0.57	0.53	0.48	0.53	0.63	0.57	0.57	0.59	0.72	0.70	0.81	0.94
Q4 1992	-0.38	0.08	0.25	0.18	0.32	0.47	0.50	0.61	0.60	0.66	0.64	0.75	0.73	0.73	0.77	0.65	0.87	0.92
Q1 1993	0.83	0.33	0.53	0.70	0.63	0.57	0.65	0.62	0.64	0.66	0.72	0.70	0.79	0.78	0.78	0.82	0.89	0.88
Q2 1993	-0.03	0.64	0.68	0.69	0.62	0.69	0.54	0.60	0.62	0.64	0.63	0.68	0.65	0.75	0.74	0.75	0.77	0.86
Q3 1993	0.18	-0.07	0.48	0.58	0.64	0.56	0.65	0.50	0.50	0.53	0.61	0.60	0.66	0.63	0.73	0.72	0.73	0.74
Q4 1993	-0.95	-0.80	0.48	0.78	0.64	0.65	0.67	0.65	0.69	0.63	0.61	0.67	0.66	0.70	0.69	0.77	0.76	0.77
Q1 1994	0.51	0.62	0.48	0.54	0.71	0.67	0.68	0.65	0.61	0.57	0.62	0.60	0.66	0.65	0.69	0.68	0.74	0.74
Q2 1994	0.26	0.48	0.71	0.60	0.54	0.70	0.71	0.72	0.74	0.70	0.60	0.63	0.61	0.68	0.67	0.70	0.68	0.74
Q3 1994	-0.26	0.87	0.74	0.79	0.72	0.68	0.77	0.77	0.72	0.72	0.74	0.65	0.68	0.66	0.71	0.70	0.73	0.70
Q4 1994	-0.14	-0.69	0.57	0.60	0.60	0.54	0.59	0.71	0.70	0.71	0.67	0.69	0.60	0.64	0.62	0.68	0.67	0.70
Q1 1995	0.96	0.89	0.87	0.85	0.81	0.84	0.80	0.75	0.77	0.82	0.81	0.77	0.78	0.71	0.72	0.70	0.73	0.72
Q2 1995	0.83	0.95	0.91	0.89	0.87	0.84	0.87	0.84	0.86	0.83	0.84	0.84	0.80	0.81	0.74	0.75	0.73	0.76
Q3 1995	-0.96	-0.90	0.34	0.15	-0.13	0.65	0.82	0.75	0.73	0.80	0.85	0.86	0.84	0.81	0.81	0.75	0.76	0.75
Q4 1995	-0.92	-0.94	-0.90	-0.69	-0.79	-0.79	-0.06	0.76	0.44	0.47	0.77	0.85	0.84	0.81	0.80	0.78	0.74	0.75
Q1 1996	-0.68	-0.87	-0.93	-0.90	-0.77	-0.80	-0.80	-0.43	0.69	0.03	0.15	0.76	0.88	0.82	0.80	0.83	0.78	0.77
Q2 1996	-0.25	-0.56	-0.76	-0.88	-0.86	-0.73	-0.74	-0.75	-0.50	0.48	-0.19	-0.06	0.69	0.89	0.80	0.80	0.85	0.78
Q3 1996	-0.38	-0.24	-0.48	-0.71	-0.85	-0.83	-0.69	-0.71	-0.73	-0.48	0.34	-0.26	-0.15	0.61	0.88	0.76	0.78	0.85
Q4 1996	-0.55	-0.51	-0.35	-0.57	-0.70	-0.83	-0.82	-0.72	-0.76	-0.73	-0.58	-0.08	-0.45	-0.38	0.27	0.78	0.64	0.74
Q1 1997	-0.89	-0.81	-0.76	-0.71	-0.72	-0.78	-0.85	-0.85	-0.78	-0.81	-0.81	-0.73	-0.51	-0.68	-0.63	-0.25	0.49	0.23
Q2 1997	-0.97	-0.61	0.13	-0.08	-0.04	-0.27	-0.47	-0.67	-0.66	-0.60	-0.62	-0.64	-0.47	0.14	-0.33	-0.24	0.46	0.85
Q3 1997	-0.63	-0.65	0.15	-0.11	-0.27	-0.23	-0.40	-0.54	-0.63	-0.70	-0.65	-0.66	-0.68	-0.57	-0.24	-0.51	-0.45	0.08
Q4 1997	0.47	-0.05	0.48	0.42	0.09	-0.07	-0.09	-0.27	-0.35	-0.59	-0.61	-0.53	-0.56	-0.58	-0.49	-0.27	-0.45	-0.41
Q1 1998	-0.90	0.18	-0.15	0.70	0.29	-0.02	-0.15	-0.18	-0.15	-0.45	-0.61	-0.63	-0.57	-0.59	-0.61	-0.54	-0.35	-0.51
Q2 1998	0.05	-0.61	0.01	-0.22	0.55	0.22	-0.04	-0.16	-0.15	-0.32	-0.43	-0.59	-0.60	-0.55	-0.57	-0.59	-0.52	-0.37
Q3 1998	0.45	0.15	-0.27	-0.19	-0.35	0.30	-0.02	-0.21	-0.20	-0.26	-0.36	-0.46	-0.61	-0.61	-0.54	-0.56	-0.58	-0.51
Q4 1998	-0.85	0.36	0.43	0.53	0.70	0.62	0.36	0.55	0.41	0.36	0.30	0.16	-0.07	-0.44	-0.44	-0.13	-0.17	-0.23
Q1 1999	-0.91	0.73	0.79	0.86	0.72	0.64	0.25	0.69	0.50	0.14	0.08	0.02	-0.10	-0.28	-0.55	-0.55	-0.32	-0.36
Q2 1999	-0.62	-0.88	0.87	0.88	0.92	0.64	0.45	-0.04	0.63	0.24	-0.09	-0.14	-0.16	-0.25	-0.40	-0.63	-0.62	-0.44
Q3 1999	0.97	0.93	0.85	0.96	0.95	0.96	0.91	0.92	0.81	0.85	0.79	0.61	0.56	0.44	0.27	-0.01	-0.54	-0.51
Q4 1999	0.85	0.99	0.95	0.91	0.96	0.96	0.97	0.90	0.95	0.90	0.88	0.86	0.76	0.73	0.63	0.48	0.20	-0.48
Q1 2000	0.03	0.73	0.97	0.97	0.88	0.96	0.97	0.97	0.95	0.93	0.86	0.90	0.84	0.73	0.69	0.58	0.42	0.16
Q2 2000	-0.61	-0.61	0.25	0.97	0.95	0.78	0.96	0.96	0.95	0.90	0.88	0.75	0.88	0.77	0.61	0.55	0.42	0.25
Q3 2000	-0.24	-0.68	-0.59	-0.01	0.92	0.87	0.57	0.93	0.95	0.94	0.86	0.82	0.65	0.85	0.69	0.51	0.44	0.32
Q4 2000	-0.81	-0.70	-0.81	-0.78	-0.59	0.79	0.65	-0.06	0.92	0.96	0.92	0.83	0.64	0.36	0.74	0.47	0.22	0.16
Q1 2001	-0.92	-0.89	-0.82	-0.86	-0.85	-0.79	-0.17	-0.45	-0.68	0.67	0.77	0.60	0.44	0.09	-0.17	0.29	-0.04	-0.23
Q2 2001	-0.10	-0.94	-0.92	-0.86	-0.87	-0.86	-0.79	-0.14	-0.40	-0.67	0.68	0.79	0.63	0.46	0.11	-0.16	0.32	-0.02
Q3 2001	0.77	0.91	-0.55	-0.75	-0.69	-0.75	-0.73	-0.60	0.38	0.12	-0.34	0.82	0.87	0.76	0.64	0.38	0.11	0.51
Q4 2001	-0.13	-0.28	-0.30	-0.72	-0.78	-0.74	-0.77	-0.76	-0.69	-0.29	-0.46	-0.62	0.40	0.54	0.35	0.20	-0.04	-0.22
Q1 2002	-0.80	-0.64	-0.32	-0.38	-0.73	-0.77	-0.74	-0.77	-0.74	-0.71	-0.33	-0.50	-0.64	0.37	0.52	0.32	0.17	-0.07
Q2 2002	0.51	0.58	0.01	0.68	0.63	-0.34	-0.59	-0.60	-0.65	-0.64	-0.52	0.37	0.13	-0.28	0.82	0.89	0.76	0.62
Q3 2002	0.03	0.65	0.62	-0.10	0.60	0.57	-0.33	-0.55	-0.56	-0.63	-0.62	-0.51	0.28	0.05	-0.32	0.81	0.87	0.73
Q4 2002	-0.30	-0.25	0.36	0.30	-0.20	0.52	0.56	-0.35	-0.59	-0.61	-0.67	-0.65	-0.54	0.55	0.31	-0.27	0.93	0.95
Q1 2003	-0.21	-0.07	-0.28	0.33	0.26	-0.35	0.42	0.40	-0.63	-0.72	-0.74	-0.78	-0.76	-0.67	0.58	0.23	-0.41	0.93
Q2 2003	0.28	-0.29	-0.25	-0.53	0.07	0.01	-0.46	0.03	0.04	-0.63	-0.74	-0.79	-0.83	-0.81	-0.75	0.25	-0.13	-0.52
Q3 2003	0.96	0.87	0.44	0.32	0.14	0.39	0.34	0.06	0.43	0.43	0.00	-0.47	-0.64	-0.76	-0.74	-0.54	0.84	0.66
Q4 2003	0.26	0.87	0.82	0.53	0.43	0.29	0.44	0.40	0.19	0.46	0.45	0.23	-0.14	-0.29	-0.51	-0.50	-0.15	0.79
Q1 2004	0.67	0.83	0.94	0.74	0.65	0.54	0.44	0.54	0.51	0.33	0.55	0.54	0.39	0.06	-0.06	-0.32	-0.31	0.16

Table 5.5a (Continued)

	Length of change (quarters)																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Q2 2004	-0.95	-0.53	0.56	0.89	0.66	0.53	0.45	0.32	0.56	0.44	0.20	0.48	0.47	0.13	-0.28	-0.45	-0.68	-0.69
Q3 2004	-0.06	-0.85	-0.75	0.21	0.85	0.56	0.42	0.39	0.34	0.47	0.40	0.14	0.42	0.40	0.04	-0.31	-0.46	-0.64
Q4 2004	0.45	0.73	0.32	0.51	0.62	0.83	0.67	0.57	0.57	0.40	0.51	0.45	0.29	0.48	0.47	0.29	0.04	-0.05
Q1 2005	-0.81	0.53	0.26	-0.46	-0.07	0.36	0.75	0.54	0.49	0.41	0.32	0.49	0.42	0.21	0.43	0.41	0.15	-0.15
Q2 2005	-0.77	-0.83	-0.13	-0.19	-0.72	-0.58	0.04	0.73	0.45	0.34	0.36	0.25	0.49	0.42	0.14	0.40	0.38	0.01
Q3 2005	-0.53	-0.86	-0.90	-0.40	-0.35	-0.69	-0.59	-0.17	0.49	0.28	0.19	0.23	0.12	0.40	0.32	0.03	0.28	0.26
Q4 2005	-0.72	-0.79	-0.90	-0.90	-0.66	-0.57	-0.77	-0.73	-0.47	0.16	0.04	0.00	0.06	-0.07	0.28	0.19	-0.15	0.10
Q1 2006	-0.10	-0.82	-0.78	-0.88	-0.91	-0.66	-0.59	-0.77	-0.71	-0.48	0.14	0.02	-0.02	0.05	-0.08	0.26	0.18	-0.16
Q2 2006	0.52	0.60	0.00	-0.30	-0.60	-0.72	-0.28	-0.27	-0.55	-0.46	-0.17	0.36	0.21	0.15	0.21	0.10	0.40	0.33
Q3 2006	0.03	0.43	0.38	-0.27	-0.44	-0.62	-0.70	-0.41	-0.37	-0.60	-0.55	-0.34	0.14	0.05	0.01	0.08	-0.03	0.30
Q4 2006	-0.36	-0.21	0.24	-0.27	-0.60	-0.69	-0.78	-0.80	-0.60	-0.53	-0.72	-0.69	-0.50	-0.03	-0.11	-0.12	-0.05	-0.17
Q1 2007	0.69	-0.20	-0.46	-0.03	-0.06	-0.50	-0.63	-0.74	-0.75	-0.54	-0.48	-0.70	-0.65	-0.44	0.05	-0.05	-0.07	0.00
Q2 2007	-0.58	-0.47	-0.70	-0.80	-0.37	-0.40	-0.62	-0.65	-0.73	-0.77	-0.58	-0.53	-0.68	-0.65	-0.50	-0.20	-0.21	-0.22
Q3 2007	0.27	0.30	0.35	-0.08	-0.23	0.20	0.16	-0.10	-0.23	-0.37	-0.52	-0.21	-0.20	-0.42	-0.34	-0.17	0.15	0.07
Q4 2007	0.47	0.47	0.56	0.61	0.25	0.12	0.44	0.41	0.17	0.01	-0.17	-0.36	-0.01	-0.03	-0.27	-0.18	-0.01	0.31
Q1 2008	0.82	0.68	0.70	0.92	0.96	0.83	0.84	0.86	0.86	0.84	0.77	0.69	0.45	0.69	0.59	0.40	0.53	0.58
Q2 2008	-0.91	0.76	0.73	0.86	0.83	0.85	0.71	0.65	0.72	0.71	0.60	0.43	0.26	0.01	0.35	0.27	0.02	0.16
Q3 2008	-0.04	-0.72	0.38	0.60	0.78	0.81	0.83	0.82	0.81	0.87	0.89	0.81	0.61	0.37	0.08	0.52	0.40	0.09
Q4 2008	-0.32	-0.13	0.08	0.58	0.55	0.52	0.73	0.83	0.79	0.80	0.91	0.92	0.92	0.94	0.90	0.83	0.95	0.95
Q1 2009	-0.55	0.26	0.33	0.54	0.62	0.59	0.59	0.71	0.73	0.76	0.78	0.90	0.91	0.88	0.85	0.72	0.58	0.84
Q2 2009	0.09	-0.77	0.15	0.26	0.31	0.62	0.60	0.60	0.62	0.79	0.71	0.75	0.89	0.90	0.92	0.90	0.86	0.76
Q3 2009	0.81	0.51	-0.17	0.15	0.34	0.44	0.69	0.67	0.69	0.74	0.81	0.75	0.78	0.89	0.90	0.91	0.89	0.90
Q4 2009	-0.86	0.42	0.23	-0.41	0.24	0.46	0.40	0.73	0.72	0.70	0.75	0.81	0.74	0.78	0.88	0.89	0.90	0.85
Q1 2010	0.01	-0.72	0.19	0.10	-0.45	0.29	0.50	0.38	0.75	0.73	0.72	0.74	0.79	0.73	0.77	0.87	0.87	0.87
Q2 2010	0.59	0.96	0.64	0.84	0.47	-0.09	0.59	0.69	0.63	0.82	0.80	0.78	0.82	0.86	0.81	0.83	0.91	0.92
Q3 2010	0.30	0.82	0.72	0.59	0.67	0.43	0.11	0.50	0.67	0.65	0.79	0.78	0.75	0.78	0.83	0.76	0.78	0.86
Q4 2010	0.03	0.22	0.68	0.61	0.49	0.60	0.41	0.15	0.77	0.60	0.61	0.77	0.76	0.72	0.75	0.80	0.73	0.75
Q1 2011	-0.73	-0.02	0.30	0.70	0.67	0.43	0.59	0.39	0.11	0.55	0.70	0.67	0.82	0.81	0.78	0.79	0.83	0.76
Q2 2011	0.89	0.17	0.49	0.51	0.80	0.77	0.59	0.67	0.46	0.24	0.65	0.77	0.73	0.85	0.85	0.82	0.82	0.85
Q3 2011	0.56	0.70	0.68	0.92	0.92	0.94	0.96	0.94	0.90	0.76	0.65	0.84	0.89	0.89	0.92	0.91	0.89	0.91
Q4 2011	-0.26	0.80	0.87	0.80	0.93	0.84	0.91	0.92	0.88	0.86	0.70	0.57	0.80	0.87	0.87	0.91	0.90	0.88
Q1 2012	-0.67	-0.68	0.26	0.55	-0.01	0.51	0.58	0.86	0.88	0.71	0.74	0.52	0.26	0.74	0.84	0.82	0.90	0.89
Q2 2012	0.78	-0.82	-0.62	0.53	0.72	0.50	0.83	0.81	0.94	0.93	0.88	0.85	0.66	0.48	0.82	0.89	0.88	0.92
Q3 2012	0.63	0.94	-0.16	-0.28	0.72	0.86	0.69	0.85	0.81	0.90	0.90	0.84	0.83	0.66	0.51	0.82	0.89	0.88
Q4 2012	-0.22	-0.65	-0.47	-0.75	-0.70	-0.22	-0.11	-0.36	-0.19	0.16	0.72	0.72	0.36	0.61	0.38	0.03	0.75	0.89
Q1 2013	-0.70	-0.60	-0.70	-0.62	-0.76	-0.69	-0.41	-0.44	-0.49	-0.53	-0.39	0.19	0.18	-0.26	0.30	0.12	-0.33	0.72
Q2 2013	-0.06	-0.56	-0.48	-0.57	-0.55	-0.70	-0.64	-0.40	-0.34	-0.58	-0.57	-0.54	-0.18	-0.16	-0.46	0.04	-0.11	-0.56
Q3 2013	0.06	0.68	-0.15	-0.26	-0.43	-0.43	-0.60	-0.56	-0.30	-0.38	-0.51	-0.50	-0.46	-0.11	-0.10	-0.41	0.08	-0.07
Q4 2013	0.73	0.58	0.82	0.31	0.14	-0.15	-0.26	-0.44	-0.44	-0.24	-0.37	-0.51	-0.52	-0.55	-0.36	-0.36	-0.54	-0.26
Q1 2014	0.68	0.24	0.32	0.28	-0.04	-0.15	-0.32	-0.35	-0.48	-0.49	-0.27	-0.36	-0.49	-0.50	-0.50	-0.26	-0.27	-0.50
Mean	-0.03	0.05	0.15	0.19	0.21	0.23	0.24	0.26	0.29	0.29	0.31	0.33	0.34	0.37	0.39	0.40	0.43	0.45

**Table 5.5b: Divisia price-exchange rate correlation coefficients:  
19- to 35- quarter changes**

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Q3 1985	0.58																
Q4 1985	0.85	0.74															
Q1 1986	0.98	0.96	0.91														
Q2 1986	0.92	0.97	0.98	0.97													
Q3 1986	0.92	0.90	0.95	0.97	0.97												
Q4 1986	0.85	0.92	0.90	0.95	0.97	0.97											
Q1 1987	0.80	0.83	0.90	0.87	0.93	0.96	0.97										
Q2 1987	0.74	0.80	0.83	0.90	0.87	0.93	0.96	0.98									
Q3 1987	0.86	0.78	0.83	0.85	0.92	0.89	0.94	0.97	0.98								
Q4 1987	0.78	0.79	0.73	0.77	0.80	0.85	0.83	0.88	0.92	0.95							
Q1 1988	0.83	0.82	0.83	0.76	0.81	0.82	0.88	0.85	0.90	0.94	0.96						
Q2 1988	0.84	0.86	0.86	0.87	0.80	0.84	0.86	0.91	0.89	0.93	0.96	0.97					
Q3 1988	0.87	0.87	0.89	0.88	0.89	0.83	0.86	0.88	0.93	0.91	0.94	0.97	0.98				
Q4 1988	0.82	0.83	0.84	0.86	0.85	0.86	0.80	0.84	0.85	0.90	0.88	0.92	0.95	0.97			
Q1 1989	0.85	0.88	0.88	0.89	0.90	0.89	0.90	0.85	0.88	0.89	0.94	0.92	0.95	0.97	0.98		
Q2 1989	0.79	0.86	0.90	0.90	0.91	0.92	0.91	0.92	0.86	0.89	0.91	0.96	0.94	0.96	0.98	0.97	
Q3 1989	0.75	0.77	0.84	0.88	0.88	0.89	0.90	0.90	0.91	0.85	0.88	0.90	0.95	0.92	0.96	0.97	0.97
Q4 1989	0.73	0.72	0.75	0.83	0.87	0.87	0.88	0.90	0.89	0.90	0.84	0.87	0.89	0.94	0.92	0.94	0.97
Q1 1990	0.76	0.76	0.74	0.78	0.87	0.91	0.91	0.93	0.94	0.93	0.94	0.88	0.91	0.93	0.98	0.96	0.98
Q2 1990	0.66	0.72	0.71	0.70	0.74	0.83	0.87	0.88	0.89	0.90	0.90	0.92	0.86	0.89	0.91	0.96	0.94
Q3 1990	0.65	0.68	0.73	0.72	0.71	0.74	0.81	0.85	0.85	0.87	0.88	0.87	0.89	0.84	0.87	0.89	0.94
Q4 1990	0.72	0.66	0.68	0.73	0.72	0.71	0.74	0.81	0.84	0.85	0.86	0.87	0.87	0.88	0.83	0.85	0.88
Q1 1991	0.62	0.75	0.68	0.70	0.75	0.74	0.73	0.76	0.84	0.87	0.88	0.89	0.90	0.89	0.91	0.87	0.88
Q2 1991	0.60	0.70	0.78	0.69	0.71	0.75	0.75	0.74	0.77	0.84	0.88	0.88	0.89	0.90	0.89	0.91	0.85
Q3 1991	0.71	0.61	0.68	0.76	0.68	0.70	0.74	0.73	0.72	0.75	0.82	0.86	0.86	0.87	0.88	0.88	0.89
Q4 1991	0.78	0.73	0.67	0.70	0.74	0.66	0.67	0.71	0.70	0.69	0.72	0.79	0.82	0.82	0.84	0.84	0.84
Q1 1992	0.84	0.84	0.79	0.71	0.75	0.80	0.70	0.71	0.75	0.74	0.73	0.76	0.83	0.86	0.86	0.88	0.89
Q2 1992	0.76	0.79	0.79	0.74	0.68	0.70	0.74	0.66	0.67	0.71	0.70	0.69	0.72	0.79	0.82	0.81	0.83
Q3 1992	0.77	0.84	0.87	0.86	0.81	0.78	0.77	0.79	0.71	0.71	0.74	0.73	0.72	0.74	0.81	0.84	0.84
Q4 1992	0.69	0.54	0.95	0.96	0.96	0.90	0.89	0.85	0.86	0.77	0.76	0.78	0.78	0.77	0.79	0.84	0.88
Q1 1993	0.92	0.93	0.88	0.93	0.94	0.94	0.90	0.89	0.86	0.86	0.79	0.78	0.80	0.79	0.78	0.81	0.85
Q2 1993	0.83	0.88	0.94	0.96	0.90	0.92	0.91	0.89	0.88	0.86	0.86	0.79	0.78	0.79	0.79	0.78	0.79
Q3 1993	0.84	0.81	0.86	0.93	0.96	0.89	0.91	0.91	0.89	0.88	0.86	0.85	0.79	0.78	0.79	0.79	0.78
Q4 1993	0.79	0.86	0.85	0.89	0.93	0.93	0.92	0.94	0.93	0.90	0.90	0.87	0.87	0.79	0.79	0.80	0.80
Q1 1994	0.75	0.76	0.83	0.81	0.85	0.91	0.95	0.89	0.91	0.90	0.89	0.88	0.86	0.86	0.80	0.79	0.80
Q2 1994	0.74	0.75	0.76	0.84	0.81	0.85	0.91	0.95	0.88	0.90	0.89	0.88	0.88	0.86	0.86	0.82	0.79
Q3 1994	0.76	0.76	0.76	0.77	0.85	0.82	0.86	0.92	0.96	0.89	0.90	0.90	0.88	0.88	0.86	0.87	0.80
Q4 1994	0.68	0.74	0.73	0.74	0.75	0.82	0.80	0.83	0.89	0.94	0.87	0.89	0.88	0.87	0.86	0.84	0.85
Q1 1995	0.75	0.72	0.77	0.76	0.77	0.76	0.82	0.80	0.83	0.88	0.92	0.86	0.88	0.87	0.87	0.87	0.85
Q2 1995	0.75	0.77	0.74	0.78	0.78	0.78	0.78	0.84	0.82	0.84	0.89	0.92	0.87	0.89	0.88	0.86	0.87
Q3 1995	0.79	0.78	0.79	0.77	0.81	0.80	0.80	0.82	0.88	0.85	0.88	0.93	0.96	0.90	0.91	0.91	0.89
Q4 1995	0.75	0.79	0.78	0.79	0.77	0.81	0.80	0.81	0.82	0.87	0.86	0.88	0.93	0.95	0.91	0.92	0.92
Q1 1996	0.79	0.80	0.82	0.82	0.83	0.82	0.85	0.84	0.85	0.86	0.89	0.89	0.91	0.92	0.93	0.94	0.95
Q2 1996	0.79	0.81	0.82	0.85	0.85	0.86	0.84	0.87	0.87	0.87	0.89	0.89	0.91	0.93	0.91	0.90	0.95
Q3 1996	0.76	0.79	0.82	0.83	0.86	0.86	0.87	0.86	0.88	0.88	0.88	0.90	0.88	0.92	0.93	0.89	0.87
Q4 1996	0.84	0.71	0.77	0.81	0.84	0.86	0.87	0.88	0.87	0.87	0.87	0.88	0.88	0.83	0.90	0.90	0.83
Q1 1997	0.49	0.74	0.46	0.66	0.74	0.80	0.79	0.81	0.87	0.87	0.85	0.83	0.86	0.80	0.65	0.85	0.84
Q2 1997	0.73	0.78	0.83	0.74	0.76	0.79	0.81	0.84	0.84	0.85	0.83	0.86	0.86	0.86	0.88	0.86	0.91
Q3 1997	0.71	0.49	0.64	0.79	0.60	0.71	0.77	0.80	0.82	0.83	0.86	0.85	0.86	0.85	0.87	0.84	0.75
Q4 1997	-0.12	0.29	0.16	0.33	0.53	0.31	0.48	0.57	0.66	0.66	0.68	0.78	0.80	0.71	0.67	0.71	0.60
Q1 1998	-0.48	-0.21	0.19	0.06	0.25	0.49	0.24	0.45	0.56	0.67	0.65	0.68	0.80	0.82	0.72	0.66	0.73

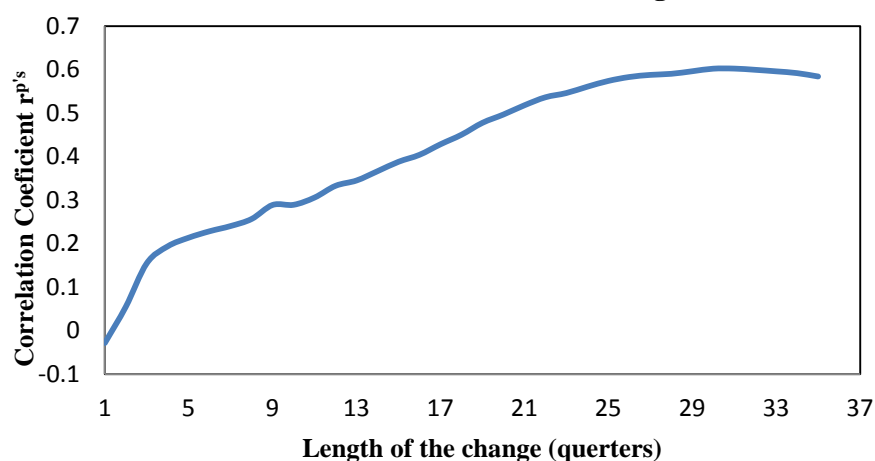
Table 5.5b (Continued)

	Length of change (quarters)																	
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	19
Q2 1998	-0.51	-0.47	-0.25	0.07	-0.02	0.14	0.35	0.13	0.34	0.44	0.57	0.54	0.58	0.74	0.78	0.64	0.56	
Q3 1998	-0.33	-0.48	-0.44	-0.20	0.13	0.04	0.20	0.39	0.19	0.37	0.46	0.57	0.56	0.59	0.73	0.77	0.63	
Q4 1998	-0.02	0.42	0.12	0.17	0.53	0.77	0.70	0.74	0.79	0.71	0.73	0.76	0.78	0.82	0.81	0.83	0.82	
Q1 1999	-0.39	-0.23	0.17	-0.13	-0.07	0.34	0.68	0.56	0.65	0.75	0.62	0.69	0.74	0.78	0.80	0.80	0.84	
Q2 1999	-0.46	-0.49	-0.35	0.02	-0.26	-0.20	0.23	0.63	0.48	0.60	0.74	0.57	0.68	0.74	0.79	0.75	0.80	
Q3 1999	0.03	-0.02	-0.06	0.22	0.66	0.41	0.44	0.72	0.87	0.80	0.83	0.86	0.80	0.81	0.84	0.86	0.87	
Q4 1999	-0.43	0.27	0.22	0.19	0.47	0.79	0.62	0.63	0.81	0.90	0.85	0.86	0.88	0.84	0.84	0.86	0.87	
Q1 2000	-0.51	-0.45	0.24	0.19	0.16	0.43	0.76	0.59	0.60	0.79	0.89	0.83	0.84	0.88	0.83	0.85	0.86	
Q2 2000	-0.01	-0.56	-0.51	0.06	0.01	-0.02	0.25	0.65	0.43	0.46	0.71	0.86	0.77	0.80	0.85	0.78	0.81	
Q3 2000	0.16	-0.07	-0.57	-0.52	-0.01	-0.06	-0.09	0.15	0.56	0.32	0.35	0.64	0.81	0.71	0.76	0.82	0.74	
Q4 2000	0.06	-0.07	-0.25	-0.62	-0.58	-0.22	-0.25	-0.29	-0.09	0.32	0.05	0.10	0.46	0.71	0.59	0.68	0.78	
Q1 2001	-0.26	-0.29	-0.35	-0.47	-0.69	-0.67	-0.45	-0.47	-0.49	-0.37	-0.08	-0.29	-0.24	0.08	0.41	0.28	0.40	
Q2 2001	-0.22	-0.25	-0.29	-0.35	-0.47	-0.70	-0.67	-0.45	-0.47	-0.50	-0.37	-0.06	-0.28	-0.23	0.10	0.43	0.30	
Q3 2001	0.23	0.02	-0.02	-0.09	-0.18	-0.33	-0.63	-0.60	-0.30	-0.33	-0.35	-0.20	0.14	-0.09	-0.04	0.25	0.55	
Q4 2001	0.14	-0.11	-0.25	-0.27	-0.29	-0.34	-0.44	-0.66	-0.63	-0.43	-0.45	-0.47	-0.36	-0.13	-0.30	-0.27	0.00	
Q1 2002	-0.25	0.11	-0.14	-0.28	-0.30	-0.32	-0.36	-0.46	-0.66	-0.64	-0.45	-0.47	-0.49	-0.39	-0.15	-0.31	-0.28	
Q2 2002	0.40	0.14	0.55	0.26	0.06	0.01	-0.05	-0.14	-0.28	-0.59	-0.56	-0.26	-0.29	-0.32	-0.17	0.15	-0.06	
Q3 2002	0.59	0.34	0.10	0.50	0.21	0.02	-0.02	-0.08	-0.16	-0.29	-0.59	-0.56	-0.28	-0.30	-0.33	-0.19	0.11	
Q4 2002	0.86	0.71	0.50	0.21	0.63	0.33	0.10	0.04	-0.03	-0.12	-0.28	-0.59	-0.57	-0.26	-0.28	-0.32	-0.16	
Q1 2003	0.97	0.91	0.77	0.51	0.18	0.66	0.31	0.05	0.00	-0.07	-0.17	-0.32	-0.63	-0.60	-0.30	-0.34	-0.36	
Q2 2003	0.85	0.94	0.88	0.68	0.41	0.04	0.61	0.19	-0.08	-0.12	-0.18	-0.25	-0.39	-0.66	-0.63	-0.36	-0.40	
Q3 2003	0.13	0.92	0.96	0.96	0.85	0.82	0.55	0.88	0.66	0.35	0.26	0.13	-0.01	-0.22	-0.62	-0.59	-0.18	
Q4 2003	0.68	0.39	0.90	0.94	0.95	0.87	0.86	0.70	0.91	0.79	0.54	0.46	0.31	0.15	-0.08	-0.56	-0.53	
Q1 2004	0.85	0.77	0.60	0.92	0.94	0.96	0.89	0.92	0.83	0.95	0.88	0.69	0.61	0.46	0.29	0.03	-0.55	
Q2 2004	-0.43	0.80	0.68	0.31	0.92	0.95	0.96	0.86	0.85	0.63	0.89	0.73	0.42	0.32	0.17	0.01	-0.22	
Q3 2004	-0.64	-0.41	0.67	0.50	0.12	0.88	0.92	0.93	0.81	0.77	0.52	0.85	0.65	0.33	0.24	0.10	-0.03	
Q4 2004	-0.23	-0.21	0.10	0.71	0.62	0.45	0.85	0.88	0.90	0.81	0.86	0.77	0.90	0.84	0.65	0.57	0.44	
Q1 2005	-0.27	-0.46	-0.45	-0.18	0.64	0.51	0.25	0.83	0.88	0.88	0.77	0.80	0.62	0.86	0.74	0.45	0.37	
Q2 2005	-0.32	-0.47	-0.62	-0.62	-0.40	0.57	0.40	0.05	0.82	0.88	0.87	0.73	0.72	0.44	0.81	0.58	0.25	
Q3 2005	-0.13	-0.40	-0.52	-0.65	-0.64	-0.48	0.36	0.18	-0.13	0.73	0.81	0.80	0.64	0.55	0.22	0.68	0.37	
Q4 2005	0.09	-0.35	-0.57	-0.67	-0.75	-0.75	-0.63	0.11	-0.08	-0.36	0.64	0.74	0.70	0.49	0.31	-0.08	0.52	
Q1 2006	0.09	0.08	-0.35	-0.57	-0.67	-0.76	-0.75	-0.63	0.09	-0.09	-0.36	0.62	0.73	0.69	0.48	0.30	-0.09	
Q2 2006	0.03	0.26	0.23	-0.12	-0.36	-0.46	-0.57	-0.56	-0.41	0.27	0.12	-0.13	0.66	0.75	0.70	0.56	0.42	
Q3 2006	0.23	-0.08	0.14	0.12	-0.24	-0.44	-0.53	-0.62	-0.60	-0.48	0.12	-0.02	-0.25	0.58	0.68	0.60	0.43	
Q4 2006	0.18	0.11	-0.20	0.02	0.01	-0.35	-0.53	-0.61	-0.69	-0.68	-0.57	0.02	-0.12	-0.34	0.55	0.65	0.58	
Q1 2007	-0.11	0.23	0.16	-0.15	0.07	0.07	-0.29	-0.48	-0.57	-0.66	-0.65	-0.53	0.08	-0.06	-0.29	0.57	0.67	
Q2 2007	-0.16	-0.26	0.05	-0.01	-0.27	-0.11	-0.11	-0.40	-0.54	-0.61	-0.67	-0.67	-0.58	-0.16	-0.26	-0.41	0.33	
Q3 2007	0.04	0.07	-0.01	0.22	0.17	-0.05	0.11	0.10	-0.15	-0.32	-0.39	-0.48	-0.47	-0.35	0.12	0.03	-0.15	
Q4 2007	0.20	0.15	0.17	0.09	0.31	0.25	0.05	0.22	0.20	-0.04	-0.22	-0.29	-0.39	-0.38	-0.24	0.25	0.15	
Q1 2008	0.76	0.63	0.56	0.55	0.52	0.62	0.58	0.45	0.58	0.56	0.42	0.25	0.19	0.10	0.11	0.28	0.66	
Q2 2008	0.29	0.56	0.43	0.36	0.37	0.32	0.48	0.44	0.26	0.42	0.40	0.20	0.01	-0.06	-0.16	-0.15	0.01	
Q3 2008	0.27	0.44	0.73	0.57	0.47	0.47	0.43	0.59	0.54	0.37	0.55	0.52	0.31	0.08	0.00	-0.13	-0.11	
Q4 2008	0.89	0.94	0.98	0.99	0.97	0.92	0.89	0.89	0.88	0.85	0.86	0.92	0.90	0.91	0.84	0.85	0.79	
Q1 2009	0.82	0.65	0.77	0.90	0.96	0.94	0.85	0.82	0.83	0.84	0.81	0.79	0.88	0.86	0.83	0.65	0.61	
Q2 2009	0.92	0.87	0.78	0.89	0.88	0.92	0.83	0.74	0.68	0.67	0.71	0.68	0.63	0.76	0.74	0.68	0.53	
Q3 2009	0.87	0.90	0.87	0.84	0.89	0.88	0.90	0.84	0.77	0.72	0.72	0.74	0.71	0.68	0.77	0.76	0.73	
Q4 2009	0.84	0.78	0.84	0.78	0.71	0.79	0.79	0.85	0.76	0.68	0.64	0.63	0.67	0.64	0.59	0.70	0.68	
Q1 2010	0.80	0.78	0.70	0.78	0.72	0.63	0.72	0.74	0.81	0.72	0.64	0.60	0.59	0.65	0.61	0.55	0.67	
Q2 2010	0.93	0.91	0.90	0.88	0.91	0.87	0.84	0.89	0.88	0.91	0.84	0.78	0.74	0.73	0.75	0.73	0.70	
Q3 2010	0.86	0.88	0.86	0.89	0.89	0.87	0.85	0.84	0.86	0.85	0.87	0.81	0.75	0.71	0.71	0.73	0.69	
Q4 2010	0.83	0.83	0.84	0.83	0.86	0.87	0.84	0.82	0.81	0.84	0.82	0.85	0.79	0.74	0.69	0.70	0.70	

Table 5.5b (Continued)

	Length of change (quarters)																	
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	19
Q1 2011	0.78	0.84	0.84	0.85	0.82	0.85	0.85	0.83	0.79	0.78	0.81	0.79	0.83	0.76	0.71	0.68	0.66	
Q2 2011	0.79	0.81	0.86	0.86	0.86	0.84	0.86	0.86	0.84	0.81	0.80	0.82	0.81	0.84	0.78	0.73	0.69	
Q3 2011	0.93	0.89	0.90	0.93	0.94	0.94	0.94	0.95	0.95	0.94	0.93	0.93	0.94	0.92	0.93	0.89	0.85	
Q4 2011	0.89	0.91	0.87	0.89	0.92	0.92	0.93	0.92	0.94	0.94	0.92	0.90	0.91	0.92	0.90	0.91	0.87	
Q1 2012	0.87	0.87	0.89	0.84	0.86	0.90	0.90	0.91	0.89	0.90	0.89	0.88	0.85	0.84	0.87	0.85	0.87	
Q2 2012	0.91	0.89	0.90	0.92	0.88	0.89	0.92	0.93	0.93	0.92	0.93	0.93	0.92	0.89	0.89	0.91	0.89	
Q3 2012	0.92	0.92	0.90	0.90	0.92	0.88	0.89	0.92	0.92	0.93	0.91	0.93	0.92	0.91	0.88	0.88	0.90	
Q4 2012	0.85	0.92	0.91	0.89	0.89	0.90	0.86	0.87	0.90	0.90	0.90	0.87	0.87	0.83	0.85	0.80	0.77	
Q1 2013	0.86	0.67	0.89	0.89	0.90	0.87	0.88	0.85	0.86	0.88	0.88	0.87	0.80	0.75	0.65	0.75	0.68	
Q2 2013	0.77	0.83	0.51	0.87	0.89	0.93	0.90	0.90	0.89	0.88	0.90	0.90	0.87	0.78	0.69	0.55	0.71	
Q3 2013	-0.48	0.74	0.90	0.63	0.92	0.93	0.95	0.91	0.92	0.89	0.89	0.89	0.89	0.86	0.78	0.71	0.57	
Q4 2013	-0.40	-0.65	0.43	0.71	0.20	0.82	0.86	0.94	0.89	0.88	0.86	0.82	0.81	0.82	0.74	0.63	0.51	
Q1 2014	-0.18	-0.33	-0.64	0.54	0.76	0.34	0.82	0.85	0.93	0.91	0.91	0.87	0.84	0.84	0.85	0.80	0.71	
Mean	0.48	0.50	0.52	0.54	0.55	0.56	0.57	0.58	0.59	0.59	0.60	0.60	0.60	0.60	0.60	0.59	0.58	

**Figure 5.5: Divisia price-exchange rate correlation coefficient: transition from the short run to the long run**



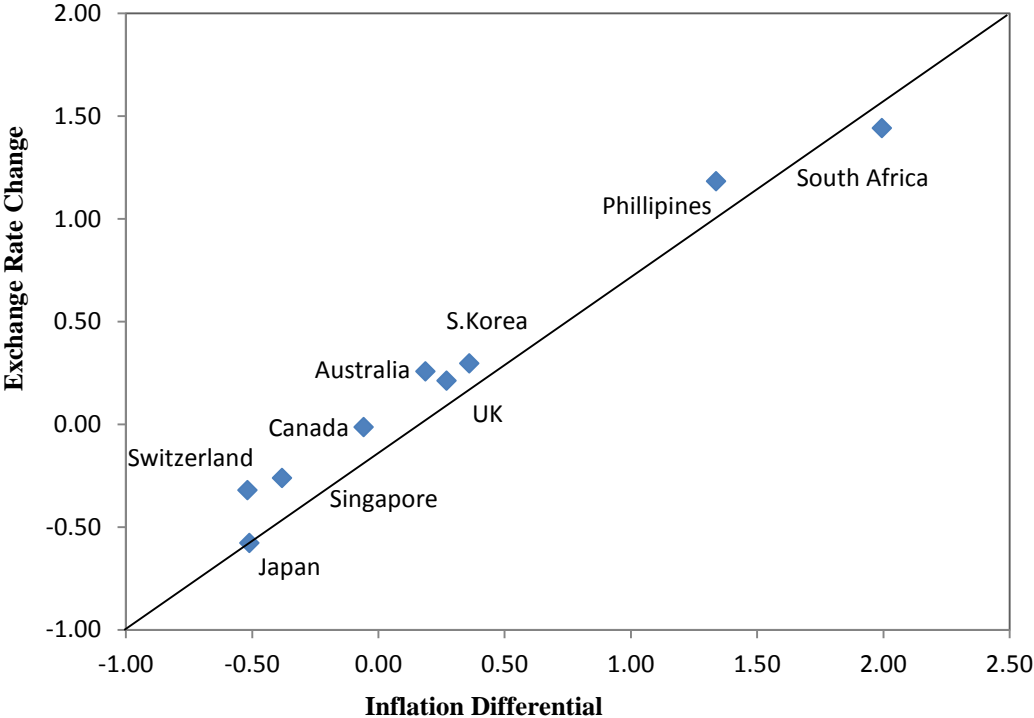
## 5.4 Additional Results

The results thus far have been based on exchange rates with GBP as the numeraire currency. For comparison purposes, this section presents results with computations re-done using the U.S. dollar as the numeraire currency. GDP shares are now recalculated with nominal GDPs converted into US dollars using the corresponding US dollar exchange rates. This section also presents results based on samples truncated into sub-groups with both GBP and U.S. dollar as numeraire currencies, respectively. The purpose of dividing the sample into sub-groups is to check if the results were to differ due to country characteristics such as, its size, location and the level of economic development. With GBP as the numeraire currency, the first sub-group consists of countries of the major currencies, namely, Australia, Canada, Japan,

Switzerland and the USA; the second sub-group has the remaining ones namely Singapore, Philippines, South Korea and South Africa. With the U.S. dollar as the numeraire currency, the USA is replaced by the UK in the first sub-group, while other things remaining the same.

Figure 5.6 is the U.S. dollar-version of Figure 5.1. As can be seen, this figure closely resembles Figure 5.1. Table 5.6 is an enlarged version of Table 5.2. In this enlarged table, full-sample and sub-group long-run results are presented with both GBP and the U.S dollar as the numeraire currencies, respectively. Note that the entries reported in this table for the full sample under GBP are the same as those in Table 5.2. The results in Table 5.6 indicate that the sub-group results are very similar to the full-sample results under both GBP and the U.S. dollar as numeraire currencies, respectively. These results imply that the choice of the numeraire currency may not be important in so far as the long-run PPP is concerned.

**Figure 5.6: Average exchange rate log-change against average inflation differential- long-run data (USD as numerary)**



**Table 5.6: A comparison of divisia moments-  
long run exchange rates and prices**

	Price Index			Variance of					price- exchange rate	
	$\Psi$	$\Pi'$	$\Pi$	$dp_1$	$E$	$\sigma^{\psi}$	$\sigma^{\pi'}$	$\sigma^{\pi}$	$\sigma^{\pi'\psi}$	$\rho^{\pi'\psi}$
<b>GBP Denominated</b>										
Full Sample	-0.39	0.63	1.02	0.97	-	0.11	0.10	0.000055	0.10	0.98
					0.05					
1 <sup>st</sup> Sub	-0.42	0.61	1.03	0.97	-	0.06	0.07	7.43E-05	0.06	0.99
					0.06					
2 <sup>nd</sup> Sub	0.43	1.30	0.86	0.97	0.10	0.58	0.30	0.007	0.41	0.99
<b>USD Denominated</b>										
Full Sample	-0.12	0.63	0.75	0.76	0.01	0.11	0.09	5.53E-05	0.10	0.98
1 <sup>st</sup> Sub	-0.15	0.61	0.76	0.76	0.00	0.06	0.07	3.76E-06	0.06	0.99
2 <sup>nd</sup> Sub	0.04	0.79	0.75	0.76	0.01	0.07	0.04	0.00014	0.05	0.99

## 5.5 Conclusion

This chapter has used a relatively simple methodology to test the purchasing power parity with data spanning over the last three decades. Following Manzur (1990), a set of test conditions are set up using the first- and second-order moments of prices and exchange rate across a mixed bundle of countries. This framework has provided an empirical test of PPP with both short-run (quarterly) and long-run data for the period 1981-2014. The results indicate that PPP does not hold up at all well in the short run. The evidence with the long-run data lends considerable support to PPP. The results also tend to identify five years as being a broad measure of the length of the long run as far as PPP is concerned. These results are consistent with the recent mainstream literature.

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## Appendix to Chapter 5

This appendix provides the data quarterly exchange rate, CPI and GDP for the Australia, Canada, Japan, Switzerland, UK, US, Philippines, Singapore, South Korea and South Africa. The data are from International Financial Statistics (IFS) through Thomson Reuters Datastream. Tables 5.1-A5.10 present the data. GDP is reported in both domestic currency and in equivalent GBP. In Table A5.11 the arithmetic averages of the GDP shares (with GBP as numeraire) are given. Note that the U.S. dollar denominated data are not reported here.

**Table A5.1: Exchange rates, prices and GDPs: Australia 1980(Q1)-2014(Q1)**

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 1980	2.0255	28.3	37.8	19
Q1 1981	1.9210	29	38.56	20
Q2 1981	1.6795	29.6	40.02	24
Q3 1981	1.5770	30.2	42.17	27
Q4 1981	1.6940	31.5	43.37	26
Q1 1982	1.6995	32	44.29	26
Q2 1982	1.7015	32.8	46.01	27
Q3 1982	1.7848	33.9	46.53	26
Q4 1982	1.6475	34.9	47.28	29
Q1 1983	1.7085	35.7	47.67	28
Q2 1983	1.7480	36.5	48.27	28
Q3 1983	1.6680	37.1	50.85	30
Q4 1983	1.6145	37.9	52.4	32
Q1 1984	1.5415	37.8	54.64	35
Q2 1984	1.5730	37.9	55.9	36
Q3 1984	1.4880	38.4	56.45	38
Q4 1984	1.4033	38.9	56.91	41
Q1 1985	1.7710	39.5	59.32	33
Q2 1985	1.9530	40.4	61.58	32
Q3 1985	1.9865	41.3	63.39	32
Q4 1985	2.1200	42.1	64.31	30
Q1 1986	2.0790	43.1	65.82	32
Q2 1986	2.2798	43.8	66.91	29
Q3 1986	2.3030	45.0	68.34	30
Q4 1986	2.2277	46.3	70.52	32
Q1 1987	2.2715	47.2	72.55	32
Q2 1987	2.2375	47.9	75.26	34
Q3 1987	2.2835	48.7	77.97	34
Q4 1987	2.6000	49.5	80.14	31
Q1 1988	2.5400	50.4	83.22	33
Q2 1988	2.1610	51.3	85.06	39
Q3 1988	2.1465	52.2	88.26	41
Q4 1988	2.1155	53.3	90.89	43
Q1 1989	2.0605	53.8	93.32	45

Table A5.1 (Continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q2 1989	2.0558	55.2	96.72	47
Q3 1989	2.0848	56.4	98.64	47
Q4 1989	2.0413	57.5	100.29	49
Q1 1990	2.1835	58.5	102.12	47
Q2 1990	2.2015	59.4	103.92	47
Q3 1990	2.2650	59.8	103.39	46
Q4 1990	2.5000	61.4	104.57	42
Q1 1991	2.2380	61.3	103.34	46
Q2 1991	2.1117	61.4	103.4	49
Q3 1991	2.1880	61.8	104.24	48
Q4 1991	2.4625	62.3	105.13	43
Q1 1992	2.2600	62.3	106.75	47
Q2 1992	2.5465	62.2	106.95	42
Q3 1992	2.4875	62.2	108.09	43
Q4 1992	2.2035	62.5	110.22	50
Q1 1993	2.1290	63.1	112.37	53
Q2 1993	2.2635	63.3	113.36	50
Q3 1993	2.3367	63.6	113.25	48
Q4 1993	2.1798	63.7	115.84	53
Q1 1994	2.1178	64.0	118.14	56
Q2 1994	2.1124	64.4	119.63	57
Q3 1994	2.1311	64.8	122.12	57
Q4 1994	2.0170	65.4	122.78	61
Q1 1995	2.2206	66.5	124.46	56
Q2 1995	2.2444	67.3	126.63	56
Q3 1995	2.0969	68.1	128.97	62
Q4 1995	2.0872	68.7	132.09	63
Q1 1996	1.9515	68.9	133.36	68
Q2 1996	1.9742	69.4	134.95	68
Q3 1996	1.9759	69.6	136.42	69
Q4 1996	2.1546	69.7	138.31	64
Q1 1997	2.0948	69.8	139.02	66
Q2 1997	2.2216	69.6	142.9	64
Q3 1997	2.2308	69.4	144.14	65
Q4 1997	2.5253	69.5	147.45	58
Q1 1998	2.5252	69.7	148.19	59
Q2 1998	2.6944	70.1	149.38	55
Q3 1998	2.8694	70.3	152.22	53
Q4 1998	2.7126	70.6	154.84	57
Q1 1999	2.5563	70.6	156.68	61
Q2 1999	2.3814	70.9	157.14	66
Q3 1999	2.5235	71.5	160.2	63
Q4 1999	2.4631	71.9	163.36	66
Q1 2000	2.6282	72.5	168.02	64
Q2 2000	2.5214	73.1	170.38	68

Table A5.1 (Continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q3 2000	2.7301	75.8	174.27	64
Q4 2000	2.6884	76.1	173.30	64
Q1 2001	2.9117	76.9	178.08	61
Q2 2001	2.7679	77.5	180.03	65
Q3 2001	2.9781	77.8	183.6	62
Q4 2001	2.8432	78.4	186.15	65
Q1 2002	2.6682	79.1	190.21	71
Q2 2002	2.7153	79.7	193.74	71
Q3 2002	2.8943	80.2	195.94	68
Q4 2002	2.8590	80.8	199.35	70
Q1 2003	2.6157	81.9	201.76	77
Q2 2003	2.4605	81.9	203.91	83
Q3 2003	2.4546	82.3	209.19	85
Q4 2003	2.3760	82.7	214.65	90
Q1 2004	2.4073	83.5	218.86	91
Q2 2004	2.6034	83.9	221.16	85
Q3 2004	2.4982	84.2	224.55	90
Q4 2004	2.4492	84.9	228.48	93
Q1 2005	2.4428	85.5	232.8	95
Q2 2005	2.3515	86.0	236.76	101
Q3 2005	2.3167	86.8	243.41	105
Q4 2005	2.3404	87.3	248.62	106
Q1 2006	2.4326	88	251.64	103
Q2 2006	2.4895	89.4	255.33	103
Q3 2006	2.5031	90.2	261.74	105
Q4 2006	2.4831	90.1	268.6	108
Q1 2007	2.4279	90.2	275.76	114
Q2 2007	2.3649	91.3	280.42	119
Q3 2007	2.3023	91.9	284.63	124
Q4 2007	2.2671	92.8	290.71	128
Q1 2008	2.1773	94.0	297.97	137
Q2 2008	2.0738	95.4	305.94	148
Q3 2008	2.2597	96.5	316.37	140
Q4 2008	2.0622	96.2	317	154
Q1 2009	2.0630	96.3	316.49	153
Q2 2009	2.0371	96.8	311.16	153
Q3 2009	1.8122	97.7	312.4	172
Q4 2009	1.7956	98.2	320.06	178
Q1 2010	1.6527	99.1	327.35	198
Q2 2010	1.7713	99.7	338.61	191
Q3 2010	1.6275	100.4	343.51	211
Q4 2010	1.5274	100.8	348.94	228
Q1 2011	1.5500	102.4	352.81	228
Q2 2011	1.4996	103.3	361.51	241
Q3 2011	1.6029	103.9	368.55	230
Q4 2011	1.5159	103.9	369.32	244
Q1 2012	1.5423	104.0	371.28	241

Table A5.1 (Continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q2 2012	1.5301	104.6	375.98	246
Q3 2012	1.5529	106.0	376.03	242
Q4 2012	1.5657	106.2	378.37	242
Q1 2013	1.4565	106.6	382.09	262
Q2 2013	1.6570	107.1	387.24	234
Q3 2013	1.7319	108.3	389.77	225
Q4 2013	1.8513	109.1	395.93	214
Q1 2014	1.7988	109.8	400.00	222

Notes: index (2010 = 100); GDPs are in current prices and in billions.

**Table A5.2: Exchange rates, prices and GDPs: Canada 1980(Q1)-2014(Q1)**

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 1980	2.8540	39.4	253513	115.76
Q1 1981	2.6605	40.7	255922	130.96
Q2 1981	2.3165	41.9	260361	155.38
Q3 1981	2.1770	43.2	261196	167.51
Q4 1981	2.2685	44.3	265677	162.59
Q1 1982	2.1910	45.4	271140	171.21
Q2 1982	2.2435	46.8	272603	168.47
Q3 1982	2.0930	47.8	274408	182.21
Q4 1982	1.9880	48.5	277819	193.65
Q1 1983	1.8290	48.9	279872	215.75
Q2 1983	1.8845	49.5	282902	215.53
Q3 1983	1.8445	50.3	286752	226.77
Q4 1983	1.8055	50.7	290169	236.22
Q1 1984	1.8415	51.4	295246	237.36
Q2 1984	1.7885	51.8	301668	249.89
Q3 1984	1.6265	52.3	306391	278.17
Q4 1984	1.5312	52.6	309008	301.64
Q1 1985	1.6875	53.2	316688	279.27
Q2 1985	1.7805	53.8	323175	270.08
Q3 1985	1.9258	54.4	327572	254.41
Q4 1985	2.0210	54.8	333443	247.78
Q1 1986	2.0710	55.5	336606	243.29
Q2 1986	2.1250	55.9	339239	239.96
Q3 1986	2.0100	56.6	341925	256.47
Q4 1986	2.0480	57.2	344211	254.34
Q1 1987	2.0965	57.8	343167	256.67
Q2 1987	2.1455	58.6	349192	257.05
Q3 1987	2.1265	59.2	357069	266.11
Q4 1987	2.4445	59.6	365828	237.39
Q1 1988	2.3265	60.1	375370	256.03
Q2 1988	2.0710	60.9	374387	293.27
Q3 1988	2.0580	61.6	383854	300.50
Q4 1988	2.1540	62.0	389351	292.91
Q1 1989	2.0160	62.8	402340	319.01
Q2 1989	1.8550	63.9	400858	353.71
Q3 1989	1.9050	64.8	410353	348.45
Q4 1989	1.8675	65.3	425453	357.63
Q1 1990	1.9270	66.2	425346	351.20
Q2 1990	2.0340	66.8	441173	334.76
Q3 1990	2.1625	67.5	449622	315.32
Q4 1990	2.2400	68.5	453857	303.63
Q1 1991	2.0110	70.5	460977	337.23
Q2 1991	1.8500	71.0	469108	369.96
Q3 1991	1.9815	71.4	469877	347.50
Q4 1991	2.1625	71.3	476969	319.21

Table A5.2 (Continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q1 1992	2.0660	71.6	478120	335.40
Q2 1992	2.2775	72.0	482722	306.23
Q3 1992	2.2230	72.3	482745	316.60
Q4 1992	1.9335	72.6	480443	366.04
Q1 1993	1.8920	73.1	487426	377.79
Q2 1993	1.9160	73.2	482228	378.48
Q3 1993	1.9975	73.5	480976	365.33
Q4 1993	1.9588	73.9	484362	377.30
Q1 1994	2.0525	73.5	494952	365.76
Q2 1994	2.1324	73.3	492697	357.60
Q3 1994	2.1153	73.6	500075	368.77
Q4 1994	2.1944	73.9	495311	360.11
Q1 1995	2.2848	74.6	495034	358.33
Q2 1995	2.1857	75.2	501432	376.75
Q3 1995	2.1318	75.4	504819	388.29
Q4 1995	2.1175	75.4	505121	394.31
Q1 1996	2.0798	75.7	506565	403.27
Q2 1996	2.1219	76.3	511873	398.92
Q3 1996	2.1298	76.4	511924	403.79
Q4 1996	2.3456	76.9	518112	372.70
Q1 1997	2.2683	77.3	522214	390.53
Q2 1997	2.2960	77.6	523368	389.12
Q3 1997	2.2337	77.8	524068	406.04
Q4 1997	2.3546	77.7	524449	390.42
Q1 1998	2.3815	78.1	514270	390.50
Q2 1998	2.4536	78.3	510426	379.92
Q3 1998	2.5937	78.4	510376	360.45
Q4 1998	2.5555	78.6	513794	371.70
Q1 1999	2.4421	78.7	506915	396.77
Q2 1999	2.3330	79.6	506661	423.99
Q3 1999	2.4201	80.1	503193	419.16
Q4 1999	2.3391	80.4	504553	442.41
Q1 2000	2.3161	80.8	511481	458.31
Q2 2000	2.2431	81.5	510302	486.57
Q3 2000	2.2246	82.3	508167	500.88
Q4 2000	2.2437	82.9	510797	501.63
Q1 2001	2.2386	83.1	514076	509.37
Q2 2001	2.1343	84.5	508704	535.65
Q3 2001	2.3217	84.5	501226	486.36
Q4 2001	2.3232	83.8	499097	484.96
Q1 2002	2.2719	84.3	498782	504.54
Q2 2002	2.3183	85.6	498469	505.93
Q3 2002	2.4945	86.5	499933	477.35
Q4 2002	2.5433	86.9	500085	477.29
Q1 2003	2.3251	88.1	493935	531.92
Q2 2003	2.2422	88.0	500464	546.97
Q3 2003	2.2420	88.3	500590	557.83

Table A5.2 (Continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 2003	2.3133	88.5	501499	545.34
Q1 2004	2.4154	88.9	505013	532.10
Q2 2004	2.4315	89.9	503610	541.75
Q3 2004	2.2901	90.1	503781	585.63
Q4 2004	2.3003	90.5	502451	589.56
Q1 2005	2.2861	90.8	501005	598.84
Q2 2005	2.1954	91.6	505377	632.73
Q3 2005	2.0533	92.4	505164	694.97
Q4 2005	2.0054	92.5	504529	726.96
Q1 2006	2.0235	93.0	505365	727.83
Q2 2006	2.0569	94.0	505903	719.20
Q3 2006	2.0840	94.0	504606	716.03
Q4 2006	2.2776	93.8	510974	660.09
Q1 2007	2.2627	94.6	513895	678.07
Q2 2007	2.1343	96.1	515159	732.46
Q3 2007	2.0246	96.1	510545	775.76
Q4 2007	1.9646	96.0	512106	812.12
Q1 2008	2.0393	96.3	513419	796.89
Q2 2008	2.0192	98.3	506364	825.56
Q3 2008	1.8951	99.3	496810	887.76
Q4 2008	1.7749	97.9	487834	906.80
Q1 2009	1.8034	97.5	468276	859.23
Q2 2009	1.9126	98.4	472884	807.90
Q3 2009	1.7166	98.5	469331	911.73
Q4 2009	1.6930	98.6	473758	950.01
Q1 2010	1.5390	99.1	479959	1067.39
Q2 2010	1.5898	99.7	482382	1038.41
Q3 2010	1.6165	100.3	486217	1027.56
Q4 2010	1.5557	100.9	481232	1090.45
Q1 2011	1.5593	101.7	471882	1107.40
Q2 2011	1.5494	103.1	464516	1124.72
Q3 2011	1.6233	103.3	474365	1091.47
Q4 2011	1.5825	103.6	475315	1136.75
Q1 2012	1.5969	104.1	480648	1132.28
Q2 2012	1.5990	104.7	474214	1132.76
Q3 2012	1.5889	104.6	470061	1148.12
Q4 2012	1.6185	104.6	470773	1134.58
Q1 2013	1.5427	105.0	475891	1207.75
Q2 2013	1.6001	105.5	477320	1165.90
Q3 2013	1.6646	105.8	479087	1135.60
Q4 2013	1.7598	105.5	480136	1082.99
Q1 2014	1.8401	106.5	487648	1052.67

Notes: index (2010 = 100); GDPs are in current prices and in billions.



**Table A5.3: Exchange rates, prices and GDPs: Japan 1980(Q1)-2014(Q1)**

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 1980	486.00	78.9	253513	521.63
Q1 1981	474.00	79.6	255922	539.92
Q2 1981	438.00	80.9	260361	594.43
Q3 1981	419.50	81.2	261196	622.64
Q4 1981	419.50	82.1	265677	633.32
Q1 1982	442.00	82.1	271140	613.44
Q2 1982	443.75	83.0	272603	614.32
Q3 1982	454.50	83.4	274408	603.76
Q4 1982	380.00	84.1	277819	731.10
Q1 1983	354.50	83.9	279872	789.48
Q2 1983	364.25	84.8	282902	776.67
Q3 1983	353.00	84.6	286752	812.33
Q4 1983	336.50	85.5	290169	862.32
Q1 1984	324.00	85.9	295246	911.25
Q2 1984	322.00	86.6	301668	936.86
Q3 1984	303.50	86.6	306391	1009.53
Q4 1984	291.50	87.6	309008	1060.06
Q1 1985	310.00	87.7	316688	1021.57
Q2 1985	325.50	88.4	323175	992.86
Q3 1985	304.75	88.6	327572	1074.89
Q4 1985	289.50	89.0	333443	1151.79
Q1 1986	266.25	89.0	336606	1264.25
Q2 1986	250.75	89.2	339239	1352.90
Q3 1986	223.35	88.8	341925	1530.89
Q4 1986	234.50	88.8	344211	1467.85
Q1 1987	234.25	88.3	343167	1464.96
Q2 1987	236.75	89.4	349192	1474.94
Q3 1987	238.00	89.2	357069	1500.29
Q4 1987	228.00	89.4	365828	1604.51
Q1 1988	234.25	89.0	375370	1602.43
Q2 1988	228.00	89.6	374387	1642.05
Q3 1988	226.50	89.7	383854	1694.72
Q4 1988	226.00	90.4	389351	1722.79
Q1 1989	223.50	89.9	402340	1800.18
Q2 1989	223.00	92.0	400858	1797.57
Q3 1989	225.50	92.2	410353	1819.75
Q4 1989	231.75	92.8	425453	1835.83
Q1 1990	259.25	93.1	425346	1640.68
Q2 1990	265.50	94.3	441173	1661.67
Q3 1990	259.00	94.6	449622	1735.99
Q4 1990	261.75	96.0	453857	1733.93
Q1 1991	245.50	96.6	460977	1877.71
Q2 1991	223.25	97.6	469108	2101.27
Q3 1991	232.75	97.6	469877	2018.81
Q4 1991	233.75	98.8	476969	2040.51
Q1 1992	231.00	98.4	478120	2069.78

Table A5.3 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q2 1992	239.75	99.7	482722	2013.44
Q3 1992	213.75	99.3	482745	2258.46
Q4 1992	189.00	99.7	480443	2542.03
Q1 1993	173.00	99.7	487426	2817.49
Q2 1993	159.50	100.6	482228	3023.37
Q3 1993	158.75	101.1	480976	3029.77
Q4 1993	165.12	100.8	484362	2933.40
Q1 1994	152.54	100.9	494952	3244.79
Q2 1994	152.25	101.3	492697	3236.03
Q3 1994	156.08	101.1	500075	3204.05
Q4 1994	156.09	101.6	495311	3173.24
Q1 1995	140.73	101.1	495034	3517.66
Q2 1995	135.07	101.3	501432	3712.46
Q3 1995	156.13	101.1	504819	3233.25
Q4 1995	160.15	101.0	505121	3153.98
Q1 1996	163.03	100.7	506565	3107.18
Q2 1996	170.42	101.4	511873	3003.54
Q3 1996	174.12	101.3	511924	2940.00
Q4 1996	198.63	101.5	518112	2608.42
Q1 1997	203.30	101.3	522214	2568.74
Q2 1997	190.45	103.5	523368	2748.12
Q3 1997	195.03	103.5	524068	2687.15
Q4 1997	213.94	103.8	524449	2451.42
Q1 1998	223.31	103.4	514270	2302.95
Q2 1998	231.56	103.9	510426	2204.27
Q3 1998	231.32	103.3	510376	2206.34
Q4 1998	187.67	104.3	513794	2737.74
Q1 1999	191.18	103.3	506915	2651.48
Q2 1999	190.79	103.6	506661	2655.60
Q3 1999	175.34	103.3	503193	2869.81
Q4 1999	164.97	103.3	504553	3058.53
Q1 2000	163.62	102.7	511481	3125.99
Q2 2000	160.17	102.9	510302	3185.94
Q3 2000	159.77	102.7	508167	3180.68
Q4 2000	170.59	102.5	510797	2994.26
Q1 2001	178.16	102.2	514076	2885.45
Q2 2001	175.40	102.1	508704	2900.25
Q3 2001	175.09	101.8	501226	2862.75
Q4 2001	190.74	101.4	499097	2616.57
Q1 2002	188.73	100.6	498782	2642.84
Q2 2002	182.70	101.2	498469	2728.40
Q3 2002	191.45	101.0	499933	2611.32
Q4 2002	191.05	100.9	500085	2617.60
Q1 2003	187.43	100.5	493935	2635.26
Q2 2003	198.14	100.9	500464	2525.79
Q3 2003	185.60	100.8	500590	2697.10
Q4 2003	191.85	100.6	501499	2614.01

Table A5.3 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q1 2004	191.20	100.4	505013	2641.27
Q2 2004	197.88	100.6	503610	2545.03
Q3 2004	199.44	100.7	503781	2525.98
Q4 2004	196.73	101.1	502451	2553.99
Q1 2005	202.11	100.4	501005	2478.85
Q2 2005	198.62	100.5	505377	2544.42
Q3 2005	200.51	100.4	505164	2519.40
Q4 2005	202.63	100.4	504529	2489.93
Q1 2006	204.66	100.3	505365	2469.30
Q2 2006	211.43	100.7	505903	2392.75
Q3 2006	220.54	101.0	504606	2288.05
Q4 2006	233.20	100.7	510974	2191.10
Q1 2007	231.59	100.2	513895	2219.02
Q2 2007	247.77	100.6	515159	2079.15
Q3 2007	234.33	100.8	510545	2178.78
Q4 2007	222.38	101.2	512106	2302.84
Q1 2008	197.83	101.1	513419	2595.31
Q2 2008	210.97	102.0	506364	2400.22
Q3 2008	189.23	103.0	496810	2625.38
Q4 2008	130.33	102.3	487834	3743.01
Q1 2009	141.57	101.0	468276	3307.69
Q2 2009	158.90	101.0	472884	2976.05
Q3 2009	143.20	100.7	469331	3277.50
Q4 2009	150.33	100.2	473758	3151.36
Q1 2010	141.74	100.1	479959	3386.21
Q2 2010	132.39	100.3	482382	3643.65
Q3 2010	131.64	99.7	486217	3693.47
Q4 2010	126.98	99.9	481232	3789.76
Q1 2011	132.85	99.6	471882	3551.92
Q2 2011	129.66	99.8	464516	3582.68
Q3 2011	120.08	99.8	474365	3950.57
Q4 2011	119.57	99.6	475315	3975.12
Q1 2012	131.49	99.9	480648	3655.48
Q2 2012	125.15	100.0	474214	3789.27
Q3 2012	125.63	99.4	470061	3741.59
Q4 2012	140.55	99.4	470773	3349.53
Q1 2013	142.76	99.3	475891	3333.40
Q2 2013	150.66	99.8	477320	3168.16
Q3 2013	158.90	100.3	479087	3014.95
Q4 2013	174.08	100.8	480136	2758.13
Q1 2014	171.69	100.8	487648	2840.26

Notes: index (2010 = 100); GDPs are in current prices and in billions.

**Table A5.4: Exchange rates, prices and GDPs: Switzerland 1980(Q1)-2014(Q1)**

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 1980	4.2500	55.1	48.4	11.39
Q1 1981	4.3150	56.4	49.3	11.43
Q2 1981	3.9500	57.2	50.4	12.76
Q3 1981	3.5650	58.5	51.1	14.33
Q4 1981	3.4350	58.9	51.7	15.05
Q1 1982	3.4450	59.4	52.4	15.21
Q2 1982	3.6475	60.5	53.5	14.67
Q3 1982	3.6800	61.8	54.2	14.73
Q4 1982	3.2450	62.3	54.4	16.76
Q1 1983	3.0925	62.3	54.5	17.62
Q2 1983	3.2050	62.7	54.6	17.04
Q3 1983	3.1775	62.9	55.3	17.40
Q4 1983	3.1650	63.4	56.5	17.85
Q1 1984	3.1050	64.1	57.7	18.58
Q2 1984	3.1625	64.5	58.8	18.59
Q3 1984	3.1100	64.6	59.6	19.16
Q4 1984	3.0150	65.3	60.1	19.93
Q1 1985	3.2150	66.5	61.1	19.00
Q2 1985	3.3275	66.9	62.3	18.72
Q3 1985	3.0925	66.7	62.9	20.34
Q4 1985	2.9775	67.4	64	21.49
Q1 1986	2.8900	67.5	64.5	22.32
Q2 1986	2.7520	67.4	65.7	23.87
Q3 1986	2.3825	67.1	66.2	27.79
Q4 1986	2.3900	67.4	66.3	27.74
Q1 1987	2.4225	68.1	66.7	27.53
Q2 1987	2.4450	68.1	67.6	27.65
Q3 1987	2.4950	68.3	68.7	27.54
Q4 1987	2.3950	68.8	69.7	29.10
Q1 1988	2.5750	69.3	70.8	27.50
Q2 1988	2.5750	69.6	71.5	27.77
Q3 1988	2.6775	69.6	72.9	27.23
Q4 1988	2.7170	70	74.3	27.35
Q1 1989	2.8050	70.9	75.3	26.84
Q2 1989	2.6000	71.6	77.6	29.85
Q3 1989	2.6200	71.8	78.8	30.08
Q4 1989	2.4875	73.1	80.9	32.52
Q1 1990	2.4625	74.4	82.7	33.58
Q2 1990	2.4700	75.1	84.8	34.33
Q3 1990	2.4325	75.9	85.3	35.07
Q4 1990	2.4600	77.4	86.2	35.04
Q1 1991	2.5300	78.8	87.4	34.55
Q2 1991	2.5225	79.8	88.1	34.93
Q3 1991	2.5400	80.6	89	35.04
Q4 1991	2.5350	81.5	89.5	35.31
Q1 1992	2.6050	82.5	90.2	34.63

Table A5.4 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q2 1992	2.6175	83.3	90.6	34.61
Q3 1992	2.2000	83.4	90.2	41.00
Q4 1992	2.2175	84.3	90.4	40.77
Q1 1993	2.2500	85.4	90.7	40.31
Q2 1993	2.2550	86.2	92.2	40.89
Q3 1993	2.1375	86.4	93	43.51
Q4 1993	2.1971	86.5	93.5	42.56
Q1 1994	2.0915	86.9	94.5	45.18
Q2 1994	2.0651	86.7	93.9	45.47
Q3 1994	2.0309	86.8	94.6	46.58
Q4 1994	2.0474	86.9	95.5	46.64
Q1 1995	1.8341	88.1	95.1	51.85
Q2 1995	1.8329	88.4	95.5	52.10
Q3 1995	1.8186	88.6	96.3	52.95
Q4 1995	1.7865	88.6	96.2	53.85
Q1 1996	1.8172	89	96.5	53.10
Q2 1996	1.9448	89.1	96.5	49.62
Q3 1996	1.9598	89.1	96.3	49.14
Q4 1996	2.2978	89.3	96.4	41.95
Q1 1997	2.3655	89.7	97.4	41.18
Q2 1997	2.4263	89.5	98.1	40.43
Q3 1997	2.3460	89.5	99.4	42.37
Q4 1997	2.3999	89.6	100.2	41.75
Q1 1998	2.5529	89.6	100.6	39.41
Q2 1998	2.5308	89.6	101.3	40.03
Q3 1998	2.3525	89.6	101.4	43.10
Q4 1998	2.2852	89.5	101	44.20
Q1 1999	2.3894	89.9	101.3	42.40
Q2 1999	2.4505	90.1	101.6	41.46
Q3 1999	2.4713	90.5	102.9	41.64
Q4 1999	2.5799	90.8	105.1	40.74
Q1 2000	2.6525	91.3	106.4	40.11
Q2 2000	2.4617	91.6	107.6	43.71
Q3 2000	2.5555	91.8	108.6	42.50
Q4 2000	2.4207	92.2	109.8	45.36
Q1 2001	2.4538	92.2	110.5	45.03
Q2 2001	2.5278	92.9	111.2	43.99
Q3 2001	2.3758	92.8	110.8	46.64
Q4 2001	2.4164	92.6	110.7	45.81
Q1 2002	2.3949	92.8	111.5	46.56
Q2 2002	2.2684	93.6	111.6	49.20
Q3 2002	2.3168	93.1	111.9	48.30
Q4 2002	2.2260	93.6	111.8	50.22
Q1 2003	2.1362	93.7	111.5	52.20
Q2 2003	2.2352	94.1	111.9	50.06
Q3 2003	2.1941	93.5	112.9	51.46
Q4 2003	2.2140	94	114.2	51.58

Table A5.4 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q1 2004	2.3283	93.8	115.4	49.57
Q2 2004	2.2713	94.9	116.3	51.21
Q3 2004	2.2596	94.3	116.6	51.60
Q4 2004	2.1832	95.3	117.1	53.64
Q1 2005	2.2523	95	117.6	52.21
Q2 2005	2.2963	95.9	118.9	51.78
Q3 2005	2.2808	95.4	120.4	52.79
Q4 2005	2.2626	96.4	122.2	54.01
Q1 2006	2.2668	96.2	124.2	54.79
Q2 2006	2.2657	97.2	126	55.61
Q3 2006	2.3424	96.6	127.9	54.60
Q4 2006	2.3891	96.8	129.9	54.37
Q1 2007	2.3945	96.3	132.1	55.17
Q2 2007	2.4590	97.7	134.4	54.66
Q3 2007	2.3800	97.2	136	57.14
Q4 2007	2.2536	98.5	138.3	61.37
Q1 2008	1.9658	98.7	140.3	71.37
Q2 2008	2.0272	100.3	143	70.54
Q3 2008	1.9987	100.1	143.9	72.00
Q4 2008	1.5303	100	140.7	91.94
Q1 2009	1.6298	98.7	138.5	84.98
Q2 2009	1.7911	99.6	137.8	76.94
Q3 2009	1.6596	99.1	138.8	83.64
Q4 2009	1.6693	99.8	139.2	83.39
Q1 2010	1.5967	99.8	141.2	88.44
Q2 2010	1.6134	100.6	142.7	88.45
Q3 2010	1.5395	99.5	143.6	93.28
Q4 2010	1.4593	100.2	145.2	99.50
Q1 2011	1.4665	100.4	145.9	99.49
Q2 2011	1.3518	101	146.5	108.37
Q3 2011	1.4150	99.9	146.1	103.25
Q4 2011	1.4532	99.7	146.6	100.88
Q1 2012	1.4442	99.5	147.3	102.00
Q2 2012	1.4846	100	147.2	99.15
Q3 2012	1.5176	99.4	148.3	97.72
Q4 2012	1.4879	99.4	149	100.14
Q1 2013	1.4379	99.1	149.6	104.04
Q2 2013	1.4351	99.5	150.3	104.73
Q3 2013	1.46435	99.3	151.5	103.46
Q4 2013	1.473	99.3	151.8	103.05
Q1 2014	1.47265	99.1	152.4	103.49

Notes: index (2010 = 100); GDPs are in current prices and in billions.

**Table A5.5: Exchange rates, prices and GDPs: US 1980(Q1)-2014(Q1)**

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP( GBP)
Q4 1980	2.3910	39.20	2915	1219
Q1 1981	2.2445	40.30	3051	1360
Q2 1981	1.9305	41.20	3084	1598
Q3 1981	1.8050	42.40	3177	1760
Q4 1981	1.9090	43.00	3195	1673
Q1 1982	1.7820	43.30	3185	1787
Q2 1982	1.7435	44.00	3241	1859
Q3 1982	1.6945	44.80	3274	1932
Q4 1982	1.6175	44.90	3313	2048
Q1 1983	1.4835	44.90	3381	2279
Q2 1983	1.5300	45.50	3482	2276
Q3 1983	1.4970	46.00	3587	2396
Q4 1983	1.4515	46.40	3688	2541
Q1 1984	1.4425	46.90	3807	2639
Q2 1984	1.3565	47.40	3906	2880
Q3 1984	1.2350	47.90	3976	3219
Q4 1984	1.1590	48.30	4034	3481
Q1 1985	1.2375	48.60	4117	3327
Q2 1985	1.3100	49.20	4176	3188
Q3 1985	1.4090	49.50	4258	3022
Q4 1985	1.4455	50.00	4319	2988
Q1 1986	1.4840	50.10	4382	2953
Q2 1986	1.5325	50.00	4423	2886
Q3 1986	1.4470	50.40	4491	3104
Q4 1986	1.4825	50.60	4543	3065
Q1 1987	1.6050	51.20	4611	2873
Q2 1987	1.6135	51.90	4687	2905
Q3 1987	1.6255	52.50	4765	2931
Q4 1987	1.8785	52.90	4883	2599
Q1 1988	1.8880	53.20	4949	2621
Q2 1988	1.7080	53.90	5059	2962
Q3 1988	1.6910	54.60	5143	3041
Q4 1988	1.8090	55.20	5251	2903
Q1 1989	1.6880	55.80	5360	3176
Q2 1989	1.5490	56.70	5454	3521
Q3 1989	1.6150	57.20	5533	3426
Q4 1989	1.6125	57.70	5582	3462
Q1 1990	1.6475	58.70	5708	3465
Q2 1990	1.7445	59.30	5797	3323
Q3 1990	1.8735	60.30	5851	3123
Q4 1990	1.9300	61.30	5846	3029
Q1 1991	1.7390	61.80	5880	3381
Q2 1991	1.6190	62.20	6144	3795
Q3 1991	1.7530	62.70	6218	3547
Q4 1991	1.8710	63.10	6279	3356
Q1 1992	1.7355	63.60	6381	3677

Table A5.5 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q2 1992	1.9040	64.10	6492	3410
Q3 1992	1.7815	64.60	6587	3697
Q4 1992	1.5140	65.10	6698	4424
Q1 1993	1.5055	65.60	6748	4482
Q2 1993	1.4935	66.10	6830	4573
Q3 1993	1.4955	66.40	6904	4617
Q4 1993	1.4795	66.80	7033	4753
Q1 1994	1.4845	67.30	7136	4807
Q2 1994	1.5434	67.70	7270	4710
Q3 1994	1.5770	68.30	7352	4662
Q4 1994	1.5645	68.60	7477	4779
Q1 1995	1.6288	69.20	7545	4632
Q2 1995	1.5909	69.80	7605	4780
Q3 1995	1.5827	70.10	7707	4869
Q4 1995	1.5526	70.40	7800	5024
Q1 1996	1.5265	71.10	7893	5171
Q2 1996	1.5538	71.80	8062	5188
Q3 1996	1.5634	72.20	8159	5219
Q4 1996	1.7113	72.70	8287	4843
Q1 1997	1.6420	73.20	8402	5117
Q2 1997	1.6643	73.50	8552	5138
Q3 1997	1.6154	73.80	8692	5381
Q4 1997	1.6454	74.00	8788	5341
Q1 1998	1.6746	74.20	8890	5309
Q2 1998	1.6685	74.60	8995	5391
Q3 1998	1.6994	74.90	9147	5382
Q4 1998	1.6638	75.20	9326	5605
Q1 1999	1.6143	75.50	9447	5852
Q2 1999	1.5763	76.20	9557	6063
Q3 1999	1.6469	76.70	9712	5897
Q4 1999	1.6117	77.20	9926	6159
Q1 2000	1.5953	77.90	10031	6288
Q2 2000	1.5139	78.80	10278	6789
Q3 2000	1.4785	79.40	10357	7005
Q4 2000	1.4938	79.80	10472	7011
Q1 2001	1.4217	80.60	10508	7391
Q2 2001	1.4064	81.40	10638	7564
Q3 2001	1.4697	81.50	10640	7239
Q4 2001	1.4554	81.30	10701	7353
Q1 2002	1.4240	81.60	10834	7608
Q2 2002	1.5243	82.50	10935	7174
Q3 2002	1.5726	82.80	11037	7018
Q4 2002	1.6099	83.10	11104	6897
Q1 2003	1.5807	83.90	11230	7105
Q2 2003	1.6502	84.20	11371	6891
Q3 2003	1.6614	84.60	11625	6997
Q4 2003	1.7902	84.70	11817	6601



Table A5.5 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q1 2004	1.8379	85.40	11988	6523
Q2 2004	1.8135	86.60	12181	6717
Q3 2004	1.8096	87.00	12368	6835
Q4 2004	1.9199	87.50	12562	6543
Q1 2005	1.8896	88.00	12814	6781
Q2 2005	1.7925	89.20	12974	7238
Q3 2005	1.7691	90.30	13205	7464
Q4 2005	1.7168	90.70	13382	7795
Q1 2006	1.7346	91.20	13649	7869
Q2 2006	1.8496	92.80	13800	7461
Q3 2006	1.8680	93.30	13909	7446
Q4 2006	1.9572	92.50	14066	7187
Q1 2007	1.9614	93.40	14233	7257
Q2 2007	2.0064	95.20	14422	7188
Q3 2007	2.0374	95.50	14570	7151
Q4 2007	1.9906	96.20	14685	7377
Q1 2008	1.9875	97.30	14668	7380
Q2 2008	1.9902	99.40	14813	7443
Q3 2008	1.7825	100.60	14843	8327
Q4 2008	1.4378	97.70	14550	10120
Q1 2009	1.4334	97.20	14384	10035
Q2 2009	1.6469	98.30	14340	8708
Q3 2009	1.5994	98.90	14384	8994
Q4 2009	1.6149	99.10	14567	9020
Q1 2010	1.5169	99.50	14681	9678
Q2 2010	1.4961	100.00	14889	9952
Q3 2010	1.5758	100.10	15058	9556
Q4 2010	1.5657	100.40	15230	9728
Q1 2011	1.6030	101.70	15238	9506
Q2 2011	1.6055	103.40	15461	9630
Q3 2011	1.5578	103.90	15587	10006
Q4 2011	1.5541	103.70	15785	10157
Q1 2012	1.5978	104.50	15957	9987
Q2 2012	1.5685	105.40	16095	10262
Q3 2012	1.6148	105.60	16269	10075
Q4 2012	1.6255	105.70	16333	10048
Q1 2013	1.5185	106.30	16502	10868
Q2 2013	1.5167	106.90	16619	10957
Q3 2013	1.6194	107.30	16872	10419
Q4 2013	1.6563	107.00	17078	10311
Q1 2014	1.6672	107.80	17044	10223

Notes: index (2010 = 100); GDPs are in current prices and in billions.

**Table A5.6: Exchange rates, prices and GDPs: Singapore 1980(Q1)-2014(Q1)**

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 1980	4.9975	58.6	6.99	1.40
Q1 1981	4.6800	59.4	6.97	1.49
Q2 1981	4.1090	61.5	7.30	1.78
Q3 1981	3.8260	63.6	7.84	2.05
Q4 1981	3.8970	64.3	8.23	2.11
Q1 1982	3.8008	64.9	8.06	2.12
Q2 1982	3.7500	64.2	8.20	2.19
Q3 1982	3.7070	64.5	8.61	2.32
Q4 1982	3.4050	64.9	9.10	2.67
Q1 1983	3.0875	65.2	8.81	2.85
Q2 1983	3.2650	65.1	9.32	2.86
Q3 1983	3.1975	65.4	9.79	3.06
Q4 1983	3.0738	65.9	10.11	3.29
Q1 1984	3.0100	67.2	9.93	3.30
Q2 1984	2.8913	67.0	10.22	3.53
Q3 1984	2.6745	67.3	10.66	3.99
Q4 1984	2.5250	67.0	10.90	4.32
Q1 1985	2.7170	67.4	10.43	3.84
Q2 1985	2.9115	67.4	10.17	3.49
Q3 1985	2.9990	67.7	10.21	3.40
Q4 1985	3.0573	67.3	10.01	3.27
Q1 1986	3.2190	67.0	9.76	3.03
Q2 1986	3.3500	66.3	9.95	2.97
Q3 1986	3.1413	66.3	10.28	3.27
Q4 1986	3.2170	66.4	10.86	3.38
Q1 1987	3.4065	66.5	10.42	3.06
Q2 1987	3.4158	66.6	10.97	3.21
Q3 1987	3.4070	67.1	11.71	3.44
Q4 1987	3.7455	67.3	12.40	3.31
Q1 1988	3.7710	67.5	12.09	3.21
Q2 1988	3.4948	67.6	12.84	3.67
Q3 1988	3.4400	68.1	13.79	4.01
Q4 1988	3.5150	68.2	14.65	4.17
Q1 1989	3.3083	68.4	13.93	4.21
Q2 1989	3.0425	69.2	14.83	4.88
Q3 1989	3.1753	69.8	15.77	4.97
Q4 1989	3.0635	70.4	16.69	5.45
Q1 1990	3.1030	71.0	16.68	5.37
Q2 1990	3.2070	71.5	17.09	5.33
Q3 1990	3.3010	72.0	17.93	5.43
Q4 1990	3.3525	73.0	18.81	5.61
Q1 1991	3.1182	73.6	18.53	5.94
Q2 1991	2.8660	74.2	19.06	6.65
Q3 1991	2.9480	74.5	20.15	6.84
Q4 1991	3.0317	74.9	20.81	6.87
Q1 1992	2.8762	75.3	19.96	6.94

Table A5.6 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q2 1992	3.0787	75.9	20.39	6.62
Q3 1992	2.8182	76.3	21.69	7.70
Q4 1992	2.4845	76.6	22.92	9.22
Q1 1993	2.4690	77.1	22.57	9.14
Q2 1993	2.4485	77.5	23.65	9.66
Q3 1993	2.3812	77.9	24.99	10.50
Q4 1993	2.3805	78.4	26.77	11.25
Q1 1994	2.3300	79.1	26.33	11.30
Q2 1994	2.3538	79.9	26.98	11.46
Q3 1994	2.3379	80.6	29.08	12.44
Q4 1994	2.2810	81.0	30.30	13.28
Q1 1995	2.2994	81.1	28.96	12.60
Q2 1995	2.2233	81.6	30.14	13.55
Q3 1995	2.2490	81.7	32.10	14.27
Q4 1995	2.1961	81.8	33.38	15.20
Q1 1996	2.1486	82.2	32.82	15.27
Q2 1996	2.1931	82.6	33.22	15.15
Q3 1996	2.2015	82.8	33.95	15.42
Q4 1996	2.3938	83.1	35.95	15.02
Q1 1997	2.3732	83.6	34.81	14.67
Q2 1997	2.3797	84.0	36.85	15.49
Q3 1997	2.4716	84.7	38.26	15.48
Q4 1997	2.7724	85.0	38.80	13.99
Q1 1998	2.7044	84.5	36.00	13.31
Q2 1998	2.8189	84.1	35.85	12.72
Q3 1998	2.8630	84.0	35.87	12.53
Q4 1998	2.7452	83.8	35.72	13.01
Q1 1999	2.7903	83.9	33.92	12.16
Q2 1999	2.6836	84.1	36.20	13.49
Q3 1999	2.8005	84.2	37.46	13.38
Q4 1999	2.6851	84.2	38.67	14.40
Q1 2000	2.7288	84.9	38.18	13.99
Q2 2000	2.6175	84.8	39.92	15.25
Q3 2000	2.5730	85.5	42.86	16.66
Q4 2000	2.5903	85.9	44.25	17.08
Q1 2001	2.5668	86.3	41.21	16.05
Q2 2001	2.5624	86.2	39.94	15.59
Q3 2001	2.5960	86.2	39.23	15.11
Q4 2001	2.6874	85.8	39.60	14.74
Q1 2002	2.6257	85.6	40.27	15.34
Q2 2002	2.6930	85.8	41.05	15.24
Q3 2002	2.7949	85.8	41.19	14.74
Q4 2002	2.7924	85.9	42.12	15.08
Q1 2003	2.7901	86.1	41.82	14.99
Q2 2003	2.9060	86.0	39.85	13.71
Q3 2003	2.8719	86.3	42.31	14.73
Q4 2003	3.0403	86.4	45.02	14.81

Table A5.6 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q1 2004	3.0807	87.2	46.24	15.01
Q2 2004	3.1237	87.6	46.35	14.84
Q3 2004	3.0466	87.9	48.86	16.04
Q4 2004	3.1340	87.8	51.55	16.45
Q1 2005	3.1165	87.4	50.31	16.14
Q2 2005	3.0244	87.6	51.01	16.87
Q3 2005	2.9889	88.3	53.57	17.92
Q4 2005	2.8546	88.8	57.18	20.03
Q1 2006	2.8068	88.6	55.48	19.76
Q2 2006	2.9248	88.7	56.93	19.47
Q3 2006	2.9634	88.9	59.36	20.03
Q4 2006	3.0029	89.3	63.07	21.00
Q1 2007	2.9781	89.1	63.18	21.21
Q2 2007	3.0686	89.6	66.58	21.70
Q3 2007	3.0244	91.4	69.66	23.03
Q4 2007	2.8654	93.0	71.84	25.07
Q1 2008	2.7391	95.0	68.25	24.92
Q2 2008	2.7040	96.3	67.90	25.11
Q3 2008	2.5484	97.4	69.55	27.29
Q4 2008	2.0715	98.1	66.29	32.00
Q1 2009	2.1790	97.4	64.21	29.47
Q2 2009	2.3836	96.5	67.67	28.39
Q3 2009	2.2536	97.4	71.98	31.94
Q4 2009	2.2672	97.7	76.00	33.52
Q1 2010	2.1207	98.3	77.79	36.68
Q2 2010	2.0887	99.5	80.07	38.34
Q3 2010	2.0727	100.6	80.34	38.76
Q4 2010	2.0057	101.6	84.16	41.96
Q1 2011	2.0205	103.4	85.30	42.21
Q2 2011	1.9709	104.2	85.01	43.14
Q3 2011	2.0300	106.2	86.21	42.47
Q4 2011	2.0151	107.2	88.19	43.77
Q1 2012	2.0090	108.5	88.51	44.06
Q2 2012	1.9869	109.7	89.51	45.05
Q3 2012	1.9809	110.7	88.50	44.68
Q4 2012	1.9856	111.4	92.03	46.35
Q1 2013	1.8838	112.8	90.97	48.29
Q2 2013	1.9236	111.4	92.45	48.06
Q3 2013	2.0320	112.7	93.19	45.86
Q4 2013	2.0912	113.7	96.20	46.00
Q1 2014	2.0965	113.9	95.51	45.56

Notes: index (2010 = 100); GDPs are in current prices and in billions.

**Table A5.7: Exchange rates, prices and GDPs: Philippines 1980(Q1)-2014(Q1)**

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 1980	17.6400	8.60	0.1393	0.0079
Q1 1981	16.8000	8.90	0.0744	0.0044
Q2 1981	15.1625	9.10	0.0783	0.0052
Q3 1981	13.9400	9.30	0.0739	0.0053
Q4 1981	15.2300	9.50	0.0855	0.0056
Q1 1982	14.7300	9.90	0.0828	0.0056
Q2 1982	14.2600	10.00	0.0880	0.0062
Q3 1982	14.4200	10.30	0.0825	0.0057
Q4 1982	14.5100	10.40	0.0981	0.0068
Q1 1983	14.1000	10.50	0.0947	0.0067
Q2 1983	16.6800	10.70	0.1027	0.0062
Q3 1983	16.2500	11.20	0.0949	0.0058
Q4 1983	19.9000	12.20	0.1166	0.0059
Q1 1984	20.1900	14.40	0.1308	0.0065
Q2 1984	23.5400	15.40	0.1454	0.0062
Q3 1984	22.2700	18.10	0.1384	0.0062
Q4 1984	22.1000	19.40	0.1664	0.0075
Q1 1985	20.3000	20.40	0.1529	0.0075
Q2 1985	22.5000	20.50	0.1624	0.0072
Q3 1985	24.9000	20.90	0.1446	0.0058
Q4 1985	26.3200	20.90	0.1737	0.0066
Q1 1986	29.5000	21.20	0.1580	0.0054
Q2 1986	31.0000	20.70	0.1716	0.0055
Q3 1986	28.8300	20.60	0.1593	0.0055
Q4 1986	29.4000	20.80	0.1857	0.0063
Q1 1987	32.5000	21.10	0.1706	0.0052
Q2 1987	32.5000	21.30	0.1877	0.0058
Q3 1987	32.8000	21.90	0.1855	0.0057
Q4 1987	37.8500	22.20	0.2126	0.0056
Q1 1988	39.1000	22.90	0.1995	0.0051
Q2 1988	34.7000	23.30	0.2169	0.0063
Q3 1988	34.5000	23.70	0.2124	0.0062
Q4 1988	37.5000	24.10	0.2567	0.0068
Q1 1989	34.7500	24.90	0.2262	0.0065
Q2 1989	33.4000	25.30	0.2442	0.0073
Q3 1989	34.5000	26.40	0.2488	0.0072
Q4 1989	34.5000	27.40	0.3062	0.0089
Q1 1990	35.9500	28.10	0.2714	0.0075
Q2 1990	39.0000	28.60	0.2826	0.0072
Q3 1990	46.2800	29.50	0.2875	0.0062
Q4 1990	51.3000	31.00	0.3521	0.0069
Q1 1991	46.8500	33.40	0.3162	0.0067
Q2 1991	43.6000	34.30	0.3319	0.0076
Q3 1991	45.9400	35.30	0.3350	0.0073
Q4 1991	48.6500	35.90	0.3997	0.0082
Q1 1992	41.8500	36.50	0.3524	0.0084

Table A5.7 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q2 1992	46.7000	37.30	0.3578	0.0077
Q3 1992	43.6470	38.30	0.3598	0.0082
Q4 1992	35.7300	38.70	0.4275	0.0120
Q1 1993	38.1100	39.20	0.3766	0.0099
Q2 1993	40.1340	39.60	0.3863	0.0096
Q3 1993	43.5400	40.80	0.3956	0.0091
Q4 1993	40.9083	41.60	0.4752	0.0116
Q1 1994	40.9366	42.90	0.4330	0.0106
Q2 1994	41.6732	43.40	0.4485	0.0108
Q3 1994	41.1597	44.10	0.4558	0.0111
Q4 1994	38.1739	44.30	0.5383	0.0141
Q1 1995	42.1860	45.60	0.4804	0.0114
Q2 1995	40.6316	46.40	0.4989	0.0123
Q3 1995	41.2373	47.90	0.5216	0.0126
Q4 1995	40.7234	48.80	0.6108	0.0150
Q1 1996	39.9638	50.60	0.5560	0.0139
Q2 1996	40.7083	51.20	0.5784	0.0142
Q3 1996	41.0158	51.80	0.5957	0.0145
Q4 1996	45.0072	52.10	0.6763	0.0150
Q1 1997	43.2914	53.30	0.6173	0.0143
Q2 1997	43.8976	53.90	0.6450	0.0147
Q3 1997	55.4891	54.90	0.6572	0.0118
Q4 1997	65.6495	55.90	0.7691	0.0117
Q1 1998	63.4655	57.50	0.6843	0.0108
Q2 1998	69.5766	59.20	0.7155	0.0103
Q3 1998	74.3489	60.60	0.7250	0.0098
Q4 1998	64.7199	61.80	0.8280	0.0128
Q1 1999	62.5542	63.20	0.7438	0.0119
Q2 1999	59.9764	63.20	0.7860	0.0131
Q3 1999	67.3562	63.90	0.7997	0.0119
Q4 1999	64.9516	64.50	0.9146	0.0141
Q1 2000	65.6147	62.60	0.8193	0.0125
Q2 2000	65.4438	63.00	0.8654	0.0132
Q3 2000	68.3068	63.80	0.8892	0.0130
Q4 2000	74.6901	65.10	1.0068	0.0135
Q1 2001	70.4073	66.30	0.8887	0.0126
Q2 2001	73.7279	66.60	0.9437	0.0128
Q3 2001	75.4692	67.50	0.9676	0.0128
Q4 2001	75.0987	67.90	1.0888	0.0145
Q1 2002	72.6525	68.30	0.9582	0.0132
Q2 2002	76.7079	68.60	1.0225	0.0133
Q3 2002	82.4436	69.20	1.0293	0.0125
Q4 2002	85.9445	69.30	1.1883	0.0138
Q1 2003	84.6043	69.80	1.0495	0.0124
Q2 2003	88.1923	70.30	1.0943	0.0124
Q3 2003	91.1693	70.70	1.1156	0.0122
Q4 2003	99.3891	71.00	1.2887	0.0130

Table A5.7 (continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q1 2004	103.2412	71.80	1.1691	0.0113
Q2 2004	101.8371	72.80	1.2372	0.0121
Q3 2004	101.8505	74.90	1.2593	0.0124
Q4 2004	107.7544	75.80	1.4548	0.0135
Q1 2005	103.7863	77.00	1.2904	0.0124
Q2 2005	100.2427	78.00	1.3818	0.0138
Q3 2005	99.1403	79.40	1.3922	0.0140
Q4 2005	91.0478	80.40	1.6135	0.0177
Q1 2006	88.7396	81.90	1.4386	0.0162
Q2 2006	98.2620	82.70	1.5292	0.0156
Q3 2006	93.7524	83.50	1.5293	0.0163
Q4 2006	95.9199	83.90	1.7741	0.0185
Q1 2007	94.6352	84.40	1.5737	0.0166
Q2 2007	92.7937	84.90	1.6912	0.0182
Q3 2007	91.7826	85.80	1.6666	0.0182
Q4 2007	82.1620	86.60	1.9613	0.0239
Q1 2008	83.0178	88.80	1.7140	0.0206
Q2 2008	89.3478	91.90	1.9161	0.0214
Q3 2008	83.8643	94.70	1.9251	0.0230
Q4 2008	68.3650	94.30	2.1657	0.0317
Q1 2009	69.2667	95.00	1.8086	0.0261
Q2 2009	79.2546	95.90	1.9689	0.0248
Q3 2009	75.7772	96.60	1.9529	0.0258
Q4 2009	74.6545	97.70	2.2958	0.0308
Q1 2010	68.5487	98.70	2.0505	0.0299
Q2 2010	69.3517	99.60	2.2458	0.0324
Q3 2010	69.1540	100.40	2.1775	0.0315
Q4 2010	68.5911	101.10	2.5296	0.0369
Q1 2011	69.5680	103.20	2.2400	0.0322
Q2 2011	69.5721	104.50	2.4243	0.0348
Q3 2011	68.1148	105.10	2.3277	0.0342
Q4 2011	68.1550	105.90	2.7143	0.0398
Q1 2012	68.5994	106.40	2.4176	0.0352
Q2 2012	66.0866	107.70	2.6210	0.0397
Q3 2012	67.3614	108.90	2.5579	0.0380
Q4 2012	66.7471	109.00	2.9708	0.0445
Q1 2013	61.9679	109.80	2.6405	0.0426
Q2 2013	65.5214	110.50	2.8510	0.0435
Q3 2013	70.5087	111.50	2.7983	0.0397
Q4 2013	73.5085	112.80	3.2584	0.0443
Q1 2014	74.7633	114.30	2.8708	0.0384

Notes: index (2010 = 100); GDPs are in current prices and in billions.

**Table A5.8: Exchange rates, prices and GDPs: South Korea 1980(Q1)-2014(Q1)**

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 1980	1577.82	26.64	12388	7.85
Q1 1981	1510.10	27.69	9315	6.17
Q2 1981	1322.58	29.05	11624	8.79
Q3 1981	1237.33	30.42	12107	9.78
Q4 1981	1337.25	30.59	15627	11.69
Q1 1982	1280.01	30.96	11169	8.73
Q2 1982	1291.58	31.48	13356	10.34
Q3 1982	1258.84	31.87	13767	10.94
Q4 1982	1211.18	31.92	17431	14.39
Q1 1983	1132.50	32.53	13364	11.80
Q2 1983	1188.35	32.64	15706	13.22
Q3 1983	1181.58	32.69	16448	13.92
Q4 1983	1154.67	32.69	20041	17.36
Q1 1984	1142.17	33.16	15633	13.69
Q2 1984	1089.81	33.34	18062	16.57
Q3 1984	1006.77	33.46	18966	18.84
Q4 1984	958.96	33.55	22466	23.43
Q1 1985	1052.25	33.85	17376	16.51
Q2 1985	1144.68	34.08	19965	17.44
Q3 1985	1256.40	34.31	21096	16.79
Q4 1985	1286.78	34.56	25625	19.91
Q1 1986	1308.18	34.84	20240	15.47
Q2 1986	1358.28	34.94	23344	17.19
Q3 1986	1261.83	35.12	24901	19.73
Q4 1986	1265.83	35.06	29626	23.40
Q1 1987	1360.13	35.30	23947	17.61
Q2 1987	1294.65	36.07	27518	21.26
Q3 1987	1311.05	36.55	28761	21.94
Q4 1987	1473.28	36.97	34939	23.72
Q1 1988	1399.90	37.95	29402	21.00
Q2 1988	1248.68	38.67	32121	25.72
Q3 1988	1209.35	39.14	34315	28.37
Q4 1988	1225.45	39.49	41274	33.68
Q1 1989	1135.50	40.07	32998	29.06
Q2 1989	1029.83	40.83	36492	35.44
Q3 1989	1079.20	41.35	38440	35.62
Q4 1989	1088.48	41.84	46824	43.02
Q1 1990	1150.90	42.68	39368	34.21
Q2 1990	1244.05	44.46	44572	35.83
Q3 1990	1337.60	45.33	47639	35.62
Q4 1990	1380.15	45.70	55112	39.93
Q1 1991	1263.45	47.37	48057	38.04
Q2 1991	1184.38	48.45	54770	46.24
Q3 1991	1295.78	49.26	57111	44.07
Q4 1991	1419.65	49.84	66070	46.54
Q1 1992	1345.58	50.72	56409	41.92



Table A5.8 (Continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q2 1992	1504.53	51.73	63600	42.27
Q3 1992	1406.05	52.23	64642	45.97
Q4 1992	1191.28	52.20	72875	61.17
Q1 1993	1184.65	53.06	62856	53.06
Q2 1993	1213.60	54.15	71457	58.88
Q3 1993	1219.60	54.55	73577	60.33
Q4 1993	1194.18	55.05	82786	69.32
Q1 1994	1198.26	56.52	73344	61.21
Q2 1994	1242.56	57.31	82523	66.41
Q3 1994	1259.55	58.32	86240	68.47
Q4 1994	1233.61	58.25	98102	79.52
Q1 1995	1257.60	59.22	86146	68.50
Q2 1995	1206.30	60.08	97768	81.05
Q3 1995	1215.83	60.60	102473	84.28
Q4 1995	1204.39	60.84	112450	93.37
Q1 1996	1194.10	61.98	99156	83.04
Q2 1996	1260.40	63.01	109729	87.06
Q3 1996	1291.37	63.67	113784	88.11
Q4 1996	1446.90	63.93	125927	87.03
Q1 1997	1470.41	64.89	107078	72.82
Q2 1997	1477.90	65.55	119975	81.18
Q3 1997	1477.20	66.20	124282	84.13
Q4 1997	2788.87	67.16	139800	50.13
Q1 1998	2319.25	70.69	114295	49.28
Q2 1998	2290.85	70.91	117910	51.47
Q3 1998	2363.44	70.85	119791	50.68
Q4 1998	2000.66	71.17	132106	66.03
Q1 1999	1980.75	71.19	116099	58.61
Q2 1999	1824.51	71.33	127617	69.95
Q3 1999	2003.39	71.31	135046	67.41
Q4 1999	1825.73	72.09	150737	82.56
Q1 2000	1763.21	72.29	147702	83.77
Q2 2000	1687.98	72.35	156789	92.89
Q3 2000	1648.75	73.58	162700	98.68
Q4 2000	1889.66	74.16	167994	88.90
Q1 2001	1892.22	75.12	159917	84.51
Q2 2001	1828.96	76.12	172002	94.04
Q3 2001	1924.57	76.56	175864	91.38
Q4 2001	1911.67	76.36	180383	94.36
Q1 2002	1889.58	77.14	176193	93.24
Q2 2002	1833.67	78.17	189831	103.53
Q3 2002	1930.76	78.48	192179	99.54
Q4 2002	1909.42	78.90	203736	106.70
Q1 2003	1982.85	80.29	188884	95.26
Q2 2003	1971.10	80.75	199978	101.45
Q3 2003	1910.86	80.97	203581	106.54
Q4 2003	2132.96	81.68	218473	102.43

Table A5.8 (Continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q1 2004	2107.00	82.89	204349	96.99
Q2 2004	2095.50	83.50	218168	104.11
Q3 2004	2083.70	84.48	222006	106.54
Q4 2004	1987.48	84.43	231510	116.48
Q1 2005	1918.89	85.50	213582	111.31
Q2 2005	1852.50	85.99	227303	122.70
Q3 2005	1842.52	86.50	234041	127.02
Q4 2005	1735.38	86.55	244872	141.11
Q1 2006	1685.38	87.37	225613	133.87
Q2 2006	1754.67	87.91	237918	135.59
Q3 2006	1768.02	88.63	246142	139.22
Q4 2006	1820.15	88.34	256382	140.86
Q1 2007	1844.85	89.12	240439	130.33
Q2 2007	1853.67	90.07	257743	139.04
Q3 2007	1864.48	90.67	264988	142.12
Q4 2007	1863.30	91.33	280088	150.32
Q1 2008	1968.32	92.51	258378	131.27
Q2 2008	2081.80	94.43	277832	133.46
Q3 2008	2151.33	95.69	283402	131.73
Q4 2008	1810.92	95.44	284880	157.31
Q1 2009	1982.68	96.13	263587	132.94
Q2 2009	2098.00	97.04	285531	136.10
Q3 2009	1884.43	97.59	296487	157.33
Q4 2009	1880.45	97.73	306103	162.78
Q1 2010	1716.30	99.00	291583	169.89
Q2 2010	1828.18	99.63	316128	172.92
Q3 2010	1796.81	100.40	321990	179.20
Q4 2010	1776.86	100.90	335607	188.88
Q1 2011	1758.36	102.80	312181	177.54
Q2 2011	1714.06	103.60	330892	193.05
Q3 2011	1835.17	104.73	337411	183.86
Q4 2011	1790.32	104.90	352197	196.72
Q1 2012	1810.33	105.90	327407	180.85
Q2 2012	1796.42	106.12	343894	191.43
Q3 2012	1794.73	106.42	347443	193.59
Q4 2012	1740.22	106.70	358713	206.13
Q1 2013	1689.43	107.55	336133	198.96
Q2 2013	1732.15	107.41	355993	205.52
Q3 2013	1740.33	107.87	363000	208.58
Q4 2013	1747.92	107.84	373169	213.49
Q1 2014	1774.60	108.76	352794	198.80

Notes: index (2010 = 100); GDPs are in current prices and in billions.

**Table A5.9: Exchange rates, prices and GDPs: South Africa 1980(Q1)-2014(Q1)**

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 1980	1.7810	6.50	65.78	36.93
Q1 1981	1.7930	6.60	69.10	38.54
Q2 1981	1.7110	6.80	71.36	41.70
Q3 1981	1.7235	7.10	73.84	42.84
Q4 1981	1.8285	7.40	76.32	41.74
Q1 1982	1.8795	7.60	77.69	41.33
Q2 1982	1.9708	7.90	80.45	40.82
Q3 1982	1.9585	8.10	84.45	43.12
Q4 1982	1.7405	8.40	87.26	50.13
Q1 1983	1.6258	8.60	89.54	55.07
Q2 1983	1.6775	8.90	92.95	55.41
Q3 1983	1.6513	9.10	95.97	58.12
Q4 1983	1.7746	9.30	98.94	55.75
Q1 1984	1.7828	9.50	105.06	58.93
Q2 1984	1.8380	9.90	108.75	59.17
Q3 1984	2.0635	10.20	112.85	54.69
Q4 1984	2.2985	10.50	115.68	50.33
Q1 1985	2.3190	10.90	121.28	52.30
Q2 1985	2.5675	11.50	125.07	48.71
Q3 1985	3.5920	11.80	128.47	35.77
Q4 1985	3.7305	12.30	135.57	36.34
Q1 1986	3.1103	13.10	138.50	44.53
Q2 1986	3.8190	13.50	146.33	38.32
Q3 1986	3.2188	14.10	152.96	47.52
Q4 1986	3.2280	14.70	159.78	49.50
Q1 1987	3.2335	15.20	165.95	51.32
Q2 1987	3.3023	15.80	169.35	51.28
Q3 1987	3.3780	16.30	177.61	52.58
Q4 1987	3.6280	16.90	185.67	51.18
Q1 1988	3.9913	17.30	195.86	49.07
Q2 1988	3.9620	17.80	204.74	51.67
Q3 1988	4.2110	18.40	215.17	51.10
Q4 1988	4.3040	19.00	222.68	51.74
Q1 1989	4.3220	19.60	235.00	54.37
Q2 1989	4.3055	20.50	251.00	58.30
Q3 1989	4.3565	21.20	257.58	59.13
Q4 1989	4.1088	21.80	263.13	64.04
Q1 1990	4.3675	22.60	275.89	63.17
Q2 1990	4.6360	23.30	289.19	62.38
Q3 1990	4.7968	24.10	293.97	61.28
Q4 1990	4.9373	25.00	300.22	60.81
Q1 1991	4.7520	25.90	313.77	66.03
Q2 1991	4.6760	26.80	326.70	69.87
Q3 1991	4.9065	27.80	338.60	69.01
Q4 1991	5.1277	29.00	348.84	68.03

Table A5.9 (Continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q1 1992	5.0042	30.00	362.39	72.42
Q2 1992	5.2775	30.90	366.04	69.36
Q3 1992	4.9717	31.70	376.57	75.74
Q4 1992	4.6267	32.20	383.90	82.98
Q1 1993	4.7822	32.80	397.35	83.09
Q2 1993	5.0265	34.10	418.52	83.26
Q3 1993	5.1747	34.70	435.18	84.10
Q4 1993	5.0270	35.20	453.49	90.21
Q1 1994	5.1673	36.00	464.58	89.91
Q2 1994	5.6374	36.60	477.20	84.65
Q3 1994	5.6244	37.90	481.90	85.68
Q4 1994	5.5449	38.70	504.80	91.04
Q1 1995	5.8254	39.50	525.80	90.26
Q2 1995	5.7850	40.50	542.66	93.80
Q3 1995	5.7788	40.80	555.45	96.12
Q4 1995	5.6599	41.20	568.49	100.44
Q1 1996	6.0728	42.10	589.26	97.03
Q2 1996	6.7285	43.00	613.71	91.21
Q3 1996	7.0924	43.90	624.67	88.08
Q4 1996	8.0046	45.00	644.18	80.48
Q1 1997	7.2585	46.20	661.18	91.09
Q2 1997	7.5485	47.00	680.76	90.18
Q3 1997	7.5318	47.70	690.91	91.73
Q4 1997	8.0071	48.10	710.07	88.68
Q1 1998	8.4381	48.70	720.01	85.33
Q2 1998	9.8275	49.40	743.65	75.67
Q3 1998	9.9925	51.40	744.45	74.50
Q4 1998	9.7875	52.40	761.58	77.81
Q1 1999	9.9845	52.80	780.20	78.14
Q2 1999	9.5119	53.00	798.84	83.98
Q3 1999	9.8811	53.10	827.42	83.74
Q4 1999	9.9241	53.50	848.28	85.48
Q1 2000	10.4413	54.30	874.15	83.72
Q2 2000	10.2639	55.60	904.84	88.16
Q3 2000	10.6763	56.60	942.97	88.32
Q4 2000	11.3081	57.20	966.62	85.48
Q1 2001	11.3875	58.30	993.74	87.27
Q2 2001	11.3372	59.20	1005.51	88.69
Q3 2001	13.2387	59.30	1019.27	76.99
Q4 2001	17.4575	59.70	1061.50	60.80
Q1 2002	16.1838	61.60	1113.56	68.81
Q2 2002	15.7150	63.70	1152.20	73.32
Q3 2002	16.5751	65.50	1183.08	71.38
Q4 2002	13.8138	67.30	1225.96	88.75
Q1 2003	12.4413	68.20	1231.92	99.02
Q2 2003	12.3927	68.70	1241.53	100.18
Q3 2003	11.5717	68.60	1271.15	109.85

Table A5.9 (Continued)

Year/Quarter	Exchange Rate	CPI	GDP( local currency)	GDP (GBP)
Q4 2003	11.9493	67.80	1298.17	108.64
Q1 2004	11.5831	68.50	1345.46	116.16
Q2 2004	11.2659	69.20	1365.94	121.25
Q3 2004	11.7169	69.50	1412.98	120.59
Q4 2004	10.8163	69.90	1457.10	134.71
Q1 2005	11.7604	70.50	1478.93	125.76
Q2 2005	11.9622	71.40	1505.80	125.88
Q3 2005	11.2474	72.20	1567.25	139.34
Q4 2005	10.8885	72.50	1646.42	151.21
Q1 2006	10.6926	73.10	1675.40	156.69
Q2 2006	13.1906	74.20	1703.88	129.17
Q3 2006	14.5105	75.90	1821.77	125.55
Q4 2006	13.7994	76.50	1868.64	135.41
Q1 2007	14.2247	77.50	1944.67	136.71
Q2 2007	14.1488	79.40	1961.35	138.62
Q3 2007	14.0511	81.20	2028.01	144.33
Q4 2007	13.6045	82.90	2130.70	156.62
Q1 2008	16.1514	86.20	2187.00	135.41
Q2 2008	15.5792	88.60	2236.30	143.54
Q3 2008	14.7599	91.30	2298.33	155.71
Q4 2008	13.2920	92.00	2328.38	175.17
Q1 2009	13.6312	93.40	2352.90	172.61
Q2 2009	12.7178	95.40	2352.63	184.99
Q3 2009	12.1191	97.20	2399.64	198.00
Q4 2009	11.8914	97.60	2487.45	209.18
Q1 2010	11.1401	98.70	2547.70	228.70
Q2 2010	11.4688	99.70	2661.41	232.06
Q3 2010	10.9901	100.50	2686.78	244.47
Q4 2010	10.3580	101.00	2799.20	270.25
Q1 2011	10.8351	102.50	2853.37	263.35
Q2 2011	10.8834	104.40	2883.26	264.92
Q3 2011	12.5233	106.00	2952.76	235.78
Q4 2011	12.5469	107.10	3041.54	242.41
Q1 2012	12.2620	108.80	3070.45	250.40
Q2 2012	12.8276	110.40	3106.18	242.15
Q3 2012	13.3240	111.40	3148.67	236.32
Q4 2012	13.7914	113.20	3230.61	234.25
Q1 2013	13.9310	115.00	3302.44	237.06
Q2 2013	15.0566	116.60	3348.93	222.42
Q3 2013	16.2972	118.40	3397.91	208.50
Q4 2013	17.3471	119.30	3492.19	201.31
Q1 2014	17.5349	121.80	3561.69	203.12

Notes: index (2010 = 100); GDPs are in current prices and in billions.

**Table A5.10: Exchange rates, prices and GDPs: UK 1980(Q1)-2014(Q1)**

Year/Quarter	CPI	GDP
Q4 1980	31.06	60.84
Q1 1981	31.79	61.99
Q2 1981	33.35	63.07
Q3 1981	33.92	64.80
Q4 1981	34.76	66.59
Q1 1982	35.32	68.24
Q2 1982	36.46	69.62
Q3 1982	36.63	70.77
Q4 1982	36.90	72.63
Q1 1983	37.08	74.85
Q2 1983	37.83	75.48
Q3 1983	38.33	77.53
Q4 1983	38.77	79.56
Q1 1984	38.99	80.22
Q2 1984	39.78	82.07
Q3 1984	40.12	82.71
Q4 1984	40.65	85.02
Q1 1985	41.14	86.93
Q2 1985	42.55	90.33
Q3 1985	42.66	91.31
Q4 1985	42.87	93.20
Q1 1986	43.17	94.82
Q2 1986	43.73	96.33
Q3 1986	43.78	97.70
Q4 1986	44.34	100.30
Q1 1987	44.88	102.67
Q2 1987	45.57	105.49
Q3 1987	45.67	109.63
Q4 1987	46.16	111.83
Q1 1988	46.39	115.40
Q2 1988	47.50	117.86
Q3 1988	48.16	121.64
Q4 1988	49.17	125.51
Q1 1989	49.96	128.11
Q2 1989	51.40	130.23
Q3 1989	51.87	133.39
Q4 1989	52.90	136.39
Q1 1990	53.84	139.45
Q2 1990	56.36	143.38
Q3 1990	57.29	145.56
Q4 1990	58.18	145.69
Q1 1991	58.52	148.35
Q2 1991	59.75	150.33
Q3 1991	60.01	151.80
Q4 1991	60.60	154.21
Q1 1992	60.92	156.44

Table A5.10 (Continued)

Year/Quarter	CPI	GDP
Q2 1992	62.24	157.23
Q3 1992	62.19	157.11
Q4 1992	62.44	159.55
Q1 1993	62.03	163.20
Q2 1993	63.03	164.27
Q3 1993	63.21	167.37
Q4 1993	63.41	169.83
Q1 1994	63.50	172.55
Q2 1994	64.65	174.51
Q3 1994	64.67	177.09
Q4 1994	65.08	181.54
Q1 1995	65.67	183.30
Q2 1995	66.86	185.58
Q3 1995	67.04	188.45
Q4 1995	67.14	190.87
Q1 1996	67.48	194.41
Q2 1996	68.36	198.28
Q3 1996	68.48	200.80
Q4 1996	68.90	202.52
Q1 1997	69.30	206.17
Q2 1997	70.18	209.61
Q3 1997	70.87	213.54
Q4 1997	71.44	216.10
Q1 1998	71.66	219.16
Q2 1998	72.99	221.16
Q3 1998	73.22	223.57
Q4 1998	73.55	228.38
Q1 1999	73.24	230.49
Q2 1999	74.02	230.64
Q3 1999	74.07	236.10
Q4 1999	74.63	241.15
Q1 2000	74.92	244.82
Q2 2000	76.33	245.06
Q3 2000	76.45	247.74
Q4 2000	76.92	249.51
Q1 2001	76.83	253.49
Q2 2001	77.79	256.27
Q3 2001	77.82	260.71
Q4 2001	77.73	261.26
Q1 2002	77.77	265.44
Q2 2002	78.74	267.90
Q3 2002	79.01	272.30
Q4 2002	79.71	275.83
Q1 2003	80.16	280.16
Q2 2003	81.11	284.61
Q3 2003	81.32	288.82
Q4 2003	81.83	294.93

Table A5.10 (Continued)

Year/Quarter	CPI	GDP
Q1 2004	82.23	297.25
Q2 2004	83.35	301.83
Q3 2004	83.84	304.78
Q4 2004	84.62	309.12
Q1 2005	84.84	312.08
Q2 2005	85.85	317.62
Q3 2005	86.17	320.63
Q4 2005	86.63	326.41
Q1 2006	86.87	332.36
Q2 2006	88.37	334.83
Q3 2006	89.13	337.82
Q4 2006	90.09	344.48
Q1 2007	90.82	348.56
Q2 2007	92.28	354.52
Q3 2007	92.65	361.09
Q4 2007	93.86	363.72
Q1 2008	94.43	370.19
Q2 2008	96.31	367.48
Q3 2008	97.23	363.49
Q4 2008	96.41	360.92
Q1 2009	94.35	351.22
Q2 2009	95.08	350.36
Q3 2009	95.89	355.96
Q4 2009	96.92	359.81
Q1 2010	98.08	366.81
Q2 2010	99.97	369.11
Q3 2010	100.41	374.38
Q4 2010	101.54	375.32
Q1 2011	103.30	380.24
Q2 2011	105.09	381.38
Q3 2011	105.67	388.05
Q4 2011	106.74	387.27
Q1 2012	107.16	389.14
Q2 2012	108.35	385.47
Q3 2012	108.74	388.40
Q4 2012	110.04	395.42
Q1 2013	110.65	398.55
Q2 2013	111.71	398.90
Q3 2013	112.22	404.69
Q4 2013	112.93	411.26
Q1 2014	113.56	416.21

Notes: index (2010 = 100); GDPs are in current prices and in billions.



**Table A5.11: Arithmetic averages of GDP shares: 10 countries 1980(Q1)-2014(Q1)**

Year/Quarter	AU	CN	JP	CH	US	SG	PH	KR	SA	UK
Q4 1980	0.94	5.81	26.16	0.57	61.15	0.07	0.00	0.39	1.85	3.05
Q1 1981	0.92	6.03	24.88	0.53	62.65	0.07	0.00	0.28	1.78	2.86
Q2 1981	0.95	6.22	23.78	0.51	63.92	0.07	0.00	0.35	1.67	2.52
Q3 1981	0.99	6.18	22.97	0.53	64.93	0.08	0.00	0.36	1.58	2.39
Q4 1981	0.97	6.18	24.06	0.57	63.58	0.08	0.00	0.44	1.59	2.53
Q1 1982	0.95	6.26	22.44	0.56	65.38	0.08	0.00	0.32	1.51	2.50
Q2 1982	0.96	6.00	21.89	0.52	66.24	0.08	0.00	0.37	1.45	2.48
Q3 1982	0.90	6.31	20.92	0.51	66.95	0.08	0.00	0.38	1.49	2.45
Q4 1982	0.91	6.13	23.15	0.53	64.85	0.08	0.00	0.46	1.59	2.30
Q1 1983	0.80	6.21	22.72	0.51	65.60	0.08	0.00	0.34	1.59	2.15
Q2 1983	0.80	6.23	22.45	0.49	65.78	0.08	0.00	0.38	1.60	2.18
Q3 1983	0.84	6.24	22.34	0.48	65.91	0.08	0.00	0.38	1.60	2.13
Q4 1983	0.84	6.14	22.42	0.46	66.07	0.09	0.00	0.45	1.45	2.07
Q1 1984	0.89	5.94	22.79	0.46	66.02	0.08	0.00	0.34	1.47	2.01
Q2 1984	0.83	5.84	21.88	0.43	67.25	0.08	0.00	0.39	1.38	1.92
Q3 1984	0.80	5.89	21.37	0.41	68.14	0.08	0.00	0.40	1.16	1.75
Q4 1984	0.80	5.95	20.93	0.39	68.71	0.09	0.00	0.46	0.99	1.68
Q1 1985	0.69	5.77	21.11	0.39	68.74	0.08	0.00	0.34	1.08	1.80
Q2 1985	0.68	5.79	21.30	0.40	68.39	0.07	0.00	0.37	1.05	1.94
Q3 1985	0.70	5.59	23.62	0.45	66.41	0.07	0.00	0.37	0.79	2.01
Q4 1985	0.66	5.40	25.08	0.47	65.07	0.07	0.00	0.43	0.79	2.03
Q1 1986	0.68	5.21	27.06	0.48	63.20	0.06	0.00	0.33	0.95	2.03
Q2 1986	0.63	5.12	28.86	0.51	61.58	0.06	0.00	0.37	0.82	2.06
Q3 1986	0.58	5.01	29.92	0.54	60.66	0.06	0.00	0.39	0.93	1.91
Q4 1986	0.63	5.06	29.22	0.55	61.01	0.07	0.00	0.47	0.99	2.00
Q1 1987	0.66	5.32	30.34	0.57	59.50	0.06	0.00	0.36	1.06	2.13
Q2 1987	0.69	5.27	30.23	0.57	59.53	0.07	0.00	0.44	1.05	2.16
Q3 1987	0.69	5.38	30.33	0.56	59.25	0.07	0.00	0.44	1.06	2.22
Q4 1987	0.66	5.06	34.20	0.62	55.41	0.07	0.00	0.51	1.09	2.38
Q1 1988	0.69	5.41	33.89	0.58	55.43	0.07	0.00	0.44	1.04	2.44
Q2 1988	0.76	5.68	31.80	0.54	57.37	0.07	0.00	0.50	1.00	2.28
Q3 1988	0.77	5.66	31.92	0.51	57.27	0.08	0.00	0.53	0.96	2.29
Q4 1988	0.83	5.63	33.11	0.53	55.78	0.08	0.00	0.65	0.99	2.41
Q1 1989	0.81	5.71	32.25	0.48	56.88	0.08	0.00	0.52	0.97	2.29
Q2 1989	0.79	5.92	30.07	0.50	58.90	0.08	0.00	0.59	0.98	2.18
Q3 1989	0.80	5.90	30.82	0.51	58.02	0.08	0.00	0.60	1.00	2.26
Q4 1989	0.82	5.97	30.67	0.54	57.83	0.09	0.00	0.72	1.07	2.28
Q1 1990	0.81	6.08	28.39	0.58	59.95	0.09	0.00	0.59	1.09	2.41
Q2 1990	0.84	5.93	29.42	0.61	58.84	0.09	0.00	0.63	1.10	2.54
Q3 1990	0.83	5.73	31.55	0.64	56.75	0.10	0.00	0.65	1.11	2.65
Q4 1990	0.78	5.63	32.14	0.65	56.14	0.10	0.00	0.74	1.13	2.70
Q1 1991	0.78	5.68	31.64	0.58	56.97	0.10	0.00	0.64	1.11	2.50
Q2 1991	0.74	5.59	31.73	0.53	57.30	0.10	0.00	0.70	1.05	2.27
Q3 1991	0.76	5.54	32.21	0.56	56.59	0.11	0.00	0.70	1.10	2.42
Q4 1991	0.70	5.26	33.62	0.58	55.29	0.11	0.00	0.77	1.12	2.54

Table A5.11 (Continued)

Year/Quarter	AU	CN	JP	CH	US	SG	PH	KR	SA	UK
Q1 1992	0.73	5.21	32.13	0.54	57.08	0.11	0.00	0.65	1.12	2.43
Q2 1992	0.69	5.04	33.11	0.57	56.07	0.11	0.00	0.70	1.14	2.59
Q3 1992	0.65	4.77	34.00	0.62	55.65	0.12	0.00	0.69	1.14	2.36
Q4 1992	0.65	4.73	32.86	0.53	57.19	0.12	0.00	0.79	1.07	2.06
Q1 1993	0.65	4.68	34.87	0.50	55.48	0.11	0.00	0.66	1.03	2.02
Q2 1993	0.60	4.52	36.07	0.49	54.56	0.12	0.00	0.70	0.99	1.96
Q3 1993	0.58	4.34	35.96	0.52	54.79	0.12	0.00	0.72	1.00	1.99
Q4 1993	0.63	4.44	34.51	0.50	55.92	0.13	0.00	0.82	1.06	2.00
Q1 1994	0.63	4.13	36.65	0.51	54.30	0.13	0.00	0.69	1.02	1.95
Q2 1994	0.65	4.09	37.01	0.52	53.87	0.13	0.00	0.76	0.97	2.00
Q3 1994	0.66	4.25	36.90	0.54	53.70	0.14	0.00	0.79	0.99	2.04
Q4 1994	0.69	4.10	36.12	0.53	54.40	0.15	0.00	0.91	1.04	2.07
Q1 1995	0.62	3.99	39.21	0.58	51.64	0.14	0.00	0.76	1.01	2.04
Q2 1995	0.60	4.03	39.70	0.56	51.11	0.14	0.00	0.87	1.00	1.98
Q3 1995	0.68	4.32	35.97	0.59	54.17	0.16	0.00	0.94	1.07	2.10
Q4 1995	0.70	4.34	34.70	0.59	55.27	0.17	0.00	1.03	1.11	2.10
Q1 1996	0.74	4.39	33.80	0.58	56.25	0.17	0.00	0.90	1.06	2.11
Q2 1996	0.75	4.38	33.00	0.55	57.01	0.17	0.00	0.96	1.00	2.18
Q3 1996	0.76	4.45	32.40	0.54	57.52	0.17	0.00	0.97	0.97	2.21
Q4 1996	0.77	4.48	31.37	0.50	58.24	0.18	0.00	1.05	0.97	2.44
Q1 1997	0.77	4.56	29.98	0.48	59.72	0.17	0.00	0.85	1.06	2.41
Q2 1997	0.73	4.43	31.31	0.46	58.54	0.18	0.00	0.92	1.03	2.39
Q3 1997	0.72	4.52	29.90	0.47	59.88	0.17	0.00	0.94	1.02	2.38
Q4 1997	0.67	4.51	28.33	0.48	61.73	0.16	0.00	0.58	1.02	2.50
Q1 1998	0.69	4.61	27.20	0.47	62.70	0.16	0.00	0.58	1.01	2.59
Q2 1998	0.66	4.51	26.14	0.47	63.94	0.15	0.00	0.61	0.90	2.62
Q3 1998	0.63	4.29	26.25	0.51	64.02	0.15	0.00	0.60	0.89	2.66
Q4 1998	0.62	4.04	29.75	0.48	60.92	0.14	0.00	0.72	0.85	2.48
Q1 1999	0.65	4.23	28.26	0.45	62.37	0.13	0.00	0.62	0.83	2.46
Q2 1999	0.68	4.39	27.52	0.43	62.84	0.14	0.00	0.72	0.87	2.39
Q3 1999	0.66	4.32	29.61	0.43	60.85	0.14	0.00	0.70	0.86	2.44
Q4 1999	0.65	4.34	30.01	0.40	60.44	0.14	0.00	0.81	0.84	2.37
Q1 2000	0.61	4.41	30.05	0.39	60.45	0.13	0.00	0.81	0.80	2.35
Q2 2000	0.61	4.42	28.93	0.40	61.64	0.14	0.00	0.84	0.80	2.22
Q3 2000	0.57	4.45	28.29	0.38	62.30	0.15	0.00	0.88	0.79	2.20
Q4 2000	0.58	4.54	27.08	0.41	63.40	0.15	0.00	0.80	0.77	2.26
Q1 2001	0.54	4.49	25.46	0.40	65.22	0.14	0.00	0.75	0.77	2.24
Q2 2001	0.56	4.63	25.08	0.38	65.41	0.13	0.00	0.81	0.77	2.22
Q3 2001	0.55	4.37	25.70	0.42	64.98	0.14	0.00	0.82	0.69	2.34
Q4 2001	0.60	4.41	23.79	0.42	66.86	0.13	0.00	0.86	0.55	2.38
Q1 2002	0.63	4.46	23.35	0.41	67.23	0.14	0.00	0.82	0.61	2.35
Q2 2002	0.65	4.60	24.83	0.45	65.28	0.14	0.00	0.94	0.67	2.44
Q3 2002	0.63	4.47	24.45	0.45	65.71	0.14	0.00	0.93	0.67	2.55
Q4 2002	0.66	4.50	24.70	0.47	65.08	0.14	0.00	1.01	0.84	2.60
Q1 2003	0.71	4.88	24.20	0.48	65.24	0.14	0.00	0.87	0.91	2.57
Q2 2003	0.78	5.16	23.84	0.47	65.03	0.13	0.00	0.96	0.95	2.69
Q3 2003	0.78	5.11	24.72	0.47	64.14	0.14	0.00	0.98	1.01	2.65

Table A5.11 (Continued)

Year/Quarter	AU	CN	JP	CH	US	SG	PH	KR	SA	UK
Q4 2003	0.87	5.23	25.08	0.49	63.33	0.14	0.00	0.98	1.04	2.83
Q1 2004	0.88	5.13	25.49	0.48	62.95	0.14	0.00	0.94	1.12	2.87
Q2 2004	0.81	5.17	24.28	0.49	64.08	0.14	0.00	0.99	1.16	2.88
Q3 2004	0.85	5.51	23.75	0.49	64.26	0.15	0.00	1.00	1.13	2.87
Q4 2004	0.90	5.66	24.53	0.52	62.85	0.16	0.00	1.12	1.29	2.97
Q1 2005	0.90	5.66	23.45	0.49	64.14	0.15	0.00	1.05	1.19	2.95
Q2 2005	0.90	5.67	22.82	0.46	64.91	0.15	0.00	1.10	1.13	2.85
Q3 2005	0.92	6.07	22.02	0.46	65.24	0.16	0.00	1.11	1.22	2.80
Q4 2005	0.90	6.16	21.08	0.46	66.00	0.17	0.00	1.19	1.28	2.76
Q1 2006	0.87	6.13	20.81	0.46	66.31	0.17	0.00	1.13	1.32	2.80
Q2 2006	0.90	6.34	21.08	0.49	65.73	0.17	0.00	1.19	1.14	2.95
Q3 2006	0.93	6.38	20.37	0.49	66.29	0.18	0.00	1.24	1.12	3.01
Q4 2006	1.00	6.09	20.21	0.50	66.29	0.19	0.00	1.30	1.25	3.18
Q1 2007	1.04	6.19	20.25	0.50	66.21	0.19	0.00	1.19	1.25	3.18
Q2 2007	1.10	6.77	19.20	0.50	66.39	0.20	0.00	1.28	1.28	3.27
Q3 2007	1.13	7.08	19.88	0.52	65.27	0.21	0.00	1.30	1.32	3.30
Q4 2007	1.13	7.14	20.24	0.54	64.84	0.22	0.00	1.32	1.38	3.20
Q1 2008	1.18	6.84	22.29	0.61	63.39	0.21	0.00	1.13	1.16	3.18
Q2 2008	1.28	7.14	20.77	0.61	64.41	0.22	0.00	1.15	1.24	3.18
Q3 2008	1.10	6.97	20.62	0.57	65.41	0.21	0.00	1.03	1.22	2.86
Q4 2008	0.98	5.76	23.78	0.58	64.29	0.20	0.00	1.00	1.11	2.29
Q1 2009	1.01	5.68	21.87	0.56	66.34	0.19	0.00	0.88	1.14	2.32
Q2 2009	1.14	6.02	22.17	0.57	64.88	0.21	0.00	1.01	1.38	2.61
Q3 2009	1.22	6.43	23.11	0.59	63.42	0.23	0.00	1.11	1.40	2.51
Q4 2009	1.26	6.71	22.27	0.59	63.75	0.24	0.00	1.15	1.48	2.54
Q1 2010	1.30	7.01	22.25	0.58	63.59	0.24	0.00	1.12	1.50	2.41
Q2 2010	1.22	6.60	23.17	0.56	63.28	0.24	0.00	1.10	1.48	2.35
Q3 2010	1.37	6.66	23.96	0.60	61.98	0.25	0.00	1.16	1.59	2.43
Q4 2010	1.44	6.90	23.97	0.63	61.52	0.27	0.00	1.19	1.71	2.37
Q1 2011	1.48	7.21	23.13	0.65	61.91	0.27	0.00	1.16	1.71	2.48
Q2 2011	1.55	7.22	23.01	0.70	61.85	0.28	0.00	1.24	1.70	2.45
Q3 2011	1.42	6.72	24.34	0.64	61.65	0.26	0.00	1.13	1.45	2.39
Q4 2011	1.48	6.90	24.12	0.61	61.62	0.27	0.00	1.19	1.47	2.35
Q1 2012	1.51	7.08	22.87	0.64	62.49	0.28	0.00	1.13	1.57	2.43
Q2 2012	1.50	6.91	23.12	0.60	62.60	0.27	0.00	1.17	1.48	2.35
Q3 2012	1.50	7.10	23.14	0.60	62.32	0.28	0.00	1.20	1.46	2.40
Q4 2012	1.53	7.20	21.26	0.64	63.77	0.29	0.00	1.31	1.49	2.51
Q1 2013	1.57	7.25	20.01	0.62	65.24	0.29	0.00	1.19	1.42	2.39
Q2 2013	1.42	7.06	19.20	0.63	66.39	0.29	0.00	1.25	1.35	2.42
Q3 2013	1.43	7.20	19.12	0.66	66.09	0.29	0.00	1.32	1.32	2.57
Q4 2013	1.39	7.06	17.98	0.67	67.21	0.30	0.00	1.39	1.31	2.68
Q1 2014	1.45	6.88	18.56	0.68	66.79	0.30	0.00	1.30	1.33	2.72

Notes: AU=Australia, Cn=Canada, JP=Japan, SW=Switzerland, US= United States, SG=Singapore, PH= Philippines, KW=Korea, SA= South Africa, UK= United kingdom.

## Chapter 6

### Conclusion:

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This thesis has provided a systematic analysis of a set of key issues in exchange rate economics. It has empirically investigated topics including exchange rate volatility and its manifestations; the presence of nonlinearity in exchange rates; and the interaction between national price levels and exchange rates. The approach is analytical and empirical, employing formal econometric and modeling techniques to a wide range of up-to-date data on the major as well as developing countries. The issues covered in this study are among the most controversial in international finance. They raise questions about the degree to which domestic inflationary propensities and their transmission across countries are conditioned by the nature of the exchange rate regimes. These questions themselves concern the more fundamental problems of exchange rate determination, the degree of monetary independence and its implications for macroeconomic policy. The empirical analyses and results of this study are expected to contribute to an understanding of the intriguing questions regarding the nature of exchange rate dynamics; the role of nonlinearity, outlier and structural change in exchange rate returns; and the content of purchasing power parity (PPP), linking exchange rate instability with domestic inflation.

The thesis has started with Chapter 1, setting the stage for the other chapters to follow. This chapter has provided a skeletal background, using set of stylised facts. Chapter 2 has given a set of broad features of major exchange rates since the early 1970s, and compared these features with those of the 1960s. Also included was an analysis of whether these features were manifested in real interest rates and in commodity prices. The results have indicated that exchange rates are not as volatile as they are generally viewed. Note that this result is instructive in view of the popular intuition that exchange rates are excessively volatile.

The next three chapters may be viewed as the core work of this thesis. Chapter 3 has given a systematic treatment of the time series properties of a mixed bundle of currencies since major currencies returned to the floating system in the early 1970s. The sample has included four major currencies and eight other relatively less-liquid currencies, all denominated in British pound-sterling. The purpose of including

relatively less liquid currencies is to compare and check if nonlinearity is more of a phenomenon for the currencies of less-developed countries. The results have indicated the presence of nonlinearity in exchange rates. However, the outliers and structural breaks have not been found to be significant in affecting the results.

Chapter 4 has provided a re-examination of the empirical content of PPP for a mixed bundle of 12 currencies using panel data techniques. Alternative panel unit root tests are implemented with the British pound sterling (GBP) as the numeraire currency. Results are then compared with a U.S. dollar-based panel. The panel unit root tests failed to provide support to PPP. The data are then analysed using alternative panel cointegration tests. The reason for this further analysis is that non-rejection of unit roots in real exchange rates does not necessarily imply a rejection of PPP. If nominal exchange rates and relative price levels are integrated of order one (in levels), then it is possible that these two variables may be cointegrated, implying a close relationship in the long run. Again, the results have not been encouraging for PPP. The sample consisting of 12 countries was then divided into 3 sub-groups to check if the results were sensitive to country characteristics. The results are mixed and the data tend to reject PPP. Chapter 5 has provided a further check on the results in Chapter 4, this time using a Divisia index approach. This approach has a similarity with the panel approach in the previous chapter in that it provides a test of PPP based on several countries jointly, rather than taking pairs of countries in isolation from the rest of the world. Using this framework, the short-run results indicate that the predictions of PPP do not hold up well. On the other hand, the long-run data are quite consistent with the PPP hypothesis. The results also identify five years as a broad measure of the length of the long run in so far as PPP is concerned.

In general, conclusions drawn in each chapter are consistent with the broad literature on these topics. However, the results in Chapters 4 and 5 are somewhat contrasting. This may be attributable to the difference in the data frequency used in the two chapters. Note that the choice of the data frequency used in these two chapters was dictated by the data availability. Given the puzzles in the results in these two chapters, it may be worthwhile to revisit these issues in future research.