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Does the nominal exchange rate regime affect the real interest parity condition?

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JEL : C32, F21, F31, F41

Keywords: Real interest parity, nominal exchange rate regime, panel unit roots, common factors

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Does the nominal exchange rate regime affect the real interest parity condition?

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Abstract. The real interest partity (RIP) condition combines two cornerstones in international finance, uncovered interest parity (UIP) and ex ante purchasing power parity (PPP). The extent of deviation from RIP is therefore an indicator of the lack of product and financial market integration. This paper investigates whether the nominal exchange rate regime has an impact on RIP. The analysis is based on 15 annual real interest rates and covers a long time span, 1870-2006. Four subperiods are distinguished and linked to fixed and flexible exchange rate regimes: the Gold Standard, the interwar float, the Bretton Woods system and the current managed float. Panel integration techniques are applied to increase the power of the tests, where cross section correlation is embedded via common factor structures. The results suggest that RIP holds as a long run condition irrespectively of the nominal exchange rate regime. However, adjustment towards RIP is affected by both the institutional framework and the historical episode. Half lives of shocks tend to be lower under fixed exchange rates and in the first part of the sample. Although barriers to trade and capital controls have been removed, they did not lead to lower half lives during the managed float.

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1 Introduction

The real interest parity (RIP) condition combines two cornerstones in international economics, uncovered interest parity (UIP) and ex ante purchasing power parity (PPP), see Marston (1995) and MacDonald and Marsh (1999). Therefore, the degree of deviation from parity can serve as an indicator for the lack of products and financial market integration. RIP states that expected real returns are equalised across countries. This proposition has important implications for investors and policymakers. If national real interest rates converge, the scope for international portfolio diversification is reduced. If the linkages in international real interest rates are almost complete, national stabilization policies cannot systematically affect the economy through the real interest rate channel (Arghyrou, Gregoriou and Kotonikas, 2009).

Because of the increased integration in international product and financial markets, one might expect that RIP is approximately in line with reality. But the evidence is less supportive. Early papers like Mishkin (1984), Cumby and Obstfeld (1984) and Cumby and Mishkin (1987) have overwhelmingly rejected the condition for the short run, see Chinn and Frankel (1995) for a review. Despite the negative result, RIP might be well interpreted as a long run anchor for real interest rates, if the deviations from the condition are stationary. However, previous papers have arrived at different conclusions. While Meese and Rogoff (1988) and Edison and Pauls (1993) detected a unit root, Cavaglia

(1992) and Wu and Chen (1998) reported mean reversion in real interest differentials. Gagnon and Unferth (1995) extracted a world real interest rate by means of factor analysis that is highly correlated with the national counterparts. Ferreira and Léon-Ledesma (2007) reported evidence in favour of RIP in a sample of industrialized and emerging countries. Their analysis reveals a high degree of market integration for developed countries and highlights the importance of risk premia, if emerging markets are involved. According to Dreger and Schumacher (2003) and Arghyrou, Gregoriou and Kontonikas (2009), RIP can be seen a long run attractor for national real interest rates in the European Monetary Union.

On the other hand, real interest rates are persistent over time, probably due to price stickiness (Rapach and Wohar, 2004, Sekioua, 2007). Real interest rate convergence is likely a gradual process, that can be subject to nonlinearities and structural breaks, see Goodwin and Grennes (1994), Holmes (2002), Mancuso, Goodwin and Grennes (2003), Camarero, Carrion-i-Silvestre and Tamarit (2006). The results may also depend on the maturities under study. Fountas and Wu (1999) and Fuijii and Chinn (2002) have stressed that the evidence is more favourable with RIP if long term interest rates are involved. In contrast, Wu and Fountas (2000) reported convergence for the short term rates.

The aforementioned studies are restricted to the period after the collapse of the Bretton Woods system. Therefore, the evidence might be blurred by singular events such as oil price hikes and shifts in monetary policies. Moreover, there is some indication that the nominal exchange rate regime might be not neutral for RIP. Eventually, the condition could perform better if exchange rates are fixed. The argument can be stated both for the PPP and UIP ingredient. If prices are sticky, real exchange rates almost mimic the time series properties of nominal exchange rates (Mussa, 1986). As the latter behave like random walks in flexible regimes, PPP is likely violated. In fact, the evidence tends to be more in line with PPP for fixed rather than for flexible nominal exchange rates (Sarno, 2005). A similar point can be made for the UIP relationship. Frankel, Schmukler and Servén (2004) have argued that national nominal interest rates respond more slowly to changes in their international counterparts in flexible regimes, due to a higher degree of monetary independence.

On the other hand, the integration of product and financial markets may provide increasing support for RIP, see Goldberg, Lothian and Okunev (2003). Barriers to foreign trade and capital controls have been substantially removed over the last decades. Country specific risks can be diversified in the portfolios of international investors. In addition, critical parameters like the degree of price stickiness might change over time. Note that economic integration is by no means a continuous process. International capital controls have been more pervasive under the Bretton Woods system when compared to the classical Gold Standard.

Overall, RIP might be primarily affected by historical periods and not by institutional arrangements for the nominal exchange rate. See Grilli and Kaminsky (1991) for similar arguments regarding the time series properties of real exchange rates. Note that the periods can be also classified according to the regime of capital restrictions. While capital moved rather freely under the Gold Standard and current floating system, massive controls existed in the interwar period and the Bretton Woods era.

This paper explores whether or not the nominal exchange rate regime affects the long run validity of the RIP condition, and whether an impact exceeds the one arising from integrated product and financial markets. The analysis is built upon a comprehensive dataset based on 15 annual real interest rates and covers a long time span, 1870-2006. Four subperiods are distinguished and linked to fixed and flexible exchange rate regimes: the Gold Standard, the interwar float, the Bretton Woods system and the managed float thereafter. The managed float is also splitted to take the European monetary integration into account. Panel techniques are applied to increase the power of the unit root tests. Dependencies between real interest differentials are embedded via a common factor structure. This approach can offer new insights into the sources of nonstationarities, i.e. whether the unit root is mainly driven by common or country specific components.

The testing strategy has several advantages. By focusing on certain episodes, the structural break argument becomes less relevant. A relatively large sample size can be retained, as a panel is considered instead of specific time series. On the other hand, no individual information is extracted. However, this drawback can be mitigated through the definition of subpanels, where only presumably nonstationary series are included. Even more important, the usage of RIP as a building bloc in theoretical models for the exchange rate assumes the validity of the condition for the common rather than for the idiosyncratic component. Whether the former shows mean reverting behaviour or not is examined by standard time series tests.

The analysis provides strong evidence in favour of RIP as a long run condition irrespectively of the nominal exchange rate regime. Adjustment towards RIP is affected by both the exchange rate arrangement and the historical episode. Half lives of shocks are lower under fixed exchange rates and in the first part of the sample, probably due to higher price flexibility before WWII. The system for the exchange rate appears to be more important than the regime of capital controls.

The paper is organized as follows: Section 2 introduces basic concepts. Section 3 provides a brief chronology of nominal exchange rate regimes since 1870. Panel integration methods are reviewed in section 4. Data and results are discussed in section 5, while section 6 offers concluding remarks.

2 Real interest parity

Real interest parity is an overall indicator for the relevance of international factors in the national economic development. Deviations from parity point to a lack of full integration in the product and/or financial markets. RIP assumes the joint validity of three conditions. Following Moosa and Bhatti (1996), the Fisher equation holds for the domestic and foreign country

(1) $$E_t r_{t+1} = i_{t,t+1} - E_t \pi_{t+1}$$

(2) $$E_t r^*_{t+1} = i^*_{t,t+1} - E_t \pi^*_{t+1}$$

where π is inflation, and r and i the real and nominal interest rate, respectively. E denotes the rational expectations operator, t is the time index and an asterisk refers to the foreign country. Hence, the ex ante real return of an asset with one period to maturity is equal to its nominal return –which is known in advance- less expected inflation. The real interest rate differential

(3) $$E_t(r_{t+1} - r^*_{t+1}) = (i_{t,t+1} - i^*_{t,t+1}) - E_t(\pi_{t+1} - \pi^*_{t+1})$$

is stationary, if two further conditions are met. According to UIP, expected fluctuations in the spot exchange rate are reflected by the nominal interest rate differential

(4) $$E_t(s_{t+1} - s_t) = i_{t,t+1} - i^*_{t,t+1}$$

where the spot rate s is defined as the logarithm of the domestic price of the foreign currency. Ex ante PPP states

(5) $$E_t(s_{t+1} - s_t) = E_t(\pi_{t+1} - \pi^*_{t+1})$$

that the expected innovation in the exchange rate can be also revealed from the rational forecast of the inflation differential. Ex ante PPP and UIP are based on perfect arbitrage and the absence of risk aversion in the product and financial markets. Equations (3), (4) and (5) can be aggregated to the RIP condition

(6) $$E_t(r_{t+1} - r^*_{t+1}) = 0$$

where ex ante real interest rates are equalized across countries. Because of the rational expectations assumption, the ex post real interest rate is the sum of the ex ante real interest rate and a serially uncorrelated error u with zero mean. If RIP holds, the ex post real interest rate differential boils down to the difference of two probably correlated rational forecast errors, i.e.

(7) $$r_{t+1} - r^*_{t+1} = E_t r_{t+1} + u_{t+1} - (E_t r^*_{t+1} + u^*_{t+1}) = u_{t+1} - u^*_{t+1}\,.$$

Equation (7) provides the basis for the empirical analysis. The validity of RIP in the long run is efficiently tested by examining whether real interest differentials are mean reverting. This is explored by a unit root analysis. If mean reversion is detected, shocks have only temporary effects, where the estimated autoregressive root serves as an indicator for the degree of shock persistence. A non zero constant might be justified, inter alia, due to the existence of transaction costs, non-traded goods, non-zero country risk premia or differences in national tax rates.

3 Classification of nominal exchange rate regimes

The evolution of real interest differentials is studied over the 1870-2006 period. Fixed and flexible nominal exchange rate regimes operated since then: the Gold Standard (1870-1914), the interwar float (1920-38), the Bretton Woods system (1950-72) and the current managed float (1973-2006), see Eichengreen (1994). Reinhart and Rogoff (2002) and Levy-Yeyati and Sturzenegger (2005) have offered detailed classifications of exchange rate regimes, thereby differentiating between *de jure* and *de facto* arrangements. While the former are based on official commitments, the latter focus on actual nominal exchange rate behaviour. But these databases are limited to the post WWII period, with special emphasis on the current float.

Bilateral exchange rates were pegged indirectly under the Gold Standard, as countries declared parities of their currencies to gold. Arbitrage in the gold market and flexible prices ensured the functioning of the system. Exchange rate stability implied the convergence of inflation, leading to similar long term interest rates. This reflected the tendency for stable exchange rates and the absence of capital controls (Eichengreen, 1994, Officer, 1996). While the US resumed gold convertibility in 1879, Japan was not a member until the turn of the century.

In the first years after WWI, exchange rates were determined by market forces. As wartime divergencies in national prices exceeded those of nominal exchange rates, a restoration of fixed exchange rates required further revaluations, with an additional fall of

European currencies against the US dollar (Bernanke and James, 1990, Eichengreen, 1994). However, policymakers affirmed their commitment to restore nominal exchange rates to pre-war levels. A return to the Gold Standard took place in the mid 1920s, but lasted only for a few years. In the Great Depression, a floating regime emerged, but with massive government intervention. Countries devaluated their currencies to improve the competitiveness and reduce deficits. International trade became largely restricted within currency blocs. Capital controls were imposed to minimize the impact of international capital movements on the exchange rate.

The Bretton Woods conference re-established fixed exchange rates after WWII. All currencies were pegged to the US dollar, while the US dollar was pegged to gold. Deficit countries could use credit facilities of the IMF. Realignments were allowed to correct for fundamental disequilibria. Because foreign currency reserves were denominated in dollar, US trade deficits could persist and ensured the provision of international liquidity. Contrary to the Gold Standard, capital controls were pervasive (Eichengreen, 1994). For example, the Bundesbank imposed discriminatory measures in 1970 to discourage purchases of German assets by foreign residents. The lack of international policy coordination and speculative attacks against weak currencies eroded the system in the early 1970s.

The current regime of flexible rates can be characterised as managed float (Eichengreen, 1994). In principle, bilateral exchange rates are determined by supply and demand conditions in the foreign exchange market. However, the breakdown of Bretton Woods system had a less radical impact. Dooley, Folkerts-Landau, and Garber (2003) have argued that the current regime operates much like a system of fixed exchange rates. Countries have intervened in the market to keep the exchange rates within desired target zones.

Another strategy is to peg the value of domestic money to a major currency or to establish a crawling peg. Policymakers moved towards an agreement to stabilize exchange rates within Europe while permitting them to fluctuate against a dollar (De Grauwe, 2007). In particular, the Deutschemark was an anchor for the Western European currencies long before the introduction of the European Monetary Union. Asian countries have often implemented export-led growth policies and successfully resisted a appreciation of their currencies against the US dollar. They became net accumulators of foreign reserves. US foreign debt deteriorated and foreign reserves became more diversified. Inflation declined substantially in the aftermath of the oil crises, as monetary policy focused more on price stability.

4 Panel unit root analysis

The presence or absence of random walks is decisive for the long run behaviour of real interest rate differentials. However, it has been widely acknowledged that standard time series tests on nonstationarity may not be appropriate since they have low power against stationary alternatives, see Campbell and Perron (1991). Panel unit root tests offer a promising way to proceed. As the time series dimension is enhanced by the cross section, the results rely on a broader information set. Gains in power are expected and more reliable evidence can be obtained, even in shorter sample periods (Levin, Lin and Chu, 2002).

Early panel unit root tests have been proposed by Levin, Lin and Chu (2002), hereafter LLC and Im, Pesaran and Shin (2004), hereafter IPS. Heterogeneity across panel members is allowed to some extent due to individual deterministic components (constants and time trends) and short run dynamics. The tests differ in the alternative considered. In the LLC approach, a homogeneous first order autoregressive parameter is assumed. The statistic is built on the *t*-value of its estimator in a pooled regression. The IPS test emerges as a standardized average of individual ADF tests. If the null of a unit root is rejected, the series are stationary for at least one individual. Hence, the IPS test extends heterogeneity to the long run behaviour.

In case the panel members are independent, a Gaussian distribution can be justified by central limit arguments. In contrast, dependencies across the panel members can lead to substantial size distortions, see Banerjee, Marcellino and Osbat (2004, 2005). The test statistics are no longer standard normal and converge to non-degenerate distributions (Gengenbach, Palm and Urbain, 2004). Note that this problem is especially relevant in the analysis presented here, since real interest rate differentials are often expressed relative to the same benchmark.

Therefore, modern tests have relaxed the independency assumption, see Hurlin (2004), Gengenbach, Palm and Urbain (2004) and Breitung and Das (2006) for recent surveys. If dependencies arise due to common time effects, panel tests can be used with mean adjusted data, where cross sectional means are subtracted in advance (Im, Pesaran and Shin, 2004). However, this approach is rather restrictive, and might not remove the actual correlation in the data. Thus, the tests suggested by Pesaran (2007) and Bai and Ng (2004) are preferred. Both capture the cross sectional correlation pattern by a common factor structure.

Pesaran (2007) has motivated a single factor approach. The common component is assumed to be stationary and embedded in the error process of the model. The procedure is a cross sectional extension of the ADF framework. The Dickey Fuller regression is extended by cross sectional averages of lagged levels and differences of the series of interest (*y*). In the model

$$\text{(8)} \qquad \Delta y_{it} = a_{0i} + \alpha_{1i} y_{i,\,t-1} + \alpha_{2i} \bar{y}_{t-1} + \alpha_{3i} \Delta \bar{y}_{t-1} + v_{it} \quad , \quad \bar{y}_t = n^{-1} \sum\nolimits_{i=1}^{n} y_{it}$$

the cross sectional average of *y* observed for *n* panel members serves as a proxy to capture the effects of a single factor. Further lags of the differentiated variables have to be included to capture autocorrelation in the residuals. Testing for the null of a unit root is based on the *t*-ratio of the first order autoregressive parameter. Equation (8) can be seen as an alternative to the ADF test in a time series setting, where information of other individuals is allowed to enter through the common component. Due to this extension, the critical values exceed those in the standard ADF setting in absolute value. The panel version arises from a cross sectional extension of the IPS test, where *t*-ratios are pooled across individuals. The limiting distribution is non-standard and depends on the deterministic terms included in the model (Pesaran, 2007).

In the PANIC (Panel Analysis of Nonstationarity in Idiosyncratic and Common components) approach advocated by Bai and Ng (2004), the variable is seen as the sum of a deterministic, a common and an idiosyncratic component, the latter accounting for the error term. A unit root is tested separately for common and idiosyncratic components. Hence, information on the sources of nonstationarity could be revealed. The analysis is built on the decomposition

$$\text{(9)} \qquad y_{it} = \alpha_i + \lambda_i ' f_t + u_{it}$$

where α_i is a country fixed effect, which might contain a linear time trend, f_t is the *r*-vector of common factors, λ_i is an *r*-vector of factor loadings and u_{it} is the idiosyncratic part. The common component is relevant for all cross sections, but with probably different loadings, while the idiosyncratic component is specific for individual series. The parameter r denotes the number of factors, and can be estimated, for example, by the information criteria discussed in Bai and Ng (2002). The variable under study contains a unit root if one or more of the common factors are nonstationary, or the idiosyncratic part is nonstationary, or both.

Principal components (PCs) are used to obtain a consistent estimate of the common factors. However, since the factors might be integrated, a transformation is required in advance. Bai and Ng (2004) estimate PCs for the differenced data, which are stationary by assumption. Once the components are estimated, they are re-cumulated to match the integration properties of the original series. Since the defactored series are independent, the nonstationarity of the idiosyncratic component can be efficiently explored by first generation panel unit root tests.

The analysis of the common component depends on the number of factors involved. In case of a single factor, an ADF test with a constant is appropriate, and inference is based on the Dickey Fuller distribution. Multiple common factors can be explored by separate ADF regressions. A procedure similar to the Johansen (1995) trace test is also available. Jang and Shin (2005) conclude that the PANIC approach has better small sample properties than the Pesaran (2007) test.

5 Panel analysis of real interest parity

The analysis is based on 15 countries obtained at the annual frequency: Belgium, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the UK and the US and covers a long time span, 1870 to 2006. Information is available for long term nominal interest rates (7-10 years to maturity) and CPI inflation. All series prior to 1950 are taken from GFD database (http://www.global-financialdata.com). Starting in 1951, the World Market Monitor of Global Insight is used. After controlling for wartimes and transition years, four regimes of the nominal exchange rate are distinguished within the overall period: the Gold Standard (1870-1914), the interwar float (1920-38), the Bretton Woods system (1950-72) and the managed float (1973-2006). Moreover, a subsample is defined to explore the effects of the European monetary integration (1999-2006).

-Figure 1 about here-

Ex post real interest rates are obtained by subtracting annual CPI inflation from nominal interest rates. Real interest differentials are defined as the difference between the real interest rates in a particular country and the US. The series are shown in figure 1.

-Table 1 about here-

Panel unit root tests reveal strong evidence in favour of the RIP condition, see table 1.[2] The IPS test with mean-adjusted data rejects the random walk for all real interest rate differentials. However, this result relies on the assumption that common time effects are

[2] In addition, the tests have been specified with different settings, with the UK and Germany as a base country, without a constant term or a varying number of factors. The evidence is largely robust against these modifications. Detailed results can be obtained from the author upon request.

appropriate to capture the cross correlation issue. In principle, the strategy might reduce correlation structures, but substantial dependencies could remain. To be on the safe side, the other tests are more reliable.

-Figure 2 about here-

For the Bai and Ng (2004) procedure, the number of factors has to be determined in advance. However, the evidence based on the information criteria suggested by Bai and Ng (2002) is not unique. Therefore, the decision has been made by examining the contribution to the overall variance. The first principal component for the various exchange rate regimes is exhibited in figure 2. It presents roughly 50 percent of the variances of the changes of real interest rate differentials under the Gold Standard, 40 percent during the interwar, 30 percent under the Bretton Woods system, and 40 percent in the managed float. Because the inclusion of further factors raises the cumulative proportion of the variance only modestly, the choice has been made for a single factor model (Forni, Hallin, Lippi and Reichlin, 2000).

Both the Pesaran (2007) and the Bai and Ng (2004) tests confirm the IPS results. Since the unit root can be rejected, real interest differentials are mean-reverting in each regime of the nominal exchange rate. This finding is underpinned by the stationarity of the common and idiosyncratic components.

While the long run validity of the RIP condition holds irrespectively of the nominal exchange rate regime, the adjustment process is affected by these arrangements, see table 2. In particular, half lives of shocks tend to be lower under fixed exchange rates. This implies, for example, that an individual real interest rate channel to stimulate domestic consumption and investment is less available for countries participating in a fixed exchange rate system. Furthermore, the choice of the historical period is relevant, as the movement towards RIP has been shorter during the first part of the sample. This evidence can be further strengthened if only the European countries in the sample are considered. Half lives decreased because of the monetary integration. However, they have been substantially higher than in the past.

-Table 2 about here-

The results can be explained within the context of the trilemma of the global financial architecture, i.e. countries may reach at most two out of three goals: monetary independence, exchange rate stability and financial integration, see Aizenman, Chinn and Ito (2008)[3]. Under the Gold Standard highly integrated product and financial markets have caused a fast adjustment towards parity. Half lives are longer in the Bretton Woods period due to the existence of capital controls. Because of the availability of credit facilities and currency realignments, the system has been also less restrictive compared to the Gold Standard. Despite the European monetary integration, inflation rates differ markedly across countries. Deviations from the RIP are more pronounced due to price rigidities and a lack of market integration. This is also important for the euro area, where heterogeneities in the development of nominal wages may explain the inflation experience (Busetti, Forni, Harvey and Venditti, 2006).

[3] The author would like to thank an anonymous referee for this suggestion.

Monetary policy can be conducted independently in a system of flexible exchange rates. With higher monetary independence, nominal interest rates can diverge. In a world with perfectly flexible prices, however, real interest rates do not need to deviate from each other. Therefore, the relative slow convergence after the Bretton Woods era can be explained in terms of raising monetary independence and with price rigidities. Higher financial integration in the post Bretton Woods era did not reduce the effectiveness of national monetary policies. Overall, the system for the exchange rate appears to be more important than the regime of capital controls.

6 Conclusion

The real interest partity (RIP) condition combines two cornerstones in international finance, uncovered interest parity (UIP) and ex ante purchasing power parity (PPP). The extent of deviation from RIP is therefore a measure of the lack of product and financial market integration. This paper investigates whether the nominal exchange rate regime has an impact on RIP. The analysis is based on 15 annual real interest rates and covers a long time span, 1870-2006. Four subperiods are distinguished and linked to fixed and flexible exchange rate regimes: the Gold Standard, the interwar float, the Bretton Woods system and the current managed float. Panel integration techniques are employed to increase the power of the tests. Cross section correlation is embedded via common factor structures.

The results suggest that RIP holds as a long run condition irrespectively of the exchange rate regimes. Adjustment towards RIP is affected by the institutional framework and the historical episode. Half lives of shocks tend to be lower under fixed exchange rates and in the first part of the sample. Although barriers to foreign trade and capital controls have been removed in the post Bretton Woods era, they did not lead to lower half lives during the managed float.

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Figure 1: Real interest differentials relative to the US, 1870-2006

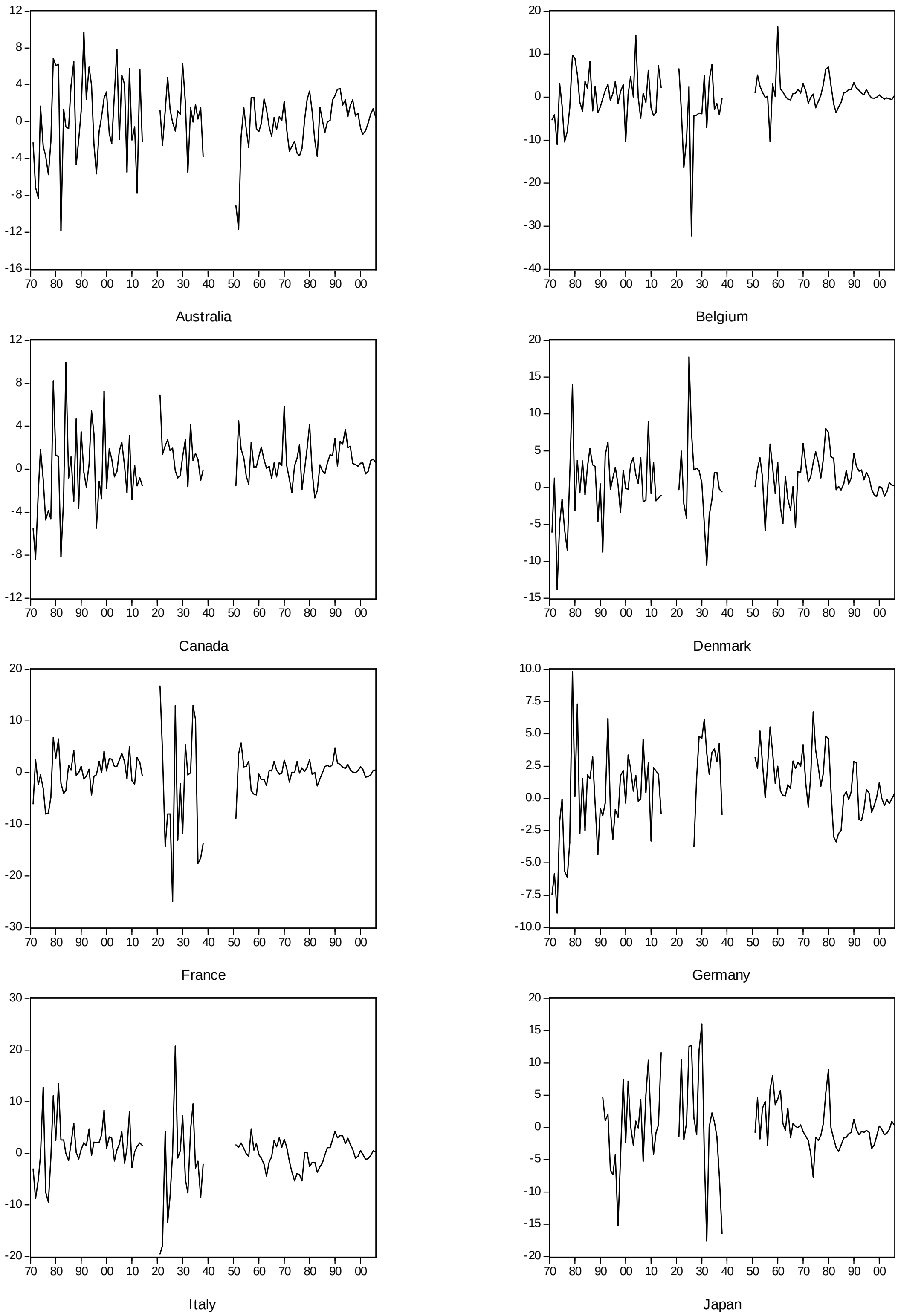
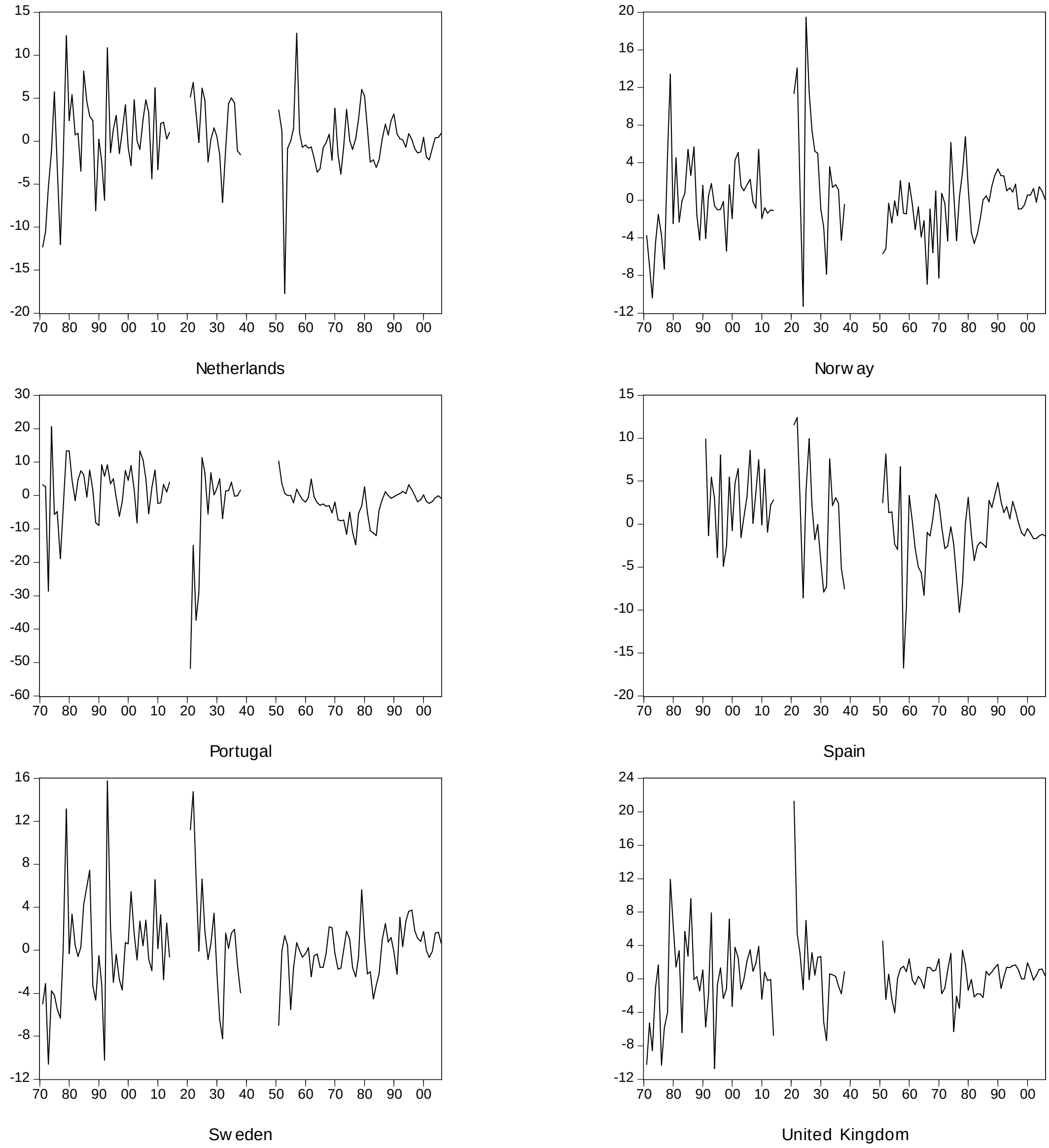
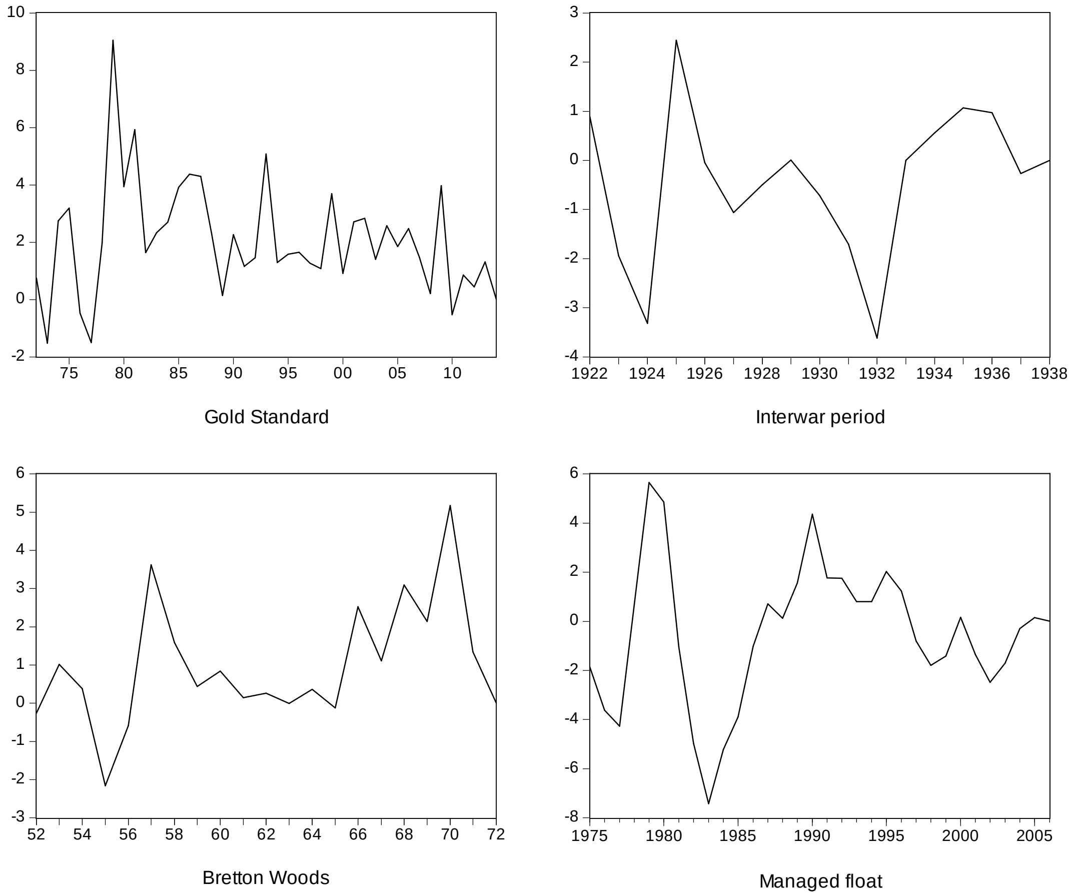


Figure 1: Real interest differentials relative to the US, 1870-2006 (cont'd)



Note: Global financial database for historical data up to 1950 and World Market Monitor (Global Insight) thereafter. Wartimes and transition years are excluded.

Figure 2: Common component of real interest differentials



Note: First principal component of real interest differentials relative to the US.

Table 1: Panel unit root tests for real interest rate differentials

	1870-1914	1920-1938	1950-1972	1973-2006	1991-06 (EU)
IPS (2003)	-17.19*	-5.243*	-8.669*	-5.884*	-4.316*
Pesaran (2007)	-4.838*	-2.285*	-3.004*	-2.544*	-2.169*
Bai and Ng (2004)					
CC (ADF)	-5.136*	-3.615*	-3.244*	-4.606*	-5.681*
IC (IPS)	-18.11*	-2.605*	-5.727*	-5.580*	-1.803*

Note: A balanced panel is required for the panel unit root tests. As data for Japan and Spain are not available before 1890, these countries are excluded from the analysis of the Gold Standard. Due to the hyperinflation period in the first part of the 1920s, Germany is removed from the interwar sample. The optimal lag length in the regressions is determined by the general-to-simple approach suggested by Campbell and Perron (1991). In particular, the Schwartz criterion has been applied, where a maximum delay of 3 years is allowed. Furthermore, all tests are carried out with a constant, but no time trend. The exception is the test for the idiosyncratic component approach, where deterministic terms are excluded. CC, IC = common, idiosyncratic component. The EU subsample includes the 10 EU member states in the analysis. An asterisk denotes the rejection of the unit root hypothesis at least at the 0.05 level.

Table 2: Estimation of half lives

	1870-1914	1920-1938	1950-1972	1973-2006	1991-06 (EU)
AR parameter	0.064 (0.046)	0.232 (0.060)	0.152 (0.056)	0.599 (0.036)	0.528 (0.055)
Half-life of shocks	0.252 (0.065)	0.473 (0.082)	0.368 (0.071)	1.352 (0.155)	1.085 (0.141)

Note: Half lives calculated according to –log(2)/log(δ), where δ is the AR parameter from a panel regression of the real interest differential on its previous value with country fixed effects. Standard errors in parantheses. For half lives, the errors are approximated by the Delta method (Rossi, 2005). The EU subsample includes the 10 EU member states in the analysis.