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Did capital market convergence lower the effectiveness of monetary policy?

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International capital market convergence reduces the ability for monetary authorities to set domestic monetary conditions. Traditionally, monetary policy transmission is channelled through the short-term interest rate. Savings and investment decisions are effected through the response of the bond yield to changes in the short-term interest rate. We find that capital market integration increased correlation between long-term interest rates across countries. Short-term interest rates also show more integration across countries and the correlation with the international business cycle has increased. A stronger linkage between international economic conditions and bond yields has important implications for the effectiveness of monetary policy. Monetary policy makers, especially in small countries, will face more difficulties in influencing domestic conditions in the bond market when they apply the traditional monetary policy framework in case of a country specific shock.

I. Introduction

It seems plausible that integration of international capital markets in the last two decades increased the convergence between long-term interest rates across countries (see, for instance, IMF, 2005, chapter 3). This might have decreased the effectiveness of domestic monetary policy and would have important implications for conventional monetary policy transmission.

Monetary policy can influence long-term interest rates directly and indirectly. The indirect relation, which runs through the term structure of interest rates, is the traditional approach. The direct channel runs through purchases and sales of government long maturity bonds, but is much less common practise. The term structure of interest rates is an important channel for monetary authorities to influence the real economy. Bond yields are related to money yields and bond yields are an important factor for investment and saving decisions. By changing money market rates central banks can influence bond yields and investment conditions. The relation between the short-term and long-term interest rates is therefore the crucial link between the execution of monetary policy and setting price incentives for saving and investment in the real economy.

Research on capital market integration can roughly be grouped in two main areas: research on capital flows and research on price differences.[1] The first

[1] See Edwards (1995, p. 4).

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approach is a well-known area of research introduced by Feldstein and Horioka (1980). This type of research measures the correlation between savings and investments. A low correlation would indicate a higher degree of integration in the international capital market. The Feldstein and Horioka savings and investment puzzle has received much attention among empirical researchers. In this article, we focus on the second approach. This approach investigates the convergence of prices, better known as the interest rate parity conditions. We approach international capital market integration from two angles: the relation of domestic bond yields with international bond yield and the relation of bond yields with the short-term interest rate. By testing interest rate parity and the term structure of interest rates, we test whether international capital market integration led to increased synchronization between long-term interest rates and whether at the same time this has led to lower relevance of domestic short-term interest rates.

Studying capital market integration using long-term interest rate differentials is an area investigated by others as well. For instance, Fell (1996), Fase and Vlaar (1997), and Sutton (2000). Christiansen and Pigott (1997) and Sasaki *et al.* (2000) confirm that the relation between long-term interest rates has gained significance in the period commencing 1980 in comparison with the 1970s. Fase and Vlaar (1997) consider the removal of capital restrictions, lower exchange rate volatility (especially for European Countries since 1992) and cohesion of monetary policy approaches as the main reasons for this. Some other researchers claim there is still a risk premium. According to Sasaki *et al.* (2000) this risk premium exists because domestic and foreign assets are imperfect substitutes and investors are home biased. Also, Pierdzioch (2003) indicates that in a world with free capital mobility home bias can still make domestic monetary policy effective.

A substantial amount of research concentrated on the relation between the long-term interest rate and the short-term interest rate, but the results are not consistent. Atesoglu (2005) finds that since the mid-1980s, long-term interest rates in the United States respond slowly to fed fund changes and that especially within a period of 1 year the effect is limited. But according to Sellon (2002) and Mehra (1996) the short-term response of long-term interest rates to changes in short-term rates has increased over time. Christiansen and Pigott (1997) found increased influence of foreign long-term interest rates on domestic long-term rates, but they did not find a weakened relation between long- and short-term interest rates over time.

We update previous research on monetary policy influence on the long-term interest rate and the relation between international long-term interest rates across countries in this article. We use a rolling regression technique to investigate developments over time. We try to add to empirical literature in a few areas. First, we confront two theoretical concepts of the domestic long-term interest rate determination (foreign long-term interest rate and domestic short-term interest rate) in a single equation. Second, we consider whether results differ between large and small countries. Third, we consider both nominal rates and real rates.

This article is structured in four sections. Section II discusses how monetary policy influences the long-term interest rate. Section III discusses our rolling regression estimate outcomes concerning convergence with the domestic short-term interest rate and the foreign long-term interest rate. Section IV looks further into consequences for global business-cycle convergence and relevance for domestic interest rates. Finally, Section V concludes.

II. How Monetary Policy Influences the Long-term Interest Rate

There are three well-established theoretical concepts that describe the term structure of interest rates. We will touch briefly on the expectations theory, the time preference theory and the preferred habitat theory.

The expectations theory is the most commonly tested theory (Shiller, 1990). The expectations theory determines the long-term interest rate as a weighted average of short-term interest rates. If the current short-term interest rate is equal to future expected short-term interest rates, both short- and long-term interest rates are equal to each other. At a given point in time, the short-term interest rate might differ from the long-term interest rate. For instance, in a situation of a relatively high inflation rate, which is credibly fought by the central bank through a tight monetary policy, the short-term interest rate might be higher than the long-term interest rate. In this case, the average expected long-term inflation rate is lower than the short-term expected inflation rate. The expectations theory predicts that the long-term interest rate is lower than the short-term interest rate, because the current short-term interest rate is lower than the average short-term interest rate.

The expectations theory is the subject of much empirical research, but results are not always consistent with the theoretical assumptions. For instance, Hardouvelis (1994) finds that the long-term interest rate responds in the longer term positively to term structure changes, but within a month the response is on average negative. The expectations theory predicts that long-term rates do not need to change, for as long as they still reflect average short-term interest rates. According to Mehra (1996), monetary policy only determines the inflation component in the longer term. In the short term it can affect the real component.

In the expectations theory of the term structure the long-term interest rate is defined as follows:

$$R_{l1} = \frac{1}{n}(R_{s1} + R_{s2} + \cdots + R_{sn}) \tag{1}$$

The time preference theory explains that investors are less keen to hold long-term deposits, because they lose flexibility to respond to changing economic circumstances, such as unexpected rises of the inflation rate. According to the time preference theory, investors are only willing to hold longer-term maturities if they are rewarded for this uncertainty.

The long-term interest rate is therefore determined as follows:

$$R_l = R_s + \Omega \tag{2}$$

where Ω is the demanded premium. This premium is assumed to be positive (≥ 0).

The preferred habitat theory shows that investments in the money market are a substitute for investments in the bond market (see, e.g. Mishkin and Eakins, 1998, chapter 6). Required returns may differ, but when the difference between returns changes, it may induce capital movements to or from the money market, leading to changing bond prices and yields. For instance, if the money market interest rate rises, it increases the relative attractiveness to hold short-term deposits over long-term deposits. Investors sell bonds (bond prices decrease and the effective yield increases) and buy deposits in the money market. Borrowers react in an opposite way – since the short-term interest rate has risen, their preference for long-term borrowing over short-term borrowing increases.

The preferred habitat theory acknowledges that investors and borrowers have a preference for a certain maturity (which makes this theory differ from the expectations theory of the term structure), but that changing prices in either the money market or bond market can change the investment or borrowing decisions for other markets. Just as in the expectations and time preference theory, short- and long-term interest rates are related as follows:

$$R_l = R_s + \Phi \tag{3}$$

where Φ is the premium or discount. Φ can be either positive or negative or even be zero.

III. Test Results of the Relation Between the Short-term Interest Rate and Long-term Interest Rate

Applying the Augmented Dickey–Fuller (ADF) test showed that the time series of the interest rates of countries we considered were integrated at $I(1)$. We decided to specify the equation with an error correction mechanism. We use the rolling regression estimate method to see whether the relation has changed over time. The estimates are conducted in a quarterly specification over the period 1960/1 to 2004/3. The rolling regressions are estimated over a 10-year period. After each estimate both starting and ending point are rolled over one quarter. This yields 139 regression outputs, for which data were available since the first quarter of 1960. We have estimated the equations for 12 industrialized countries: United States, Japan, Germany, United Kingdom, France, Italy, Canada, Spain, Australia, The Netherlands, Belgium and Switzerland. To see whether the results are different for larger than smaller countries we have divided the countries in two groups: the first six are in the large country group, the latter six in the small country group.

To determine the foreign interest rate, we identify three main interest rate regions: United States, Japan and Germany (euro area). The foreign interest rate for a country is calculated as the average of the interest rates of the regions the country is not a member of. We have treated all euro countries as being part of the euro/German block. This means that the external long-term interest rate for euro countries is an unweighted average of the US and Japanese long-term rate. This is different for European countries like the United Kingdom and Switzerland. Since these countries are not part of the euro area, we calculated their foreign interest rate as an unweighted average of the German, US and Japanese long-term interest rate. This is the same for Australia and Canada. The US foreign rate is an unweighted average of the Japanese and German long-term rate, the Japanese foreign rate is the average of the German and US long-term rate.

We do not include exchange rate developments in the nominal interest equations. Although exchange rate expectations are a key component in the interest rate parity theory, in general, they do not explain long-term interest rate variability very well; see, for instance, Christiansen and Pigott (1997) or den Butter and Jansen (2004). Taking into account exchange rate development could make it more difficult to interpret the relative importance of the domestic short-term rate and the foreign long-term rate of long-term interest explanation, which is the purpose of this article.

We review both nominal and real interest rates. Calculating real long-term interest rates has limitations. We can group approaches to calculating real yields in roughly two categories: forward-looking and backward-looking. A forward-looking measure is the use of inflation-indexed bonds. Downfalls here are that for a limited number of countries data are available and the history of available data is limited. Another limitation is that inflation-indexed bonds have lower liquidity than nominal bonds, which affects the real rate. Another forward-looking approach is the use of consensus forecast data on inflation. Upper and Worms (2003) use this method. The disadvantage of this method is that data are mainly available for a shorter term. An example of backward-looking methods is the use of the HP filter to calculate long-term inflation rates. For instance, Krämer (1998) applies this method. This method smoothes long-term inflation developments. OECD (2005) deflates long-term interest rates with an average inflation rate over 12 previous months. An obvious downfall of backward-looking methods is that they are relatively slow in identifying structural changes in inflation levels which might already been priced in bonds. Because of problems with availability of long-term forward-looking data for our broad set of countries, we calculate the real long-term interest rate by discounting nominal rates with 5 years moving averages of the consumer price index. The results are comparable to the use of the HP filter (see Figs A1 and A2 in the Appendix for a comparison for the CPI developments in Germany and the United States).

Before discussing the results of the rolling regression estimates, we first present the estimation results of an error-correction model for both equations over the period 1980/1 to 2003/4 for the above mentioned 12 countries.

$$\Delta R_l = \alpha + \beta_1 \Delta R_s + \beta_2 \Delta R_l^f + \beta_3 \left(R_l - \gamma_1 R_s - \gamma_2 R_l^f - \sigma \right) \qquad (4)$$

$$\Delta r_l = \alpha + \beta_1 \Delta r_s + \beta_2 \Delta r_l^f + \beta_3 \left(r_l - \gamma_1 r_s - \gamma_2 r_l^f - \sigma \right) \qquad (5)$$

where R is the nominal rate, r is the real rate, R_l^f is the foreign long-term interest rate and R_s is the short-term interest rate.

We estimated Equations 4 and 5 under the restriction that the coefficient values of the short-term interest rate and the foreign long-term rate add up to one. Theoretically this is what one would expect, since both dependent and independent variables are interest rates. Estimating the equations in unrestricted form shows that this can be empirically confirmed. On average, the nominal equation shows a coefficient value sum of 0.8 (Table 1). Only for Switzerland and Belgium the coefficient value sum is less than 0.8. Over time, the average sum of coefficient values has risen from 0.6 in the 1960s and 1970s to 1.0 (Table 2). For the equation in real terms, the average of the sum of coefficient values is a bit lower. This reflects a lower adjusted R^2 and not the impact of inflation differences. If differences of inflation rates would have been the reason for a lower sum of coefficient values this could not have affected the average sum to differ from the nominal but only for specific countries, where inflation volatility differs significantly from the international average.

Table 3 shows the results of the nominal interest rate Equation 4 over the period 1960 to 2004. Countries are ranked in Table 3 by the level of the coefficient value of the short-term interest rate variable. Table 3 shows that the coefficient value is slightly higher for the larger six countries (average: 0.268) than for the smaller countries (average: 0.213).

Table 1. Average sum of coefficient values of the short-term interest rates and the foreign long-term interest rate

	Nominal	Real
Italy	0.8	0.7
Japan	0.8	0.6
Germany	0.9	0.6
Netherlands	0.8	0.6
France	0.8	0.8
US	0.8	0.8
Switzerland	0.6	0.5
Spain	1.0	0.5
Australia	0.9	0.8
Belgium	0.7	0.6
UK	0.8	0.8
Canada	1.1	0.9
Total unweighted	0.8	0.7

Table 2. Sum of coefficient values and *t*-values of the short-term and foreign long-term interest rate

	1965–1975	1970–1980	1975–1985	1980–1990	1985–1995	1990–2000	1995–2004
Nominal rates							
Sum *t*-values	5.1	6.2	6.4	8.2	8.3	7.6	7.2
Sum coefficients	0.6	0.6	0.7	0.8	0.9	1.0	1.0
Adj. R^2	0.36	0.37	0.38	0.48	0.49	0.45	0.46
Real rates							
Sum *t*-values	3.6	5.1	4.5	6.2	6.6	6.0	4.9
Sum coefficients	0.6	0.7	0.6	0.7	0.8	0.8	0.7
Adj. R^2	0.28	0.28	0.26	0.34	0.36	0.37	0.34

Table 3. Estimation results of nominal long-term interest rate changes (1980–2004; European Restructuring Monitor (ERM) quarterly specification; *t*-values in brackets)

	C		R_{short}		R_{long}		LT		Adj. R^2	DW-stat.	SD dep var.
Italy	−0.01	(−0.22)	0.44	(7.07)	0.56	(8.91)	−0.08	(−1.75)	0.370	1.43	0.77
Japan	−0.00	(−0.23)	0.40	(9.90)	0.60	(15.0)	−0.52	(−6.28)	0.511	1.80	0.44
Germany	0.02	(0.85)	0.38	(8.34)	0.62	(13.45)	−0.06	(−1.87)	0.603	1.85	0.44
Netherlands	0.03	(0.92)	0.28	(7.11)	0.72	(18.6)	−0.09	(−2.88)	0.564	1.98	0.41
France	0.01	(0.19)	0.26	(7.00)	0.74	(20.4)	−0.11	(−2.40)	0.577	1.60	0.51
US	0.01	(0.17)	0.25	(5.34)	0.75	(16.34)	−0.13	(−2.68)	0.490	1.88	0.62
Switzerland	0.04	(1.38)	0.24	(7.67)	0.76	(24.9)	−0.06	(−2.13)	0.342	2.06	0.31
Spain	−0.03	(−0.51)	0.24	(6.30)	0.76	(19.8)	−0.16	(−3.10)	0.289	1.70	0.74
Australia	0.01	(0.16)	0.24	(5.53)	0.76	(17.9)	−0.10	(−2.07)	0.437	2.02	0.64
Belgium	0.01	(0.26)	0.23	(6.67)	0.77	(22.11)	−0.23	(−3.67)	0.434	2.08	0.43
UK	−0.03	(−0.72)	0.17	(5.58)	0.83	(27.2)	−0.11	(−2.72)	0.472	1.69	0.49
Canada	−0.00	(−0.09)	−0.00	(−0.07)	1.00	(38.5)	−0.18	(−3.24)	0.633	1.98	0.64

Nevertheless, the results show that the significance of foreign bond yield changes is higher than the significance of domestic short-term interest rates.[2] This is in line with findings of Hardouvelis (1994) who found higher first difference correlations between domestic long-term interest rates and foreign long-term than between domestic long-term interest rates and domestic short-term interest rates. For Canada, the long-term interest rate is primarily determined by the foreign long-term interest rate.[3]

Table 4 shows the same equation but now interest rates are defined in real terms. The estimation outcome shows a similar distribution of country ratings as the equation with nominal interest rates. However, the adjusted R^2 is lower. For the larger countries we found an average coefficient value for the short-term interest rate of 0.168 and with 0.173 this is almost the same for the smaller countries.

The lower explanatory power for the real interest rate equations could be a result of the difficulty to specify real rates, which were addressed at the start of this section. The proxy of 5 years average inflation rates that we used to calculate real long-term rates could diverge from bond market investors' expectations.

At first glance, the results may contradict expectations. As capital restrictions have slowly been removed over time and the global economy became increasingly more integrated, the estimation results do not show a fall of the short-term interest rate coefficient value. However, there is a difference between large and small countries. For small

[2] We did not run tests on causality between long-term interest rates. Causality between long-term interest rates has, for instance, been considered by Bruneau and Jondeau (1999). A result of this study is that the authors could not identify the causality direction between the United States and Germany.

[3] When an ERM equation for the Canadian long-term interest rate is estimated using only the short-term interest rate as explanatory variable, there is a positive but weak relationship. This model yielded an adjusted R^2 of 0.093, which was together with results for Belgium (also 0.093) the lowest in the group of 12 countries. For all countries we found an average of 0.204 (0.238 for large countries, 0.163 for small countries).

Table 4. Estimation results of real long-term interest rate changes (1980–2004, ERM quarterly specification)

	C		r_{short}		r_{long}		LT		Adj. R^2	DW-stat.	SD dep var.
Italy	0.03	(0.48)	0.32	(5.36)	0.68	(11.60)	−0.05	(−1.50)	0.191	1.45	0.71
Japan	−0.01	(−0.18)	0.29	(5.88)	0.71	(14.42)	−0.15	(−2.89)	0.200	1.92	0.44
France	0.03	(0.82)	0.21	(6.06)	0.79	(23.29)	−0.06	(−2.12)	0.492	1.63	0.48
Spain	0.03	(0.39)	0.21	(5.88)	0.79	(21.85)	−0.13	(−3.14)	0.249	1.68	0.76
Switzerland	0.01	(0.38)	0.20	(6.97)	0.80	(28.20)	−0.05	(−2.51)	0.175	1.83	0.30
Belgium	−0.01	(−0.37)	0.20	(6.68)	0.80	(26.04)	−0.12	(−3.13)	0.267	2.12	0.40
Netherlands	−0.01	(−0.31)	0.20	(6.11)	0.80	(23.78)	−0.09	(−2.94)	0.449	1.87	0.41
US	0.02	(0.41)	0.19	(3.94)	0.81	(16.40)	−0.11	(−2.42)	0.400	1.55	0.64
UK	0.01	(0.35)	0.14	(4.26)	0.86	(26.85)	−0.03	(−1.59)	0.357	1.89	0.48
Australia	0.02	(0.34)	0.11	(2.52)	0.89	(21.33)	−0.08	(−2.75)	0.277	1.82	0.64
Germany	−0.01	(−0.20)	0.09	(3.28)	0.91	(32.90)	−0.05	(−1.60)	0.174	1.70	0.42
Canada	0.02	(0.41)	−0.01	(−0.39)	1.01	(35.30)	−0.06	(−2.35)	0.597	1.98	0.65

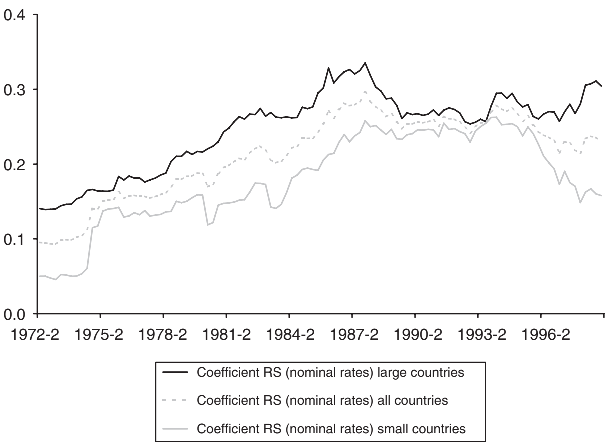

Fig. 1. Coefficient value of the domestic nominal short-term interest rate in a rolling regression equation explaining long-term interest rate movement

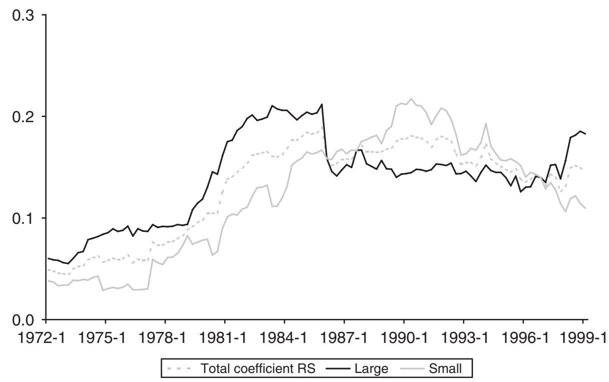

Fig. 2. Coefficient value of the domestic real short-term interest rate in a rolling regression equation explaining long-term interest rate movement

countries we find a fall during the 1990s of the short-term interest rate coefficient.

Figures 1 and 2 show the coefficient values of the short-term interest rate for, respectively, the nominal rate equation (Fig. 1) and the real rate equation (Fig. 2). A rising short-term interest rate coefficient value would indicate increasing importance of the short-term interest rate in explaining movements of long-term interest rates. Therefore, monetary policy would have more influence on the long-term interest rate. A fall of the coefficient value implies the contrary.

As mentioned in Section I of this article, a number of studies confirmed that the relation between long-term interest rates has gained strength in the period after 1980. We separated the short-term interest rate and the foreign long-term interest rate and estimated singular equations to see how the explanatory power of both variables changed over time when studied in isolation. Both equations are as follows:

$$\Delta R_l = \alpha + \beta_1 \Delta R_l^f \quad (6)$$

$$\Delta R_l = \alpha + \beta_1 \Delta R_s \quad (7)$$

Both the short-term interest rate and the foreign long-term interest rate have higher explanatory power for smaller countries than for larger countries. Both our individual regression of long-term foreign interest rates and the short-term interest rate show that both variables gained explanatory power over time. In line with findings of Christiansen and Pigott (1997), we do not find that synchronization of long-term interest rates led to lower relevance for short-term rate relevance for interest rate determination in the bond market. Figure 3 shows the singular relation with the long-term foreign interest rate and Fig. 4 shows the relation with the domestic short-term interest rate.

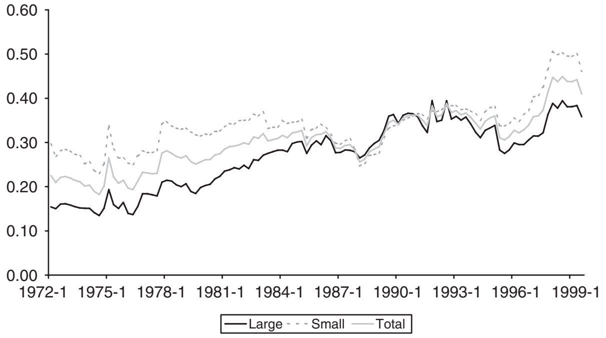

Fig. 3. Adjusted R^2 for rolling first difference equation, explaining changes in the nominal long-term interest rate with the nominal long-term foreign interest rate

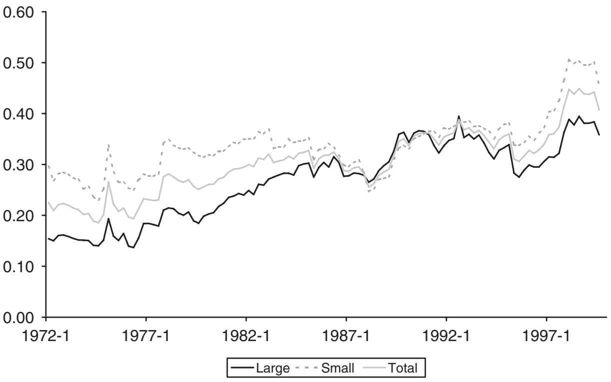

Fig. 4. Adjusted R^2 for rolling first difference equation, explaining changes in the nominal long-term interest rate with the nominal short-term interest rate

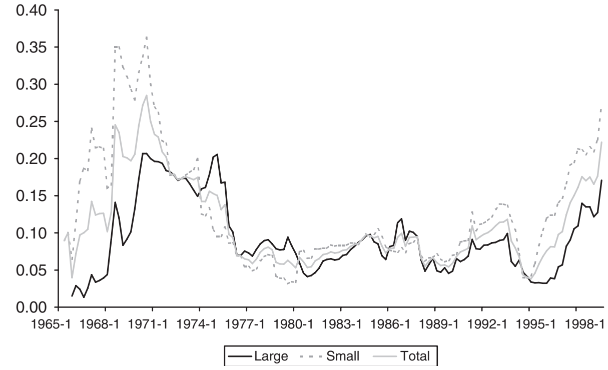

Fig. 5. Adjusted R^2 from rolling equations in which domestic nominal short-term interest rate is explained by the foreign nominal short-term interest rate

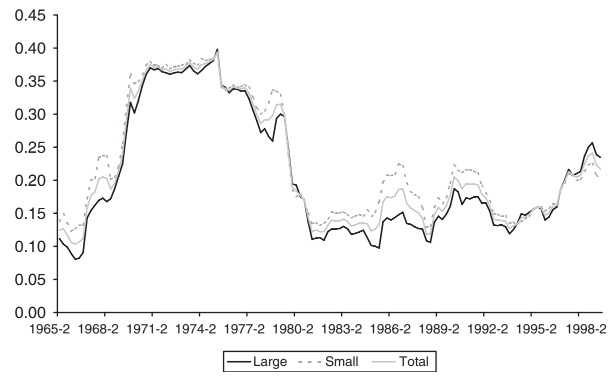

Fig. 6. Adjusted R^2 from rolling equations in which domestic business cycle is explained by the foreign business cycle

IV. Business Cycle Synchronization as a Cause for Improved Relevance for the Term Structure

The previous section showed that increased explanatory power of the foreign long-term interest rate did not reduce explanatory power of the domestic short-term rate. This section looks further into the causes of this increased explanatory power of the domestic short-term interest rate and whether this could be caused by increased synchronization of global business cycles. To measure this we apply the same empirical approach of estimating rolling regressions. The purpose of estimating Equation 8 is to find whether the relation between the domestic short-term rate and the foreign short-term rate has changed over time. The purpose of Equation 9 is to find whether this development is more or less in accordance with the business cycle integration. As proxy for the business cycle we have used economic sentiment indicators.

$$\Delta R_s = \alpha + \beta_1 \Delta R_s^f \qquad (8)$$

$$\Delta \text{Cycle} = \alpha + \beta_1 \Delta \text{Cycle}^f \qquad (9)$$

The results of both rolling equations are shown respectively in Figs 5 and 6. Figure 5 shows that there was a stronger convergence in the 1970s and that this convergence gained strength in the second half of the 1990s. Similar peaks can be found in Fig. 6. In our opinion this indicates two events. The strong convergence in the 1970s can be attributed to two oil-inflation shocks, which affected inflation and interest rate developments in all industrialized countries and called for monetary tightening across the industrialized world. In the 1990s the situation is slightly different. Here, business cycle synchronization is more likely to be a consequence of enhanced global trade. According to the IMF (2005, p. 129) the real economy has synchronized noticeably between industrialized countries. Upper and Worms (2003) found that in the late 1990s monetary policy has synchronized across industrialized countries.

If business-cycle integration has been the driver of continued relevance of short-term interest rates for explaining long-term interest rate movements, this does have important implications for the effectiveness of traditional monetary policy. In the traditional theory on monetary policy transmission, the short-term interest rate is exogenously set. If the short-term interest rate is determined by the international business cycle, economic integration has led to the short-term interest rate being determined endogenously and is therefore put outside the control of the central bank. In this case it is not the domestic short-term interest rate that matters for the domestic bond market, but the global average of short-term interest rates. This complicates the ability to respond to country specific shocks with a traditional monetary policy framework, especially for policy makers in smaller countries.

Besides synchronization of international economic conditions in the second half of the 1990s, other authors identified a number of other reasons which could explain monetary policy synchronization. Sutton (2000) claims, for instance, that there could be similar, but not necessarily coordinated, views on the importance of fighting inflation. Sutton argues that from the 1960s to the early 1990s there is a buildup of inflation and then a reduction of inflation to very low levels in a number of industrialized countries. This shared view on conducting monetary policy will especially lead to convergence when price shocks have a global or external origin, like oil price shocks.

Increased importance of the short-term interest rate could also be a consequence of institutional factors. Sellon (2002) argues that more mortgages are financed at flexible rates and that costs of refinancing mortgages have fallen. These institutional effects have led to broadening of the impact of monetary policy on the real economy. They also point out that the passing through of policy rate changes to mortgage rates has increased from 20% in the early 1970s to almost 100% at the end of the 1990s. Several authors pointed out that the development of the capital market led to more anticipation of bond investors to expected policy rates (see, for instance, Roley and Sellon, 1995; Sellon, 2002; Wu, 2005). At the time of policy rate changes, the reaction of long-term interest rates could be either way. There will be no change when the policy rate change was fully expected and anticipated, the response would be positive if the policy rate change was not (fully) expected and the response could be negative if the policy rate change falls short of expectations.

V. Conclusion

In this article, we have tested whether traditional term structure-based monetary policy lost effectiveness due to international capital market integration. We have applied a rolling error correction technique to test whether the relation between the domestic short-term interest rate and the long-term interest rate lost significance.

We found that there has been a steady rise of the influence of the short-term interest rate, which lasted until the mid-1980s. On average, the influence remained steady after the mid-1980s and fell slightly in the late 1990s. During the late 1990s we observe a small rise of the influence of the domestic short-term interest rate in the larger countries, while at the same time it fell for smaller countries. For the interest rate equation specified in real terms the pattern is similar, although the fall of the importance of the domestic short-term interest rate started somewhat earlier (beginning of the 1990s). Also the foreign long-term interest rate has gained significance in explaining long-term interest rate movements over time. Both in nominal and in real terms, both for smaller and larger countries. Taking both variables together in one equation, coefficient values have been quite stable since the early 1980s.

We found that strong explanatory power of short-term rates is probably caused by business cycle integration. We found that both economic cycles and short-term interest rates became more integrated. The increased relevance of the international business cycle for domestic long-term interest rates has important implications for the effectiveness of monetary policy. It means that the short-term interest rate has become more endogenous, where it is set by the international business cycle while it was previously set by the central bank. If there would be a country specific shock, it will be much more difficult to set domestic monetary conditions when long-term interest rates are influenced by international bond markets and the global business cycle. In such an event, fiscal policy would be the preferred policy tool to respond to changing conditions.

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Appendix

Actual inflation developments and long-term inflation calculations using 5-years smoothing and HP-filter for Germany and the United States are provided in Figs A1 and A2.

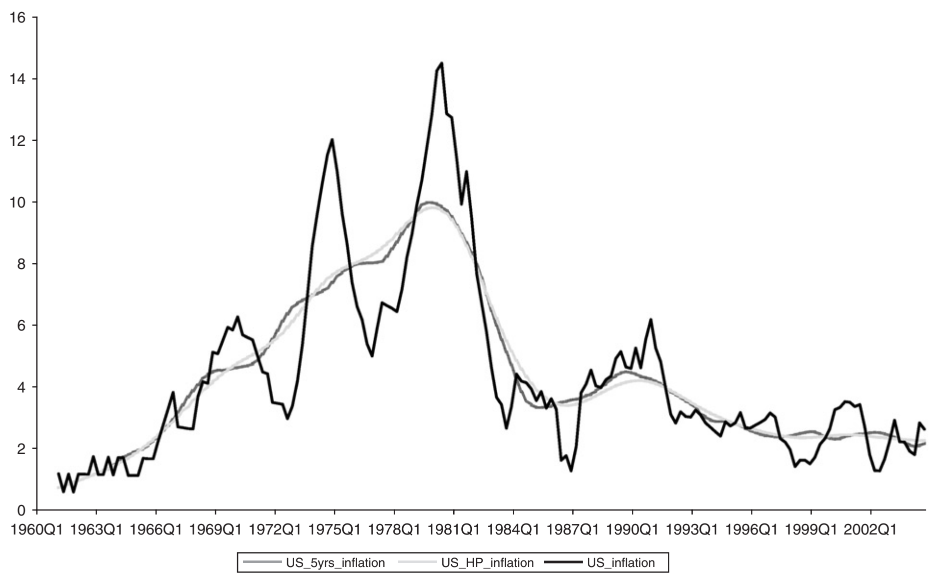

Fig. A1. United States

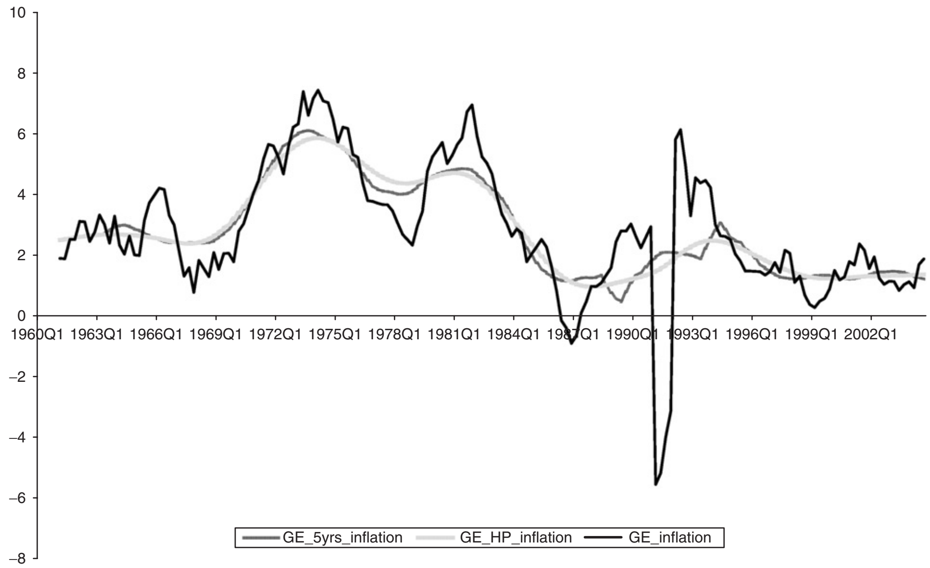

Fig. A2. Germany