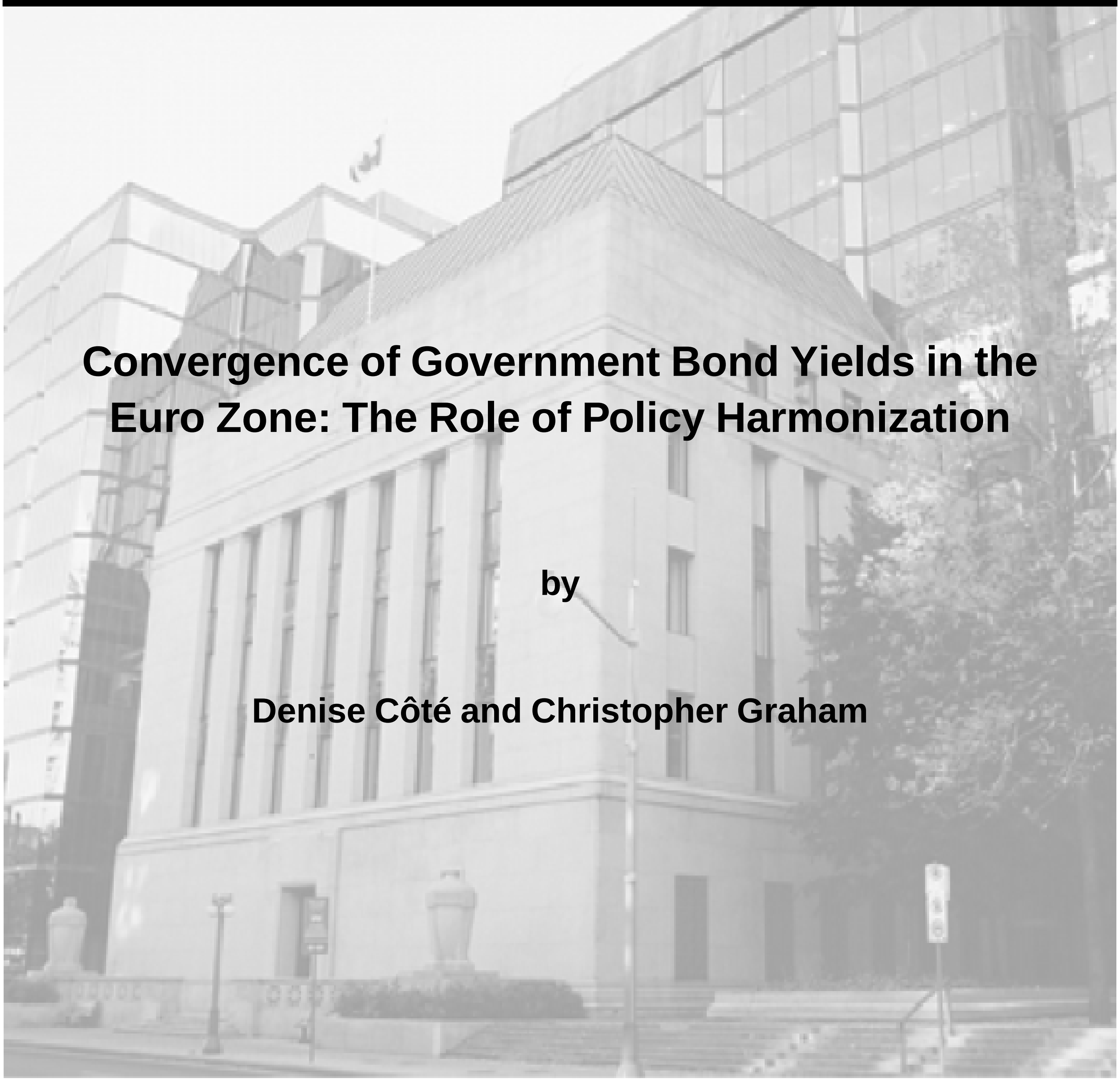
Bank of Canada Banque du Canada

Working Paper 2004-23 / Document de travail 2004-23



Convergence of Government Bond Yields in the Euro Zone: The Role of Policy Harmonization

by

Denise Côté and Christopher Graham

ISSN 1192-5434

Printed in Canada on recycled paper

Bank of Canada Working Paper 2004-23

June 2004

Convergence of Government Bond Yields in the Euro Zone: The Role of Policy Harmonization

by

Denise Côté and Christopher Graham

International Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9
dcote@bank-banque-canada.ca
cgraham@bankofcanada.ca

Contents

Acknowledgements

We would like to thank Jocelyn Jacob, Peter Hann, Michael King, Robert Lafrance, Daryl Merrett, Graydon Paulin, Florian Pelgrin, James Powell, Eric Santor, and Larry Schembri for helpful suggestions and discussions. We would like to thank our research assistants, Joan Teske, Sylvie Malette, and Danielle Henri, for providing help in constructing the database. We are grateful for the comments received at a seminar at the Bank of England in April 2004, at the European Central Bank, and at the 3rd Annual Meeting of the European Economics and Finance Society, University of Gdansk, Poland, in May 2004 and at the 38th Annual Meetings of the Canadian Economics Association in June 2004. We are also thankful to Glen Keenleyside for his excellent work in editing this document.

Abstract

Since the early 1980s, long-term government bond yields in the euro zone have declined, in line with those in other industrialized countries. In this paper, the authors examine the monetary and fiscal policies adopted by European countries on the path to Economic and Monetary Union (EMU), and assess how these policies, including the introduction of the common currency, have contributed to the convergence of national long-term government bond yields in the euro zone.

The authors find evidence that increased harmonization of monetary and fiscal policies on the path to EMU contributed greatly to the convergence of long-term government bond yields in the euro zone. More importantly, their findings suggest that the convergence of national long-term government bond yields in the euro zone cannot be attributed primarily to the introduction of the common currency itself, since two control groups of other OECD countries experienced a similar convergence. The first control group consists of other European Union (EU) countries not included in EMU (Denmark, Sweden, and the United Kingdom), and the second group includes other OECD countries that are members of neither EMU nor the EU (Australia, Canada, Norway, and Switzerland). The authors also find evidence that currency risk premiums declined gradually following the adoption of the Maastricht Treaty and were largely eliminated by the time the single currency was introduced in January 1999. These findings suggest that, in the context of integrated international financial markets, harmonization of sound monetary and fiscal policies across countries will cause national long-term bond yields to converge. Based on evidence from the euro zone, the adoption of a common currency will have, at most, a secondary effect on the convergence of national bond yields.

JEL classification: C23, E43, E44, F36
Bank classification: Interest rates; International topics

Résumé

Depuis le début des années 1980, les rendements des obligations d’État dans la zone euro affichent une tendance à la baisse, laquelle a également été observée dans d’autres pays industrialisés. Dans cette étude, les auteurs examinent les politiques monétaires et budgétaires qu’ont adoptées les pays européens en voie d’intégrer l’Union économique et monétaire (UEM) et évaluent le rôle joué par ces politiques, y compris l’introduction de la monnaie unique, dans la convergence des rendements des obligations à long terme émises par les membres de la zone euro.

Les résultats obtenus par les auteurs indiquent que la poursuite de l’harmonisation des politiques monétaires et budgétaires des candidats à l’UEM a favorisé considérablement cette convergence. Plus important encore, ces résultats semblent montrer que l’introduction de la monnaie unique n’a pas joué un rôle primordial à cet égard, les rendements des obligations à long terme de deux groupes témoins formés d’autres pays de l’OCDE ayant connu une convergence similaire. Le premier groupe comprend les pays membres de l’Union européenne qui ne font pas partie de l’union monétaire, soit le Danemark, la Suède et le Royaume-Uni. Le second est composé de quatre membres de l’OCDE qui ne font partie ni de l’UEM ni de l’Union européenne, à savoir l’Australie, le Canada, la Norvège et la Suisse. Par ailleurs, certaines observations donnent à penser que les primes de risque de change ont diminué graduellement après l’adoption du Traité de Maastricht et avaient en grande partie disparu au moment du lancement de la monnaie unique, en janvier 1999. Ces résultats portent à croire que l’harmonisation de politiques monétaires et budgétaires saines entre les pays, dans le contexte de marchés financiers intégrés à l’échelle internationale, entraîne une convergence des rendements des obligations d’État à long terme. L’expérience vécue dans la zone euro montre que l’adoption d’une monnaie unique aura, tout au plus, un effet secondaire à cet égard.

Classification JEL : C23, E43, E44, F36
Classification de la Banque : Taux d’intérêt; Questions internationales

1. Introduction

Since the early 1980s, long-term government bond yields in the euro zone have declined, in line with those in other industrialized countries. In fact, by the time the euro currency was introduced in 1999, long-term government bond yields across the euro zone had largely converged to that of Germany (the euro zone's largest economy). In general, the convergence of national yields to a stable level with reduced risk aids the overall economy, by allowing cheaper access to debt financing with less uncertainty regarding the value of such funds over time. This, in turn, stimulates investment and output within converging countries. The recent expansion of the euro-zone bond market is one beneficial outcome of this process (Hartmann, Maddaloni, and Manganelli 2003). Given the stabilizing effect that convergence to stable and predictable interest rates has on the financial system, it is important to identify the factors that can bring this convergence about and maintain it over the long term.

Statements by the European Central Bank (2003) give one possible explanation for the convergence of yields observed in the euro zone:

> In the run-up to Stage Three of Economic and Monetary Union, which started on 1 January 1999, there was a significant convergence in the long-term government bond yields of those countries which subsequently adopted the euro. This convergence was driven by the anticipation of the introduction of the euro and the corresponding elimination of intra-euro area exchange rate risk.

In an effort to investigate the convergence of national bond yields, we examine the monetary and fiscal policies adopted by European countries on the path to Economic and Monetary Union (EMU), and assess how these policies, including the introduction of the common currency, have contributed to the convergence of national long-term government bond yields in the euro zone.

To shed some light on this issue, our study uses cointegration and panel estimation techniques to analyze a set of long-term determinants of 10-year nominal government bond yields for a pool of EMU countries and two control groups of other OECD countries over the 1980 to 2002 period. The first control group consists of three European Union (EU) countries (EU3: Denmark, Sweden, and the United Kingdom) not included in EMU, and the second includes other OECD countries (OECD4: Australia, Canada, Norway, and Switzerland) that are members of neither EMU nor the EU. In our empirical work, we consider the following set of long-term determinants: general government fiscal balance as a share of nominal GDP; the stock of accumulated general government debt as a share of nominal GDP, to account for country risk; and expected inflation. We also include a measure of the world real long-term bond yield, since developments in large countries influence real long-term yields in smaller countries (small open-economy assumption).

Our results indicate that increased harmonization of monetary and fiscal policies on the path to EMU contributed greatly to the convergence of long-term government bond yields in the euro zone, by prompting the convergence of their long-run determinants. More importantly, our findings suggest that the convergence of national long-term government bond yields in the euro zone cannot be attributed primarily to the introduction of the common currency itself, since our two control groups of other OECD countries (EU3 and OECD4) experienced a similar convergence.

We also find evidence that currency risk premiums declined gradually following the adoption of the Maastricht Treaty and were largely eliminated by the time the single currency was introduced in January 1999. These findings suggest that, in the context of integrated international financial markets, harmonization of sound monetary and fiscal policies across countries will cause national long-term bond yields to converge. Based on evidence from the euro zone, the adoption of a common currency will have, at most, a secondary effect on the convergence of national bond yields. With regards to the EU3 and OECD4, however, the policy commitment inherent in the framework for the adoption of the euro currency (i.e., the Maastricht criteria) may have given additional credibility to national euro-zone monetary and fiscal policies.

This paper is organized as follows. Section 2 provides institutional background on the major economic policies adopted by European countries on the path to EMU, and reviews the stylized facts on how these policies have likely contributed to the convergence of the euro-zone bond market. Section 3 surveys the existing theoretical and empirical literature on the fundamental determinants of long-term interest rates. Section 4 provides new empirical evidence on the long-run relationship between the 10-year nominal government bond yield and its fundamental determinants on a country-by-country basis, and using panel estimation. Empirical information is then used to assess how increased harmonization of monetary and fiscal policies contributed to the convergence of long-term government bond yields across euro-zone countries by driving the convergence of their long-run determinants. Section 5 concludes and suggests future research.

2. Institutional Background and Stylized Facts

This section provides some institutional background regarding the path towards the EU, and, subsequently, the common currency. We then review the stylized facts on how key economic policies adopted by the various countries in the lead up to EMU likely contributed to the convergence of the euro-zone bond market.

2.1 Institutional background

This section summarizes the institutional background. Appendix B provides a detailed EMU timeline.

EMU was built on over 40 years of concerted economic integration between western European nations. By the late 1980s, the majority of this integration had taken place. The European Community, as it was then known, had grown to 12 members, including the recent inductees of Greece (1981), Spain (1986), and Portugal (1987).

The EU as we know it today was born out of the Maastricht Treaty in 1993.[1] Besides enacting a common foreign and security policy, and dealing with EU-level matters of justice, this treaty specified the three steps required for EMU to take place: by the end of 1993, capital flows were to be completely freed within the EU; by 1999, member states preparing to adopt the euro currency upon its launch had to satisfy a set of convergence criteria by which major economic policies were coordinated across nations; effective at the beginning of 1999, the European Central Bank would be established, along with the official euro currency for which member-country conversion rates were irrevocably set. The Maastricht Treaty convergence criteria were as follows:

- the ratio of general government deficit to GDP must not exceed 3 per cent
- the ratio of gross general government debt to GDP must not exceed 60 per cent
- the average inflation rate over the year before assessment must not exceed by more than 1.5 percentage points the average of the three best performing member states in terms of price stability
- the long-term nominal interest rate must not exceed by more than 2 percentage points the average of the three best performing member states in terms of price stability
- the exchange rate mechanism (ERM) must be respected without severe tensions for at least the last two years before assessment

In 1995, three new members were admitted to the EU (Austria, Finland, and Sweden), bringing the total number of member states to 15.[2,3] At the launch of the euro in 1999, EMU consisted of

1. The original member states of the EU were Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom.
2. Norway and Switzerland, while remaining members of the European Free Trade Association, are not members of the EU. Norway has applied twice for accession. The first application was submitted in 1967 but was rejected in a national referendum in 1972. In 1992, Norway again applied for membership, but a second referendum in 1994 failed to pass. Switzerland applied for membership in 1992 and maintains an open invitation, but has not actively pursued membership.
3. Ten new European countries joined the EU on 1 May 2004: Poland, Hungary, the Czech Republic, Estonia, Latvia, Lithuania, Slovakia, Slovenia, Cyprus, and Malta. New members are required to eventually adopt the euro and will, thus, have to satisfy the convergence criteria, including the current version of the ERM.

11 of the 15 EU countries; those that did not participate in EMU were the United Kingdom, Sweden, Denmark, and Greece (Greece later joined in 2001).[4] By the beginning of 2002, all former national currencies (also known as "legacy" currencies) were phased out and the euro became the sole legal currency in EMU member states.

Now that monetary integration has been realized in much of western Europe, the ongoing challenge is for all EU member countries to continuously meet the Stability and Growth Pact (primarily, the first two conditions of the Maastricht Treaty convergence criteria). Currently, several members of EMU (including Germany, France, and Italy) are experiencing difficulty in maintaining a deficit-to-GDP ratio below the 3 per cent limit and a debt-to-GDP ratio below the 60 per cent maximum.[5]

2.2 Stylized facts

Figures 1 and 2 show that euro-zone long-term government bond yields have converged to an extraordinary degree over the course of the last 20 years. Figure 3 shows the average spread of long-term government bond yields in eight countries versus the German yield over the 1980 to 2003 period.[6] This spread declined from a high of 646 basis points in the second quarter of 1983 to a low of 12 basis points in the same quarter of 1998, which suggests a substantial convergence in national yields over this period. Throughout the remainder of our sample (1999 to 2002), the average spread was about 21 basis points.[7]

A gradual downward trend is visible in Figure 3, accentuated by three steep drops: the first occurring in the mid-1980s, the second in the early 1990s, and the third in the mid-1990s. The path of major economic policy variables, as well as changes in the institutional structure, as discussed in section 2.1, likely contributed to this convergence.

---

4. In sync with the second stage of EMU, 1999 marked the introduction of ERMII, which replaced the ERM as a voluntary means for non-EMU members of the EU to reduce exchange rate fluctuations and prepare for eventual adoption of the euro. Currently, Denmark is the only nation participating in ERMII and has elected to follow a 4.5 per cent band around the euro, as opposed to the minimum requirement of a 30 per cent band. Estonia, Lithuania, Slovenia, and Cyprus are expected to apply in 2004 for entrance into ERMII, with the remaining new central and eastern European EU members to follow.
5. Italy is a special case, in that it was admitted to EMU with a debt-to-GDP limit far exceeding the 60 per cent limit, on the condition that this level be reduced over time.
6. Figure 3 and all tables in this paper report empirical results for the nine euro zone countries that feature a complete dataset available from 1980 to 2002 (Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal, and Spain), unless otherwise noted. Together, these countries made up about 96 per cent of U.S.-dollar euro-zone GDP in 2002. Although data are available from 1977, some studies (see section 3.1) suggest (and our findings concur) that the relationship between fiscal variables and yields is unclear when data from the 1970s are included. Hence, we follow the convention of existing literature and begin our sample in 1980.
7. As of 2003Q4, the average spread was about 7 basis points.

As Figures 4 and 5 illustrate, monetary policy in the future euro-zone countries independently achieved a notable disinflation beginning in the early 1980s.[8] To the extent that movements in inflation are reflected in nominal interest rates, national 10-year government bond yields would have declined as well, contributing to their convergence across countries. On the fiscal side, general government balance and debt levels also began to improve following the introduction of the Maastricht Treaty (Figures 6 to 9). By reducing the net supply of issued bonds and the likelihood of default, such progress in fiscal positions could be expected to lower the equilibrium yield and the risk premium attached to long-term government bond yields. Indeed, euro-zone national sovereign credit ratings have, on the whole, improved over this period, reflecting lower default risk.[9] Thus, fiscal policy also appears to have contributed to the convergence of long-term government bond yields across the euro-zone countries.

Regulatory changes, as discussed earlier, mark the more rapid periods of convergence in government bond yields. For instance, in Figure 3, the decline during the mid- to late 1980s coincides with the signing of the Single European Act (SEA) in February of 1986, and its entrance into force the following July. The goals of this act—to achieve a single market for goods and services, labour, and capital within five years—marked a renewed push towards general economic and financial integration between members of the EU. In turn, this reduction in barriers between countries aided convergence of financial markets, including the bond market (Hartmann, Maddaloni, and Manganelli 2003). Also in Figure 3, an upward swing is visible in 1992, caused by the September ERM crisis. Soon after, a strong push was made towards convergence in the lead up to the Maastricht Treaty's entrance into force in November of 1993. Investors began to take account of the low inflation, improved fiscal position, and lower risk premiums inherent in the convergence criteria. The mid-1990s were, however, an uncertain period in terms of compliance with the Maastricht Treaty. Nonetheless, as the national governments acted to satisfy the necessary criteria, relative long-term yields entered one final period of rapid convergence during the second half of the 1990s.

The convergence of long-term government bond yields since 1980 is also characterized by increased co-movement between national yields. Table 1 illustrates the rise in correlation between the individual national long-term government bond yields and the German yields over the two halves of our sample. Notably, dividing our sample in half around 1991/1992 also corresponds closely to the signing of the Maastricht Treaty (draft signed 10 December 1991 and final treaty signed 7 February 1992). On average, the correlation has increased from 0.69 over the period

8. The measure of expected inflation shown in Figures 4 and 5 is simply a geometrically declining average of past year-over-year inflation values.

9. For instance, Moody's has increased their rating for Finland, Greece, Ireland, Italy, Portugal, and Spain over the period 1993 to 2002 (see Moody's 2003).

1980 to 1991 to 0.97 over 1991 to 2002, with all countries showing an increase in correlation between the two periods. Interestingly, Austria and the Netherlands maintained very high correlations with the German yield throughout our entire sample due, in part, to the fact that both countries had pegged their currencies to the Deutsche Mark and were effectively subject to German monetary policy.[10]

Simple correlations also help provide preliminary evidence of how the harmonization of monetary and fiscal policies contributed to the convergence of euro zone long-term government bond yields. Tables 2 and 3 report relevant correlation statistics between the long-term bond yield of each country and corresponding data for expected inflation, general government balance (as a percentage of GDP), and general government debt (as a percentage of GDP) over our complete sample and the two halves of our sample, respectively.[11] Figures 4 through 9 depict these relevant variables for the euro zone.

The Fisher principle suggests that expected inflation should have a one-for-one positive relationship with the long-term nominal yield. Indeed, over our sample, expected inflation is strongly positively correlated with the long-term bond yield. Moreover, this correlation is stronger in the first half of the sample (0.810 versus 0.653), which suggests that expected inflation explains more of the movement in the nominal long-term yield during the general disinflation of the 1980s than during the period of relatively low and stable inflation in the second half of the sample.

The correlation between the general government balance as a percentage of GDP and long-term bond yields is generally negative over our sample, lending credence to the theory that positive balances (i.e., budgetary surpluses) effectively reduce the supply of bonds, and thereby the yield, as well as the perceived default risk on sovereign debt. Although not all countries exhibit this negative relationship over the 1980 to 1991 period, the opposite is true in the second half of our sample. The general increase in government balances (i.e., reduced deficits), as required by the Maastricht Treaty, led all countries to show a negative relationship between their fiscal balance and long-term yield.

Relatedly, one may also expect changes in the level of government debt as a percentage of GDP to indicate an altered level of default risk, especially in light of the Maastricht Treaty convergence criteria. In the long run this should hold, however. Over our sample, government debt is negatively

10. Austria's currency was pegged to the Deutsche Mark starting in 1974, whereas the Netherlands' peg began in 1983. Both currencies continued to trade tightly with the Deutsche Mark while in the ERM.

11. General government balance and debt data are thought to capture more fully overall external financing needs and default risk for a given long-term sovereign debt instrument, since any default by lower levels of government (e.g., state, local) may ultimately be financed by the central government. These measures are also used in the definition of the Stability and Growth Pact.

correlated with the long-term yield, which suggests a need for further empirical investigation (see section 4).[12]

Overall, preliminary evidence indicates that increased harmonization of macroeconomic policies on the path to EMU helped promote the convergence of long-term government bond yields in the euro zone. In the following section, we survey the existing theoretical and empirical literature on the fundamental determinants of long-term interest rates.

3. Literature Review

Interest rates on financial assets like bonds are determined in credit markets by the demand for, and supply of, loanable funds.[13] Ultimately, the propensity to save (rate of time preference) determines the supply of loanable funds (or demand for bonds), and the productivity of capital determines the demand for funds (or the supply of bonds). In the former case, households optimize their intertemporal consumption-saving decisions, thus influencing the supply of funds. In the latter case, the productivity of capital or perceived rate of return on capital results from optimizing decisions of firms, which in turn determines the demand for funds. In the specific instance of the government bond market, however, the supply of bonds results from the government's fiscal position.[14]

Governments finance their spending/investment by taxing consumers or borrowing from them by issuing debt. The amount of debt issuance (i.e., the demand for funds or supply of bonds) depends on the government's external financing needs; i.e., the difference between their expenditures and tax revenues. Through bonds, consumers hold a claim on government debt. The effect on interest rates of a change in government fiscal position depends, however, on the assumption made regarding the consumption–savings decisions of households. Several views are documented in the economic literature, but there are three main schools of thought concerning the economic effects of government fiscal positions (Bernheim 1989): the neoclassical, Keynesian, and Ricardian paradigms. The central issues among these schools of thought are whether consumers are far-sighted and whether they consider government bonds as wealth.

---

12. For many countries (especially after 1992), dynamic correlations reveal a strong positive relationship between the long-term yield today and government debt eight to twenty quarters in the future. Likewise, an increased negative relationship is shown between the long-term yield today and the government balance at a similar horizon. These facts imply an important role for current expectations of the future level of debt and balance in determining the current long-term government bond yield.
13. The equilibrium interest rate is the price that equilibrates saving and investment in the economy. This equilibrium corresponds to an economy operating at full capacity with stable inflation. For small open economies, this also requires that the exchange rate be in equilibrium.
14. This does not preclude public spending on productive investment projects.

In the neoclassical paradigm (Diamond 1965), it is assumed that consumers are far-sighted and plan their consumption profile over their entire lifetime (i.e., individuals have finite lifespans). In this framework, an increase in the government's budget deficit, for example, shifts tax liabilities onto future generations, and therefore raises the lifetime consumption of individuals of the current generation. In a closed economy with full employment, the stimulus to aggregate demand produces higher interest rates and crowds out private investment. In an open economy, the widened budget deficit has, to some degree, an impact on the exchange rate and therefore on net exports. In a small open economy (that takes the world interest rate as given), all the adjustment occurs through net exports.

In the Keynesian framework, a large proportion of consumers are myopic or liquidity-constrained. They ignore future tax increases that are necessary to finance a rise in government expenditure. It is also assumed that the economy begins in a position of underemployment. In this framework, an increase in the government budget deficit leads to a proportionately large increase in aggregate demand and nominal income. Because of this increase in nominal GDP, aggregate national savings may or may not decline, so the effect on interest rates is unclear.

In both paradigms, an exogenous change in the fiscal position shifts the investment–savings (IS) curve, since economic agents consider government bonds to be wealth, thereby affecting the interest rate. While the full-employment assumption and self-equilibrating forces push the economy back to equilibrium in the neoclassical model, a fiscal shock may have permanent effect in the Keynesian framework if the shock occurs in a position of underemployment.

In the modern Ricardian paradigm (Barro 1974), rational and far-sighted individuals realize that government spending must be paid for either now or later. Government dissaving will therefore be offset fully by increased household saving, in anticipation of future tax liabilities.[15] Ricardian equivalence, however, is obtained under a number of stringent assumptions, including the absence of liquidity constraints and infinite foresight. Moreover, to obtain infinite foresight with finite-lived agents, it must be assumed that successive generations are linked by a purely altruistic bequest motive, with the implication that consumption is determined as a function of dynastic resources (the total resources of an individual and all of their descendants), unaffected by the timing of taxes (Bernheim 1987, 1989).[16]

15. An increase in the deficit that reflects additional public spending on productive investment projects would not be expected to require further taxes later, however, and thus should not elicit a private saving response.

16. This dynastic view of the family assumes that each family is an infinitely lived unit; it therefore differs considerably from the neoclassical model and the life-cycle model, which assumes finite lifetimes. Other intertemporal models combine the infinite horizon approach with a constant probability of death, no bequests, and a positive birth rate, thereby introducing a wedge in equilibrium between rates of interest and rates of time preference (Yaari 1965, Blanchard 1985, Buiter 1988). These latter models imply that government deficits/surpluses are largely, but not completely, offset by private saving.

Overall, the theoretical literature on the economic effects of government fiscal positions on interest rates points to a number of potential important long-term determinants. In the following subsections, we review the existing empirical literature on the fundamental determinants of interest rates. In section 4, we assess empirically how these fundamental determinants have likely contributed to the convergence of long-term government bond yields across the euro zone. We also describe the specific variables that we have selected to represent these factors in our empirical work.

3.1 Government fiscal position

In light of the three main schools of thought identified above, the most widely accepted view in the literature concerning the effects of government fiscal balances holds that an increase in the government deficit will not be fully offset by higher household saving, because (among other factors) intergenerational transfers are neither universal nor predominantly altruistic (Buiter 1988), and because the probability of death is different from zero (Blanchard 1985). Consequently, households will expect that at least part of the future tax liabilities will be borne by subsequent generations.

Indeed, empirical studies fail to support a full offset of fiscal actions as predicted by the Ricardian equivalence paradigm. Existing empirical evidence for industrialized countries suggests that each dollar increase in the government deficit is associated with an increase in household saving of about 0.5 to 0.6 dollars (Bernheim 1987; Masson, Bayoumi, and Samiei 1995). Other things being equal, interest rates must rise as a result of the net stimulus to aggregate demand. Nonetheless, even with a partial offset of fiscal actions by consumers (i.e., an increase in the supply of funds), higher equilibrium interest rates may not follow if the increase in the government deficit is met by an increase in inflow of foreign capital (open economy), or if the supply of funds itself is infinitely elastic (i.e., in a small open economy). Any increase in government debt is, however, likely to increase the risk premium.

Based on a loanable-funds equilibrium approach, Correia-Nunes and Stemitsiotis (1995) find strong empirical support for the hypothesis of a positive link between nominal long-term interest rates and budget deficits for ten OECD countries after controlling for expected inflation, short-term interest rates, public debt, and real GDP growth (i.e., an accelerator effect on investment). Their country-by-country results suggest that a 1 percentage point deterioration in the fiscal position (as a share of nominal GDP) may raise long-term interest rates by around 25 to 30 basis points in Belgium, Ireland, and Germany, and by around 55 basis points in France and the Netherlands.[17]

17. The Correia-Nunes and Stemitsiotis country-by-country single equation is estimated using the 2SLS procedure with annual data for ten OECD countries over the 1970 to 1993 period.The estimated parameter corresponding to the budget deficit-to-GDP ratio ranges from 0.18 for Denmark to 0.74 for the United States.

Orr, Edey, and Kennedy (1995) examine a sample of seventeen OECD industrialized countries and find that the rate of return on capital, a risk premium related to inflation credibility (i.e., a country's historical inflation relative to existing expectations), the level of current account balances, and government deficits relative to GDP are all important determinants of trend real long-term interest rates—both as a group and relative to one another. Their panel error-correction model results suggest that a 1 percentage point deterioration in the fiscal position may raise long-term interest rates by around 15 basis points.[18] Knot and de Haan's results (1995), based on five European countries, suggest a larger effect, in the order of 40 to 60 basis points on the long-term yield.[19]

Brook (2003) examines recent and prospective trends in real long-term interest rates and discusses what drives these trends (with an emphasis on the relationship between fiscal balances and interest rates). She also provides an extensive summary of key empirical results from the existing literature regarding the estimated impact of fiscal flows and stocks on interest rates. Brook concludes that empirical results depend on the estimation time period, the definition of the interest rate, and the countries covered. Reported studies using the 10-year bond yield estimate that a 1 percentage point deterioration in the fiscal position (an increase in the deficit-to-GDP ratio) raises interest rates by 15 basis points to 60 basis points.[20] Interestingly, Brook notes that earlier studies, especially those using data covering the 1970s, find fiscal flow positions to have an insignificant or even negative effect on interest rates. One possible reason for a weak statistical relationship between fiscal variables and interest rates may be the existence of stricter financial regulations and/or capital controls prior to the 1980s (Fukao and Hanazaki 1986; Pigott 1994; Throop 1994; Orr, Edey, and Kennedy 1995; Gjersem 2003; Goldberg, Lothian, and Okunev 2003).

Besides the theoretical and empirical links between long-term interest rates and fiscal position, debt-financed deficits and tax deferrals lead to another issue: they create uncertainty about how a country will ultimately resolve its debt obligations. This uncertainty translates into a premium on the yield the government must pay to borrow money. Such premiums can cause average long-term yields to exceed those in countries where such problems are less serious. More specifically, the overall risk premium, which captures both the default risk and currency risk, typically affects the

18. Orr, Edey, and Kennedy use error-correction estimations within pooled time-series over the 1981Q2 to 1994Q2 period. They do not find a significant role for domestic and external debts in explaining long-run movements in real interest rates.
19. Knot and de Haan use ordinary least squares and two-stage least squares with instrumental variables over the 1960 to 1989 estimation period.
20. Brook's empirical literature review includes the findings of Orr, Edey, and Kennedy (1995). Reported studies for the United States show a stronger relationship between fiscal flow variables and interest rates: Cebula (2000) with 86 basis points and Laubach (2003) with about 25 basis points.

interest rate and exchange rate simultaneously. The premium associated with the risk of default (or country/sovereign risk, in the case of government debt) increases with the size of the public debt, while the premium associated with exchange rate uncertainty (currency risk) increases with inflation variability.[21] Thus, it follows that the larger the government debt and deficits relative to the size of the tax base (nominal GDP), the higher the interest rate. As such, the risk premium is usually defined by the interest rate differential across countries under nominal interest rate parity and purchasing power parity (which are assumed to hold in the long run).

In the empirical literature, the risk premium is often linked to several variables: the stock of the government debt as well as its rate of change (each as a share of nominal GDP), the relative external net indebtedness-to-GDP ratio, or the fiscal and current account deficits. Cross-country evidence from twelve OECD countries reported by Alesina et al. (1993) suggests a positive and significant correlation between the risk premium and the stock of debt (and its rate of change).[22] This correlation is, however, present only in countries with an unstable debt-to-GDP ratio. In particular, they find a strong positive relationship between default risk and the level of debt for countries where debt levels are high and not sustainable (above 50 per cent). They also find a strong positive relationship between default risk and the growth in debt for countries where debt is accumulating rapidly but the stock of debt is relatively low. Their results suggest a non-linear relationship (i.e., an increasing convex function) between risk premiums in the nominal interest rate on government debt and the stock of debt relative to nominal GDP (interpreted as the tax base). It follows that, at low and moderate debt-to-GDP ratios, the effect of the debt-to-GDP ratio on the risk premium of government debt is either small or absent. In other words, countries with relatively high debt levels (as a share of nominal GDP) do face higher financing costs. Similar conclusions are reached by Correia-Nunes and Stemitsiotis (1995), who show that country risk is a relevant factor, but only in some cases (i.e., for countries with high debt-to-GDP ratios).

In this study, we use the general government fiscal balance as a share of nominal GDP to estimate the long-term relationship between fiscal balances and interest rates. Consistent with previous studies, we include the ratio of the stock of accumulated general government public debt to nominal GDP in an attempt to account for country risk. We then examine empirically how the

---

21. The currency risk is the uncertainty associated with the level of the nominal exchange rate as a result of inflation volatility in one country relative to that in other countries. This risk can occur as a result of perceived uncertainty about how the government will ultimately deal with its debt obligations. In other words, currency risk reflects inflation risk on government debt. As such, it is primarily an issue for long-term non-indexed debt, given that inflation risk is less important for short-term debt. This risk is also more significant for large levels of government debt, since the government may be tempted to inflate away added deficits. Note that when debt is denominated in foreign currency, currency risk is non-existent. Furthermore, a central bank formally committed to low inflation effectively eliminates inflation risk on government debt.
22. Alesina et al. use a panel estimation procedure with quarterly data over the 1974 to 1989 period.

major fiscal policies adopted by countries on the path to EMU, as proxied by these ratios, have contributed to the convergence of national long-term government bond yields in the euro zone.[23]

3.2 Expected inflation

In an environment where assets lose their value due to inflation, the ex ante real cost of borrowing and the real return to lending depend ultimately on expected inflation.[24] The interest rate, which affects saving and investment decisions, includes, therefore, an inflation premium to compensate lenders for the expected decline in the purchasing power of their assets. It follows that, when inflation is expected to rise, nominal interest rates tend to increase proportionately to compensate lenders for expected erosion in the purchasing power of their assets (the Fisher principle). Whereas the realized, or ex post, real interest rate is easily measured, however, the measurement of the perceived, or ex ante, real interest rate, on which lenders and borrowers base their decisions, is not directly observable (since expected inflation is unobservable).

There are several ways to construct a measure of the expected rate of inflation in order to deal with this issue. For example, inflation expectations can be implied from actual inflation. An alternative to using actual inflation is to use an empirical model's forecast of inflation. Another method of estimating expected inflation is through qualitative data generated by surveys (Carlson and Parkin 2001). As a final example, the difference between the yield on non-indexed and index-linked government bonds provides a measure of expected inflation, although it may capture the effect of other factors such as differences in tax treatment, inflation uncertainty, and liquidity premiums. Moreover, index-linked bonds are relatively recent and issued in only a few countries.[25]

When inflation is stable and predictable, alternative proxies for expected inflation should yield similar results.[26] Moreover, to the extent that expectational forecast errors are mean-reverting in the long run, the estimated parameter on expected inflation should remain asymptotically consistent. Indeed, Orr, Edey, and Kennedy (1995) compare alternative proxies for inflation

23. de Bandt and Mongelli (2000) investigate whether there has been some convergence in euro-zone national fiscal policies over the past three decades. Three variables are used: government net lending, total current revenue, and total current expenditure. Quarterly data from 1985 to 1997 provide evidence that government net lending is driven partly by common cyclical factors across countries, whereas such links are rare for total revenues and expenditures. de Bandt and Mongelli conclude that significant convergence has occurred in the euro zone, but a notable share of variability in fiscal policy can still be explained by country-specific factors.

24. Assets include money.

25. At this time, inflation-linked 10-year government yields are issued in France (from 1998Q4), the euro zone as a whole (begins 2001Q4), the United Kingdom (from 1993Q4), and the United States (from 1997Q1).

26. Low, stable, and predictable inflation also contributes to reduce the inflation-risk premium.

expectations and conclude that medium-term trends in real interest rates are not substantially affected by the specific choice in a range of reasonable proxies for trend inflation.

The preferred measure of expected inflation used in this study is a simple 8-quarter moving average of the annual percentage change in the national quarterly consumer price index with geometrically declining weights. We use this measure to estimate the long-term relationship between the 10-year nominal government bond yield and expected inflation. We then examine empirically how the national monetary policies followed by European countries on the path to EMU have contributed to the convergence of their 10-year nominal government bond yields through their influence on expected inflation. Given that the measurement of an unobservable variable, such as expected inflation, has proved to be somewhat difficult in empirical work, we also use an alternative measure of inflation expectations to explore the robustness of our results.[27]

To sum up, the empirical work of this paper considers the following long-run determinants: general government fiscal balance as a share of nominal GDP, the stock of general government debt as a share of nominal GDP, and expected inflation. We also include a measure of the world real interest rate, since large-country developments influence real rates in smaller countries (i.e., the small open-economy assumption). In the context of international financial markets with no controls on the flow of financial assets across countries, the larger world market determines interest rates, on average, over time.

4. Empirical Analysis

In this section, we examine empirically the long-run relationship between the 10-year nominal government bond yield and the fundamental factors discussed in the literature review. To estimate the trend in the 10-year government bond yield, we first use a country-by-country approach. Because the data are non-stationary, conventional statistical procedures would not result in asymptotically efficient estimates of the estimated parameters, nor would they lead to valid inferences about them (Granger and Newbold 1974, Phillips 1986). Accordingly, we examine the possibility that the 10-year nominal government bond yield is cointegrated with expected inflation, the fiscal balance as a share of nominal GDP, the fiscal debt as a share of nominal GDP, and the world real interest rate. Implicit in this single-equation approach is the assumption that there is only one endogenous variable. This variable is given the economic interpretation of a government bond yield equation. Given our small sample, we also estimate panel versions of our

27. The alternative measure of expected inflation is generated using the low-frequency component of the annual percentage change in the national quarterly consumer price index; a Hodrick-Prescott filter with a lambda value of 1600 is used in the filtering process.

single equation to improve the efficiency of the estimated parameters (in section 4.2). Our country-specific regressions and panel versions are estimated over the sample period 1980 to 2002 using quarterly data, and are reported in Tables 5 through 10.

4.1 Country-by-country analysis

In our analysis, we consider the long-run determinants of the 10-year nominal government bond yield using an empirical equation of the following form:

$$RL_{\mathrm{t}} = \alpha S_{\mathrm{t}} + \upsilon_{\mathrm{t}}, \tag{1}$$

where the "residual" υ_t is I(0) under the cointegration hypothesis. RL_t is the nominal long-term government bond yield, and S_t is a vector comprising the structural factors given in equation (1.1):

$$\alpha S_{\mathrm{t}} = \alpha_1 ecpi_{\mathrm{t}} + \alpha_2 gbal_{\mathrm{t}} + \alpha_3 gdebt_{\mathrm{t}} + \alpha_4 rrlw_{\mathrm{t}}, \tag{1.1}$$

where,

ecpi = expected inflation,

gbal = general government fiscal balance as a share of nominal GDP (+: surplus; –: deficit),

gdebt = general government fiscal debt as a share of nominal GDP,

rrlw = U.S. or German government real 10-year bond yields as measures of the world real yield.

Figures 1 to 9 illustrate the above variables. Based on casual observation, the 10-year nominal government bond yields, expected inflation, fiscal balance, and debt for individual countries appear to be non-stationary. Hence, unit-root and cointegration tests are used to examine the long-run relationship between the 10-year nominal government bond yield and its potential long-run determinants.[28] Note that all the variables are measured at a quarterly frequency and are seasonally adjusted.[29] Table 4 reports the results of unit-root tests.[30] Overall, for the level of the 10-year nominal government bond yields, expected inflation, fiscal balance, and debt, the ADF and Phillips-Perron (PP) tests are unable to reject the null hypothesis of a unit root with drift against the trend-stationary alternative hypothesis. Mixed evidence is found, however, for

---

28. All country-by-country estimations and statistical tests were performed using the RATS package.
29. All data are taken from OECD (2003), BIS, and IMF databases with the exception of Switzerland's general government fiscal balance and debt which are taken from Thomson Financial Datastream. Mnemonics are described in Appendix A.
30. For the Augmented Dickey-Fuller (ADF) test, we follow the lag-selection procedure advocated by Ng and Perron (1995).

expected inflation and the ratio of government debt to nominal GDP for some countries (e.g., expected inflation for Belgium, Germany, Italy, Portugal, and the United States).

Stationarity tests performed on the first differences of all these variables indicate that these series are mean-stationary (in most cases, at the 0.10 per cent level). The exception is the ratio of government debt to nominal GDP variable, *gdebt*, for Belgium, Finland, Italy, the Netherlands, and Spain, for which both the ADF and PP tests cannot reject the unit-root hypothesis against the mean-stationarity in the first difference, which suggests that this ratio is I(2) for these countries. This conclusion is clearly supported by our statistical stationarity tests. Stationarity tests performed on the second difference of *gdebt* indicate that it is mean-stationary.

Taken together, these tests suggest that the 10-year nominal and real government bond yields, expected inflation, fiscal balance, and debt ratio are integrated of order one. That is, they are I(1) (except for the debt ratio, which is I(2) for some countries), and it is therefore appropriate to examine the possibility that they are cointegrated. We conduct the empirical analysis by estimating the nominal long-term government bond yield equation (equation (1)) using the Stock and Watson (1993) leads-and-lags procedure.[31] We examine all possible combinations of cointegrating vectors involving the four structural factors listed above, each time using the U.S. real yield or the German real yield as a measure of the “world real interest rate,” and follow a “general-to-specific” procedure to isolate a combination of the structural factors that is cointegrated with the observed long-term government bond yield.

Like the unit-root test, the evidence of cointegration is evaluated on the basis of the ADF test and the PP normalized bias test. The estimated long-run parameters corresponding to equation (1.1) over the 1980Q1 to 2002Q4 period, along with the cointegration tests, are presented in Table 5. Note that these estimates are derived with four lags and four leads on all the variables. We do not find evidence in any of the combinations examined that the long-term government bond yield is cointegrated with the four structural factors.[32] For all countries, the ADF and PP tests fail to reject the null hypothesis of non-cointegration at a 0.10 level, with the exception of mixed evidence in the case of the United Kingdom.[33] Although most of the estimated parameters appear to be of the expected signs and statistically significant, recall that their relationship with the long-term government bond yield is spurious under the null hypothesis (Granger and Newbold 1974;

31. In our analysis, it is unlikely that the government balance and the government debt are strongly exogenous with respect to the long-term government bond yield. The Stock and Watson (1993) estimator corrects for the endogeneity bias that is likely to be present in the right-hand-side variables, and thus produces estimates of the cointegrating parameters that are asymptotically efficient.

32. We report in Table 5 the estimation results of the general specification only, since none of the combinations examined provide evidence of cointegration.

33. Unit-root tests suggest that data for Australia, Canada, Japan, Norway, and Switzerland are also I(1). Unit-root and cointegration tests for these countries are available upon request.

Phillips 1986). Based on casual observation, however, the error-correction term for individual countries, although somewhat persistent, appears to revert to its mean and is hence indicative of a tendency of the 10-year bond yield to revert to its long-run determinants (Figure 10).[34] Since cointegration tests are generally known to lack power, particularly in small samples, we suspect that the formal non-rejection of the null hypothesis could be reversed with the accumulation of more data.

4.2 Panel estimations and error-correction models

4.2.1 Standard panel estimations of the long-run parameters

Building on our country-by-country analysis, we estimate the long-run determinants of the nominal 10-year government bond yields using a panel dataset.[35] The additional degrees of freedom afforded by combining both cross-sectional and time-series data into a panel result in more efficient estimates of the overall long-run relationship across the euro-zone countries in question. Table 6 presents the results of our basic panel estimation.[36] Data for Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal, and Spain are included over our quarterly sample from 1980 to 2002. As in the country-by-country analysis, we investigate the results using each of the real U.S. and German 10-year government bond yields as a measure of the world real interest rate.[37] In cases where the estimated sign on government debt is negative or statistically insignificant, we also provide estimates of the long-run relationship excluding this variable.

Overall, our panel estimation results for the euro-zone countries suggest that, regardless of the choice of world interest rate, the 10-year government bond yield incorporates about 80 per cent of any changes in expected inflation, roughly in line with the Fisher equation, which predicts one-for-one movement.[38] Furthermore, a 1 percentage point increase in the ratio of the government fiscal balance to GDP (a decline in deficit or an increase in surplus) results in a decline of about 20 basis points in the yield. This figure is in line with results reported in other studies, such as Orr, Edey, and Kennedy (1995) and Brook (2003). The ratio of government debt to GDP, on the other

34. Interestingly, the importance of the world interest rate differs substantially, depending on the choice of the proxy used. Whenever the U.S. yield is used, the estimated parameter is very small compared with that of the German yield.
35. Following on the country-by-country analysis above, we also find evidence of a unit root in the level of all relevant variables, based on the Hadri panel stationarity test.
36. All panel estimations and statistical tests were performed using the Stata package.
37. In the latter case, Germany is excluded from the dataset as an endogenous variable.
38. The fact that expected inflation is not fully reflected in nominal bond yields may be explained by the fact that our measure of expected inflation is an ex post measure, whereas investment and saving decisions at the time would have been made on an ex ante basis.

hand, takes a small negative sign, which runs counter to theory. Note that the estimated parameters on the other explanatory variables do not change much when debt is dropped from the estimations. Most interestingly, the importance of the world interest rate varies substantially, depending on the choice of proxy. When the U.S. yield is used, the estimated parameter takes the relatively small value of 0.23, consistent with the results of Knot and de Haan (1995). In comparison, using the German yield gives a coefficient of at least 0.70. This result suggests that, possibly due to size and comparative euro-zone financial integration, German markets play a much larger role in influencing other national euro-zone bond yields than does the U.S. yield. Overall, these panel estimates suggest that variations in expected inflation, the general government fiscal balance as a ratio of GDP, and the world interest rate explain at least 85 per cent of the movement in 10-year government bond yields of specified euro-zone countries.

Under the assumption of cointegration (to be formally tested in section 4.2.2), our panel estimation results suggest that policy harmonization in the euro zone, which caused long-run determinants of 10-year government bond yields to converge, resulted in a convergence of national yields. This harmonization was primarily driven by the Maastricht criteria, to which countries had to abide in order to adopt the euro. Given this fact, it is pertinent to ask whether a similar trend occurred in EU countries not included in EMU (i.e., EU3: Denmark, Sweden, and the United Kingdom). Indeed, as Figure 11 shows, national government 10-year bond yields in these three countries converged in much the same fashion as in the euro zone. To address this issue empirically, we performed panel regressions on these three countries using the same specifications used for our euro-zone country group. These results are also presented in Table 6 and, with the exception of a smaller sample of countries, are analogous to our euro-zone results. The estimated relative importance of the long-run determinants in the EU3 is qualitatively similar to that of their euro-zone counterparts, except for the debt ratio (discussed further in section 4.2.4). Policy variables and the world interest rate still explain approximately 75 per cent of the variance in national yields. In addition to satisfying the Stability and Growth Pact (Figures 13 and 14), the EU3 countries have also chosen independently to pursue sound monetary policy (Figure 12).

Unlike for the euro zone, the estimated parameter on the ratio of debt to GDP is positive and statistically significant for the EU3 countries, likely because two of the three countries in the sample (Sweden and Denmark) experienced a significant increase and reduction in their debt levels over our sample (Figure 14). Given this wide variance, the debt likely contained significant information that would explain the path of 10-year yields in the EU3. The same cannot be said of the majority of euro-zone countries, where movements in the debt ratio were limited and gradual (recall that, in section 4.1, the debt ratio in several euro-zone countries was found to be an I(2) process over our sample). In addition, as noted in section 3, Alesina et al. (1993) suggest that default risk premiums are more influenced by high and variable levels of national debt. Unlike Denmark and Sweden, the majority of euro-zone countries maintained relatively low levels of debt to GDP throughout our sample. We also find that the estimated coefficient on the world interest rate is larger for the EU3 countries when the German yield is used, as opposed to the U.S. yield. Again, the level of financial integration in the EU may explain this result.

Admittedly, the market may expect the EU3 countries to eventually adopt the euro currency. Indeed, one can argue that national yields in EU3 converged in much the same fashion as in the euro zone specifically for this reason. Thus, it is pertinent to ask whether a similar convergence occurred in other OECD countries that are members of neither EMU nor the EU. As Figure 15 shows, national 10-year government bond yields for Australia, Canada, Norway, and Switzerland (OECD4) converged in much the same fashion over the 1980 to 2002 period as for the euro-zone and EU3 countries, although differentials in OECD4 yields remained at the end of 2002.[39,40] Whereas convergence illustrates the independent adoption of sound monetary and fiscal policies on the part of these countries (Figures 16 to 18), the remaining differentials reflect the fact that such policies were adopted in the EU with a more concerted and formal effort. Furthermore, with regards to the EU3 and OECD4, the policy commitment inherent in the framework for the adoption of the euro currency (i.e., the Maastricht criteria) may have provided additional credibility to national euro-zone monetary and fiscal policies.

To address this issue empirically, and to further verify the robustness of our main results, we perform panel regressions on the OECD4 countries using the same specifications as for the euro zone and EU3. These results are presented in the third panel of Table 6. Overall, the estimated relative importance of the long-run determinants for the OECD4 countries is qualitatively similar to that for their euro-zone and EU3 counterparts. Policy variables and the world interest rate still explain about 70 per cent of the variance in national nominal yields. Like the control group of EU3 countries, the OECD4 countries have chosen independently to pursue sound monetary policy. Unlike for the EU3 countries, however, the market does not expect the OECD4 control group of countries to satisfy the Stability and Growth Pact, since they are not members of the EU.

39. Our second control group of OECD countries was restricted to a small number of economies based on data availability.

40. As Figure 15 shows, national 10-year government bond yields for Japan did not converge in the same fashion as for the OECD4 countries. The remaining divergence in expected inflation and in the deficit and debt-to-GDP ratios for Japan explains the large differential in Japanese yields relative to those of the OECD4 countries at the end of our sample (Figures 16 to 18).

These facts suggest that the convergence of long-term government bond yields is confined neither to members of the common currency nor to a common market (e.g., the EU).[41,42,43]

4.2.2 Error-correction models

Our panel results thus far suggest that 10-year government bond yields in the euro-zone, EU3, and OECD4 countries are driven in the long run by important monetary and fiscal policy variables. Recall, however, that we did not find formal evidence of cointegration in our country-by-country analysis (section 4.1). Thus, empirical evidence of a cointegrating relationship using panel data would confirm that, despite short-run deviations from trend, there is a tendency of the 10-year bond yield to revert to its long-run determinants.

We use the two-step Engle-Granger procedure to estimate an error-correction model of the following form:

$$C(L)\Delta RL_t = D(L)\Delta S_t + E(L)Z_t + \gamma[RL_{t-1} - \alpha S_{t-1}] + \nu_t. \tag{2}$$

Under the assumption that there is only one cointegrating vector among our five long-run variables, the first step of the Engle-Granger procedure is used to estimate this cointegrating relationship (equation (1)). To this end, we utilize our standard long-run panel results as reported in section 4.2.1 (and Table 6). In the second step, the residual from this long-run estimation is taken as an error-correction term within equation (2). More specifically, the long-run parameters estimated in Table 6 appear as vector α in equation (2). The short-run dynamics are modelled by a fourth-order lag process of the first difference in the long-run variables, ΔS_t, as well as a fourth-order lag process of other stationary cyclical variables, Z_t. This process is repeated using each of the U.S. and German real yields as the world rate for our euro-zone group, the EU3 and OECD4. In this error-correction framework, actual 10-year government bond yields move toward their

41. We also present the panel estimation results, in the bottom panel of Table 6, for the OECD5 countries (OECD4 countries plus Japan). Overall, the estimated long-run parameters remain unchanged, except for the parameter associated with the debt-to-GDP ratio, which becomes negative. This is contrary to our expectations. We therefore refer to the OECD4 as our second control group of countries.
42. Standard panel estimation imposes equality of parameters across countries. This is not an unreasonable assumption in our study, given the similarities in the determinants of long-run growth across OECD countries; i.e., similar technology and demographics.
43. Our regular panel estimates are likely subject to endogeneity bias (see footnote 31). In an effort to assess the direction and magnitude of endogeneity bias, we re-estimate our long-run relationship using the general government primary fiscal balance, which excludes interest payments, and find that the estimated parameter associated with fiscal balance is reduced from -0.2 to -0.1 for EMU countries, and remains statistically the same for EU3 and for three members of OECD4 countries, given a lack of government primary fiscal balance data for Switzerland. This slight upward bias associated with the effect of fiscal balance for EMU countries does not affect our main results, however. Interestingly, Knot and de Haan's (1995) results, based on five European countries, suggest a larger estimated parameter for the effect of fiscal balance once endogeneity bias is taken into account (from 40 to 60 basis points). Estimation of the long-run parameters using the panel generalized method of moments approach (Baltagi 2002) is reserved for future research. We acknowledge that our standard panel estimator is neither asymptotically consistent nor efficient when the number of countries (*N*) is smaller than the number of time observations (*T*) (Nickell 1981 and Alvarez and Arellano 2003). Note also that the small-sample properties of our estimator are unknown.

long-run level with a speed of adjustment, γ. For $\gamma < 0$, the error-correction term ensures that RL_t converges towards S_t in the long run and provides evidence of cointegration.[44] A rejection of the non-cointegration hypothesis, $\gamma = 0$, against the (stationarity) alternative hypothesis, $\gamma < 0$, is evidence that RL_t and S_t are cointegrated. This suggests that one can test for cointegration in the context of equation (2) by making inferences on the basis of the *t*-statistic corresponding with $\hat{\gamma}$, which we will refer to as $\hat{\tau}_{\gamma}$.[45]

Table 7 presents our estimated long-run relationships (as shown in Table 6) and the associated estimates of the short-run adjustment parameter (γ) from our error-correction model. In this "base case," the short-run dynamics are modelled purely using a lag process of our first-differenced long-run variables (ΔS_t). No other stationary cyclical variables are included. For the euro zone, our estimated adjustment parameters (γ) are negative and statistically significant, thus providing evidence of cointegration. In the case of the EU3 and OECD4, the *t*-statistics associated with the estimated adjustment parameters (γ) are generally lower than those of the euro-zone countries. This result reflects the difference in cross-sectional sample size between the country groups. Indeed, when the EU3 and OECD4 groups are pooled, the *t*-statistics associated with the estimated adjustment parameters (γ) increase substantially, providing evidence of cointegration.[46]

In general, adjustment to long-run equilibrium occurs more rapidly in the euro zone than in the EU3 and OECD4 countries. For the euro zone and the EU3, the speed of adjustment is somewhat faster when the German real yield is used as a measure of the world interest rate, as opposed to the U.S. real yield. Finally, we also find evidence of real convergence for all countries when we impose the unit restriction on expected inflation. This implies that convergence in national long-term bond yields is not only the result of monetary policy harmonization, but also the result of fiscal policy harmonization.[47]

4.2.3 Sensitivity analysis

Misspecification that arises, for instance, from measurement error may play a significant role in determining which long-run determinants are important in explaining movements in long-term bond yields. To this end, we present, in Table 8, results of our error-correction model estimation using an alternative definition of expected inflation (calculated using a Hodrick-Prescott (HP)

---

44. The Granger Representation Theorem states that, if two variables (or a variable versus a vector of variables) are cointegrated, then there exists an error-correction model that can capture the dynamics underlying the cointegrating relationship between the variables (see Engle and Granger 1987).
45. In the estimation procedure, γ is constrained to be equal across countries within each country group.
46. The evidence of cointegration holds when Japan is added to the OECD4 countries. See OECD5 countries in the bottom panel of Table 7.
47. The real convergence results using panel error-correction models are available upon request.

filter on the year-over-year inflation rate). This measure of expected inflation provides results that are qualitatively similar to those using our standard “geometric average” series for expected inflation (Table 7).[48] Furthermore, the magnitude and, more importantly, the *t*-statistics associated with the estimated adjustment parameters (γ) increase substantially, indicating stronger evidence of cointegration.

Providing further evidence against specification error, we also find that our error-correction model results (as shown in Table 8), are robust when the output gap is included as a cyclical variable in matrix Z of equation (2). The same holds true when the error-correction model lag process is reduced from fourth order to second order.[49] Interestingly, when we include the output gap, our alternative (HP filter) definition of expected inflation, and a two-order lag structure, our estimates of the speed of convergence are still statistically significant, but are also more precise (i.e., they have higher *t*-statistics) than in our base-case results.

4.2.4 Further results of the long-run analysis

Thus far, our analysis has shown that monetary and fiscal policy are of prime importance in reducing risk premiums on long-term government bond yields. Building on our long-run estimates as shown in Table 6, we can accentuate this result with a number of secondary observations.

For reasons of data availability for its national 10-year government bond yield, Ireland is excluded from the dataset we use in Table 6. Given the dramatic fiscal improvements experienced in Ireland since the mid-1980s, we are interested in determining whether the inclusion of Irish data, available starting in 1985, would significantly change our results. We therefore re-estimate our panel regressions beginning in 1985 both with and without the data for Ireland. The results of this exercise, reported in Table 9, show that including Ireland does not significantly change the estimated long-run parameters. Interestingly, when compared with our original results (Table 6), the shorter sample (from 1985) raises the estimated parameter on expected inflation to almost exactly one (as predicted by the Fisher principle). Given the reduced volatility of inflation observed in the post-1985 period, this result is consistent with the decreased expectational error on the part of market participants.

48. The fact that the world yield takes a larger coefficient in all cases possibly results from the comparatively smooth nature of the HP-filtered series for expected inflation. With a very smooth series for expected inflation, the real world yield picks up more of the variance in national 10-year government yields.

49. These additional results are available upon request. Interestingly, reducing the lag process to order two increases the speed of adjustment for the EU3 countries (using the German world yield) from about -0.05 to about -0.07, and increases the statistical significance. These results are more in line with those obtained for the euro zone.

Recall also that the ratio of debt to GDP consistently takes a negative parameter in our long-run estimates for the euro zone (Table 6), counter to theory. Because the overall variance of this ratio is rather low in our sample of euro-zone countries, its ability to explain movements in 10-year government bond yields does seem questionable. However, an additional form of panel estimation, called fixed-effects panel estimation, may help to illustrate the true role of debt in determining yields for these countries. In simple terms, the fixed-effects estimator transforms all time-series variables into deviations from their historical average, thereby inducing more variance in the time series. By including a constant (or fixed effect) for each country, the fixed-effects estimator provides a "catch-all" estimate of country-specific factors.

Table 10 reports the results of our fixed-effects panel estimates. In general, these results are very similar to those obtained using standard panel estimation for the euro zone (Table 6). Because the fixed-effects estimator expresses variables in deviation from their average over time, however, one would expect more variation in the debt series, making its estimated marginal contribution in explaining the variance in bond yields more precise. In fact, this is the case when the German yield is used as the world interest rate. The debt ratio is indeed estimated with a reasonable, positive, and statistically significant coefficient. Thus, this result provides some evidence that a rising level of debt (as a share of nominal GDP) increases country risk premiums on 10-year government bond yields in the euro zone.

4.2.5 Empirical interpretation of the trend 10-year government bond yield

In terms of monetary policy applications, our error-correction model estimates, as presented in Table 7, allow us to make a general statement regarding the trend level of euro-zone 10-year government bond yields. Figure 19 graphs our estimated trend yield over the period 1980Q1 to 2003Q4 (as implied by the fourth row of estimates in Table 7). In particular, our results suggest that the downward trend in 10-year government bond yields from the early 1980s and thereafter stems largely from its strong relationship with expected inflation, developments in the bond yields of the larger countries, and, to a lesser extent, from the effects of persistent changes in general government fiscal balances. Currently, the average yield lies below its trend level. How much further long-term interest rates will rise during the expected economic recovery depends on how far they are from their equilibrium value. While our results need to be interpreted with caution, they suggest that, in the current environment of low inflation and small government deficits (that are expected to move into surplus in the coming years), the trend in government bond yields in the euro zone and other EU countries should remain low, hence mitigating adverse effects to the stability of the financial system.

4.2.6 Currency risk

Although the distinction between types of risk (e.g., currency risk, default risk, and liquidity risk) seems clear on theoretical grounds, it is empirically difficult to identify each risk separately, given that they are not directly observable. In an attempt to roughly gauge the direct effects of currency union, and the implicit removal of currency risk, on euro-zone government bond yields, we perform a breakpoint test by adding intercept and multiplicative slope dummy variables to our set of long-run panel estimations. Taken together, equations (3) and (3.1) specify the model used in our breakpoint test:

$$RL_t = \alpha_0 + \alpha_1 ecpi_t + \alpha_2 gbal_t + \alpha_3 gdebt_t + \alpha_4 rrlw_t + DUM_t + \upsilon_t, \tag{3}$$

$$DUM_t = \alpha_5 D_t + \alpha_6 (D_t{*}ecpi_t) + \alpha_7 (D_t{*}gbal_t) + \alpha_8 (D_t{*}gdebt_t) + \alpha_9 (D_t{*}rrlw_t). \tag{3.1}$$

The dummy variable (D_t) takes a value of zero up until the end of 1998, and a value of one from 1999 on. As a whole, the intercept and slope dummies, as shown in equation (3.1), should capture any evident structural shift effective upon the introduction of the euro currency (1 January 1999). To test the null hypothesis of no structural shift, we perform a Chow test, which is equivalent to testing whether parameters α_5 through α_9 are jointly equal to zero. For our euro-zone sample, we reject the null hypothesis (at the 0.01 level), suggesting that there is evidence of a structural break concurrent with the introduction of the euro currency. This result holds true regardless of whether we use the German or U.S. real yield as our measure of the world interest rate. Our conclusion contrasts with that of Codogno, Favero, and Missale (2003), who could not reject the null hypothesis in a similar Chow test of a 1999 regime shift in their empirical models of euro-zone yield spreads.

To investigate the extent to which the intercept and slope dummy variables may reflect the strict effect of currency union (i.e., the removal of currency risk), we perform an equivalent Chow test on our sample of the EU3 and OECD4 country groups. In both cases, we find identical results, rejecting (at the 0.01 level) the null hypothesis of no structural break at the beginning of 1999.[50] The robustness of these results across our three country groups suggests that the intercept and slope dummy variables do not reflect specifically the effect of currency union itself, but capture other factors not included in our specification.[51,52]

---

50. Detailed test results are available upon request.
51. Despite statistical evidence of a structural break, ending our basic panel estimation in 1998, prior to the introduction of the euro, yields qualitatively the same results as estimation over the complete sample period (i.e., 1980 to 2002).
52. The inclusion of similar dummy variables, marking the introduction of the Maastricht Treaty (November 1993), yields similar results.

Another, more direct, way to assess the specific effect of the removal of currency risk is to compare two euro-zone assets, actively trading when the euro currency was introduced, that are identical in every respect except their currency of issue. In general, given flexible exchange rates, differentials between yields of identical assets denominated in different currencies reflect national distinctions in macroeconomic determinants and their implications for expected exchange rate movements. Differences in economic conditions and economic policy lead to differences in national yields, which at the same time reflect market expectations about expected future exchange rate movements and the risk associated with such movements.

With these facts in mind, we assembled data for two bonds issued by the European Investment Bank (EIB): one issued in Dutch guilders, and the other in Italian lira.[53] Each are of a 10-year maturity and were issued just slightly over a month apart. Because the bonds were issued by the same corporation, they feature the same level of default risk; any difference between the two yields should reflect only national distinctions in currency risk and/or liquidity risk. The yields of these two corporate bonds are plotted in Figure 20. Given that only liquidity risk remained following the introduction of the euro currency, we know, from Figure 20, that liquidity risk is negligible and can safely be presumed to have been constant since the time our chosen EIB corporate bonds were issued. Thus, we know that the difference between the two yields before 1999 was almost purely a result of currency risk and that this risk declined gradually, disappearing well in advance of the date of currency union (1 January 1999). In line with this reasoning, Figure 21 plots the daily percentage change in the guilder and the lira versus the Deutsche Mark. The lira was clearly more variable than the guilder early on, but this variability declined with the reduction in currency risk shown in Figure 20. These facts suggest that it was not the technical introduction of the euro, but the convergence in national fundamental interest rate determinants, that caused the decline in currency risk. Indeed, as a result of the Maastricht Treaty, Italy adopted a monetary policy of low and stable inflation similar to that which the Netherlands had maintained for some years. This policy reduced the long-run variability of the Italian currency.[54] At the same time, the fiscal framework of smaller deficits and debts imposed by the treaty prompted Italy to improve its fiscal position, more in line with that of the Netherlands, and to decrease the likelihood of debt monetization (and higher inflation in the long run). As a result, the variability of, and uncertainty

53. The EIB is the EU’s financing institution, and is primarily involved in raising funds for capital spending in member states on behalf of the EU. Despite our best efforts, we were not able to locate other suitable assets for this analysis (i.e., assets issued at the same time, of the same maturity, by the same issuer in euro-zone legacy currencies).

54. Although intervention in currency markets can reduce currency risk, neither the Netherlands nor Italy have changed their exchange rate policy since joining the ERM in 1979. Thus, direct intervention in currency markets probably did not change much over the 1996 to 1998 period, nor contribute significantly to the removal of currency risk.

over, movements in the lira declined, gradually removing the currency risk and causing the Italian EIB corporate bond yield to converge with that of the Netherlands.

When considering this example, it is important to keep in mind that it is one of extremes. Because the Netherlands had followed a very similar policy to Germany for some time, its interest rate was very close to that of Germany.[55] In comparison, Italy maintained much higher inflation, as well as larger fiscal deficit and debt levels. As a result, uncertainty over future movements of its currency (i.e., its currency risk) was quite large. If one were to compare bonds from the Netherlands with those from, say, France, the size of the currency risk and its decline would not be as dramatic. Nonetheless, we would expect to see the same pattern of gradual disappearance in terms of currency risk in advance of currency union.

5. Conclusions

The main conclusion we draw from our analysis is that increased harmonization of monetary and fiscal policies on the path to EMU contributed greatly to the convergence of long-term government bond yields in the euro zone by prompting the convergence of their long-run determinants. More importantly, our findings suggest that the convergence of national long-term government bond yields in the euro zone cannot be attributed primarily to the introduction of the common currency itself, since two control groups of other OECD countries experienced a similar convergence in their national long-term yields. The first control group consists of other EU countries (EU3) not included in EMU (Denmark, Sweden, and the United Kingdom), and the second includes other OECD countries (OECD4) that are members of neither EMU nor the EU (Australia, Canada, Norway, and Switzerland).

We also find evidence that currency risk premiums gradually declined following the adoption of the Maastricht Treaty and were largely eliminated by the time the single currency was introduced in January 1999. These findings suggest that, in the context of integrated international financial markets, harmonization of sound monetary and fiscal policies across countries will cause national long-term bond yields to converge. Based on evidence from the euro zone, the adoption of a common currency will have, at most, a secondary effect on the convergence of national bond yields. With regards to the EU3 and OECD4, however, the policy commitment inherent in the framework for the adoption of the euro currency (i.e., the Maastricht criteria) may have given additional credibility to national euro-zone monetary and fiscal policies.

55. The Dutch guilder had been pegged to the Deutsche Mark since 1983 and the Dutch and German monetary and fiscal policies had been quite similar (Figures 2, 5, 7, and 9).

To examine empirically how harmonization of monetary and fiscal policies contributed to the convergence of national long-term government bond yields across euro-zone countries, we assessed how these policies contributed to the convergence of their long-run determinants. This entailed examining the determinants across euro-zone countries over the 1980 to 2002 period, first on a country-by-country basis using cointegration techniques, and then using panel estimation techniques to improve the efficiency of the estimated parameters.

On a country-by-country basis, we did not find any evidence of cointegration between the 10-year nominal government bond yields and their long-run determinants over the 1980 to 2002 period. The set of long-term determinants that we examined were general government fiscal balance as a share of nominal GDP, the stock of accumulated general government debt as a share of nominal GDP, expected inflation, and the U.S. or German real 10-year government bond yield as a measure of the world real interest rate.

We then examined the trend in 10-year nominal government bond yields using panel estimation over the 1980 to 2002 period for our pool of EMU countries, as well as our two control groups (EU3 and OECD4) not included in EMU. Considering the same set of long-term determinants as in our country-by-country analysis, we first estimated the long-run parameters using panel estimation. We then estimated alternative error-correction models in which the change in the 10-year nominal government bond yields was regressed on the residuals of the static panel regression from the first step, along with other stationary variables. In general, we found estimates of the error-correction term that were negative and statistically significant, providing evidence of cointegration between the 10-year nominal government bond yields and their long-run determinants. We also found evidence of real convergence for all countries when we imposed the unit restriction on expected inflation, reinforcing the idea that convergence in national long-term bond yields is not only the result of monetary policy harmonization but also the result of fiscal policy harmonization.

Our euro-zone estimation results also show that, when we use the real German yield to proxy the world interest rate, the long-run estimated parameter is three times the size of that of the real U.S. yield, which suggests higher integration of EMU country bond markets with the German market than that of the United States. The estimated speed of convergence to long-run equilibrium is also somewhat faster when using the German yield as opposed to the U.S. yield.

In general, our results suggest that the downward trend in 10-year government bond yields since the early 1980s stems largely from their strong relationship with expected inflation, developments in the bond yields of the larger countries, and, to a lesser extent, from the effects of persistent changes in general government fiscal balances. Currently, the average yield lies below its trend level. Indeed, how much further long-term interest rates rise during the expected economic recovery depends on how far they are from equilibrium. In the global financial system, such changes in the price of debt instruments hold balance-sheet implications for corporations, households, financial institutions (e.g. banks, pension funds, and life-insurance firms), and governments. While our results should be interpreted with a level of caution, they suggest that, in the current environment of low inflation and small government deficits (expected to move into surplus in the coming years), the trend in government bond yields in the euro zone and other EU countries should remain low, hence mitigating adverse effects to the stability of the financial system.

Our results are supported by formal statistical tests for cointegration within the error-correction framework and appear to hold across the broader EU; i.e., in the euro zone and in the other EU countries (EU3) not included in EMU (Denmark, Sweden, and the United Kingdom). Further evidence on the robustness of these results is provided by a second control group of other OECD countries (OECD4) that are members of neither EMU nor the EU (Australia, Canada, Norway, and Switzerland). Our results are also qualitatively robust with respect to alternative measures of expected inflation, alternative dynamic error-correction specifications (i.e., four lag-lengths versus two), and the inclusion of another cyclical variable, such as the output gap.

Two points should be noted regarding our analysis. First, it pays little attention to how the 10-year government bond yields are determined in the short run. Second, it does not encompass all the factors that could potentially influence 10-year government bond yields (see Orr, Edey, and Kennedy 1995 for other potential determinants). We have limited our analysis to the factors most discussed in the literature.

Finally, as more data become available, our analysis could be extended to the ten central and eastern European countries that joined the EU on 1 May 2004. This extension is left for future study.

Bibliography

Alesina, A., M. De Broeck, A. Prati, and G. Tabellini. 1993. "Default Risk on Government Debt in OECD Countries." *Economic Policy: A European Forum* October: 428–63.

Alvarez, J. and M. Arellano. 2003. "The Time Series and Cross-Section Asymptotics of Dynamic Panel Data Estimators." *Econometrica* 71(4): 1121–60.

Baltagi, B.H. 2002. *Econometric Analysis of Panel Data*. New York: John Wiley & Sons Ltd.

Banerjee, A., J.J. Dolado, and R. Mestre. 1993. "On Some Simple Tests for Cointegration: The Costs of Simplicity." Bank of Spain Working Paper No. 9302.

Barro, R.J. 1974. "Are Government Bonds Net Wealth?" *Journal of Political Economy* 82: 1095–1117.

———. 1989. "The Ricardian Approach to Budget Deficits." *Journal of Economic Perspectives* 3(2): 37–54.

Bernheim, B.D. 1987. "Ricardian Equivalence: An Evaluation of Theory and Evidence." In *NBER Macroeconomics Annual*, edited by S. Fischer. Cambridge: MIT Press.

———. 1989. "A Neoclassical Perspective on Budget Deficits." *Journal of Economic Perspectives* 3(2): 55–72.

Blanchard, O.J. 1985. "Debt, Deficits, and Finite Horizons." *Journal of Political Economy* 93 (April): 223–46.

Bofinger, P. 2000. "The European Monetary System (1979–1988): Achievements, Flaws and Applicability to Other Regions of the World." Background paper for special session IV on global financial issues, UN/ECE Conference, *Financing for Development*, December 2000.

Brook, A.-M. 2003. "Recent and Prospective Trends in Real Long-Term Interest Rates: Fiscal Policy and Other Drivers." Economics Department Working Paper No. 367.

Buiter, W.H. 1988. "Death, Birth, Productivity Growth and Debt Neutrality." *The Economic Journal* 98 (391): 279–93.

Caramazza, F., K. Clinton, A. Côté, and D. Longworth. 1986. *International Capital Mobility and Asset Substitutability: Some Theory and Evidence on Recent Structural Changes*. Technical Report No. 44. Ottawa: Bank of Canada.

Carlson, J.A. and C.L. Osler. 1999. "Determinants of Currency Risk Premiums." Krannert School of Management and Federal Reserve Bank of New York.

Carlson, J.A. and M. Parkin. 2001. "Inflation Expectations." *Economica* (May): 123–38.

Cebula, R. 2000. "Impact of Budget Deficits on Ex-Post Real Long-Term Interest Rates." *Applied Economic Letters* 7(3): 177–79.

Codogno, L., C. Favero, and A. Missale. 2003. "Yield Spreads on EMU Government Bonds." In *EMU: Assessing the Impact of the Euro*, edited by R. Baldwin, 211–40.

Correia-Nunes, J. and L. Stemitsiotis. 1995. "Budget Deficit and Interest Rates: Is There a Link? International Evidence." *Oxford Bulletin of Economics and Statistics* 57(4): 425–49.

Davidson, R. and J.G. MacKinnon. 1993. "Estimation and Inference in Econometrics." New York, Oxford: Oxford University Press.

de Bandt, O. and F.P. Mongelli. 2000. "Convergence of Fiscal Policies in the Euro Area." European Central Bank Working Paper No. 20.

Diamond, P.A. 1965. "National Debt and Neoclassical Economic Growth." *American Economic Review* 55: 1125–50.

Durré, A., S. Evjen, and R. Pilegaard. 2003. "Estimating Risk Premia in Money Market Rates." European Central Bank Working Paper No. 221.

Engle, R.F. and C.W.J. Granger. 1987. "Co-Integration and Error Correction: Representation, Estimation and Testing." *Econometrica* 55: 251–76.

European Central Bank. 2003. *ECB Monthly Bulletin*, November.

Fillion, J.-F. 1996. "L'endettement du Canada et ses effets sur les taux d'intérêts de long terme." Document de travail de la Banque du Canada, No. 96-14.

Fukao, M. and M. Hanazaki. 1986. "Internationalisation of Financial Markets: Some Implications for Macroeconomic Policy and for the Allocation of Capital." OECD Working Paper No. 37.

Gale, W.G. and P.R. Orszag. 2002. "The Economic Effects of Long-Term Fiscal Discipline." Tax Policy Center, *Urban Institute and Brookings Institution.*

Gali, J. and R. Perotti. 2003. "Fiscal Policy and Monetary Integration in Europe." NBER Working Paper No. 9773.

Gjersem, C. 2003. "Financial Market Integration in the Euro Area." Economics Department Working Paper No. 368.

Goldberg, L.G., J.R. Lothian, and J. Okunev. 2003. "Has International Financial Integration Increased?" *Open Economies Review* 14: 299–317.

Granger, C.W.J. and P. Newbold. 1974. "Spurious Regressions in Econometrics." *Journal of Econometrics* 2: 111–20.

Hartmann, P., A. Maddaloni, and S. Manganelli. 2003. "The Euro Area Financial System: Structure, Integration and Policy Initiatives." ECB Working Paper No. 230.

Haug, A.A. 1992. "Critical Values for the $\hat{\mathbf{Z}}_{\alpha}$ - Phillips-Ouliaris Test for Cointegration." *Oxford Bulletin of Economics and Statistics* 54(3): 473–80.

Hsiao, C. 1990. *Analysis of Panel Data*. Econometric Society Monographs, Cambridge University Press.

Knot, K. and J. de Haan. 1995. "Fiscal Policy and Interest Rates in the European Community." *European Journal of Political Economy* 11(1): 171–87.

Laubach, T. 2003. “New Evidence on the Interest Rate Effects of Budget Deficits and Debts.” Board of Governors of the Federal Reserve System Working Paper No. 2003-12.

MacKinnon, J.G. 1991. “Critical Values for Cointegration Tests.” In *Long-Run Economic Relationships: Readings in Cointegration*, edited by R. Engle and C. Granger, Chapter 13. Oxford: Oxford University Press.

Macklem, T. 1994–1995. “Some Macroeconomic Implications of Rising Levels of Government Debt.” *Bank of Canada Review* (Winter): 41–60.

Macklem, T., D. Rose, and R. Tetlow. 1995. “Government Debt and Deficits in Canada: A Macro Simulation Analysis.” Bank of Canada Working Paper No. 95-4.

Masson, P., T. Bayoumi, and H. Samiei. 1995. “Saving Behavior in Industrial and Developing Countries.” World Economic and Financial Surveys, Staff Studies for the World Economic Outlook (September). Chapter I, 1-27. IMF.

Moody’s Investors Service. 2003. “Sovereign Bond Defaults, Rating Transitions and Recoveries (1985-2002).” *Special Comment*, February.

Nickell, S. 1981. “Biases in Dynamic Models with Fixed Effects.” *Econometrica* 49: 1417–26.

Ng, S. and P. Perron. 1995. “Unit Root Tests in ARMA Models with Data Dependent Methods for the Selection of the Truncation Lag.” *Journal of the American Statistical Association* 90(429): 268–81.

OECD. 2003. *OECD Economic Outlook* 2(74): December.

Orr, A., M. Edey, and M. Kennedy. 1995. “Real Long-Term Interest Rates: The Evidence from Pooled-Time-Series.” OECD Economic Studies No. 25, 1995/II: 75–107.

Phillips, P.C.B. 1986. “Understanding Spurious Regressions in Econometrics.” *Journal of Econometrics* 33(3): 311–40.

Phillips, P.C.B. and P. Perron. 1988. “Testing for a Unit Root in Time Series Regression.” *Biometrica* 75: 335–46.

Pigott, C. 1994. “International Interest Rate Convergence: A Survey of the Issues and Evidence.” Federal Reserve Bank of New York.

Stock, J.H. and M.W. Watson. 1993. “A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems.” *Econometrica* 61(4): 783–820.

Throop, A.W. 1994. “International Financial Market Integration and Linkages of National Interest Rates.” Federal Reserve Bank of San Francisco, *Economic Review* 3: 3–18.

Weil, P. 1989. “Overlapping Families of Infinitely-Lived Agents.” *Journal of Public Economics* 38 (March): 183–98.

Yaari, M.E. 1965. “Uncertain Lifetime, Life Insurance, and the Theory of the Consumer.” *Review of Economic Studies* 32 (April) 137–50.

Appendix A: Data Description

This appendix describes the data mnemonics used in this paper. Data are taken from OECD (2003), BIS, and IMF databases. All mnemonics consist of an "economic variable" component, as shown in the table below. Each mnemonic also contains a second component that denotes the country.

Mnemonic	Description
Economic Variable Component	
rl<country>	10-year nominal government bond yield.
ecpi<country>	Expected inflation calculated as an 8-quarter moving average of the annual percentage change in the national quarterly consumer price index with geometrically declining weights.
ecpihp<country>	Expected inflation generated using the low-frequency component of the annual percentage change in the national quarterly consumer price index; a Hodrick-Prescott filter with a lambda value of 1600 is used in the filtering process. CPI inflation forecasts for 2004 and 2005 are from Consensus Forecasts, survey date 8 March 2004.
gbal<country>	General government fiscal balance as a percentage of nominal gross domestic product. Quarterly estimates generated by linear interpolation of annual OECD data.
gdebt<country>	General government debt as a percentage of nominal gross domestic product. Quarterly estimates generated by linear interpolation of annual OECD data. Fourth quarter stock value corresponds to overall annual stock value.
rrl<country>	Real 10-year government bond yield (deflated using *ecpi*).
rrl<country>hp	Real 10-year government bond yield (deflated using *ecpihp*).
rrlw	Real world 10-year government bond yield (deflated using *ecpi*).
rrlw = rrlus	Real U.S. 10-year government bond yield (deflated using *ecpius*) as a measure of world interest rate.
rrlw = rrlgy	Real German 10-year government bond yield (deflated using *ecpigy*) as a measure of world interest rate.
rrlwhp = rrlushp	Real U.S. 10-year government bond yield (deflated using *ecpihpus*) as a measure of world interest rate.
rrlwhp = rrlgyhp	Real German 10-year government bond yield (deflated using *ecpihpgy*) as a measure of world interest rate.
Country Component	
Eurozone countries	Austria (*aut*), Belgium (*belg*), Finland (*fin*), France (*fr*), Germany (*gy*), Ireland (*ire*), Italy (*it*), Netherlands (*neth*), Portugal (*pt*), Spain (*spain*).
EU3	Denmark (*dnk*), Sweden (*swed*), United Kingdom (*uk*).
Other OECD countries	Australia (*aust*), Canada (*ca*), Japan (*jpn*), Norway (*nor*), Switzerland (*swit*), United States of America (*us*).
OECD4	Australia (*aust*), Canada (*ca*), Norway (*nor*), Switzerland (*swit*).
OECD5	Australia (*aust*), Canada (*ca*), Japan (*jpn*), Norway (*nor*), Switzerland (*swit*).

Appendix B: Timeline for Economic and Monetary Union

As illustrated in Chart B1, the long path to EMU was born out of the ashes of World War II. In 1952, only three years after the end of post-war reconstruction, “the Six” (Germany, France, Italy, Belgium, Luxembourg, and the Netherlands) took a critical step in reunifying Europe by establishing the European Coal and Steel Community (ECSC). Five years later, in 1957, the Treaty of Rome was signed, creating the European Economic Community (EEC) which, among other things, marked the beginning of the push towards free movement of labour and capital. In 1960, several European countries (Austria, Denmark, Norway, Portugal, Sweden, Switzerland, and the United Kingdom) formed the European Free Trade Association (EFTA) in an effort to liberalize trade and counterbalance the EEC. The ECSC and the EEC (as well as the European Atomic Energy Community) merged in 1967, to form the European Community (EC). Two years later, the first agreement was made among EC member states to coordinate short-term economic policies.

In 1970, the Werner Report laid out, for the first time, the eventual steps to European monetary union. In 1972, “the snake” exchange rate system was introduced, wherein the Six agreed to limit the margin of currency fluctuations to a 4.5 per cent band around an agreed central parity. When the United Kingdom, Ireland, and Denmark acceded to the EC in 1973, they also joined “the snake.” However, this first attempt at European exchange rate coordination fell victim to the effects of the oil-price crises in the late 1970s. By 1978, only five of nine member states remained on “the snake.” The mid-1970s had, nonetheless, brought progress on another front. A significant free trade agreement had been reached in 1974 between the EC and the EFTA, broadening the scope of trade liberalization across western Europe.

The experience of “the snake” paved the way for the establishment of the European Monetary System (EMS) in 1979, leading to the beginning of the empirical sample period used throughout this paper (1980 to 2002). Within the EMS, the concept of the European Currency Unit (ECU), a virtual currency based on relative GNP and trade values for all EC countries, was introduced, along with the exchange rate mechanism (ERM). The ERM marked the second attempt at a coordinated EC exchange rate policy and initially included all EC countries except the United Kingdom. Participants in the ERM were originally permitted, like “the snake,” to move within a 4.5 per cent band around a central parity with the ECU, except for Italy, which adopted a 12 per cent band because of its higher inflation rate.

In 1981, Greece acceded to the EC, followed five years later by Spain and Portugal. In 1987, the original Treaty of Rome was modified by the Single European Act, which formalized, among other things, the plan to create a single European economic market in goods and services, labour, and capital by the end of 1992. The ERM expanded to include Spain, the United Kingdom, and Portugal in 1989, 1990, and 1992, respectively, although using the wider 12 per cent band of fluctuation (Italy had, meanwhile, adopted the standard 4.5 per cent band in 1990). Despite several revaluations within the ERM, the mechanism functioned relatively smoothly until 1992, when speculative currency attacks forced the United Kingdom and Italy to withdraw from the arrangement. The following year, a new 30 per cent band was adopted to provide added flexibility and reduce the threat of speculative attacks. Italy subsequently rejoined the ERM in 1996, whereas the United Kingdom has since abstained.

The European Union (EU) as we know it today was born out of the Maastricht Treaty in 1993.[56] Besides enacting a common foreign and security policy, and dealing with EU-level matters of justice, this treaty specified the three steps required for Economic and Monetary Union (EMU): by the end of 1993, capital flows were to be completely freed within the EU; by 1999, member states preparing to adopt the euro currency upon its launch had to satisfy a set of convergence criteria by which major economic policies were coordinated across nations; effective at the beginning of 1999, the European Central Bank would be established, along with the official euro currency for which member-country conversion rates were irrevocably set. The Maastricht Treaty convergence criteria were as follows:

- the ratio of general government deficit to GDP must not exceed 3 per cent
- the ratio of gross general government debt to GDP must not exceed 60 per cent
- the average inflation rate over the year before assessment must not exceed by more than 1.5 percentage points the average of the three best performing member states in terms of price stability
- the long-term nominal interest rate must not exceed by more than 2 percentage points the average of the three best performing member states in terms of price stability
- the ERM must be respected without severe tensions for at least the last two years before assessment (30 per cent band around the ECU)

56. The original member states of the EU were Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom.

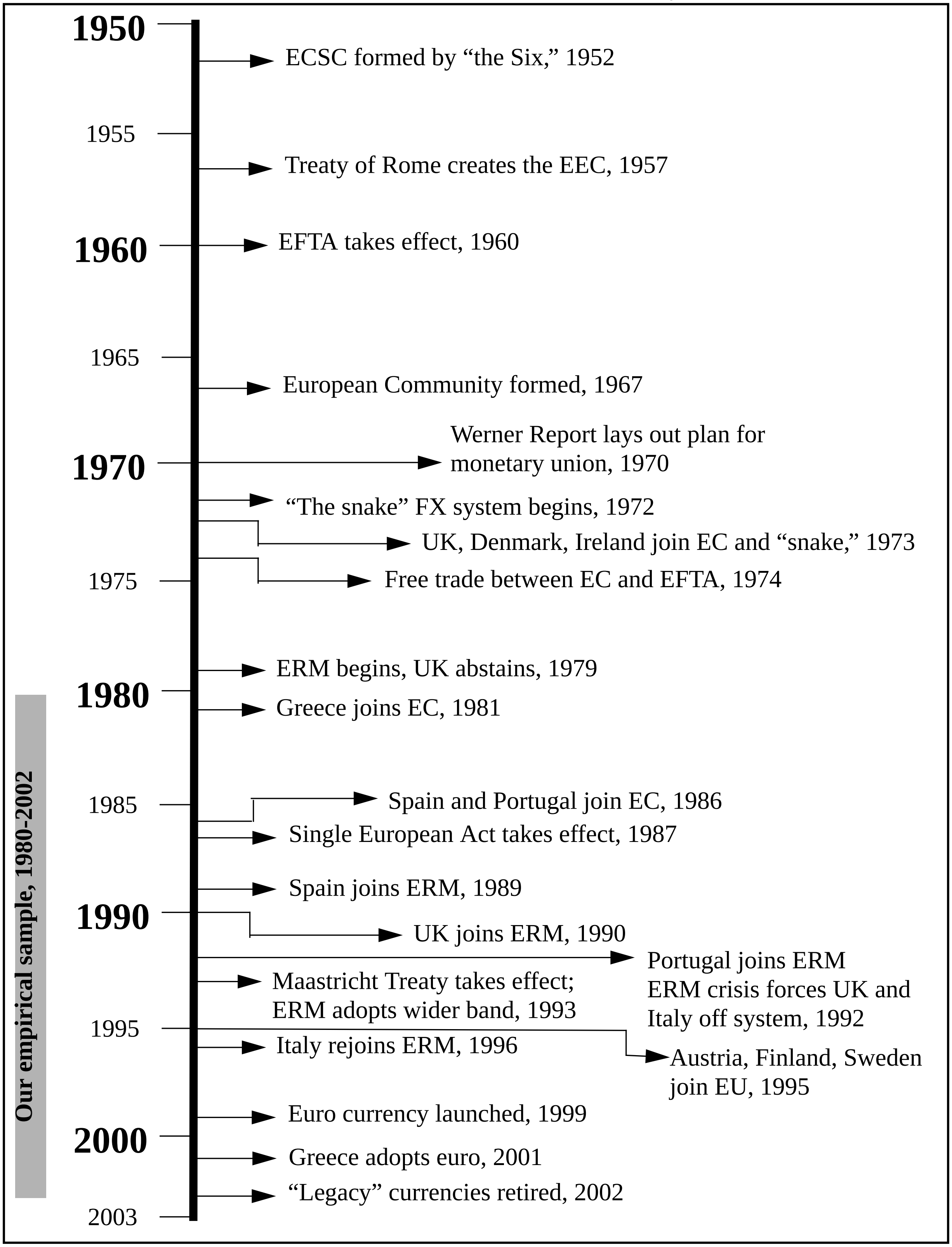
In 1995, three new members were admitted to the EU (Austria, Finland, and Sweden), bringing the total number of member states to 15.[57,58] At the launch of the euro in 1999, EMU consisted of 11 of the 15 EU countries; those that did not participate in EMU were the United Kingdom, Sweden, Denmark, and Greece (Greece later joined in 2001).[59] By the beginning of 2002, all former national currencies (also known as "legacy" currencies) were phased out and the euro became the sole legal currency in EMU member states.

Now that monetary integration has been realized in much of western Europe, the ongoing challenge is for all EU member countries to continuously meet the Stability and Growth Pact (primarily, the first two conditions of the Maastricht Treaty convergence criteria). Currently, several members of EMU (including Germany, France, and Italy) are experiencing difficulty in maintaining a deficit-to-GDP ratio below the 3 per cent limit and a debt-to-GDP ratio below the 60 per cent maximum.[60]

---

57. Norway and Switzerland, while remaining members of the EFTA, are not members of the EU. Norway has applied twice for accession. The first application was submitted in 1967 but was rejected in a national referendum in 1972. In 1992, Norway again applied for membership, but a second referendum in 1994 failed to pass. Switzerland applied for membership in 1992 and maintains an open invitation, but has not actively pursued membership.
58. Ten new European countries joined the EU on 1 May 2004: Poland, Hungary, the Czech Republic, Estonia, Latvia, Lithuania, Slovakia, Slovenia, Cyprus, and Malta. New members are required to eventually adopt the euro and will, thus, have to satisfy the convergence criteria, including the current version of the ERM.
59. In sync with the second stage of EMU, 1999 marked the introduction of ERMII, which replaced the ERM as a voluntary means for non-EMU members of the EU to reduce exchange rate fluctuations and prepare for eventual adoption of the euro. Currently, Denmark is the only nation participating in ERMII, and has elected to follow a 4.5 per cent band around the euro, as opposed to the minimum requirement of a 30 per cent band. Estonia, Lithuania, Slovenia, and Cyprus are expected to apply in 2004 for entrance into ERMII with the remaining new central and eastern European EU members to follow.
60. Italy is a special case, in that it was admitted to EMU with a debt-to-GDP limit far exceeding the 60 per cent limit, on the condition that this level be reduced over time.

Chart B1: Timeline for Economic and Monetary Union



Appendix C

Table 1: Correlation of Long-Term Government Bond Yields with Germany

	1980Q1–1991Q4	1991Q1–2002Q4
Austria	0.924	0.996
Belgium	0.796	0.986
Finland	0.540	0.967
France	0.730	0.989
Italy	0.795	0.955
The Netherlands	0.963	0.994
Portugal	0.100	0.890
Spain	0.686	0.952
Average	0.692	0.966

Table 2: Correlation with Long-Term Government Bond Yields

1980Q1–2002Q4	Expected inflation	General government balance (% of GDP)[a]	General government debt (% of GDP)[b]
Austria	0.830	-0.173 -0.674 (+14)	-0.827
Belgium	0.870	-0.922 -0.954 (+6)	-0.411 0.611 (+23)
Finland	0.671	-0.018 -0.624 (+11)	-0.695
France	0.947	0.201 -0.034 (+11)	-0.888
Germany	0.715	-0.287 -0.304 (+2)	-0.838
Italy	0.878	-0.754 -0.800 (+5)	-0.756
The Netherlands	0.583	-0.673 -0.687 (+3)	-0.209 +0.505 (+19)
Portugal	0.919	-0.596 -0.752 (+8)	-0.321 +0.374 (+18)
Spain	0.849	-0.519 -0.804 (+10)	-0.849
Average	0.807	-0.416	-0.644

a. The second row of numbers for each country denotes the most negative correlation between the long-term yield and the government balance up to two years in the future. The value in brackets denotes the number of quarters by which the balance leads the yield.

b. The second row of numbers for each country denotes the strongest positive correlation between the long-term yield and the government debt up to two years in the future. The value in brackets denotes the number of quarters by which the debt leads the yield.

Table 3: Correlation with Long-Term Government Bond Yields

	Expected inflation	General government balance (% of GDP)[a]	General government debt (% of GDP)[b]
1980Q1–1991Q4			
Austria	0.850	0.629 -0.187 (+20)	-0.757 -0.777 (+2)
Belgium	0.916	-0.766 -0.860 (+7)	-0.774
Finland	0.348	0.310 -0.839 (+10)	-0.208 0.704 (+12)
France	0.970	0.004 -0.241 (+3)	-0.890
Germany	0.844	-0.743 -0.760 (+1)	-0.629 +0.158 (+12)
Italy	0.890	0.341 -0.429 (+14)	-0.708
The Netherlands	0.828	-0.061 -0.274 (+22)	-0.739
Portugal	0.851	-0.251 -0.492 (+5)	-0.072 +0.323 (+14)
Spain	0.717	0.005 -0.707 (+5)	-0.618
Average	0.802	-0.059	-0.599
1991Q1–2002Q4			
Austria	0.723	-0.529 -0.868 (+13)	-0.464 0.089 (+15)
Belgium	0.633	-0.884 -0.932 (+5)	0.785 0.902 (+6)
Finland	0.349	-0.783 -0.920 (+7)	-0.066 0.910 (+23)
France	0.734	-0.698 -0.805 (+3)	-0.789
Germany	0.764	-0.196 -0.428 (+5)	-0.811
Italy	0.909	-0.901	-0.361 0.931 (+13)
The Netherlands	0.206	-0.770 -0.780 (+1)	0.717 0.859 (+1)
Portugal	0.921	-0.518 -0.921 (+5)	0.140 +0.656 (+10)
Spain	0.898	-0.809 -0.923 (+4)	-0.459 +0.912 (+15)
Average	0.682	-0.676	-0.145

a. The second row of numbers for each country denotes the most negative correlation between the long-term yield and the government balance up to two years in the future. The value in brackets denotes the number of quarters by which the balance leads the yield.

b. The second row of numbers for each country denotes the strongest positive correlation between the long-term yield and the government debt up to two years in the future. The value in brackets denotes the number of quarters by which the debt leads the yield.

Table 4: Stationarity Tests
Sample: 1980Q1–2003Q4 (96 Observations)

Tests in the absence of drift[a]			**Tests in the presence of drift**		
Unit-root tests[b]			***Unit-root tests***		
Variables	***ADF:*** $\hat{\tau}_\mu$	***PP:*** $Z(\hat{\alpha})$	***Variables***	***ADF:*** $\hat{\tau}_\tau$	***PP:*** $Z(\tilde{\alpha})$
Austria					
Δ*rlaut*	-6.51 [<.01]	-50.24 [<.01]	*rlaut*	-2.99 [>.10]	-15.02 [>.10]
Δ*ecpiaut*	-4.95 [<.01]	-19.69 [.025]	*ecpiaut*	-2.96 [>.10]	-11.89 [>.10]
Δ*gbalaut*	-4.52 [<.01]	-19.41 [.025]	*gbalaut*	-2.09 [>.10]	-9.69 [>.10]
Δ*gdebtaut*	-2.33 [>.10]	-17.08 [.025]	*gdebtaut*	-2.25 [>.10]	-3.23 [>.10]
Belgium					
Δ*rlbelg*	-4.81 [<.01]	-50.73 [<.01]	*rlbelg*	-3.36 [.10]	-14.32 [>.10]
Δ*ecpibelg*	-3.32 [.025]	-17.84 [.025]	*ecpibelg*	-3.86 [.10]	-8.48 [>.10]
Δ*gbalbelg*	-2.66 [.10]	-16.38 [.05]	*gbalbelg*	-2.96 [>.10]	-19.53 [.10]
Δ*gdebtbelg*	-1.83 [>.10]	-4.12 [>.10]	*gdebtbelg*	-2.09 [>.10]	-2.08 [>.10]
Finland					
Δ*rlfin*	-3.02 [.05]	-37.64 [<.01]	*rlfin*	-2.24 [>.10]	-7.81 [>.10]
Δ*ecpifin*	-3.78 [<.01]	-15.20 [.05]	*ecpifin*	-3.68 [.10]	-9.98 [>.10]
Δ*gbalfin*	-3.05 [.05]	-15.26 [.05]	*gbalfin*	-2.50 [>.10]	-6.00 [>.10]
Δ*gdebtfin*	-1.79 [>.10]	-10.26 [>.10]	*gdebtfin*	-2.75 [>.10]	-3.64 [>.10]
France					
Δ*rlfr*	-6.30 [<.01]	-48.35 [<.01]	*rlfr*	-2.90 [>.10]	-11.35 [>.10]
Δ*ecpifr*	-2.40 [>.10]	-17.47 [.025]	*ecpifr*	-2.74 [>.10]	-2.55 [>.10]
Δ*gbalfr*	-3.38 [.025]	-16.04 [.05]	*gbalfr*	-2.65 [>.10]	-9.24 [>.10]
Δ*gdebtfr*	-2.09 [>.10]	-12.51 [.10]	*gdebtfr*	-3.00 [>.10]	-5.23 [>.10]

a. In the absence of drift, the ADF and PP tests include a constant term but do not include a linear time trend, whereas in the presence of drift they include a constant term as well as a linear time trend.
b. The ADF and PP normalized bias statistics test the null hypothesis of non-stationarity (i.e., H_0: y is I(1)) against the alternative hypothesis of stationarity (i.e., H_1: y is I(0)). *P*-values for the ADF *t*-statistics and the PP normalized bias statistics (reported in square brackets) are obtained from the critical values reported by Davidson and MacKinnon (1993, Table 20.1).

(continued)

Table 4: Stationarity Tests (continued)
Sample: 1980Q1–2003Q4 (96 Observations)

Tests in the absence of drift			Tests in the presence of drift		
Unit-root tests			*Unit-root tests*		
Variables	***ADF:*** $\hat{\tau}_\mu$	***PP:*** $Z(\hat{\alpha})$	***Variables***	***ADF:*** $\hat{\tau}_\tau$	***PP:*** $Z(\tilde{\alpha})$
Germany					
Δ*rlgy*	-2.80 [.10]	-53.14 [<.01]	*rlgy*	-2.93 [>.10]	-11.86 [>.10]
Δ*rrlgy*	-4.99 [<.01]	-45.06 [<.01]	*rrlgy*	-3.36 [.10]	-12.90 [>.10]
Δ*ecpigy*	-2.24 [>.10]	-20.26 [.025]	*ecpigy*	-3.25 [.10]	-7.35 [>.10]
Δ*gbalgy*	-2.63 [.10]	-18.49 [.025]	*gbalgy*	-2.16 [>.10]	-11.87 [>.10]
Δ*gdebtgy*	-2.21 [>.10]	-17.52 [.025]	*gdebtgy*	-2.86 [>.10]	-5.29 [>.10]
Ireland (1985Q1–2003Q4)					
Δ*rlire*	-4.86 [<.01]	-48.60 [<.01]	*rlire*	-3.29 [.10]	-19.86 [.10]
Δ*ecpiire*	-3.02 [.05]	-19.82 [.025]	*ecpiire*	-1.97 [>.10]	-7.65 [>.10]
Δ*gbalire*	-3.34 [.025]	-14.69 [.10]	*gbalire*	-1.13 [>.10]	-7.01 [>.10]
Δ*gdebtire*	-1.78 [>.10]	-12.20 [.10]	*gdebtire*	-2.23 [>.10]	-4.20 [>.10]
Italy					
Δ*rlit*	-5.67 [<.01]	-42.00 [<.01]	*rlit*	-2.98 [>.10]	-14.30 [>.10]
Δ*ecpiit*	-2.33 [>.10]	-21.59 [.025]	*ecpiit*	-3.73 [.05]	-4.64 [>.10]
Δ*gbalit*	-1.66 [>.10]	-28.64 [<.01]	*gbalit*	-1.99 [>.10]	-6.17 [>.10]
Δ*gdebtit*	-1.46 [>.10]	-9.16 [>.10]	*gdebtit*	-1.85 [>.10]	-1.16 [>.10]
The Netherlands					
Δ*rlneth*	-5.07 [<.01]	-56.09 [<.01]	*rlneth*	-3.18 [.10]	-11.00 [>.10]
Δ*ecpineth*	-2.93 [.10]	-16.67 [.05]	*ecpineth*	-3.12 [>.10]	-5.96 [>.10]
Δ*gbalneth*	-2.35 [>.10]	-18.65 [.025]	*gbalneth*	-1.92 [>.10]	-12.16 [>.10]
Δ*gdebtneth*	-1.47 [>.10]	-5.30 [>.10]	*gdebtneth*	-2.57 [>.10]	-1.45 [>.10]
Portugal					
Δ*rlpt*	-7.60 [<.01]	-81.08 [<.01]	*rlpt*	-2.64 [>.10]	-10.50 [>.10]
Δ*ecpipt*	-3.41 [.025]	-18.48 [.025]	*ecpipt*	-3.95 [.025]	-10.11 [>.10]
Δ*gbalpt*	-3.02 [.05]	-20.73 [.025]	*gbalpt*	-2.60 [>.10]	-17.48 [>.10]
Δ*gdebtpt*	-2.18 [>.10]	-15.28 [.05]	*gdebtpt*	-2.50 [>.10]	-6.96 [>.10]

(continued)

Table 4: Stationarity Tests (continued)

Sample: 1980Q1–2003Q4 (96 Observations)

Tests in the absence of drift			Tests in the presence of drift		
Unit-root tests			*Unit-root tests*		
Variables	***ADF:*** $\hat{\tau}_{\mu}$	***PP:*** $Z(\hat{\alpha})$	***Variables***	***ADF:*** $\hat{\tau}_{\tau}$	***PP:*** $Z(\tilde{\alpha})$
Spain					
Δ*rlspain*	-3.15 [.025]	-45.26 [<.01]	*rlspain*	-3.28 [.10]	-13.75 [>.10]
Δ*ecpispain*	-2.93 [.05]	-29.91 [<.01]	*ecpispain*	-1.93 [>.10]	-2.84 [>.10]
Δ*gbalspain*	-2.41 [>.10]	-17.08 [.025]	*gbalspain*	-1.64 [>.10]	-7.24 [>.10]
Δ*gdebtspain*	-1.45 [>.10]	-7.56 [>.10]	*gdebtspain*	-2.54 [>.10]	-1.07 [>.10]
Denmark					
Δ*rldnk*	-2.68 [.10]	-48.06 [<.01]	*rldnk*	-3.29 [.10]	-7.54 [>.10]
Δ*ecpidnk*	-2.16 [>.10]	-31.64 [<.01]	*ecpidnk*	-2.72 [>.10]	-2.69 [>.10]
Δ*gbaldnk*	-3.44 [.025]	-13.02 [.10]	*gbaldnk*	-3.77 [.025]	-9.09 [>.10]
Δ*gdebtdnk*	-2.40 [>.10]	-10.93 [>.10]	*gdebtdnk*	-3.01 [>.10]	-5.15 [>.10]
Sweden					
Δ*rlswed*	-6.46 [<.01]	-35.61 [<.01]	*rlswed*	-2.84 [>.10]	-15.71 [>.10]
Δ*ecpiswed*	-2.63 [.10]	-22.67 [<.01]	*ecpiswed*	-2.94 [>.10]	-14.05 [>.10]
Δ*gbalswed*	-3.17 [.05]	-14.39 [.10]	*gbalswed*	-2.77 [>.10]	-6.65 [>.10]
Δ*gdebtswed*	-2.30 [>.10]	-10.83 [>.10]	*gdebtswed*	-3.19 [>.10]	-5.90 [>.10]
United Kingdom					
Δ*rluk*	-5.58 [<.01]	-58.59 [<.01]	*rluk*	-3.60 [.05]	-17.03 [>.10]
Δ*ecpiuk*	-4.39 [<.01]	-28.29 [<.01]	*ecpiuk*	-3.22 [.10]	-7.72 [>.10]
Δ*gbaluk*	-2.99 [.05]	-14.58 [.10]	*gbaluk*	-3.12 [>.10]	-6.89 [>.10]
Δ*gdebtuk*	-2.40 [>.10]	-19.51 [.025]	*gdebtuk*	-3.16 [.10]	-7.03 [>.10]
United States					
Δ*rlus*	-5.90 [<.01]	-65.61 [<.01]	*rlus*	-2.76 [>.10]	-17.34 [>.10]
Δ*rrlus*	-5.23 [<.01]	-67.45 [<.01]	*rrlus*	-3.33 [.10]	-9.08 [>.10]
Δ*ecpius*	-2.77 [.10]	-26.86 [<.01]	*ecpius*	-3.77 [.05]	-6.53 [>.10]

Table 5: Cointegration Tests for the Individual Country Equations

Estimates of the long-run parameters Sample: 1980Q1–2002Q4, 92 observations	Cointegration tests[a]		$RBAR^2$
(αs_t)[b]	*ADF:* $\hat{\tau}_\mu$	*PP:* $Z(\hat{\alpha})$	
Austria			
0.09 + 0.71*ecpi* - 0.56*gbal* - 0.08*gdebt* - 0.11*rrlus*	-3.66	-11.77	
(4.75) (3.81) (6.78) (3.53) (0.88)	[>.10]	[>.10]	0.8406
0.00 + 1.12*ecpi* - 0.31*gbal* + 0.01*gdebt* + 0.58*rrlgy*	-1.98	-11.95	
(0.07) (9.17) (4.15) (0.85) (8.10)	[>.10]	[>.10]	0.9401
Belgium			
0.03 + 0.43*ecpi* - 0.50*gbal* + 0.01*gdebt* - 0.06*rrlus*	-2.94	-18.61	0.9828
(2.44) (4.49) (10.30) (0.89) (0.83)	[>.10]	[>.10]	
0.02 + 0.41 *ecpi* - 0.46*gbal* + 0.02*gdebt* - 0.02*rrlgy*	-3.29	-18.15	0.9879
(1.96) (4.26) (7.41) (1.82) (0.27)	[>.10]	[>.10]	
Finland			
0.07 + 0.53 *ecpi* - 0.55*gbal* - 0.05*gdebt* + 0.72*rrlus*	-3.59	-11.65	0.8923
(2.76) (3.50) (5.41) (1.74) (3.59)	[>.10]	[>.10]	
-0.04 + 0.70*ecpi* - 0.15*gbal* + 0.04*gdebt* + 1.79*rrlgy*	-3.67	-13.05	0.8882
(0.84) (3.94) (1.24) (0.82) (4.29)	[>.10]	[>.10]	
France			
0.11 + 0.54 *ecpi* - 0.17*gbal* - 0.12*gdebt* + 0.20*rrlus*	-3.95	-18.16	0.9856
(11.43)(15.80) (0.67) (13.27) (1.87)	[>.10]	[>.10]	
0.12 + 0.56 *ecpi* - 0.39*gbal* - 0.13*gdebt* - 0.10*rrlgy*	-4.15	-17.53	0.9837
(4.63) (7.47) (0.98) (6.69) (0.53)	[>.10]	[>.10]	
Germany			
0.08 + 0.52 *ecpi* - 0.39*gbal* - 0.08*gdebt* + 0.16*rrlus*	-3.82	-15.26	0.8697
(8.05) (3.95) (1.56) (6.21) (1.97)	[>.10]	[>.10]	
Ireland			
(1985Q1–2002Q4)	-2.25	-13.07	0.9271
0.12 - 0.83*ecpi* - 1.31*gbal* - 0.01*gdebt* - 0.89*rrlus*	[>.10]	[>.10]	
(3.40) (2.53) (3.74) (0.30) (2.36)			
0.05 - 0.05*ecpi* - 0.62*gbal* + 0.04*gdebt* - 0.33*rrlgy*	-2.92	-13.05	0.9651
(2.71) (0.17) (3.27) (2.27) (3.19)	[>.10]	[>.10]	
Italy			
-0.11 + 0.79*ecpi* - 0.58*gbal* + 0.10*gdebt* + 0.30*rrlus*	-2.42	-14.20	0.9459
(1.58) (7.08) (1.91) (2.15) (1.13)	[>.10]	[>.10]	
-0.34 + 1.34*ecpi* - 0.66*gbal* + 0.25*gdebt* + 1.05*rrlgy*	-1.83	-13.48	0.9518
(7.36) (10.98) (3.70) (8.59) (3.30)	[>.10]	[>.10]	

(continued)

Table 5: Cointegration Tests for the Individual Country Equations

Estimates of the long-run parameters Sample: 1980Q1–2002Q4, 92 observations	**Cointegration tests[a]**		**RBAR^2**
$(\alpha S_t)^b$	*ADF:* $\hat{\tau}_\mu$	*PP:* $Z(\hat{\alpha})$	
The Netherlands			
0.05 + 0.64*ecpi* - 0.79*gbal* - 0.02*gdebt* - 0.19*rrlus*	-2.65	-16.46	0.8992
(3.09) (5.04) (5.12) (1.17) (1.47)	[>.10]	[>.10]	
-0.06 + 1.36*ecpi* - 0.08*gbal* + 0.09*gdebt* + 0.92*rrlgy*	-2.84	-16.04	0.9453
(3.31) (8.86) (0.49) (4.61) (5.47)	[>.10]	[>.10]	
Portugal			
-0.27 + 1.54*ecpi* - 0.80*gbal* + 0.51*gdebt* - 1.28*rrlus*	-2.80	-14.97	0.9657
(8.61)(12.58) (2.03) (6.53) (3.56)	[>.10]	[>.10]	
-0.27 + 0.99*ecpi* - 1.45*gbal* + 0.35*gdebt* + 1.10*rrlgy*	-2.67	-18.17	0.9741
(8.70) (14.92) (8.12) (7.25) (4.13)	[>.10]	[>.10]	
Spain			
0.25 - 0.15*ecpi* - 0.17*gbal* - 0.27*gdebt* + 0.34*rrlus*	-2.46	-10.77	0.9462
(6.76) (0.97) (0.82) (6.97) (3.03)	[>.10]	[>.10]	
0.05 + 0.28*ecpi* - 0.25*gbal* - 0.07*gdebt* + 1.52*rrlgy*	-2.97	-11.93	0.9651
(1.60) (2.36) (1.84) (2.11) (7.44)	[>.10]	[>.10]	
Denmark			
-0.07 + 1.58*ecpi* - 0.12*gbal* + 0.17*gdebt* - 0.33*rrlus*	-3.08	-26.63	0.9797
(5.35)(18.72) (1.13) (6.78) (1.40)	[>.10]	[>.10]	
-0.03 + 1.28*ecpi* - 0.32*gbal* + 0.09*gdebt* + 0.40*rrlgy*	-3.04	-21.72	0.9755
(2.29)(11.32) (2.30) (3.48) (1.54)	[>.10]	[>.10]	
Sweden			
0.07 + 0.85*ecpi* - 0.31*gbal* - 0.04*gdebt* + 0.12*rrlus*	-2.80	-8.93	0.8858
(1.17) (3.42) (2.83) (0.47) (0.49)	[>.10]	[>.10]	
-0.01 + 0.84*ecpi* - 0.52*gbal* + 0.02*gdebt* + 1.11*rrlgy*	-2.20	-9.32	0.9497
(0.48) (10.07) (7.07) (0.59) (6.50)	[>.10]	[>.10]	
United Kingdom			
-0.04 + 0.84*ecpi* - 0.66*gbal* + 0.10*gdebt* + 0.43*rrlus*	-2.46	-9.54	0.9658
(2.05) (33.66) (10.22) (2.78) (9.28)	[>.10]	[>.10]	
-0.07 + 0.70*ecpi* - 0.46*gbal* + 0.13*gdebt* + 1.04*rrlgy*	-4.52	-15.50	0.9625
(3.81)(23.90) (8.33) (3.95) (10.10)	[.10]	[>.10]	

a. The ADF and PP statistics test the null hypothesis of *non-cointegration* (i.e., H_0: $RL_t - \alpha S_t$ is I(1)) against the alternative hypothesis of *cointegration* (i.e., H_1: $RL_t - \alpha S_t$ is I(0)). Probability values for the ADF *t*-statistics (reported in square brackets) are obtained from the critical values reported by MacKinnon (1991, Table 1), while those for the PP normalized bias statistics are obtained from the critical values reported by Haug (1992, Table 2).

b. The estimates of the long-run parameters reported above are obtained using the Stock-Watson procedure.

Table 6: Panel Estimation of Government Bond Yields

	Estimates of the long-run parameters, sample: 1980Q1–2002Q4 $\alpha_1 ecpi_t + \alpha_2 gbal_t + \alpha_3 gdebt_t + \alpha_4 rrlw_t$	RBAR^2
Euro-zone Countries	**U.S. yield as the "world" yield (9 countries, 828 observations)**	
	0.04 + 0.81*ecpi* - 0.21*gbal* - 0.01*gdebt* + 0.23*rrlus* (18.54) (52.24) (10.26) (3.54) (7.09)	0.8584
	0.04 + 0.83*ecpi* - 0.17*gbal* + 0.23*rrlus* (23.98) (61.87) (10.02) (7.25)	0.8565
	German yield as the "world" yield (8 countries, 736 observations)	
	0.02 + 0.81*ecpi* - 0.21*gbal* - 0.01*gdebt* + 0.70*rrlgy* (6.83) (52.73) (10.66) (2.90) (13.74)	0.8808
	0.02 + 0.83*ecpi* - 0.18*gbal* + 0.72*rrlgy* (6.49) (64.09) (11.04) (14.08)	0.8796
EU3 Countries	**U.S. yield as the "world" yield (3 countries, 276 observations)**	
	0.01 + 0.85*ecpi* - 0.11*gbal* + 0.04*gdebt* + 0.36*rrlus* (1.80) (22.16) (3.09) (3.01) (5.80)	0.7301
	German yield as the "world" yield (3 countries, 276 observations)	
	-0.01 + 0.76*ecpi* - 0.23*gbal* + 0.05*gdebt* + 0.82*rrlgy* (1.50) (20.07) (6.32) (4.70) (8.24)	0.7574
OECD4 Countries	**U.S. yield as the "world" yield (4 countries, 368 observations)**	
	0.03 + 0.91*ecpi* - 0.05*gbal* + 0.01*gdebt* + 0.33*rrlus* (6.97) (26.18) (1.97) (1.25) (6.34)	0.7009
	German yield as the "world" yield (4 countries, 368 observations)	
	0.02 + 0.87*ecpi* - 0.06*gbal* + 0.01*gdebt* + 0.49*rrlgy* (4.51) (24.65) (2.72) (1.01) (5.83)	0.6963
OECD5 Countries = OECD4 + Japan	**U.S. yield as the "world" yield (5 countries, 460 observations)**	
	0.03 + 0.91*ecpi* - 0.05*gbal* - 0.01*gdebt* + 0.33*rrlus* (9.66) (28.21) (2.15) (2.93) (7.55)	0.7391
	German yield as the "world" yield (5 countries, 460 observations)	
	0.03 + 0.88*ecpi* - 0.07*gbal* - 0.01*gdebt* + 0.48*rrlgy* (7.04) (26.46) (3.12) (3.47) (6.60)	0.7321

Table 7: Panel Error-Correction Models[a]

	Step 1: Estimates of long-run relationship using panel data $\alpha_1 ecpi_t + \alpha_2 gbal_t + \alpha_3 gdebt_t + \alpha_4 rrlw_t$	RBAR^2	Step 2: Estimate error-correction model $C(L)\Delta rl_t = D(L)\Delta S_t + E(L)Z_t + \gamma[rl_{t-1} - \alpha S_{t-1}]$ Error-correction term (γ)[b]
Euro-zone Countries	**Euro-zone countries**		
	Sample: 1980Q1–2002Q4, 9 countries, 828 observations		
	0.04 + 0.81*ecpi* - 0.21*gbal* - 0.01*gdebt* + 0.23*rrlus* (18.54) (52.24) (10.26) (3.54) (7.09)	0.8584	-0.0606 (5.02)
	0.04 + 0.83*ecpi* - 0.17*gbal* + 0.23*rrlus* (23.98) (61.87) (10.02) (7.25)	0.8565	-0.0596 (5.00)
	0.02 + 0.81*ecpi* - 0.21*gbal* - 0.01*gdebt* + 0.70*rrlgy* (6.83) (52.73) (10.66) (2.90) (13.74)	0.8808	-0.0811 (6.04)
	0.02 + 0.83*ecpi* - 0.18*gbal* + 0.72*rrlgy* (6.49) (64.09) (11.04) (14.08)	0.8796	-0.0804 (6.09)
EU3 Countries	**Denmark, Sweden, and UK**		
	Sample: 1980Q1–2002Q4, 3 countries, 276 observations		
	0.01 + 0.85*ecpi* - 0.11*gbal* + 0.04*gdebt* + 0.36*rrlus* (1.80) (22.16) (3.09) (3.01) (5.80)	0.7301	-0.0416 (2.01)
	-0.01 + 0.76*ecpi* - 0.23*gbal* + 0.05*gdebt* + 0.82*rrlgy* (1.50) (20.07) (6.32) (4.70) (8.24)	0.7574	-0.0585 (2.82)
OECD4 Countries	**Australia, Canada, Norway, and Switzerland**		
	Sample: 1980Q1–2002Q4, 4 countries, 368 observations		
	0.03 + 0.91*ecpi* - 0.05*gbal* + 0.01*gdebt* + 0.33*rrlus* (6.97) (26.18) (1.97) (1.25) (6.34)	0.7009	-0.0371 (2.48)
	0.02 + 0.87*ecpi* - 0.06*gbal* + 0.01*gdebt* + 0.49*rrlgy* (4.51) (24.65) (2.72) (1.01) (5.83)	0.6963	-0.0483 (3.10)
OECD5 Countries	**Australia, Canada, Japan, Norway, and Switzerland**		
	Sample: 1980Q1–2002Q4, 5 countries, 460 observations		
	0.03 + 0.91*ecpi* - 0.05*gbal* - 0.01*gdebt* + 0.33*rrlus* (9.66) (28.21) (2.15) (2.93) (7.55)	0.7391	-0.0451 (3.29)
	0.03 + 0.88*ecpi* - 0.07*gbal* - 0.01*gdebt* + 0.48*rrlgy* (7.04) (26.46) (3.12) (3.47) (6.60)	0.7321	-0.0532 (3.81)

a. When the German government yield is used as a measure of the world interest rate, Germany is excluded from the dataset as an endogenous variable.

b. Error-correction terms are represented by the parameter γ. Critical values for $\hat{\tau}_\gamma$ are from Banerjee, Dolado, and Mestre (1993).

Table 8: Panel Error-Correction Models Using Alternative Expected Inflation[a]

	Step 1: Estimates of long-run relationship using panel data $\alpha_1 ecpihp_t + \alpha_2 gbal_t + \alpha_3 gdebt_t + \alpha_4 rrlwhp_t$	RBAR^2	Step 2: Estimate error-correction model $C(L)\Delta rl_t = D(L)\Delta S_t + E(L)Z_t + \gamma[rl_{t-1} - \alpha S_{t-1}]$ Error-correction term (γ)[b]
Euro-zone Countries	**Euro-zone countries**		
	Sample: 1980Q1–2002Q4, 9 countries, 819 observations		
	0.03 + 0.83*ecpihp* - 0.21*gbal* - 0.01*gdebt* + 0.47*rrlushp* (10.60)(46.25) (9.31) (2.15) (9.99)	0.8410	-0.0757 (6.81)
	0.03 + 0.85*ecpihp* - 0.18*gbal* + 0.49*rrlushp* (13.27)(53.45) (10.10) (10.56)	0.8403	-0.0755 (6.83)
	-0.00 + 0.80*ecpihp* - 0.19*gbal* - 0.00*gdebt* + 1.24*rrlgyhp* (0.54) (43.23) (8.32) (1.20) (13.80)	0.8551	-0.0741 (6.14)
	-0.01 + 0.81*ecpihp* - 0.17*gbal* + 1.26*rrlgyhp* (1.62) (50.41) (9.59) (14.44)	0.8550	-0.0745 (6.21)
EU3 Countries	**Denmark, Sweden, and UK**		
	Sample: 1980Q1–2002Q4, 3 countries, 273 observations		
	-0.00 + 1.04*ecpihp* - 0.11*gbal* + 0.05*gdebt* + 0.40*rrlushp* (0.43) (22.44) (3.62) (4.82) (5.22)	0.7974	-0.0814 (3.90)
	-0.04 + 0.92*ecpihp* - 0.15*gbal* + 0.05*gdebt* + 1.25*rrlgyhp* (5.08)(20.85) (5.67) (5.90) (9.92)	0.8364	-0.0960 (4.49)
OECD4 Countries	**Australia, Canada, Norway, and Switzerland**		
	Sample: 1980Q1–2002Q4, 4 countries, 368 observations		
	0.02 + 1.08*ecpihp* - 0.05*gbal* + 0.01*gdebt* + 0.29*rrlushp* (5.39)(27.00) (2.55) (2.23) (4.34)	0.7518	-0.0682 (4.30)
	0.01 + 1.04*ecpihp* - 0.05*gbal* + 0.01*gdebt* + 0.65*rrlgyhp* (1.07) (25.22) (2.42) (2.37) (5.27)	0.7575	-0.0695 (4.34)
OECD5 Countries	**Australia, Canada, Japan, Norway, and Switzerland**		
	Sample: 1980Q1–2002Q4, 5 countries, 460 observations		
	0.03 + 1.1*ecpihp* - 0.05*gbal* - 0.00*gdebt* + 0.31*rrlushp* (7.36)(30.15) (2.57) (1.10) (5.68)	0.7881	-0.0705 (4.80)
	0.01 + 1.1*ecpihp* - 0.05*gbal* - 0.00*gdebt* + 0.66*rrlgyhp* (2.28)(28.54) (2.69) (1.15) (6.55)	0.7926	-0.0689 (4.72)

a. When the German government yield is used as a measure of the world interest rate, Germany is excluded from the dataset as an endogenous variable.

b. Error-correction terms are represented by the parameter γ. Critical values for $\hat{\tau}_\gamma$ are from Banerjee, Dolado, and Mestre (1993).

Table 9: Panel Estimation of Government Bond Yields Including Ireland

Estimates of the long-run parameters, sample: 1985Q1–2002Q4 $\alpha_1 ecpi_t + \alpha_2 gbal_t + \alpha_3 gdebt_t + \alpha_4 rrlw_t$	RBAR^2
Euro zone excluding Ireland, 9 countries, 648 observations[a]	
0.03 + 1.01*ecpi* - 0.18*gbal* - 0.01*gdebt* + 0.31*rrlus* (11.42) (42.57) (7.70) (3.21) (5.64)	0.8271
0.02 + 1.00*ecpi* - 0.19*gbal* - 0.01*gdebt* + 0.63*rrlgy* (6.34) (43.75) (8.63) (2.92) (12.32)	0.8620
Euro zone including Ireland, 10 countries, 720 observations[b]	
0.03 + 1.00*ecpi* - 0.17*gbal* - 0.00*gdebt* + 0.39*rrlus* (9.90) (41.81) (7.55) (1.23) (7.25)	0.8100
0.02 + 0.99*ecpi* - 0.18*gbal* - 0.00*gdebt* + 0.66*rrlgy* (5.25) (42.86) (8.70) (1.19) (13.66)	0.8463

a. When the German government yield is used as a measure of the world interest rate, Germany is excluded from the sample, leaving data for eight countries and 576 observations.
b. When the German government yield is used as a measure of the world interest rate, Germany is excluded from the sample, leaving data for nine countries and 648 observations.

Table 10: Fixed-Effect Panel Estimation of Government Bond Yields

	Estimates of the long-run parameters, sample: 1980Q1–2002Q4 $\alpha_1 ecpi_t + \alpha_2 gbal_t + \alpha_3 gdebt_t + \alpha_4 rrlw_t$	RBAR^2
Euro-zone Countries	**U.S. yield as the “world” yield (9 countries, 828 observations)**	
	0.04 + 0.78*ecpi* - 0.27*gbal* - 0.00*gdebt* + 0.22*rrlus* (8.60) (38.26) (12.13) (0.10) (7.02)	0.8126
	Fixed-country effects: AT: -0.005, BG: -0.005, FN: 0.013, FR: 0.002, GY: -0.003, IT: -0.010, NT: -0.004, PT: 0.011, SP: 0.000	
	German yield as the “world” yield (8 countries, 736 observations)	
	-0.005 + 0.84*ecpi* - 0.28*gbal* + 0.02*gdebt* + 0.75*rrlgy* (1.00) (44.06) (13.75) (4.37) (15.67)	0.8576
	Fixed-country effects: AT: -0.001, BG: -0.015, FN: 0.021, FR: 0.007, IT: -0.021, NT: -0.002, PT: 0.010, SP: 0.002	

Figure 1
10-Year Government Bond Yield
(1977Q1-2003Q4)

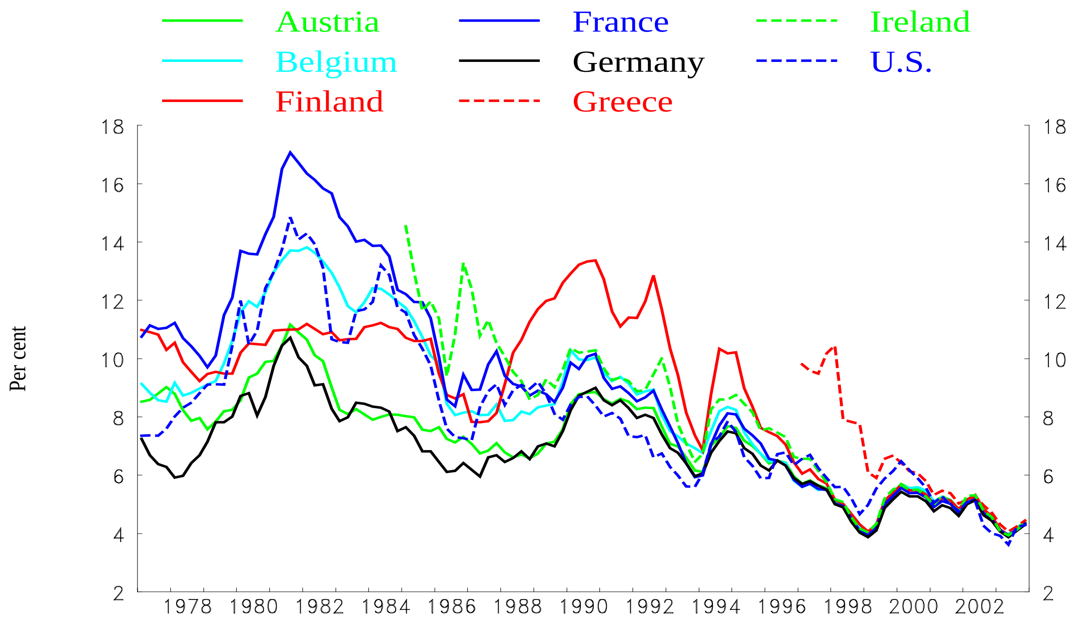


Figure 2
10-Year Government Bond Yield
(1977Q1-2003Q4)

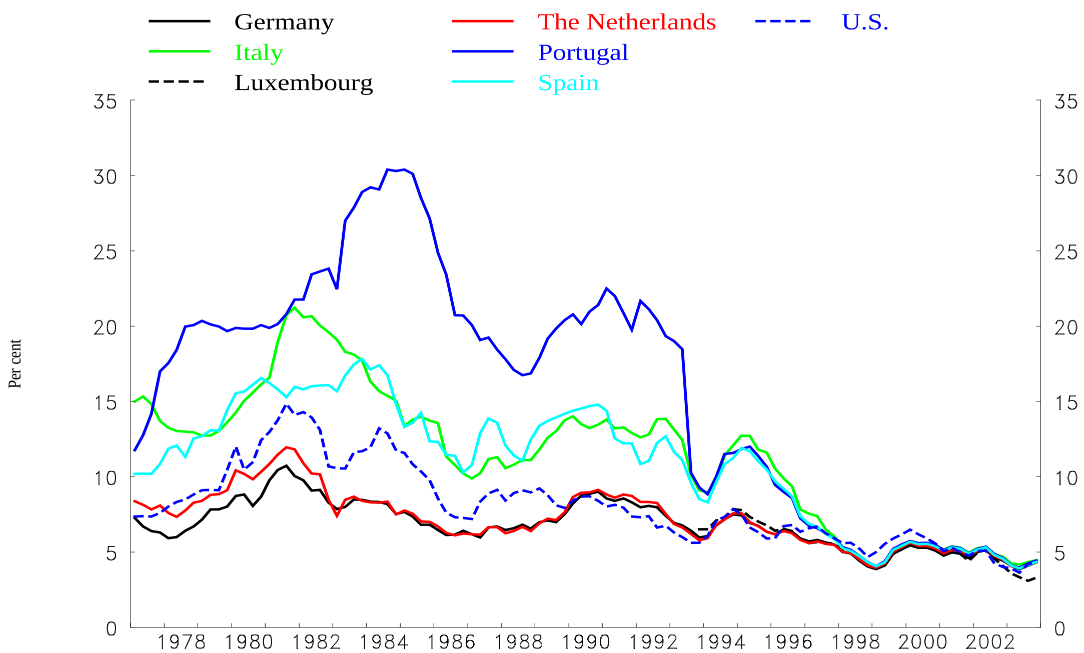
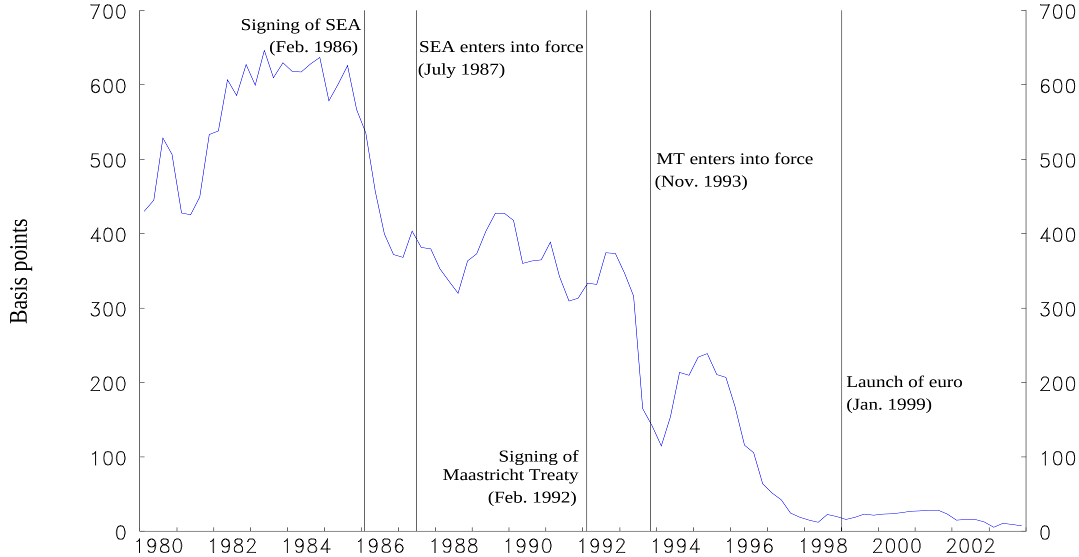


Figure 3
Average Spread of Long-Term Government Bond Yields from the German Yield*
(1980Q1-2003Q4)



* Includes Austria, Belgium, Finland, France, Italy, the Netherlands, Portugal, and Spain.

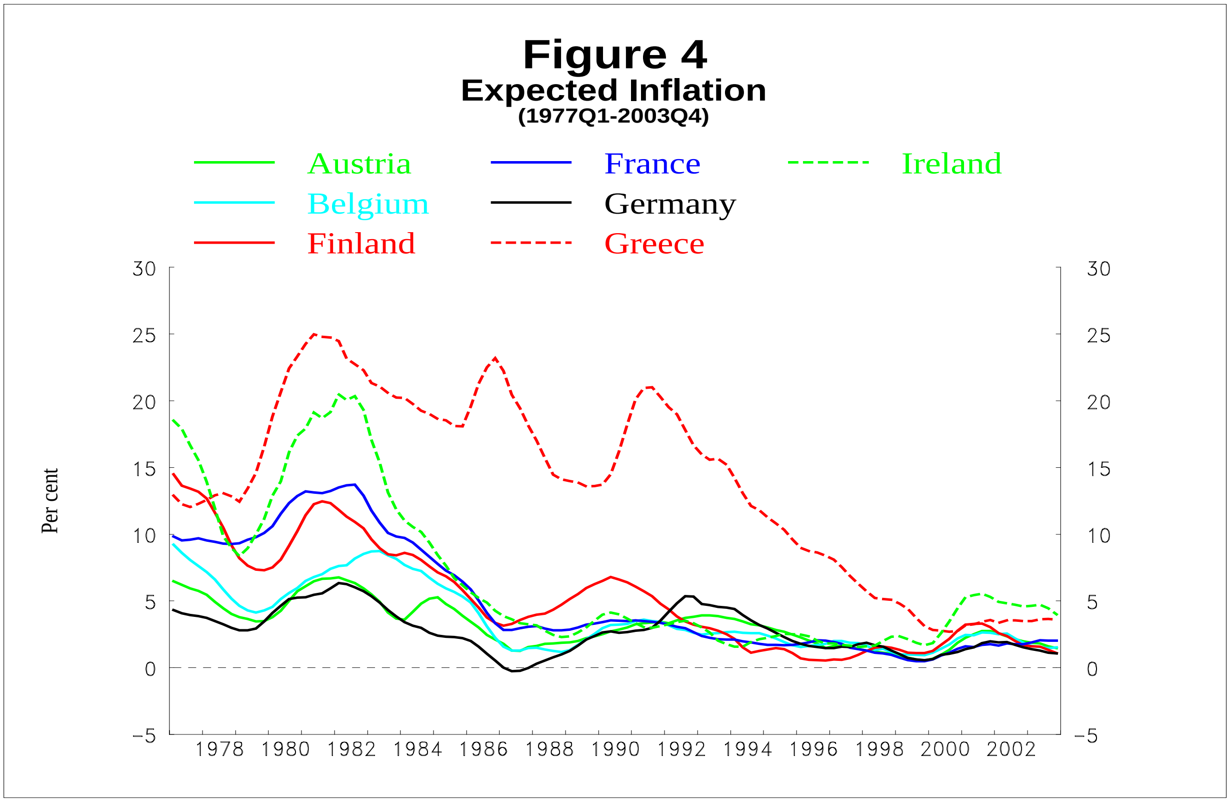


Figure 4
Expected Inflation
(1977Q1-2003Q4)
Austria
Belgium
Finland
France
Germany
Greece
Ireland
Per cent
30
25
20
15
10
5
0
−5
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002

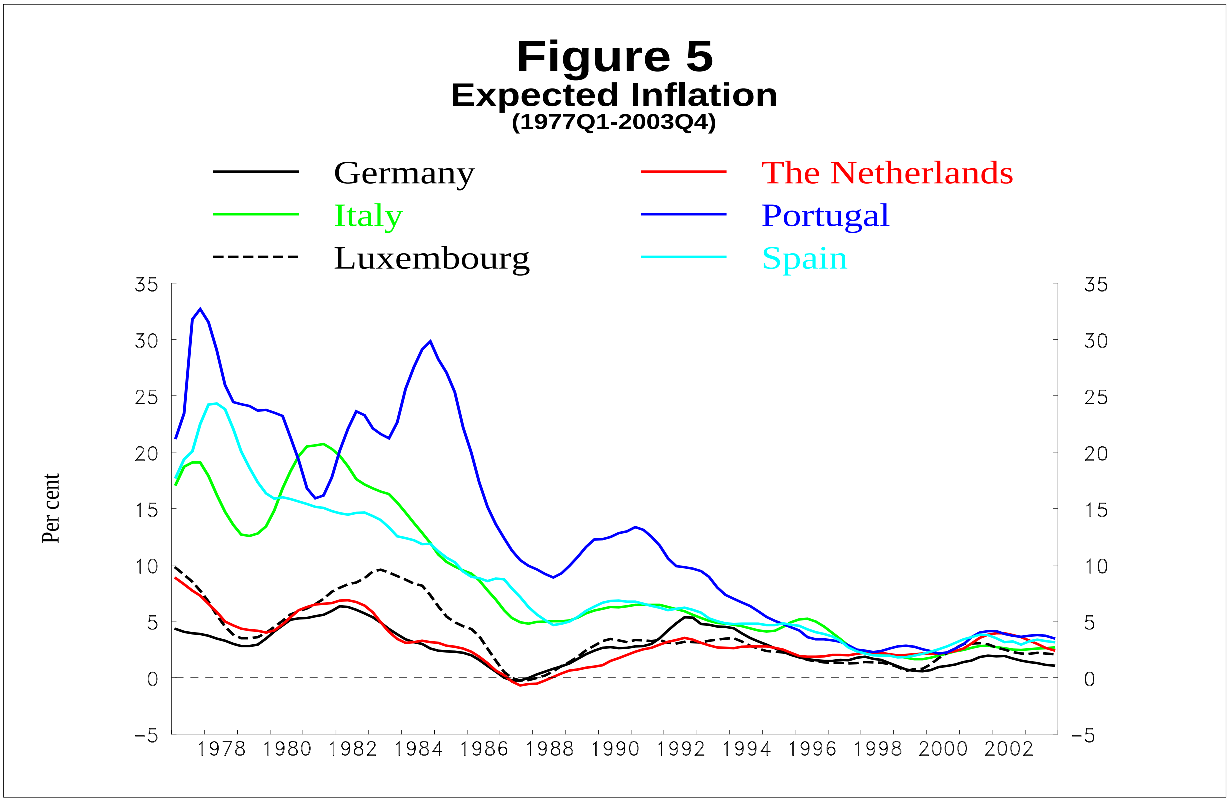


Figure 5
Expected Inflation
(1977Q1-2003Q4)
Germany
Italy
Luxembourg
The Netherlands
Portugal
Spain
Per cent
35
30
25
20
15
10
5
0
−5
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002

Figure 6

General Government Balance as a Ratio of Nominal GDP

(1977Q1-2003Q4; + surplus, - deficit)

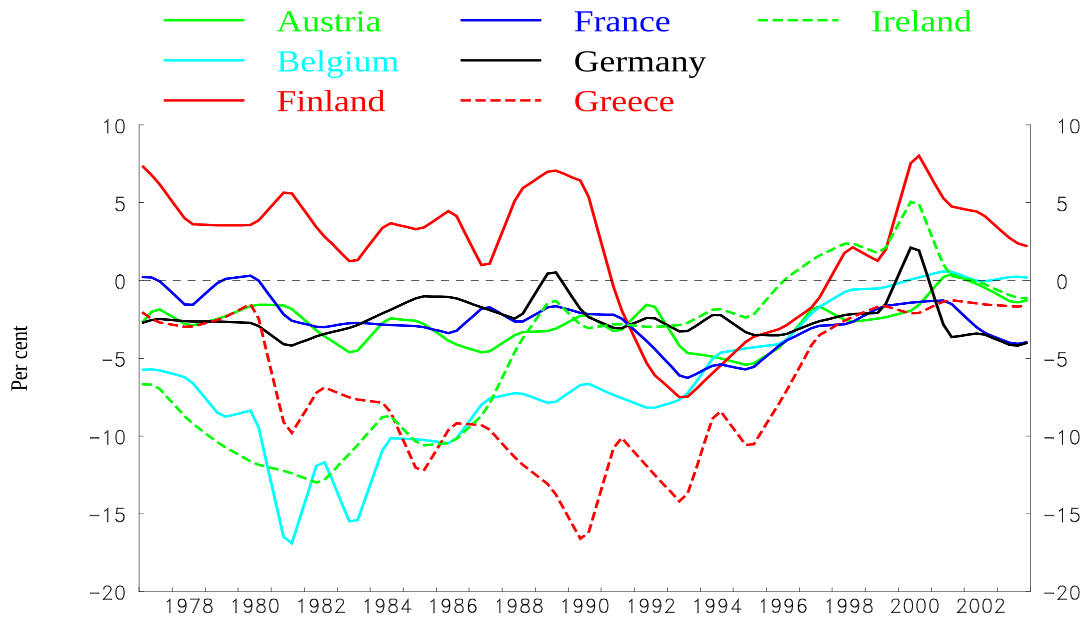
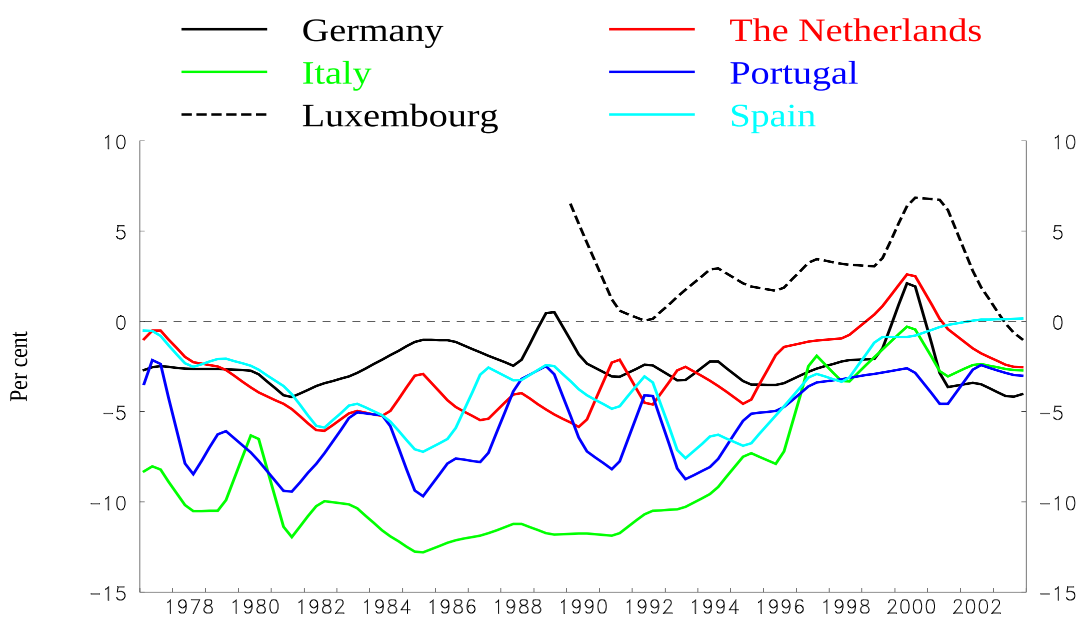


Figure 7

General Government Balance as a Ratio of Nominal GDP

(1977Q1-2003Q4; + surplus, - deficit)



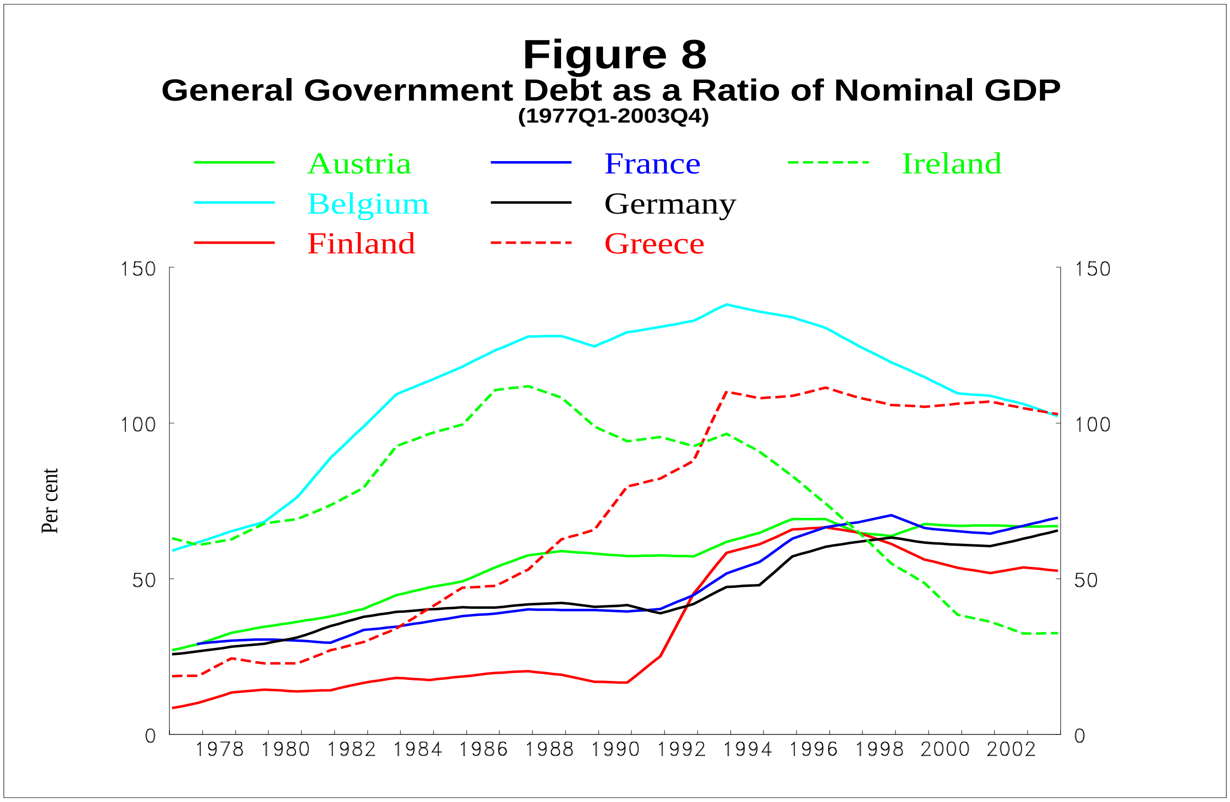


Figure 8
General Government Debt as a Ratio of Nominal GDP
(1977Q1-2003Q4)
Austria
France
Ireland
Belgium
Germany
Finland
Greece
Per cent
150
100
50
0
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002

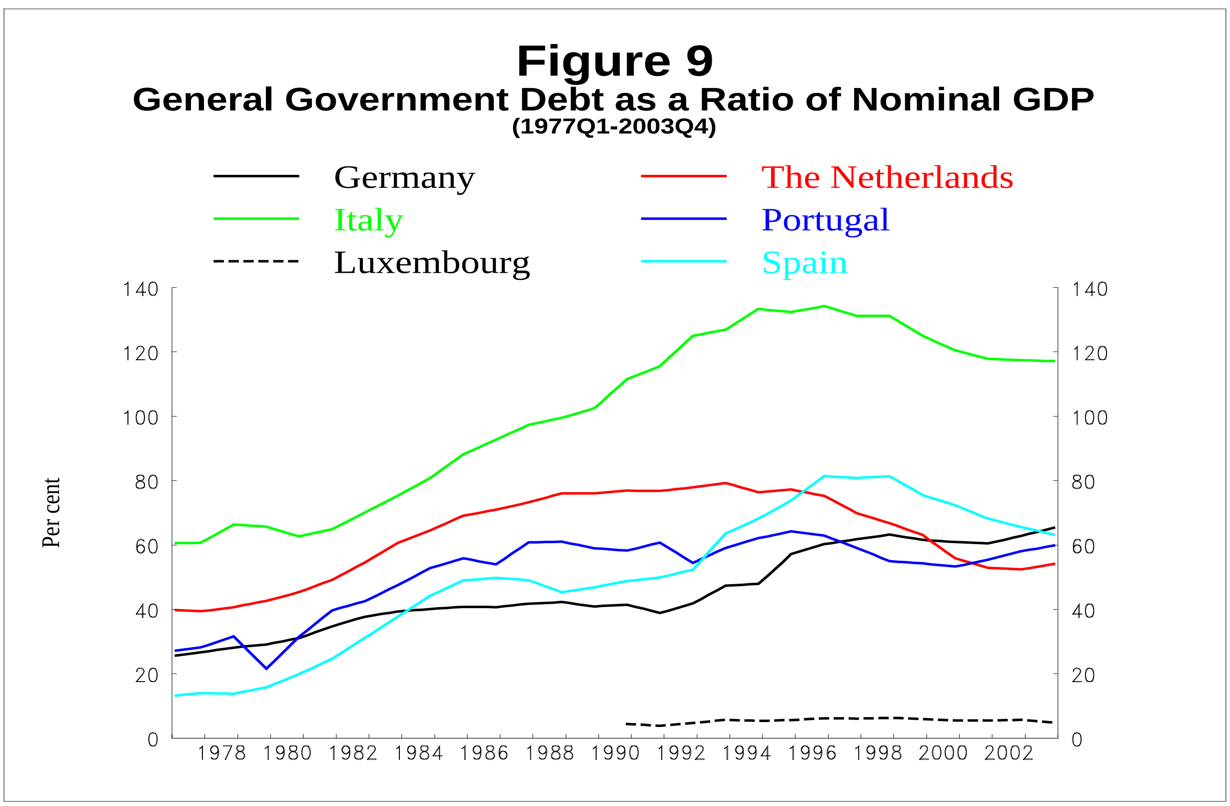


Figure 9
General Government Debt as a Ratio of Nominal GDP
(1977Q1-2003Q4)
Germany
The Netherlands
Italy
Portugal
Luxembourg
Spain
Per cent
140
120
100
80
60
40
20
0
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002

Figure 10
Error-correction terms
(1980Q1-2003Q4)

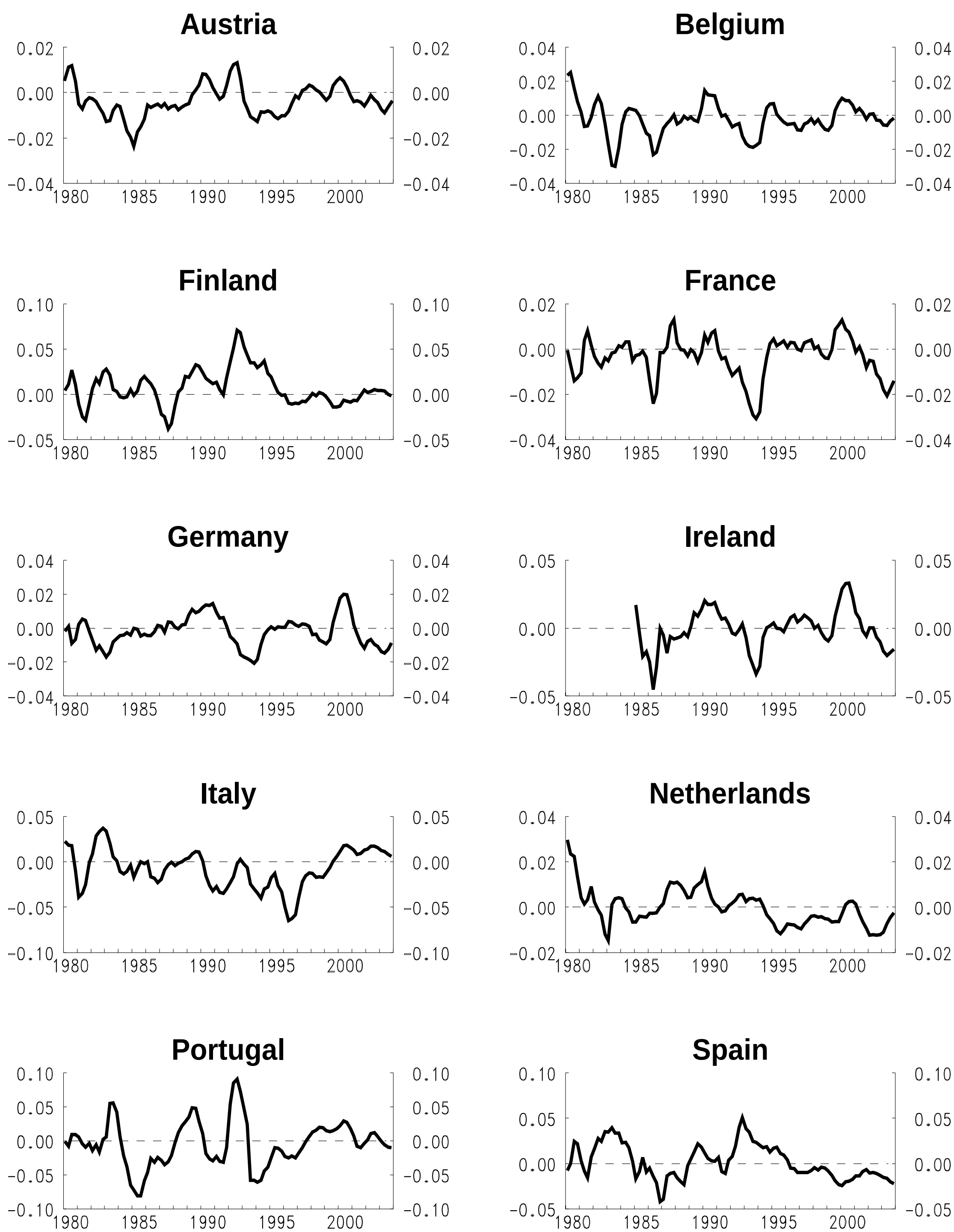


Figure 11
10-Year Government Bond Yield
(1977Q1-2003Q4)

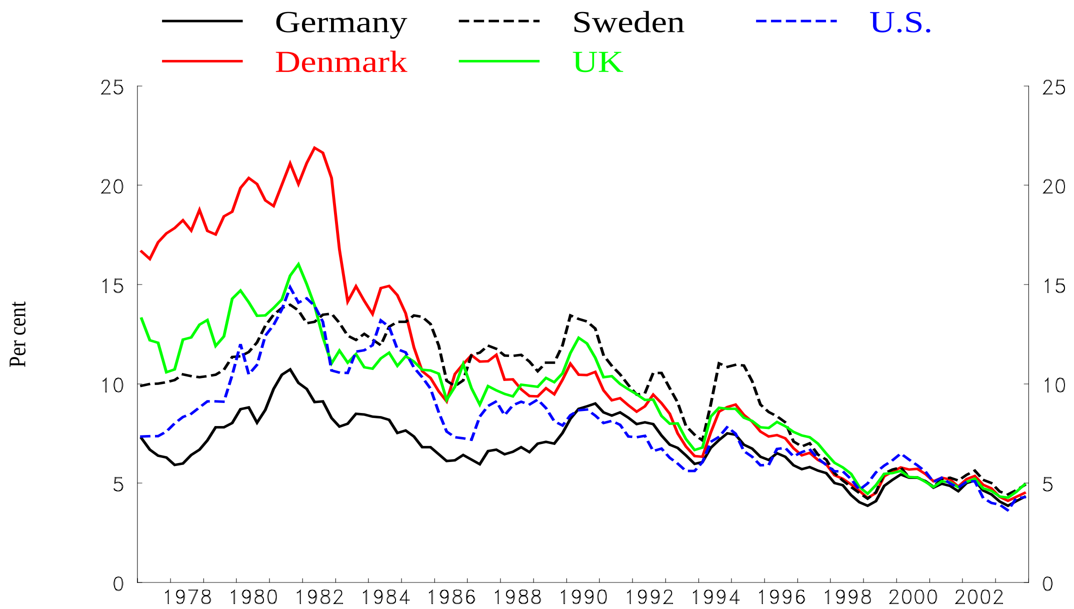
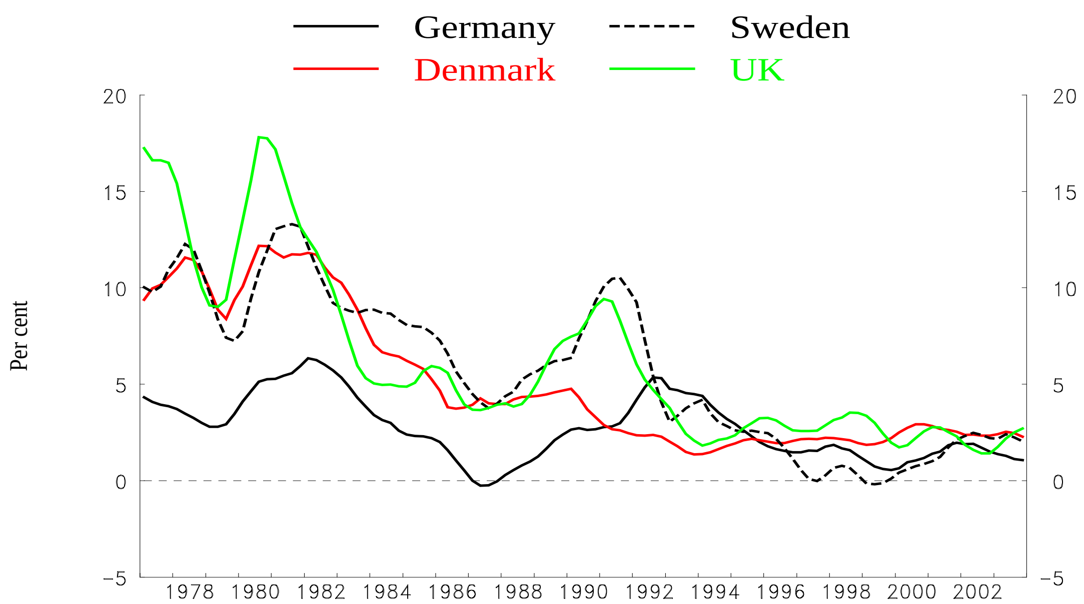


Figure 12
Expected Inflation
(1977Q1-2003Q4)



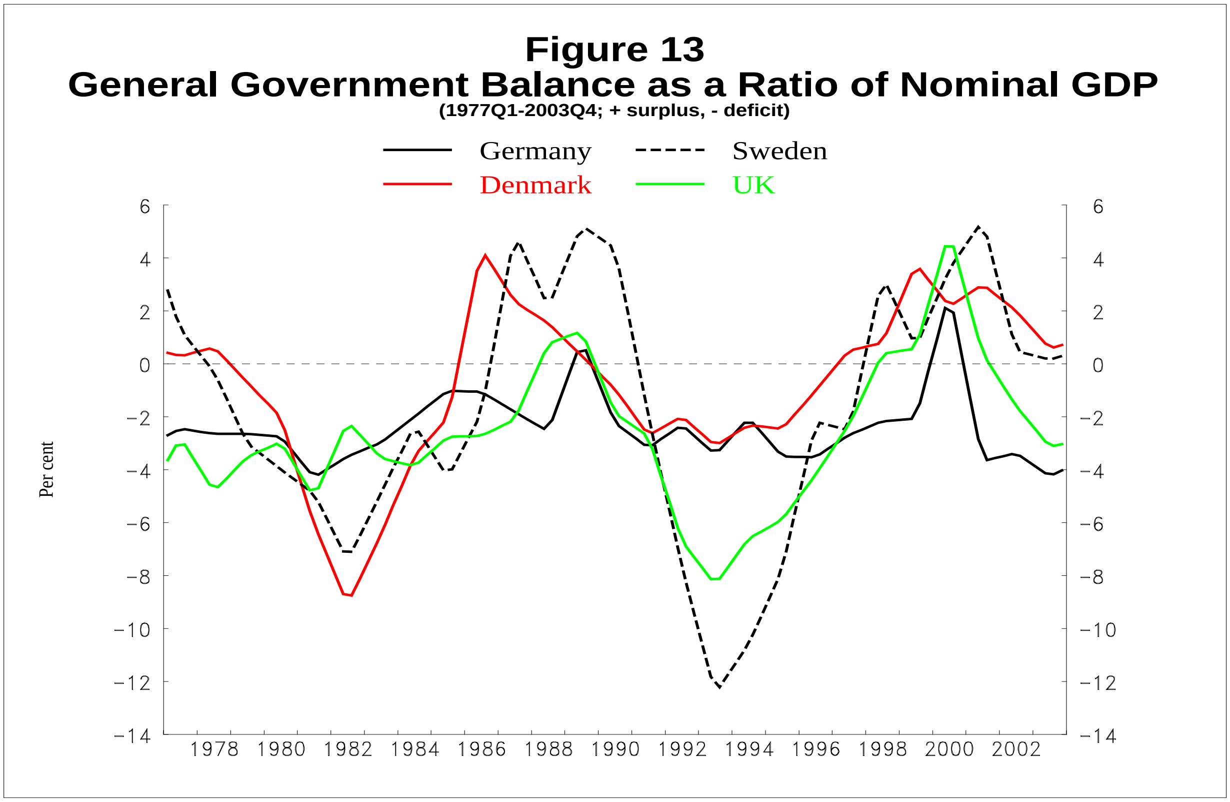


Figure 13
General Government Balance as a Ratio of Nominal GDP
(1977Q1-2003Q4; + surplus, - deficit)
Germany
Sweden
Denmark
UK
Per cent
6
4
2
0
−2
−4
−6
−8
−10
−12
−14
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002

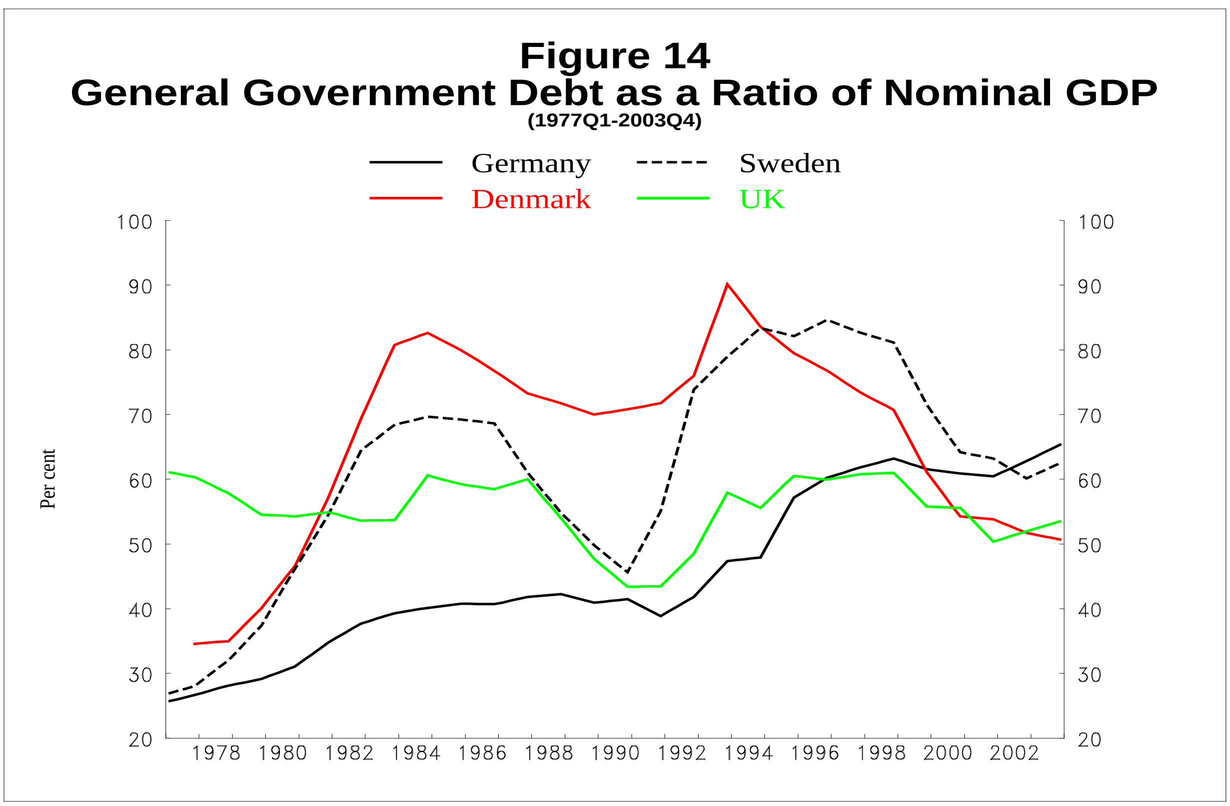


Figure 14
General Government Debt as a Ratio of Nominal GDP
(1977Q1-2003Q4)
Germany
Sweden
Denmark
UK
Per cent
100
90
80
70
60
50
40
30
20
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002

Figure 15
10-Year Government Bond Yield
(1977Q1-2003Q4)

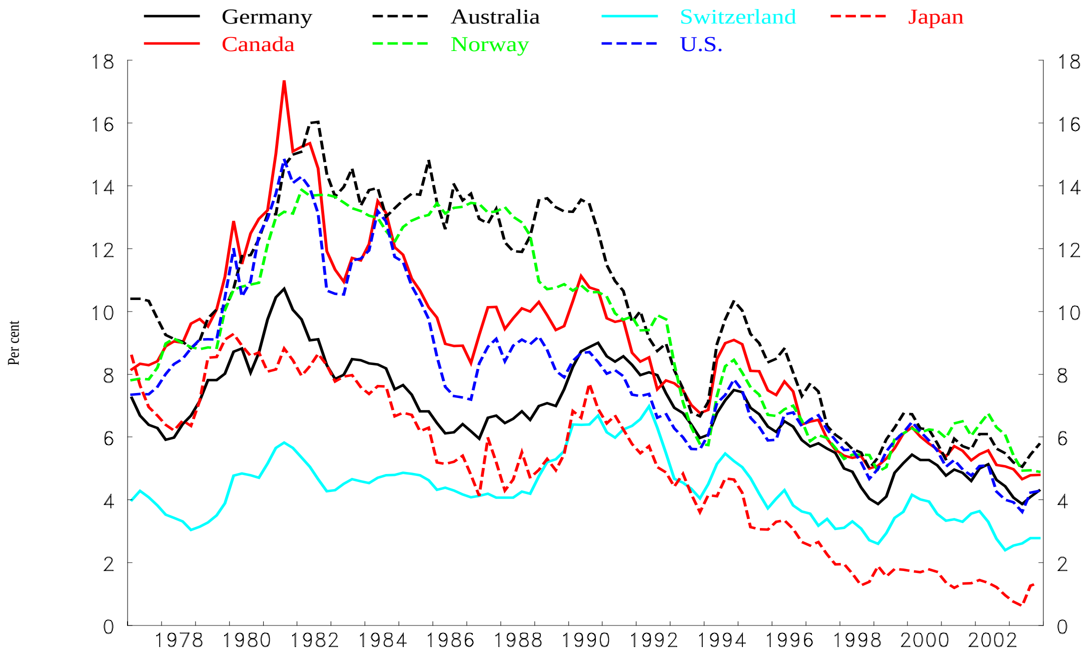
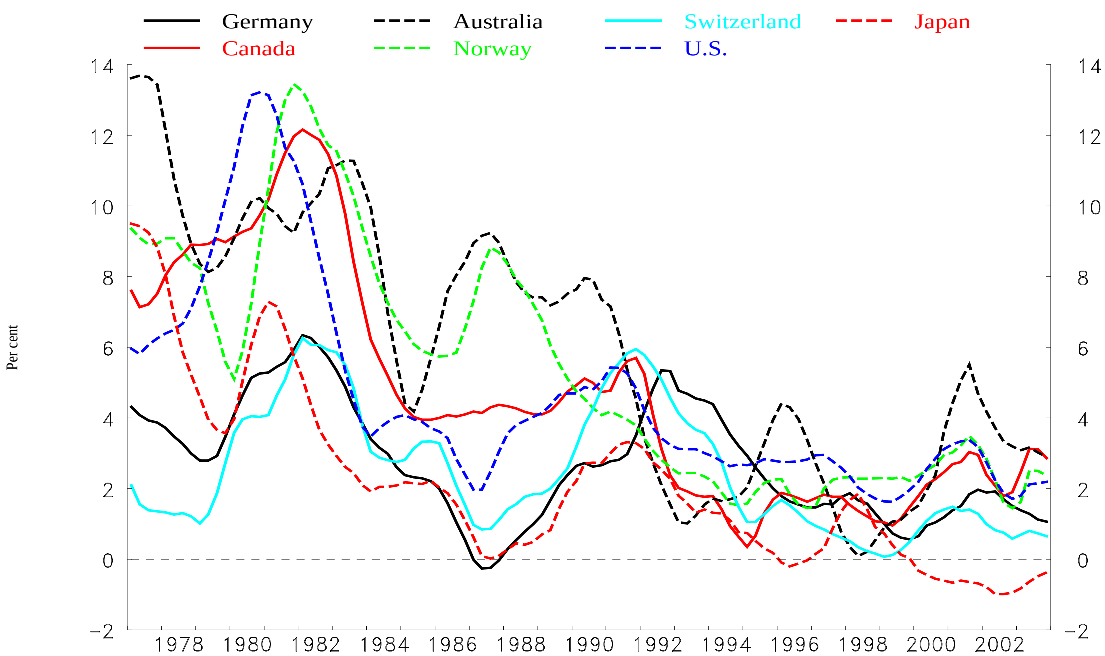


Figure 16
Expected Inflation
(1977Q1-2003Q4)



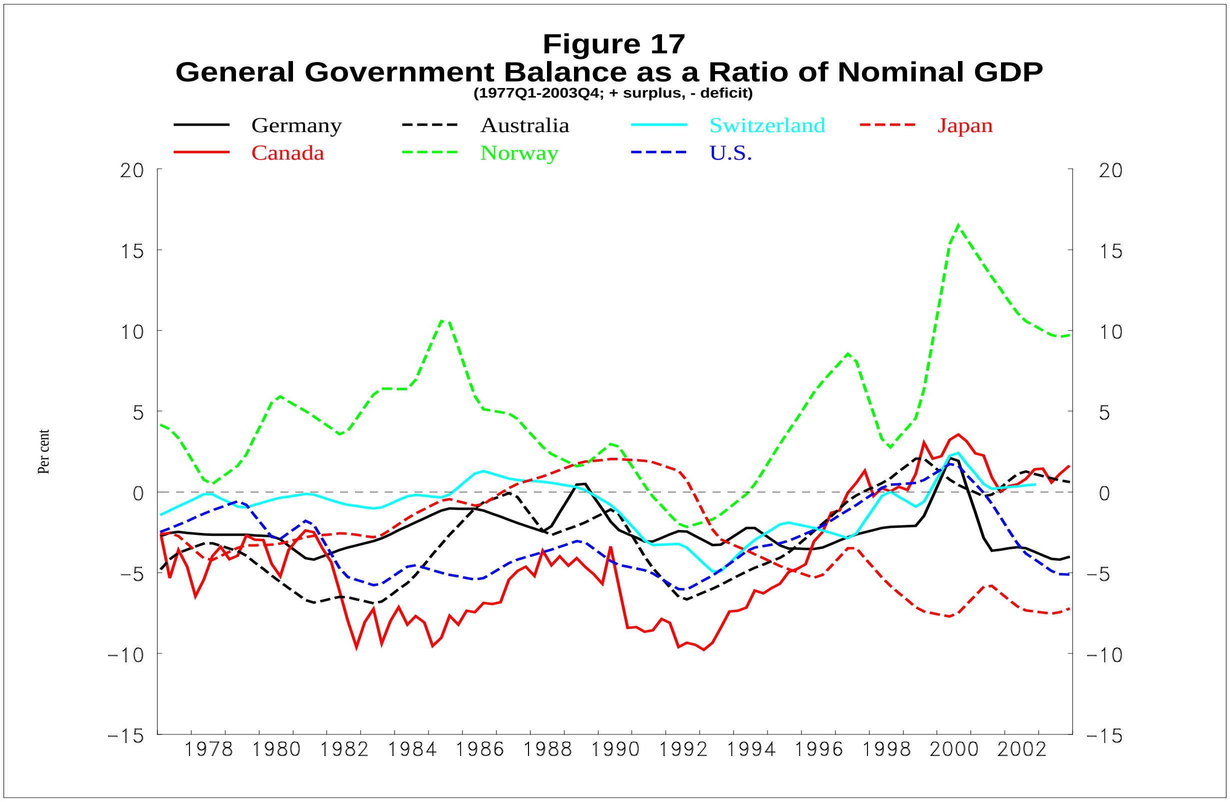


Figure 17
General Government Balance as a Ratio of Nominal GDP
(1977Q1-2003Q4; + surplus, - deficit)
Germany
Australia
Switzerland
Japan
Canada
Norway
U.S.
Per cent
20
15
10
5
0
−5
−10
−15
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002

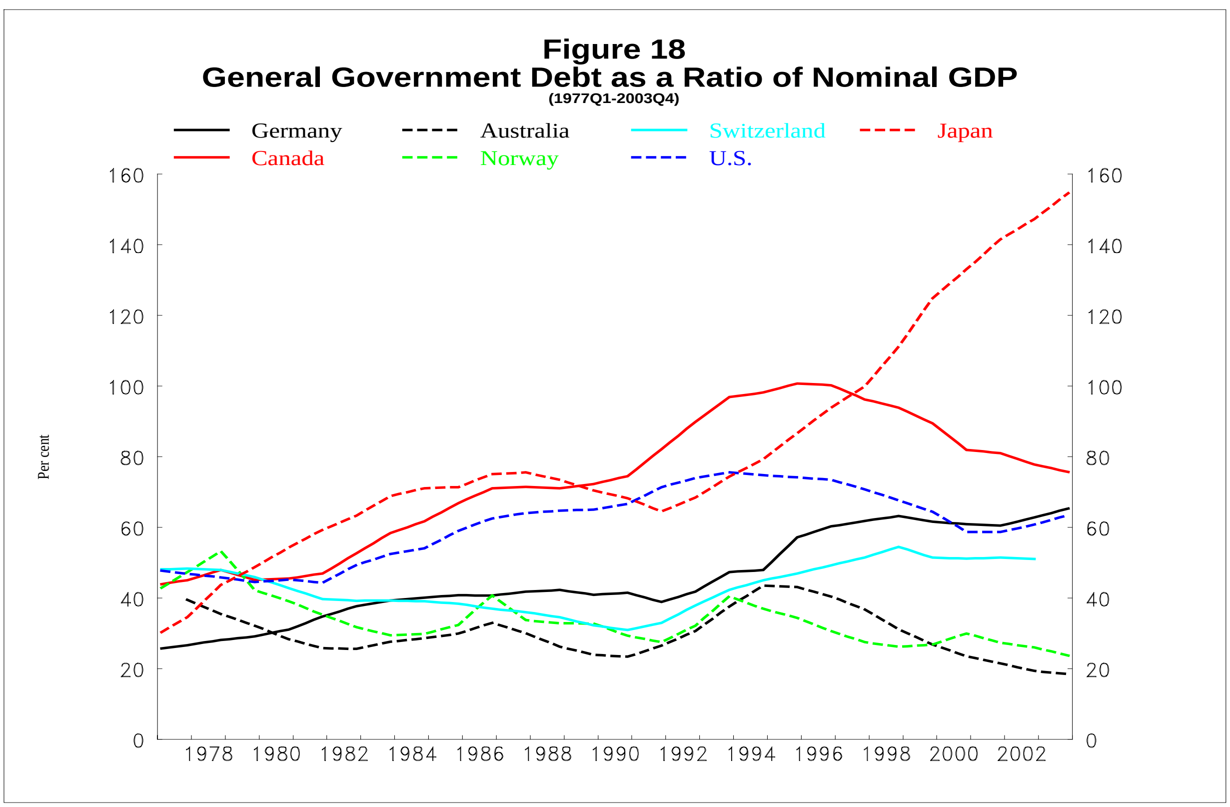
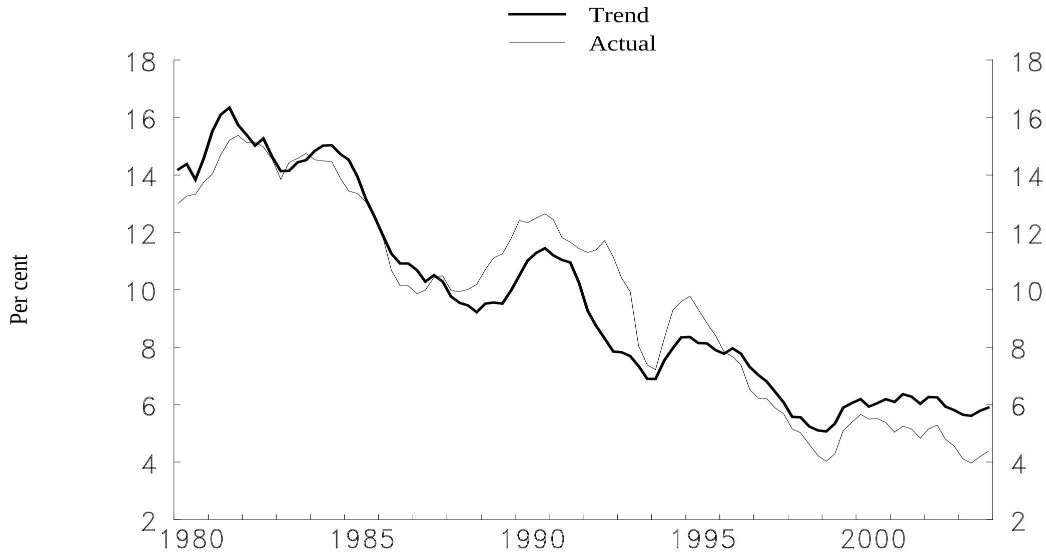


Figure 18
General Government Debt as a Ratio of Nominal GDP
(1977Q1-2003Q4)
Germany
Australia
Switzerland
Japan
Canada
Norway
U.S.
Per cent
160
140
120
100
80
60
40
20
0
1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002

Figure 19
Trend versus Actual Long-Term Bond Yield
(1980Q1-2003Q4; Euro zone)



* Includes Austria, Belgium, Finland, France, Italy, the Netherlands, Portugal, and Spain, and uses the real German yield as the world yield (see Table 7, row 4).

Figure 20
Corporate Bond Yields
(18 December 1995 - 26 November 2003; 10-Year Bonds Issued by the European Investment Bank)

Source: Bloomberg

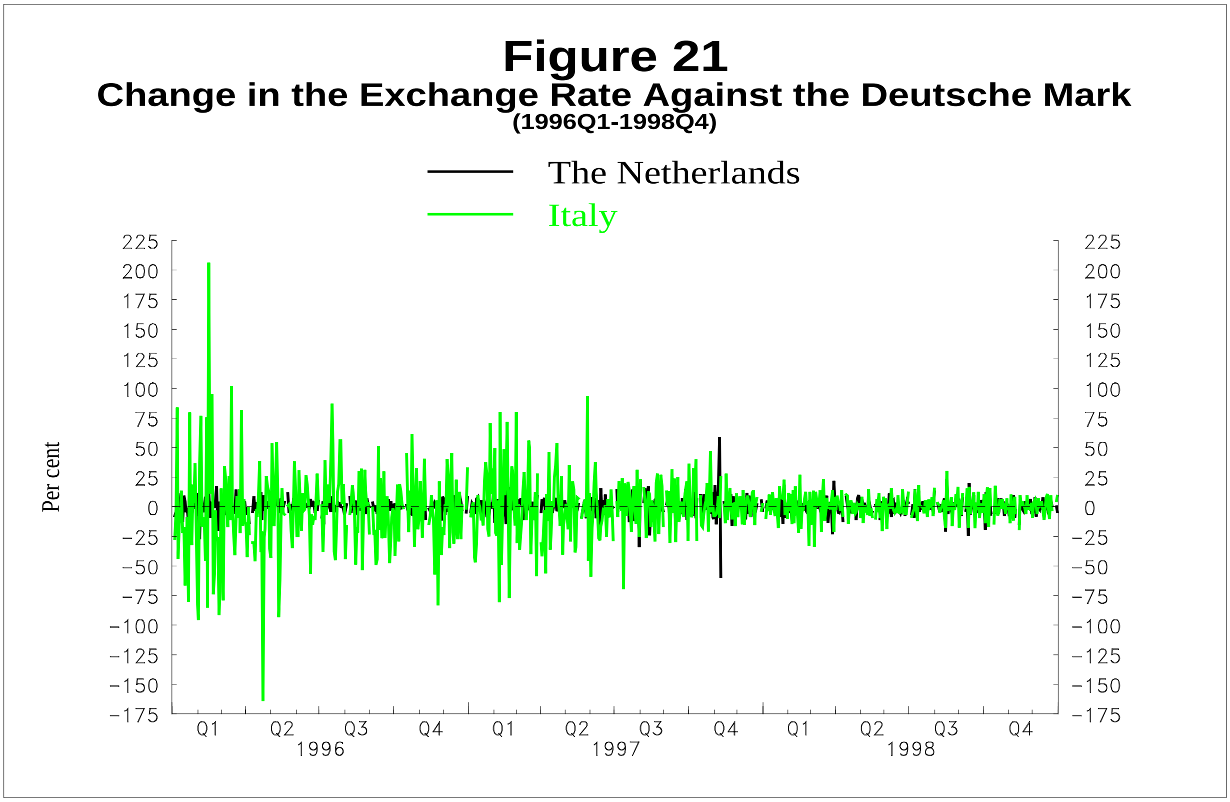


Figure 21
Change in the Exchange Rate Against the Deutsche Mark
(1996Q1-1998Q4)
The Netherlands
Italy
Per cent
225
200
175
150
125
100
75
50
25
0
−25
−50
−75
−100
−125
−150
−175
Q1
Q2
Q3
Q4
1996
1997
1998

Bank of Canada Working Papers
Documents de travail de la Banque du Canada

Working papers are generally published in the language of the author, with an abstract in both official languages. ***Les documents de travail sont publiés généralement dans la langue utilisée par les auteurs; ils sont cependant précédés d'un résumé bilingue*****.**

2004

2004-22	Financial Conditions Indexes for Canada	C. Gauthier, C. Graham, and Y. Liu
2004-21	Exchange Rate Pass-Through and the Inflation Environment in Industrialized Countries: An Empirical Investigation	J. Bailliu and E. Fujii
2004-20	Commodity-Linked Bonds: A Potential Means for Less-Developed Countries to Raise Foreign Capital	J. Atta-Mensah
2004-19	Translog ou Cobb-Douglas? Le rôle des durées d'utilisation des facteurs	E. Heyer, F. Pelgrin and A. Sylvain
2004-18	When Bad Things Happen to Good Banks: Contagious Bank Runs and Currency Crises	R. Solomon
2004-17	International Cross-Listing and the Bonding Hypothesis	M. King and D. Segal
2004-16	The Effect of Economic News on Bond Market Liquidity	C. D'Souza and C. Gaa
2004-15	The Bank of Canada's Business Outlook Survey: An Assessment	M. Martin and C. Papile
2004-14	National Saving–Investment Dynamics and International Capital Mobility	F. Pelgrin and S. Schich
2004-13	Contraintes de liquidité et capital humain dans une petite économie ouverte	F. Pelgrin
2004-12	Durées d'utilisation des facteurs et fonction de production : une estimation par la méthode des moments généralisés en système	E. Heyer, F. Pelgrin, and A. Sylvain
2004-11	Estimating New Keynesian Phillips Curves Using Exact Methods	L. Khalaf and M. Kichian
2004-10	Public Venture Capital and Entrepreneurship	O. Secrieru and M. Vigneault
2004-9	Estimating Policy-Neutral Interest Rates for Canada Using a Dynamic Stochastic General-Equilibrium Framework	J.-P. Lam and G. Tkacz
2004-8	The Economic Theory of Retail Pricing: A Survey	O. Secrieru
2004-7	The Demand for Money in a Stochastic Environment	J. Atta-Mensah

Copies and a complete list of working papers are available from:
Pour obtenir des exemplaires et une liste complète des documents de travail, prière de s'adresser à :

Publications Distribution, Bank of Canada
234 Wellington Street, Ottawa, Ontario K1A 0G9
E-mail: publications@bankofcanada.ca
Web site: http://www.bankofcanada.ca

Diffusion des publications, Banque du Canada
234, rue Wellington, Ottawa (Ontario) K1A 0G9
Adresse électronique : publications@banqueducanada.ca
Site Web : http://www.banqueducanada.ca