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Transmission Channels, Risk Sharing, and EMU Dispersions

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Abstract
First, using a small theoretically founded general equilibrium model fitted to the data by Bayesian techniques, the article assesses the contribution of interest rates and housing prices to dispersions within the European Monetary Union (EMU). It finds that the different behavior of interest rates just before and after the introduction of the euro has contributed significantly to growth dispersions in the EMU. However, this has been a one-off shock whose effects, particularly on construction, should decline over time. Second, the article analyzes the contribution of the financial system to sharing country-specific risks in a panel framework. It finds that further financial sector integration in the EMU could do much more to insure countries against shocks and increase consumption smoothing.

1. Introduction

A better understanding of the driving forces of European Monetary Union (EMU) inflation and growth dispersions is important from both analytical and policy standpoints. The role of income and price level convergence as well as the relative importance of country-specific versus common shocks in explaining dispersions has been analyzed in (Stavrev, 2008). This study extends the analysis in two ways. First, it studies the relative importance of transmission channels, in particular, the contribution of real interest rate and the real estate sector to the dispersions. Second, it examines the potential of further financial integration in insuring against country--specific shocks and reducing dispersions.

The article analyzes these questions by using two approaches. First, it assesses the role of the interest rate and the housing sector in the adjustment process before and after euro introduction, using Bayesian techniques to fit a small theoretically founded general equilibrium model to the data. Second, the article analyzes the contribution of the financial system to consumption and income smoothing across EMU countries by sharing country-specific risks, using a panel framework.

Several results come out of the analysis. First, the different behavior of interest rates just before and after the introduction of the euro has contributed significantly to growth dispersions. However, this has been a one-off shock whose effects are declining over time. Second, and related to the interest rate shock, the construction sector has contributed to the growth dispersions. Third, financial sector integration could do much more to insure countries against shocks and increase consumption smoothing.

The rest of the article is organized as follows. Section 2 provides an overview of the findings in the literature. Section 3 analyzes the role of shock transmission and

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the relative importance of channels, Section 4 looks at the role of the financial sector for cross-country consumption smoothing, while Section 5 concludes.

2. Literature Review

Cyclical synchronization has increased and shock propagation has become more similar since the introduction of the EMU. Giannone and Reichlin (2006) find that business cycles and shock propagation are similar across EMU countries and the bulk of euro-area dispersions are explained by relatively small but persistent idiosyncratic shocks. They also note that the EMU adjusts more sluggishly to shocks than the United States, but that cycles are less volatile. Eickmeir (2006) also finds that, in general, output and inflation responses to common shocks (demand, supply, monetary policy, and external) across euro-area countries are similar, but long-lasting idiosyncratic shocks are responsible for output and inflation variations across countries. EC (2006) finds that country-specific shocks, including a fall in risk premia following the introduction of the euro, relaxation of credit constraints, and productivity in traded and non-traded goods are important explanatory factors for divergences.

However, despite similarities in the transmission of shocks, differences remain. For example, van den Noord (2004) finds that the decline in interest rates after the launch of the euro had a different impact on the housing markets in the small and large countries and, via this channel, the shock has had a different effect on economic activity in the two groups. Also, Hoeller et al. (2004) argue that, as the cyclical position of housing prices in the small countries may be out of line with the common monetary policy, the construction sector raises dispersions via its impact on activity.

The results in the literature suggest that the competitiveness channel dominates the adjustment process in the medium run, but operates slowly. EC (2006) finds that the procyclical effect of the real interest rate channel has been somewhat less important than previously thought and dominates in the initial phase of the expansion, while in the medium term adjustments in competitiveness are more important. The study also finds that wage and price rigidities influence the efficiency of the adjustment process and could lead to slow correction in competitiveness and result in protracted economic divergences.

The literature concludes that fiscal policy has contributed to the reduction of output volatility over time, but elements of procyclicality remain. Darvas et al. (2005) find evidence that fiscal convergence (persistently similar GDP ratios of government balances) is associated with synchronization of business cycles. They also observe that the Maastricht fiscal criterion may have moved the EMU closer to an optimal currency area by reducing countries' scope to cause idiosyncratic shocks. Darvas et al. recognize that by imposing convergence of budget deficits, the criterion could make fiscal policy less effective in counteracting asymmetric shocks, but the results suggest that the synchronization effect of fiscal policy has dominated.

The literature finds that risk sharing has increased over the past decade, but the share of idiosyncratic shocks smoothed by the financial system is significantly lower in the EMU than in the United States. In particular, Kalemli-Ozcan, Sørensen, and Yosha (2004) find that about 10 percent of idiosyncratic (country-specific) shocks to the per capita gross domestic product of the EMU countries (over 1993–2000) are smoothed through capital markets, while the figure for the United States is 55 percent

(over 1991–1998). Marinheiro (2003) estimates a somewhat higher share of smoothed country-specific shocks for the EMU (25 percent), but still significantly lower than in the United States. He also finds that if financial system integration in the EMU reaches the level of the United States, its contribution to smoothing idiosyncratic shocks could increase by about 20 percentage points.

3. Shock Transmission and the Relative Importance of Channels

The relative importance of the transmission channels was studied using a general equilibrium model.[1] Equations (1)–(4) represent the core of the model, which, in principle, follows the New Keynesian framework.

$$y_t = \beta_1 y_{t-1} + \beta_2 y_{t+1} + \beta_3 hg_{t-1} + \beta_4 rg_{t-1} + \beta_5 zg_{t-1} + \beta_6 \hat{y} + \varepsilon_t^y \tag{1}$$

where y_t is the output gap, hg_t is the real house price gap, rg_t is the real interest rate gap, zg_t is the real exchange rate gap, and $\hat{y}$ stands for the current period EMU output gap in a country model/the lagged output gap of a country in the EMU model, and is supposed to capture foreign demand. Potential output, the equilibrium interest rate, the equilibrium real exchange rate, and equilibrium real house prices are also defined in the model, which allows consistent estimates of the gaps within the model (for the full model specification see the Appendix).

$$\pi_t = \alpha_1 \pi_{t-1} + (1-\alpha_1)\pi_{t+1} + \alpha_2 y_{t-1} + \alpha_3 \Delta z_t + \alpha_4 \hat{\pi} + \varepsilon_t^{\pi} \tag{2}$$

where π_t is inflation, z_t is the logarithm of the real exchange rate, $\hat{\pi}$ denotes the current period EMU inflation in a country model/the lagged inflation of a country in the EMU model, which is supposed to capture the exogenous cost-push factors driving inflation, and Δ is the first difference operator.

$$hg_t = \rho_1 hg_{t-1} + \gamma_1 rg_{t-1} + \varepsilon_t^{hg} \tag{3}$$

where hg_t is the real house price gap.

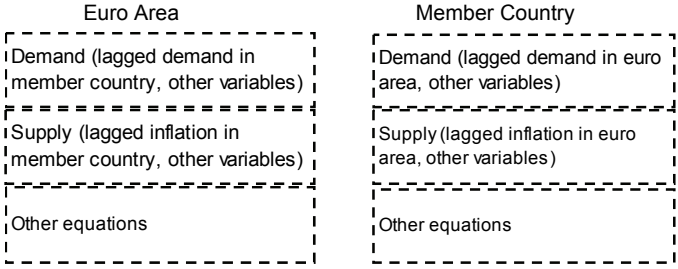
$$rs_t = \delta_1 rs_{t-1} + (1-\delta_1)[re_{t-1} + \pi_t + \delta_2(\pi_{t+1} - \bar{\pi}) + \delta_3 y_t] + \varepsilon_t^{rs} \tag{4}$$

where rs_t is the nominal interest rate, re_t is the real equilibrium interest rate, and $\bar{\pi}$ is the inflation target.

Equation (1) is an aggregate demand function which has a lagged term to capture persistence in the data and a forward-looking component as in (Gali, Gertler 1999). Aggregate demand depends also on the real interest rate gap, capturing the interest rate channel, the real house price gap, which captures wealth effects (see (van den Noord, 2004), for a similar way of controlling for wealth effects on aggregate demand) and cyclical effects from asset prices on aggregate demand, and external demand.

[1] The model was estimated using Bayesian techniques for Austria, France, Germany, Italy, the Netherlands, Portugal, Spain, and the EMU (weighted average of the sample countries) over three periods: (i) the full sample, 1980–2006; (ii) the pre-EMU period, 1980–1995; and (iii) the EMU period, 1996–2006. While formally the above countries renounced their monetary policy in 1999, interest rates converged and the exchange rate ceased to be used as a policy tool as from 1996. Hence, for estimation purposes the EMU period starts in 1996.

FIGURE 1



Equation (2) is a standard open economy Phillips curve in which inflation is driven by demand conditions, exchange rate developments, and external shocks. Equation (3) defines the real house price gap as a function of real interest rates. Real interest rate changes affect house prices by changing the opportunity cost of capital invested in housing, the cost of servicing mortgage credit, and the present value of future household earnings. Finally, equation (4) is a monetary policy reaction function in which the central bank cares about inflation and the output gap.

The models were estimated using the following data: real GDP and CPI for each member state and the EMU; real effective exchange rates, short-term (3-month money market) interest rates, and real house prices (deflated by the CPI index) for each EMU member state. The 3-month nominal interest rate of the United States was used as a proxy for the foreign interest rate. The real GDP, CPI, and interest rate data are from Eurostat, while the nominal house prices are from the OECD.

The general equilibrium model framework estimated with Bayesian techniques has several advantages over the VAR approach in analyzing EMU dispersions. In particular, the general equilibrium approach is better suited for separating the various shocks that drive the dispersions than the VAR framework. By using expert knowledge and estimates already existing in the literature, Bayesian techniques allow for more robust estimation results and orthogonalization of the shocks. At the same time, the simultaneous estimation of more than two shocks using the VAR approach is increasingly data intensive and requires long time series. To ensure robust results, the estimates from other studies as well as our own single equation estimates are used. For example, the EMU parameters were chosen in line with van den Noord (2004), while the prior mean values of the coefficients for the EMU member states were set based on the ordinary least square estimates for each behavioral equation. To ensure robustness of the estimates, relatively diffuse prior distributions were set for the coefficient estimates and the residuals.

The impact of various shocks on the dispersions was assessed by simulating the estimated models for each country with that for the EMU together. The interaction of area-wide and country-specific shocks takes place through the demand and supply equations in the model of the EMU and that of a member country. Area-wide demand and supply shocks are assumed to affect each country contemporaneously, while country-specific shocks are assumed to affect euro-area demand and inflation with a lag (*Figure 1*).

The simulations with the estimated models suggest that:

– the EMU-related changes in interest rates have contributed to growth divergences, accounting on average for about 25 percent of them (*Figure 1*);

– the impact of house prices differs across the countries reviewed and explains about 15 percent of the growth dispersions (*Figures 2–3*).

4. Cross-country Consumption and Income Smoothing

The degree of cross-country risk sharing and the role of the financial system over time were estimated using a panel regression featuring cross-country correlations of GNP/private consumption conditional on output. The idea is that the absence of a correlation between GNP/private consumption and real GDP suggests risk sharing, e.g., via the credit or capital markets. Thus,

$$\Delta x_{i,t} - \Delta x_t^{EA} = \alpha + \beta_t (\Delta y_{i,t} - \Delta y_t^{EA}) + \varepsilon_{i,t} \tag{5}$$

where the deviation of per capita GNP/private consumption growth of country *i* from the EMU ($\Delta x_{i,t} - \Delta x_t^{EA}$) is regressed on the deviation of country *i* per capita real GDP growth from the EMU ($\Delta y_{i,t} - \Delta y_t^{EA}$), and the coefficient β_t measures uninsured risk over time ($\beta_t = 0$ means perfect risk sharing). To assess the contribution of the financial system, the time varying coefficient β_t is specified as a function of time and the dispersion of financial development in the EMU countries:[2]

$$\beta_t = \beta_0 + \beta_1 t + \beta_2 (F_{i,t} - F_t^{EA}) \tag{6}$$

Substituting (6) into (5) results in:

$$\begin{aligned} \Delta x_{i,t} - \Delta x_t^{EA} = \alpha + \beta_0 (\Delta y_{i,t} - \Delta y_t^{EA}) + \beta_1 t (\Delta y_{i,t} - \Delta y_t^{EA}) + \\ + \beta_2 (F_{i,t} - F_t^{EA})(\Delta y_{i,t} - \Delta y_t^{EA}) + \varepsilon_{i,t} \end{aligned} \tag{7}$$

The coefficient β_0 measures the average uninsured risk, β_1 indicates how risk sharing evolves over time, and β_2 captures the effect of the financial system. A negative β_2 coefficient lowers the degree of co-movement between private consumption/GNP with real GDP, reducing the amount of unshared risk. Equations (5) and (8) were estimated for the EMU excluding Ireland and Luxembourg over the period 1980–2006.[3] – *Table 1*.

[2] The GDP share of credit of deposit money banks to the private sector was used as a proxy for financial system development. The advantage of this indicator is that it does not consider credit issued to governments, but a shortcoming is that it captures only the role of the banking system and not that of other financial institutions or the securities market. However, given the dominant role of banks in the EMU, using this indicator may not result in a large bias. In future work the following alternative indicators could be used as a cross-check: (i) liquid liabilities, comprising currency and interest-bearing liabilities of bank and non-bank financial intermediaries; (ii) stock market capitalization; and (iii) the common component of the three measures from a principle component regression.

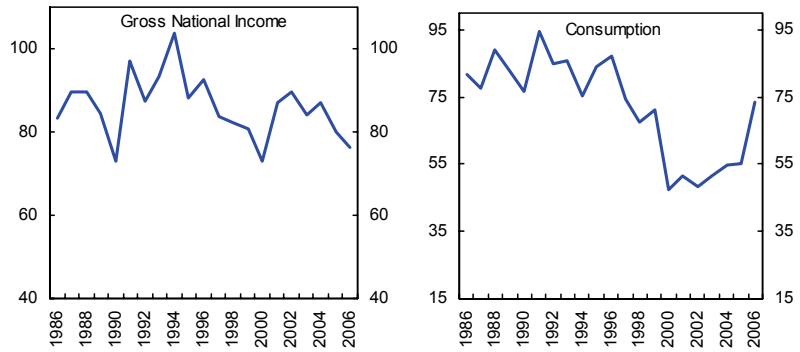
[3] The equations were estimated using a panel regression with cross-section weights. As a robustness check, equations (5)–(7) were also estimated using the full EMU sample (including Ireland and Luxembourg) as well as excluding the two largest EMU members (Germany and France) instead of Ireland and Luxembourg. The estimation results from all three variations were reasonably stable, as the point estimates of the coefficients from all three samples remained within ± 1 standard deviation of the estimated coefficients.

TABLE 1 Regression Results[a]

	GNP	Consumption
β_0	0.94	0.70
	(0.13)	(0.23)
β_1	-0.005	0.01
	(0.01)	(0.01)
β_2	-0.96	-0.19
	(0.18)	(0.24)

Note: [a] Standard errors in parentheses. Estimation period 1980–2006.

FIGURE 2 Unshared Risk[a] (in percent)



Note: 5-year moving average of coefficient β_t in equation (5)

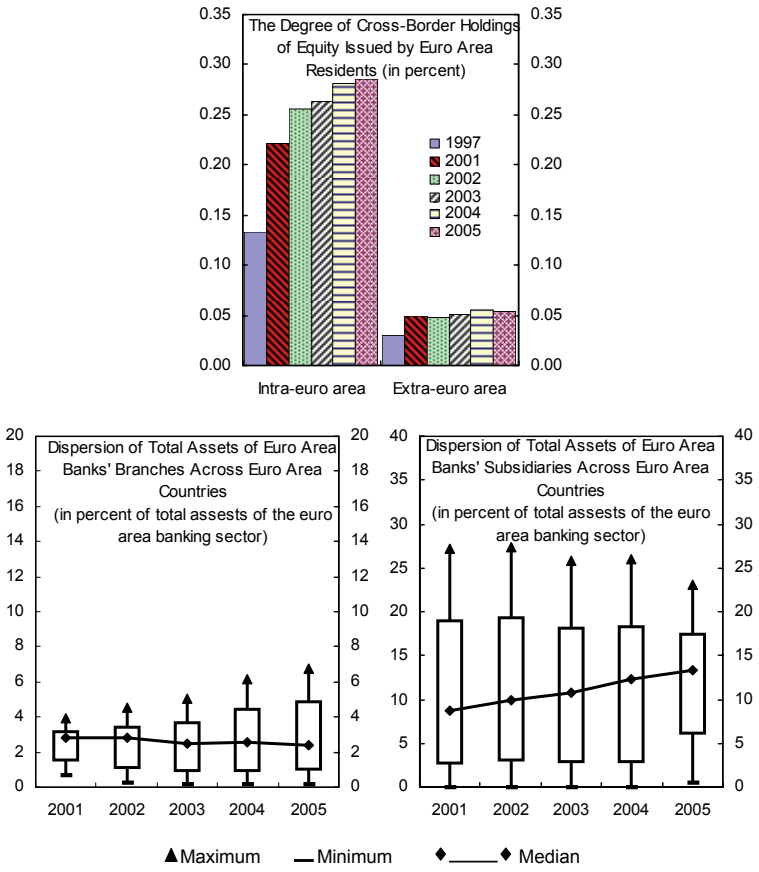
The empirical results suggest that the financial system has played a role in income (= GNP) but not in private consumption risk sharing. The coefficient on the interaction of financial system development with real GDP (coefficient β_2) is significant for GNP, but insignificant for private consumption. Also, the contribution of the financial system to risk sharing does not seem to have changed significantly over time, as the trend coefficients in both the GNP and private consumption equations are insignificant. See *Figure 2*.

This finding suggests that risk sharing via the financial markets is better developed for investment (which accounts for much of the difference between GNP and private consumption) than for household consumption.[4] One reason may be the still limited integration of retail banking in Europe. While the share of cross--border holdings of equities by euro-area residents doubled between 1997 and 2005, the median share of total assets of branches of euro-area banks that are located outside home countries remained practically unchanged at below 3 percent of all euro--area banking assets; the same figure for subsidiaries increased marginally to around 13 percent in 2005, from around 9 percent in 2001 (ECB, 2007). Overall, it is well known that retail banking is appreciably less well integrated than many other financial activities (among others, see (Decressin et al., 2007)). See *Figures 3*.

The potential welfare gains from further financial integration among the EMU members are substantial for each euro-area country. A comparison of the volatility of

[4] Auxiliary regressions confirmed this and are available upon request.

FIGURE 3 Indicators of Financial Integration



Source: ECB

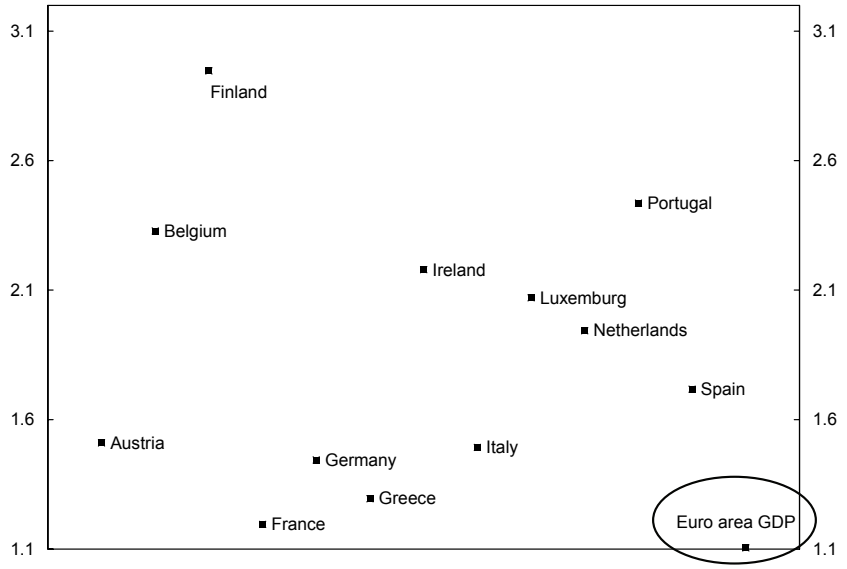
the individual euro-area members' private consumption growth with the volatility of euro-area output growth suggests a high potential for additional risk sharing. Euro--area output is less volatile than consumption in each member state. Specifically, at 1.1 percentage points, the standard deviation of euro-area output growth is far lower than the maximum standard deviation of private consumption growth of around 3 percentage points and lower than the minimum standard deviation of private consumption growth of 1.2 percentage points. See *Figure 4*.

5. Conclusions

EMU-related changes in interest rates and house price developments represent idiosyncratic shocks that have contributed to EMU inflation and growth dispersions. While not necessarily orthogonal to income and price level convergence, they can account for up to 40 percent of growth divergences and may largely be of a one-off nature.

Financial sector integration has accelerated, but it has not achieved its full potential. For example, as shown in the literature and confirmed in this study, the con-

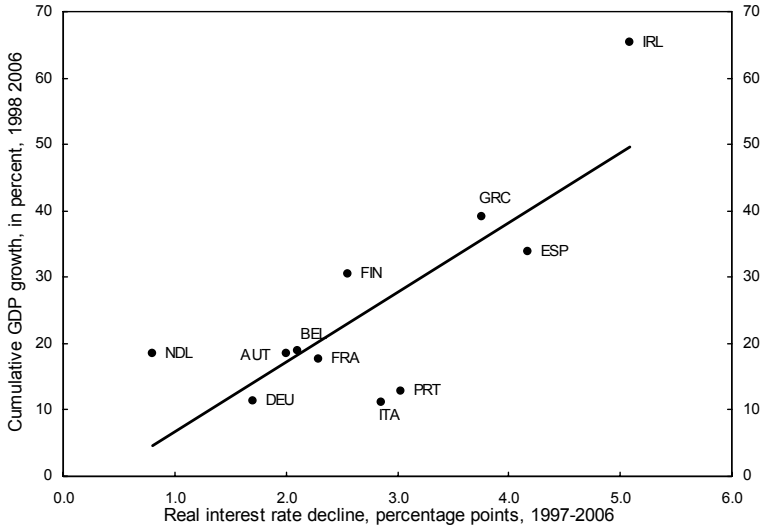
FIGURE 4 Euro Area: Volatility of Member States' Private Consumption and Euro Area Real GDP
(Standard deviation over 1990–2006, in percentage points)

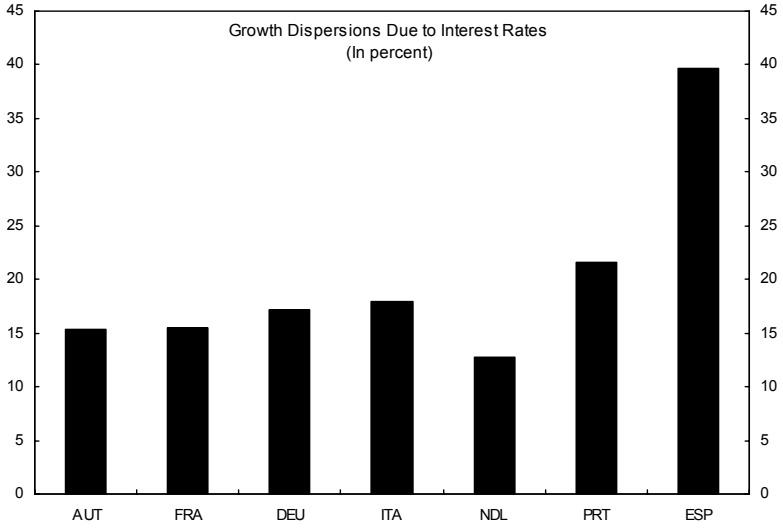


tribution of the financial sector to income smoothing could be increased significantly – some studies suggest by 20 percentage points or more, if its level of integration reaches that of the United States. A fully integrated financial system could serve as a powerful insurance mechanism against asymmetric shocks. It can ensure relatively stable consumption – funded via private rather than public borrowing and government intervention – despite fluctuations in domestic output. Further integration of the European capital markets can play an important role in this respect. Integration of retail banking can also contribute to risk sharing, as the resulting flow of cross-country interest payments will help countries smooth idiosyncratic shocks and incomes, lowering consumption growth dispersions in the EMU.

APPENDIX 1

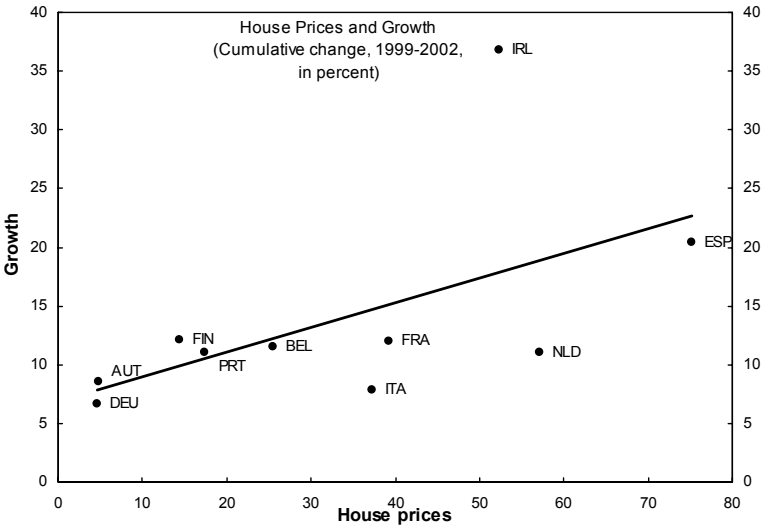
FIGURE A1 EMU: Interest Rates and Growth Dispersions

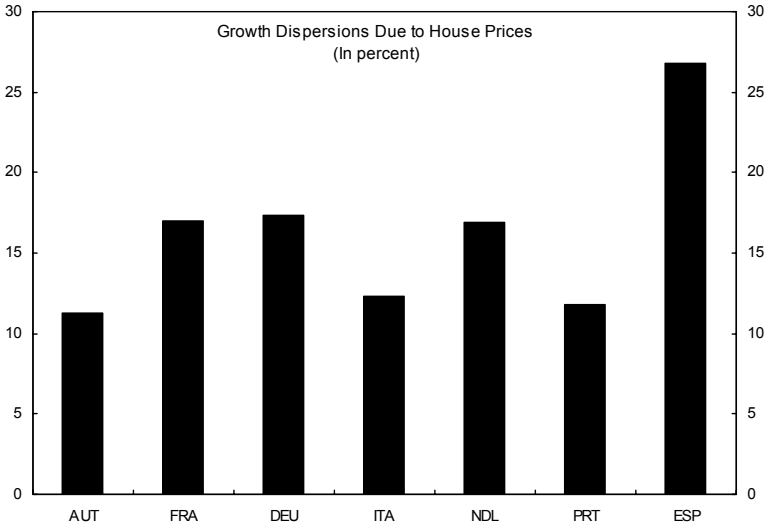




Source: IMF Staff calculations

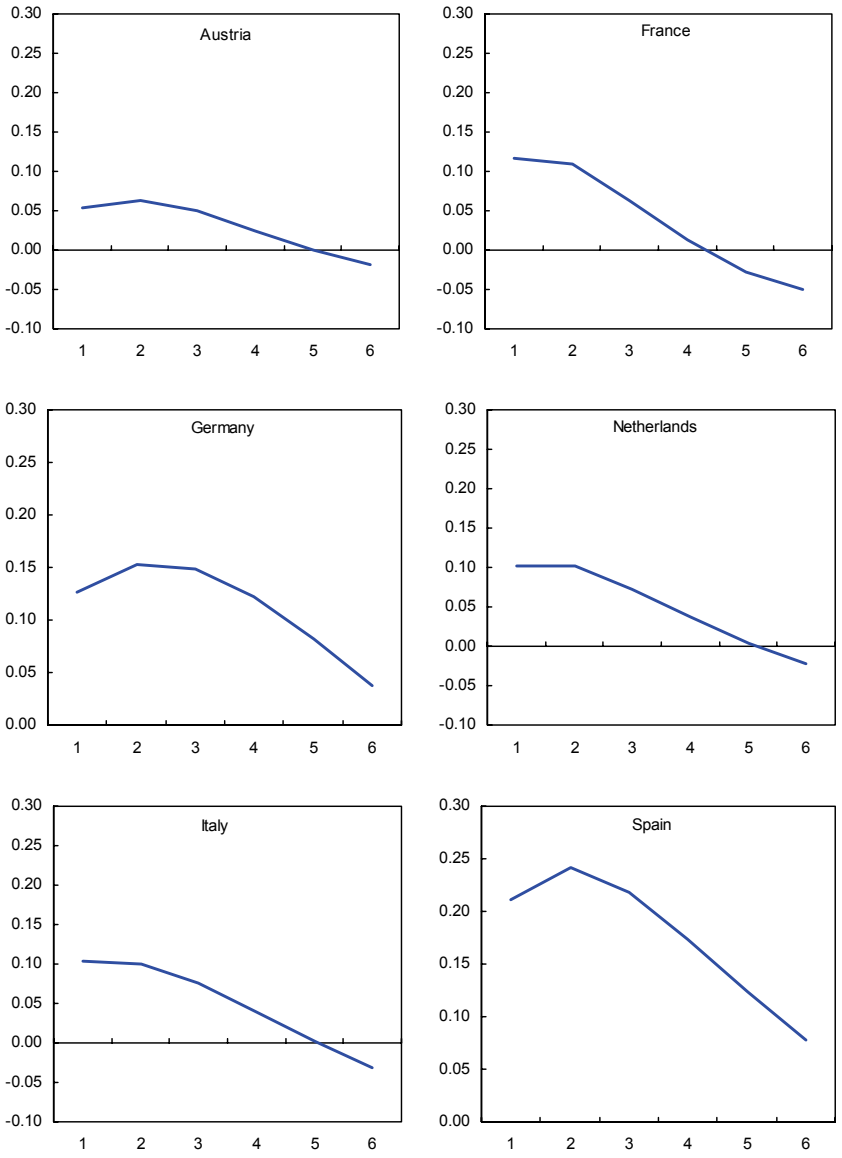
FIGURE A2 EMU: House Prices and Growth Dispersions





Sources: BIS and IMF Staff calculations

FIGURE A3 EMU: Impulse Response of Output to Real House Price Shock (10 percentage point shock to house prices)



Source: Fund staff estimates

APPENDIX 2

Dynamic General Equilibrium Model

The model consists of the following equations.

Output

Aggregate demand:

$$y_t = \beta_1 y_{t-1} + \beta_2 y_{t+1} + \beta_3 hg_{t-1} + \beta_4 rg_{t-1} + \beta_5 zg_{t-1} + \beta_6 \hat{y} + \varepsilon_t^y \quad (1)$$

where y_t is the output gap, hg_t is the real house price gap, rg_t is the real interest rate gap, zg_t is the real exchange rate gap, and $\hat{y}$ stands for the current period EMU output gap in a country model/the lagged output gap of a country in the EMU model.

Potential growth

$$g_t = \lambda g\_s + (1-\lambda) g_{t-1} + \varepsilon_t^g \quad (2)$$

where g_t is potential growth, and g_s is steady state growth.

Potential output

$$lye_t = lye_{t-1} + g_t + \varepsilon_t^{lye} \quad (3)$$

where lye_t is the logarithm of potential output.

GDP

$$ly_t = lye_t + y_t \quad (4)$$

where ly_t is the logarithm of GDP.

Phillips curve:

$$\pi_t = \alpha_1 \pi_{t-1} + (1-\alpha_1)\pi_{t+1} + \alpha_2 y_{t-1} + \alpha_3 \Delta z_t + \alpha_4 \hat{\pi} + \varepsilon_t^{\pi} \quad (5)$$

where π_t is inflation, z_t is the logarithm of the real exchange rate, $\hat{\pi}$ denotes the current period EMU inflation in a country model/the lagged inflation of a country in the EMU model, and Δ is the first difference operator.

House prices

Real house price gap

$$hg_t = \rho_1 hg_{t-1} + \gamma_1 rg_{t-1} + \varepsilon_t^{hg} \quad (6)$$

where hg_t is the real house price gap.

Growth of real house prices

$$gh_t = \tau gh\_s + (1-\tau) gh_{t-1} + \varepsilon_t^{gh} \quad (7)$$

where gh_t is growth of real house prices, and gh_s is equilibrium growth of real house prices.

Equilibrium real house prices

$$he_t = he_{t-1} + gh_t + \varepsilon_t^{he} \tag{8}$$

where he_t is the logarithm of real equilibrium house prices.

Real house prices

$$h_t = he_t + hg_t \tag{9}$$

where h_t is the logarithm of real house prices.

Exchange rate

Real exchange rate gap

$$zg_t = z_t - ze_t \tag{10}$$

where zg_t is the real exchange rate gap, z_t is the logarithm of the real exchange rate, and ze_t is the logarithm of the real equilibrium exchange rate.

Equilibrium real exchange rate

$$ze_t = ze_{t-1} + \varepsilon_t^{ze} \tag{11}$$

Uncovered Interest Parity

$$z_t = z_{t+1} + (r_t - rf_t) + \varepsilon_t^{z} \tag{12}$$

where r_t is the domestic interest rate, and rf_t is the foreign interest rate.

Interest rates

Real interest rate

$$r_t = rs_t - \pi_{t+1} \tag{13}$$

where r_t is the real interest rate, and rs_t is the nominal interest rate.

Equilibrium real interest rate

$$re_t = \vartheta re\_s + (1-\vartheta) re_{t-1} + \varepsilon_t^{re} \tag{14}$$

where re_t is the real equilibrium interest rate, and *re_s* is the steady state real interest rate.

Real interest rate gap

$$rg_t = r_t - re_t \tag{15}$$

Monetary policy reaction function

$$rs_t = \delta_1 rs_{t-1} + (1-\delta_1)[re_{t-1} + \pi_t + \delta_2(\pi_{t+1} - \overline{\pi}) + \delta_3 y_t] + \varepsilon_t^{rs} \tag{16}$$

where rs_t is the nominal interest rate, re_t is the real equilibrium interest rate, and $\overline{\pi}$ is the inflation target.

***Observable variables**:* Real GDP, inflation, real effective exchange rate, nominal interest rates, real house prices, and foreign interest rates.

***Unobservable variables**:* Potential output, output gap, real equilibrium interest rate, real interest rate gap, real equilibrium exchange rate, real exchange rate gap, real equilibrium house price, and real house price gap.

***Unit root variables**:* Real GDP, real equilibrium house prices, real house prices, real exchange rate, potential output, and real equilibrium exchange rate

***Sample**:* EMU7 (Austria, France, Germany, Italy, Netherlands, Portugal, and Spain)

***Sample period**:* 1980–2006

***Frequency**:* Quarterly, annual

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