Current Issues in

Emerging Market Economies

Organised by the Croatian National Bank

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Capital Flows in Euroland

Hotel "Argentina", Dubrovnik
June 28 - 30, 2001

Draft version
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CAPITAL FLOWS IN EUROLAND

AND IMPLICATIONS FOR

UNILATERAL ADOPTION OF THE EURO IN EASTERN EUROPE

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for presentation at the

Seventh Dubrovnik Economic Conference,
Dubrovnik, Croatia,

June 28 – 29, 2001.

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1. Introduction

A critical question for countries such as Poland, Hungary, Slovenia and the Czech Republic that aspire to EU membership is whether and when to adopt the euro. Indeed this question faces countries such as Bosnia and Bulgaria that have fixed their currencies to the Deutsche Mark but are some distance from meeting either the criteria for EU membership or those laid down by Brussels for euroization. The question also faces countries such as Croatia and Yugoslavia that are heavy users of the DM *de facto* but have not formally fixed to it.

A theoretical issue that is key to answering this question is whether exchange rate fixity (or a common currency) acts to stabilize capital flows or vice versa. If the former, a transition country such as Poland, Croatia or Slovenia that faces potentially volatile capital inflows and outflows might be well advised to adopt the euro unilaterally, without waiting to meet Maastricht-like conditions. If the latter, the country would be better advised to try to tame capital flows first, perhaps indirectly by meeting the Maastricht conditions of convergent interest and inflation rates.

This paper illuminates the issue empirically by examing whether the volume of net capital flows increased and the volume and/or volatility of speculative capital flows decreased within “Euroland” as intra-European exchange rates hardened vis a vis one another throughout the 1990s. A putative benefit of the euro is its encouragement of intra-European capital flows. But staged introduction of the euro may affect gross capital flows within Euroland quite differently from net flows. We will use the term “speculative flows” to describe gross minus net flows.

After the currency crises of 1992-93, exchange rate fixity between countries signed on to the Maastricht treaty gradually hardened: both spot and forward exchange rates showed less volatility. We hypothesize that this hardening increased net capital flows but reduced the volatility of speculative flows, and perhaps their volume as well. We test these and related hypotheses by analyzing newly-

compiled data on bond issues within the euro region, and relating them to intra-Euroland exchange rate volatility.

A broader motivation for this study is to illuminate debate about exchange rate regimes. While many aspects of this debate have been extensively researched empirically, the costs of capital account "churning" have not. If these costs are substantial, and if, in addition, churning is eliminated or at least reduced via hard fixes, currency boards or common currencies, the potential benefits of such regimes are enhanced. The benefits from such regimes are also enhanced if the volume of net capital flows increases. Moreover, it should be possible, for particular cases, to project the benefits of moving from flexible or managed regimes to hard fixes or to common or external currencies. Capital account benefits from increased exchange rate credibility are commonly imputed from currency risk premiums on domestic-currency interest rates. Our measures and conditional estimates of gross and net capital flows provide a useful quantity-side perspective on these issues.

A final motivation is to illuminate debate about whether capital account volatility is primarily the result of exchange rate volatility or the reverse -- or whether indeed volatility in both responds to an independent third factor, such as expectations. While our paper cannot resolve this issue directly, it does lend weight to the view that volatile capital flows result from volatile exchange rates, or expectations of volatile exchange rates, rather than the reverse. This, in turn, suggests that policy makers should concentrate on stabilizing or eliminating exchange rates, not regulating short-term capital flows. It also implies that transition economies in Eastern and Central Europe might consider unilateral adoption of the euro rather than waiting until they have achieved macroeconomic stability.

2. Literature

The central hypotheses underlying the "capital flows" case for unilateral adoption of an external currency, or alternatively a common currency, are that elimination of exchange rate risk will i) reduce volatility in gross minus net capital flows ("speculative" flows) and ii) increase the level of net flows. The prescient paper was

Mundell (1973), presented in Madrid at a 1970 conference on optimum currency areas. By invoking enhanced international reserve pooling and portfolio diversification, the paper drew a link between reduction of exchange rate risk and an increase in net cross-border capital flows. The essential implication was that such diversification could potentially counter the putative resource losses facing a country hit by an adverse shock by allowing the country to dissave or to borrow.

Though prescient, the paper was scarcely seminal. Economists analyzing exchange rate regimes continued to rely on *Mundell (1961)*, which spells out the famous optimum currency area criteria. The innovation of the 1973 paper is that it drops the assumption of stationary exchange rate expectations. The implication is that neither of the 1961 conditions – neither labor mobility nor symmetric shocks – is necessary to the case for a common currency. Yet this implication continues to elude much of the economics profession, perhaps because the 1973 paper remains largely unread.[1]

Nevertheless, several recent theoretical papers have picked up the general theme that exchange rate risk may inhibit net capital flows. *Persson and Svensson (1989)* analyze the effect of exchange rate variability on capital flows and international portfolio diversification without coming to any strong conclusions, partly because they assume incomplete international asset markets, an assumption that introduces a bias against fixed rates. Fixed rates or common currencies reduce the scope for risk sharing when there are gaps in asset markets because they remove currency-denomination as a source of diversification. However, this bias against fixed rates can be turned on its head. As *Neumeyer (1998)* puts it

> *"…with … incomplete markets … a monetary union is desirable when the gains from eliminating the excess volatility of nominal variables exceed the cost of changing the asset structure."*

[1] It has, however, been elaborated by several of Mundell's students, for example Frenkel and Mussa (1980).

The moral is that, without evidence, theorizing readily degenerates into sophistry.

It is well known that with complete asset markets (and rational expectations) the inter-temporal efficiencies of flexible and fixed rate regimes are identical *(Helpman and Razin, 1979; Lucas, 1981*). In that case, fixed regimes become superior unless optimal, state-dependent monetary injections occur under flexible rates: in other words, fixed rates guarantee optimal monetary policy due to the intra-period automaticity of monetary adjustment, whereas flexible rates do not. If asset markets really are "complete", this would seem to settle the issue for practical purposes in favor of fixed or common currencies, since optimal discretionary monetary policy is virtually impossible in an uncertain world.

Hence the key empirical question is whether modern asset markets are sufficiently complete – or cross-border capital flows sufficiently efficient – to compensate for potential welfare losses in a fixed rate regime whose economy is hit by an adverse and asymmetric shock. A first step in answering this question is to look at the relationship between exchange rate stability and capital flows.

There has been surprisingly little empirical work on this relationship. However, some researchers (notably *Andrew Rose*: see for example, *Jeanne and Rose, 1999*) have linked the extensive finance literature on "noise trading" to the (even more extensive) literature on foreign exchange determination. Noise trading in this context is defined as exchange rate trading *not* based on "fundamental" considerations such as productivity and price differentials. This issue is important because when coupled with the well-known finding that volatility in flexible exchange rates does not simply get transferred to fundamental parts of the economy when exchange rates are subsequently fixed, it implies that fixing -- or even announcing credible target zones[2]*)* -- can result in real welfare gains. Conversely, it implies that much foreign exchange trading may be unnecessary,

[2] See Krugman and Miller (1993) for the canonical argurment that mere announcement of target zones deters destabilizing speculation.

wasteful or worse.[3] The noise trading approach is a promising research avenue because it does lend itself to empiricism, in particular studies of trading behavior at the micro-market level.

Before presenting our empirical results, it will be instructive to analyze the exchange rate-capital flow relationship theoretically in the context of a simple model.

3. A Model: Exchange Rate Volatility, Capital Flows, and Risk-Sharing

The microeconomic motivation for capital flows is to smooth consumption, both inter-temporally and across states-of-nature. Without capital flows, welfare losses arise under fixed rates arise because price and wage stickiness causes demand shocks to be transmitted into output losses. The open-economy corollary of price and wage stickiness is that cross-border prices deviate from purchasing power parity (PPP). Perhaps the simplest model illustrating the links between exchange rate volatility and capital flows is that of Solnik (1974), which is well-known because it first internationalized the capital asset pricing model (CAPM). The Solnik model shows quite clearly that exchange rate volatility reduces capital flows and inhibits international risk sharing.

[3] By unnecessary we mean that it has no resource consequences, by wasteful we mean that traders are paid without adding value, and by worse we mean that noise traders cause exchange rate volatility that has either reduces aggregate output or makes it more volatile.

The key ingredients of this model, which make it international in a nontrivial way, are that the consumption bundles of domestic residents are biased toward domestic goods, and that Purchasing Power Parity (PPP) does not hold. As a result, investors in different countries wish to hedge *different* risks. This complicates the usual CAPM intuition.

Because of deviations from PPP, foreign currency-denominated bonds contain exchange rate risk. Despite this risk, Solnik shows that domestic residents may still want to hold them as a hedge against their foreign equity positions. Specifically, domestic residents can hedge the exchange rate risk of their foreign equity holdings by going short (i.e., borrowing) the foreign currency, or equivalently, by selling it forward. Foreigners willingly take the other side as a hedge against their domestic inflation, or because such positions are riskless (if domestic inflation rates are deterministic in local currency terms).

To see exactly how this works, assume without essential loss of generality that domestic and foreign equity offer the same expected (local currency) returns, which are uncorrelated. This lack of correlation gives rise to diversification benefits. Also assume the expected change in the nominal exchange rate is zero, and that exchange rate innovations are uncorrelated with (real) equity returns.

Letting the two countries be Germany (*G*) and France (*F*), we get the following portfolio demands, expressed as shares of total wealth:

$$\omega_G = \frac{1}{\alpha\sigma_G^2}\left(r - i_G\right)$$

$$\omega_F = \frac{1}{\alpha\sigma_F^2}\left(r - i_F\right)$$

$$\omega_{BF} = \frac{1}{\alpha\sigma_S^2}\left(i_F - i_G\right) - \omega_F$$

$$\omega_{BG} = 1 - \omega_G - \omega_F - \omega_{BF}$$

where *r* is the expected rate of return on equity, i_G is the German nominal interest rate, i_F is the French nominal interest rate, α is the coefficient of relative risk aversion (assumed to be the same across countries), σ_G^2 is the variance of the (local currency) return on German equity, σ_F^2 is the variance of the (local currency) return on French equity, and σ_S^2 is the variance of the exchange rate. An entirely symmetric set of portfolio demands applies to residents of France, denoted with asterisks.

In equilibrium, of course, the interest rates are endogenous (equity returns are too, but as usual we can assume an underlying stochastic constant returns to scale production technology, which effectively makes them exogenous). Letting W_G denote German wealth and W_F denote French wealth, bond market clearing requires:

$$\omega_{BG} \cdot W_G + \omega_{BG}^* \cdot W_F = 0$$

$$\omega_{BF} \cdot W_G + \omega_{BF}^* \cdot W_F = 0$$

These two equations determine the following market-clearing nominal interest rates:

$$i_G = r - \alpha\sigma_G^2\left[\frac{\sigma_F^2 + \gamma_G \cdot \sigma_S^2}{\sigma_G^2 + \sigma_F^2 + \sigma_S^2}\right]$$

$$i_F = r - \alpha\sigma_F^2\left[\frac{\sigma_G^2 + (1-\gamma_G)\cdot\sigma_S^2}{\sigma_G^2 + \sigma_F^2 + \sigma_S^2}\right]$$

where γ_G denotes the share of German wealth. Finally, substituting these into the demand equations gives the following expressions for equilibrium portfolio shares :

$$\omega_G = \omega_G^* = \frac{\sigma_F^2 + \gamma_G\cdot\sigma_S^2}{\sigma_G^2 + \sigma_F^2 + \sigma_S^2}$$

$$\omega_F = \omega_F^* = \frac{\sigma_G^2 + (1-\gamma_G)\cdot\sigma_S^2}{\sigma_G^2 + \sigma_F^2 + \sigma_S^2}$$

$$\omega_{BF} = -(1-\gamma_G)$$

$$\omega_{BG} = (1-\gamma_G)$$

Notice that German residents are short in French bonds ($\omega_{BF} < 0$) and long in German bonds ($\omega_{BG} > 0$). Of course, the opposite applies to residents of France.
These debt positions reflect the desire to hedge foreign equity purchases against exchange rate risk.

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What are the implications of this model for capital *flows* (as opposed to stocks)? As is well known, these kinds of models generate flows only via revaluation effects. Because the currency compositions of German and French portfolios differ, exchange rate innovations produce wealth redistributions, which then generate rebalancing capital flows. For example, suppose there is a sudden appreciation of the mark against the

franc. Because German residents are long marks and short francs (and vice versa for French residents), this raises German wealth and reduces French wealth. To rebalance their portfolios, German residents want to sell marks in exchange for franc-denominated debt and equity. Conversely, French residents find their German debts suddenly increased, so they willingly buy the marks that German residents are selling so that they can pay down their debt. These sorts of rebalancing capital flows increase as exchange rates become more volatile. They also increase the variance of wealth and consumption. As a result, exchange rate volatility reduces welfare.

Hence, in principle, we do not need to appeal to noise traders to explain the positive association between exchange rate volatility and unstable capital flows. However, as an empirical matter, both elements are likely to be at work. (See, e.g., Bohn and Tesar (1996)).

4 Evidence

The euro was introduced as an official settlement currency and unit of account on January 1, 1999. The effects on European capital markets have been dramatic. Corporate bond issues have exploded, growing by 80% during the first half of 1999 (McKinnon, 2000). Issues of European equity have reached record highs, with the emergence of entirely new markets and market indices, such as Neue Market in Frankfurt and Italy's Nuovo Mercado. Portfolios are now allocated on a pan-European sectoral basis, rather than on a country basis. Eurex, started only in 1998, has now surpassed the Chicago Board of Trade to become the world's largest derivatives exchange. Banks all over Europe are merging and forming cross-border alliances on an unprecedented scale, creating an entirely new banking environment. (See Danthine, Giavazzi, and von Thadden (2000) for a wide-ranging discussion of these and other developments).

Summarizing and assessing all these developments is beyond the scope of this paper. Here we focus just on the debt markets. This task is made possible by the European Central Bank's (ECB) recent release of data on Euro-area debt issues, both before and after the introduction of the euro. The ECB has constructed a continuous, inter-temporally comparable series by aggregating debt issues denominated in all eleven legacy currencies before 1999.[4]

The data are monthly, beginning in January 1990, and ending in February 2001. They pertain to negotiable securities, traded on secondary markets. Money market paper, and, in principle, private placements are included. The ECB estimates that approximately 95% of total debt issues by euro area residents are included. Euro-denominated debt issues by non-residents of the euro area residents (which mushroomed during 1999[5]) are excluded.

[4] The relevant website is www.ecb.int/stats/sec/sec.htm

[5] See Detken and Hartmann (2000) for an analysis of the euro's role in international capital markets during its first year, 1999. They show that the issuance of euro-denominated debt securities by non-residents of the euro area had, by the third quarter of 1999, lifted the euro share of the global total to a peak of 35 percent, compared to 32 percent for the US dollar and 17 percent for the Japanese yen.

While providing a reasonably accurate and comprehensive picture of the supply side of the euro area debt market, these data suffer from the drawback of not providing information on the demand side of the market. That is, we have no way of knowing who is buying these securities. This problem is endemic to all detailed empirical studies of international capital markets. It is virtually impossible to get reliable data on bilateral capital flows. Hence when relating these data to models of exchange rate risk and risk-sharing, the implicit assumption we must adopt is that most of these debt issues are being purchased by other euro area residents.

Figures 1 and 2 contain time-series plots of the overall data, and Tables 1 and 2 provide summary statistics on more detailed breakdowns. This is possible since the ECB reports data broken down by (i) sector (i.e., Monetary-Financial Institutions (MFI's), Non-financial Corporations, and Governments), (ii) currency of denomination (i.e., euro vs. non-euro), and (iii) maturity (i.e., long-term vs short-term).

As noted earlier, economic theory predicts that exchange rate volatility might have different effects on gross flows than on net flows. For example, noise trader models predict that exchange rate volatility stimulates gross flows (Jeanne and Rose, 1999), while standard risk-sharing models predict that exchange rate volatility reduces net flows (Bacchetta and Van Wincoop, 1998). The Solnik model sketched above predicts that exchange rate volatility leads to wealth redistributions, and hence increases both the mean and variance of gross capital flows (due to portfolio rebalancing). As a result, we analyze gross and net flows separately. (Note: net issues are defined as gross issues minus redemptions , where redemptions comprise all repurchases by the issuer for cash, whether at maturity or earlier).

Several points are clear from these figures and tables. First, both net and gross private debt issues increased after the euro was introduced. However, perhaps because of fiscal contraction, public debt issues decreased. Although the increase in gross debt might seem contrary to what we would expect, it is important to keep in mind that we are not isolating the pure effect of exchange rate risk here. At the same time that exchange rate risk has been eliminated, there has been market liberalization and deregulation, which might be expected to increase gross capital flows of all kinds. Without a more explicit model, it is not possible to partial out these effects.

Besides the effects on the levels of capital flows, it is also clear from Tables 1 and 2 that volatilities (as measured by the standard deviation) have increased as well. However, since the levels increased at the same time, it is perhaps more accurate to think in terms of the coefficients of variation (i.e., the standard deviation divided by the mean). Generally speaking, these have decreased since the euro was introduced.

To examine the effect of exchange rate volatility on the level of capital flows, Table 3 reports the results of simple OLS regressions of capital flows on a measure of exchange rate volatility. For simplicity, we define euro area exchange rate volatility as an equally-weighted average of the volatilities of the DM/French Franc and DM/Italian Lira exchange rates, where the volatilities of the individual exchange rates are just the absolute values of the residuals from a regression of (log) exchange rate changes on a constant. This series is plotted in Figure 3. To conserve space, we report only the results for euro-denominated short-term debt issued by MFIs.

The results in Table 3 suggest that exchange rate volatility increases gross debt flows and decreases net debt flows, although only the effects on gross flows are statistically significant. This is broadly consistent with the predictions of both noise trader models and risk-sharing models.

One troubling feature of Table 3 is the low Durbin-Watson statistics in the gross capital flows regressions. This suggests that we are missing some important dynamics (in addition to casting doubt on the validity of the standard errors). Earlier we conjectured that there might be some dynamic interactions between the volatilities of capital flows and exchange rates. To estimate and account for these interactions, we next estimate a bivariate ARCH-M model. (See, e.g., Bollerslev, Engle, and Wooldridge (1988)). The results are reported in Table 4.

In this model, the conditional variances of exchange rate changes and capital flows are assumed to depend on lagged (squared) innovations in exchange rates and capital flows. In addition, we permit the current conditional standard deviation of exchange rate changes to affect the *level* of capital flows (this is what makes it an ARCH-M model, as opposed to just an ARCH model). We can then test for feedback between exchange rate volatility and capital flows volatility by examining the off-diagonal coefficients in the estimated ARCH process. For example, the γ_{13} coefficients in Table 4 estimate the effects of capital flows volatility on exchange rate volatility, while γ_{31} captures the effects of exchange rate volatility on capital flows volatility. Estimates of α_{22} suggest, once again, that exchange rate volatility increases gross capital flows and decreases net capital flows.

5 Implications for Eastern Europe and the Euro

Countries aspiring to join the European Monetary Union are still asked to meet conditions similar to those set down in the Maastricht Treaty of 1992. These involve convergence of inflation rates, interest rates, debt ratios and deficit ratios toward levels that already obtain among countries now in the euro area. There is good reason to argue that these conditions are nonsensical when applied to Central and Eastern European Countries. Indeed, we would argue that the first two conditions – and probably the last two as well – would be more readily met were aspirant countries to euroize unilaterally, rather than waiting to meet Maastricht criteria.[6] This should begin with the so-called CEEC5 who are next in line to join the EU: the Czech Republic, Poland, Hungary, Estonia and Slovenia.

To begin with, euroization would immediately bring tradeables inflation down to Euroland levels. But it would not necessarily bring non-tradeables inflation down to Euroland levels, nor would that be desirable. It would be surprising indeed if average productivity growth in the CEECs turns out to be at or below the average for

[6] For discussion of unilateral euroization, see Segal (2001); for argument in faor see Coricelli (2001); and against see Dietz (2001), Gabrisch (2001) and Wojik (2001).

Euroland: indeed it will probably be higher. And if the Belassa-Samuelson effect holds, as it surely will, we would expect higher inflation rates in non-tradeables.[7] Hence if these countries were to adopt the euro, we would expect their real exchange rates to appreciate when measured in terms of relative consumer prices. But there would be no appreciation in terms of relative unit labor costs and hence no loss of external competitiveness.

Hence to require CEECs to meet the Maastricht inflation rate criterion is economic nonsense. As long as productivity growth in tradeables sectors is higher than in Euroland, higher inflation in non-tradeables sectors is consistent with sustained trade balances in euroized CEECs. Suppressing overall inflation to Euroland levels would simply force relative wage deflation in non-tradeables. More precisely, it would force nominal wages in non-tradeables sectors to rise at a rate below that in tradeables by an amount equal to the difference between productivity growth in tradeables and non-tradeables. This is hardly a policy prescription made in heaven for governments concerned with social stability. It would likely lead to both wage strife and unemployment among non-tradeables workers.

Requiring euro-aspirants to meet Maastricht interest rate convergence criteria is equally misguided. Adoption of the euro would immediately eliminate currency risk premia, prompting automatic nominal interest convergence. Default risk premia would probably also be reduced, given that exchange rate uncertainty increases the risk of default on foreign-currency-denominated debt. Moreover real interest rates would probably also decline, which would stimulate investment.

It might, nevertheless, be argued that the CEECs should retain flexible exchange rates – or perhaps adjustable pegs – until such time as they face less volatile capital inflows and outflows. Otherwise, they might be expected to be buffeted by bouts of inflation when capital surges in, and by deflation and recession when it flows out. This argument might be made even by those who accept the putative benefits from interest rate convergence that would arise from preemptive euroization.

[7] See Podkaminer, Leon (2001).

Our results – summarized in Tables 3 and 4, and based on EMU data – suggest that the last decade's gradual (though sporadic) reduction in Euroland exchange rate volatility has been associated with less volatility in capital flows, and as well with higher net cross-border flows. We interpret this as evidence – albeit partial and preliminary – that the argument asserting that euroization should await stablization of capital flows should be reversed. Euroization would, in fact, probably act to stablize capital flows. Moreover, it would probably increase their net volume. This evidence reinforces the case for unilateral euroization, particularly when added to *a priori* aguments that lowering overall inflation to Euroland levels as a pre-condition for euroization would cause labor unrest and increase unemployment, but that unilateral euroization would lower nevertheless lower tradeables inflation and real interest rates.

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Figure 1: Gross Debt Issues (Billions of Euro)

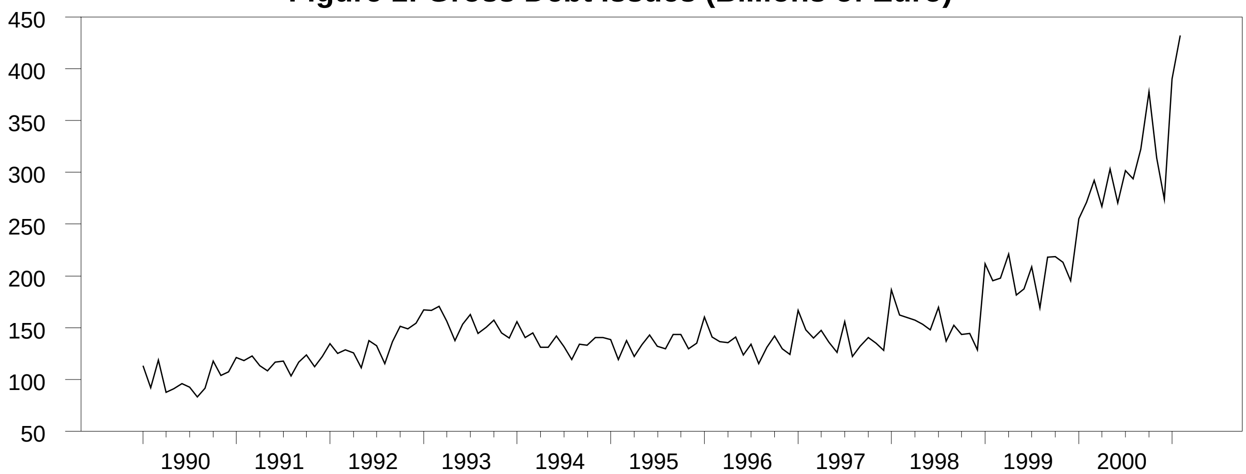

Figure 2: Net Debt Issues (Billions of Euro)

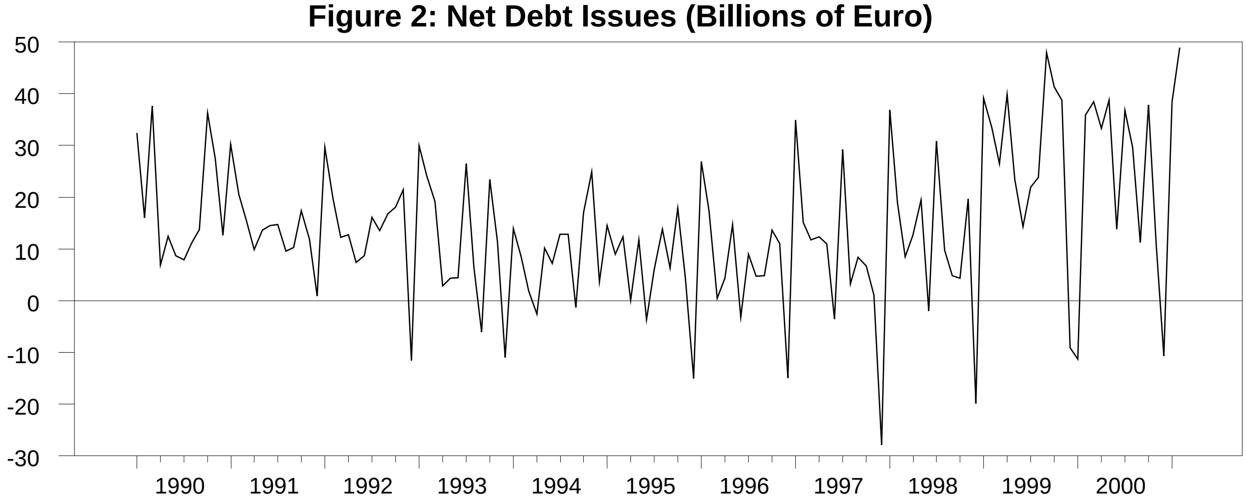

Figure 3: Intra-European Exchange Rate Volatility

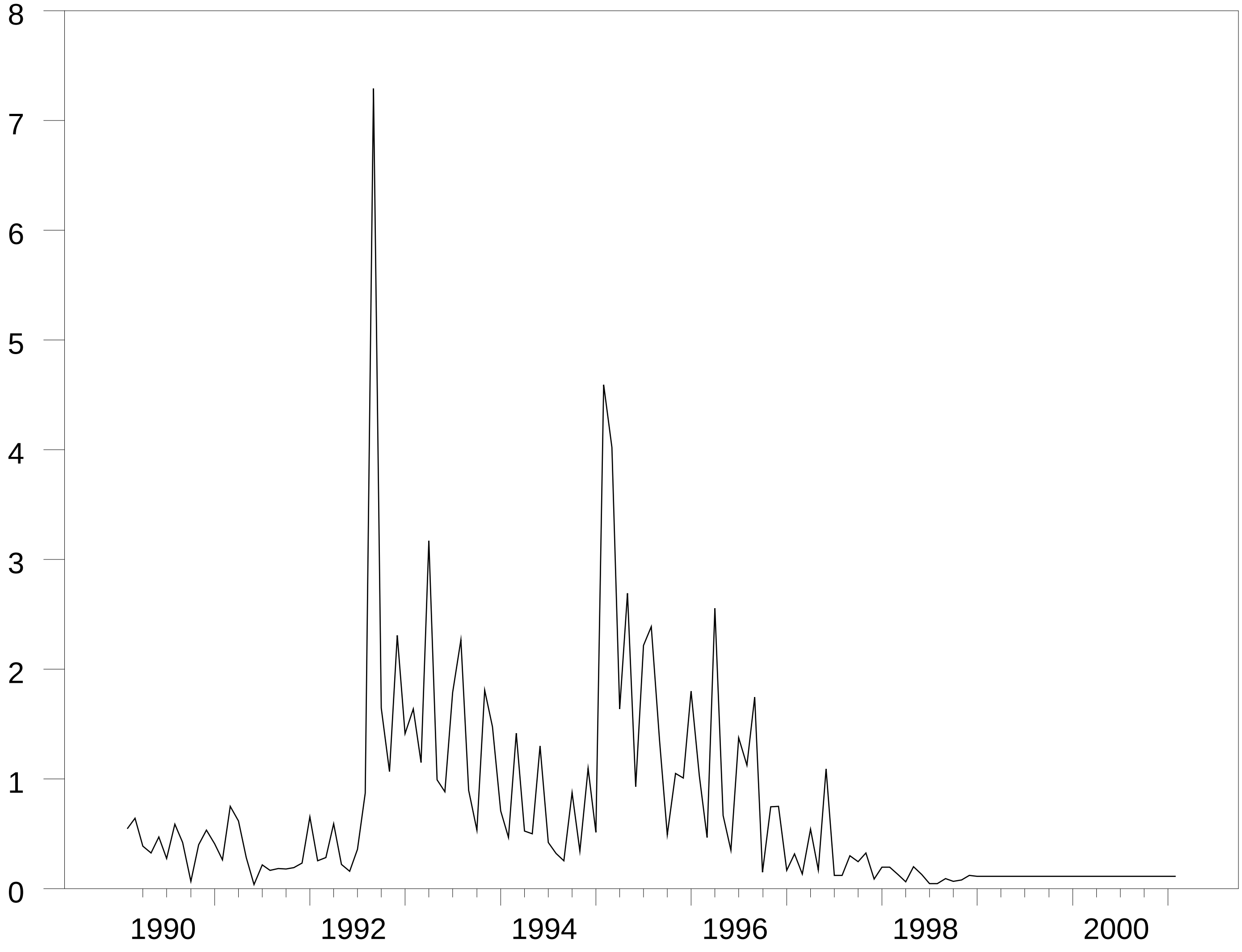

TABLE 1

GROSS MONTHLY DEBT ISSUES (BILLIONS OF EURO)

	1990:1-1998:12		1999:1-2001:2			
	μ_1	σ_1	μ_2	σ_2	$Z_{\mu_2-\mu_1}$	$F_{\sigma_2^2/\sigma_1^2}$
Monetary-Financial Institutions						
Euro Short-term	72.3	13.2	147.6	50.6	7.51 (.000)	14.6 (.000)
Euro Long-term	25.5	6.04	45.1	8.12	11.5 (.000)	1.81 (.020)
Non-Euro Short-term	1.76	1.27	10.0	4.56	9.12 (.000)	12.9 (.000)
Non-Euro Long-term	3.04	1.96	6.68	1.97	8.46 (.000)	1.02 (.453)
Corporate						
Euro Short-term	27.9	4.15	44.8	10.7	7.91 (.000)	6.69 (.000)
Euro Long-term	2.45	1.69	4.76	2.58	4.34 (.000)	2.32 (.001)
Non-Euro Short-term	0.06	0.09	0.51	0.55	4.10 (.000)	40.0 (.000)
Non-Euro Long-term	0.54	0.51	1.40	1.89	2.29 (.022)	13.5 (.000)
Central Government						
Euro Short-term	57.7	9.12	39.2	8.46	−9.89 (.000)	0.86 (.656)
Euro Long-term	35.8	11.4	46.6	13.8	3.70 (.000)	1.45 (.099)
Non-Euro Short-term	0.15	0.33	0.97	0.79	5.18 (.000)	5.67 (.000)
Non-Euro Long-term	1.21	1.14	0.85	1.04	−1.57 (.117)	0.83 (.701)

Notes: (1) $Z_{\mu_2-\mu_1} = (\mu_2 - \mu_1)/\sqrt{\sigma_1^2/n_1 + \sigma_2^2/n_2}$ and is asymptotically standard normal.
(2) $F_{\sigma_2^2/\sigma_1^2} = \sigma_2^2/\sigma_1^2$ and has an F-distribution with 25/107 degrees of freedom.
(3) P-values in parentheses.

TABLE 2

NET MONTHLY DEBT ISSUES (BILLIONS OF EURO)

	1990:1-1998:12		1999:1-2001:2			
	μ_1	σ_1	μ_2	σ_2	$Z_{\mu_2-\mu_1}$	$F_{\sigma_2^2/\sigma_1^2}$
Monetary-Financial Institutions						
Euro Short-term	0.85	6.04	3.54	9.32	1.40	2.38
					(.161)	(.001)
Euro Long-term	7.81	5.56	13.7	10.2	2.85	3.36
					(.004)	(.000)
Non-Euro Short-term	0.02	0.81	1.51	1.73	4.30	4.57
					(.000)	(.000)
Non-Euro Long-term	1.37	1.82	2.78	2.69	2.55	2.19
					(.011)	(.003)
Corporate						
Euro Short-term	0.12	2.58	1.78	2.02	3.54	0.61
					(.000)	(.922)
Euro Long-term	0.88	1.81	2.36	3.37	2.16	3.48
					(.031)	(.000)
Non-Euro Short-term	−0.00	0.07	0.09	0.24	1.95	12.2
					(.051)	(.000)
Non-Euro Long-term	0.17	0.56	0.86	2.03	1.71	13.2
					(.087)	(.000)
Central Government						
Euro Short-term	0.39	6.03	−2.08	7.26	−1.60	1.45
					(.109)	(.101)
Euro Long-term	16.8	9.60	9.90	11.8	−2.78	1.51
					(.005)	(.075)
Non-Euro Short-term	0.01	0.17	0.03	0.68	0.20	15.4
					(.839)	(.000)
Non-Euro Long-term	0.56	1.21	−0.19	1.45	−2.44	1.43
					(.015)	(.106)

Notes: (1) $Z_{\mu_2-\mu_1} = (\mu_2 - \mu_1)/\sqrt{\sigma_1^2/n_1 + \sigma_2^2/n_2}$ and is asymptotically standard normal.
(2) $F_{\sigma_2^2/\sigma_1^2} = \sigma_2^2/\sigma_1^2$ and has an F-distribution with 25/107 degrees of freedom.
(3) P-values in parentheses.

TABLE 3

REGRESSIONS OF SHORT-TERM EURO-DENOMINATED CAPITAL FLOWS ON INTRA-EUROPEAN EXCHANGE RATE VOLATILITY

Model: $CF_t = \alpha_0 + \alpha_1 \cdot EuroDumm_t + \alpha_2 \sigma_{t-1}$

	1990:3-2001:2		1990:3-1998:12	
	Gross	Net	Gross	Net
α_0	68.7**	1.07	68.7**	1.07
	(3.11)	(.863)	(1.49)	(.770)
α_1	78.3**	2.50	–	–
	(5.67)	(1.57)		
α_2	4.83**	−.274	4.83**	−.275
	(2.31)	(.640)	(1.11)	(.571)
R^2	.602	.026	.155	.002
DW	0.38	2.17	0.67	2.24

Notes: (1) Asymptotic standard errors in parentheses.
(2) $**$ = significant at the 5% level.
(3) $*$ = significant at the 10% level.
(4) $EuroDumm = 0$ before 1999 and $= 1$ after 1999.

TABLE 4

BIVARIATE ARCH(1)-M ESTIMATES

$\Delta e_t = \alpha_{10} + u_{1t}, \qquad u_{1t} \sim N(0, h_{1t}^2)$

$CF_t = \alpha_{20} + \alpha_{21} \cdot EuroDumm_t + \alpha_{22} h_{1t} + u_{2t}, \qquad u_{2t} \sim N(0, h_{2t}^2)$

$h_{1t}^2 = \gamma_{10} + \gamma_{11} u_{1t-1}^2 + \gamma_{12} u_{1t-1} u_{2t-1} + \gamma_{13} u_{2t-1}^2$

$h_{2t}^2 = \gamma_{30} + \gamma_{31} u_{1t-1}^2 + \gamma_{32} u_{1t-1} u_{2t-1} + \gamma_{33} u_{2t-1}^2$

$\mathrm{cov}(u_{1t}, u_{2t}) = \gamma_{20} + \gamma_{21} u_{1t-1}^2 + \gamma_{22} u_{1t-1} u_{2t-1} + \gamma_{23} u_{2t-1}^2$

	1990:4-2001:2		1990:4-1998:12	
	Gross	Net	Gross	Net
α_{10}	.110**	.105**	−.133*	.118**
α_{20}	73.2**	.867**	70.0**	.640**
α_{21}	75.8**	2.55**	–	–
α_{22}	.005	−.003	3.77**	−.157
γ_{10}	1.13**	1.17**	.625**	1.50**
γ_{11}	.055*	.101**	.104	.086
γ_{12}	.004**	.011**	−.064**	.070**
γ_{13}	−.000137**	−.0025**	.009**	−.005**
γ_{20}	1.39**	1.49**	.841	1.54**
γ_{21}	.013	.163**	.982*	.116
γ_{22}	.053	.044**	.314**	.090
γ_{23}	−.0002**	−.0053**	−.028**	−.0006
γ_{30}	364.2**	42.6**	59.4**	33.3**
γ_{31}	−.209	1.08	4.18	.048
γ_{32}	.021	−1.26*	3.12*	−.364
γ_{33}	.070**	.048**	.557**	.044

Notes: (1) $**$ = significant at the 5% level.
(2) $*$ = significant at the 10% level.