Preliminary
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Exchange Rates and Inflation under EMU: An Update

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Abstract

In our recent *Economic Policy* article (Honohan and Lane, 2003), we argued that the strength of the US dollar 1999-2001 had an important impact on inflation divergence within the EMU and in particular the surge in Ireland's inflation to over 7 per cent. This hypothesis has been subjected to a grueling out-of-sample test: would the dollar's subsequent weakness contribute to inflation convergence and in particular to a fall in Irish inflation? Fortunately for us, the theory has passed the test with flying colours. Irish inflation stopped dead in its tracks: consumer prices were unchanged between May and November of 2003. Regression analysis on quarterly inflation data across EMU members 1999.1-2004.1 confirms the importance of the exchange rate channel, although pinning down the exact dynamic specification will require a further span of data.

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Introduction

In our recent *Economic Policy* article (Honohan and Lane, 2003), we argued that exchange rate movements have an important impact on inflation divergence within the EMU and in particular that Ireland's outlying inflationary experience in 2000-2003 was strongly affected by the dollar's weakness during1999-2002. This hypothesis has subsequently been subjected to a grueling out-of-sample test over the 12 months following completion of the paper during which the dollar's weakness, especially from early 2002, should have been passing through to EMU country inflation rates. [1] [2] Fortunately for us, the theory has passed the test with flying colours.

In this short note, we first revisit the Irish case. Next, we report updated panel regressions for inflation differentials among eurozone countries over 1999-2003. Finally, we present new empirical specifications that model the relation between exchange rates and inflation at a quarterly frequency over 1999.1 to 2004.1.

Revisiting the Irish Case

The Irish case once again provides the most dramatic evidence about the connection between exchange rates and inflation. To recap, Irish inflation, below 5 per cent for almost fifteen years and averaging just under 2 per cent per annum in the five years prior to EMU membership, suddenly accelerated in late 1999 and from then until mid-2003 was persistently at the top of the EMU inflation league. CPI inflation touched an annual rate of 7 per cent in the twelve months to November 2000, before retreating to the 4-5 per cent range, where it stood when we presented our paper at the *Economic Policy* panel meeting in Athens in April 2003. The published version also includes the 12-month inflation rate to May 2003, still as high as 3.7 per cent and still the highest in EMU (Figure 1 – which extends Figure 7 in the published paper). Our claim was that the strength of the dollar had been an important contributor to Ireland's inflationary surge.

If our theory was both true and reversible, the slide from early 2002 and subsequent weakness of the dollar should already have resulted in some evident effect on Ireland's inflation rate should already by mid 2003. Indeed the pass-through was already under way and consumer price inflation stopped in its tracks (see also Lane 2003). From April to November 2003 the CPI index remained at the same level, resulting in a steady fall in the cumulative 12-month inflation to a low of 1.3 per cent at March 2004. Although

[1] Cf Jaume Ventura's discussion in the published version: "The key test of [the theory's'] validity is being conducted as I write this discussion. According to the Honohan-Lane hypothesis, the recent appreciation of the euro should reverse the trend once again and generate a new period of inflation convergence. I look forward to seeing whether events will confirm this prediction."

[2] Against the euro, the dollar peaked in the fourth quarter of 2000. Its subsequent decline accelerated from early 2002, reaching a floor in the first quarter of 2004 at which point it had fallen by 32 per cent in less than two years. Sterling also fell especially from early 2002, though not by as much and its floor was reached earlier, in May 2003.

inflation was falling across the EMU in the same period, Irish inflation fell much faster and was at or below median EMU-inflation in the first half of 2004.

The close but typically lagged correlation between trends in Irish CPI inflation and level of the nominal effective exchange rate for Ireland is shown in Figure 2.[3] This index has returned close to where it was at the beginning of EMU (although it remains well short of its earlier peak in 1996). The amplitude of the fluctuation is higher for Ireland than for other EMU members (essentially because as previously noted, Ireland has by far the smallest share of its trade with euro-area participants – 31 per cent, compared to 54 per cent for the others).

Despite some reflection of the global slowdown in the Irish economy, it is not easy to point to other convincing sources of such a sharp slowdown in Irish inflation. Indeed, although there were some signs of a slowdown during 2001-2002, the economy displayed a surprising degree of resilience to the global slowdown. Thus, a range of macroeconomic indicators all show signs of a pick up in activity during 2003-2004:

- Having stagnated in 2002, GNP grew by over 3 per cent in 2003 and is expected comfortably to exceed that in 2004. These are much lower growth rates than were recorded before 2001, but still overall reflect a moderately strong macro economy.

- Unemployment, having dipped to 3.7 per cent in early 2001, moved up only to 4.6 per cent on average in 2003, and had dipped again to 4.3 per cent by mid-2004.

- Real wage rates advanced in 2003 by 3.0 per cent in industry and 1.8 per cent in distribution and business services, close to or above the average of the previous three years (1.7 per cent and 2.4 per cent respectively).

- House prices too provide little sign of demand weakness in 2003-4: having slumped during 2001, average house prices recovered sharply in 2002 and have continued to increase in the range 11-15% per annum to the latest available date (May 2004).

- The General Government balance, having averaged 2.2 per cent of GDP (surplus) in the previous five years, moved just slightly into deficit in 2002 but remained close to balance in 2003. Although a deficit of over 1 per cent of GDP was budgeted for 2004, unanticipated revenue buoyancy in the first half of the year promises to leave the government accounts close to balance again in 2004. This pattern certainly does not suggest a sufficient fiscal tightening to explain the abrupt slowing of inflation in 2003.[4]

[3] Figure 2 uses the Central Bank of Ireland's trade-weighted competitiveness index (TWCI) series. The international comparisons below instead use *International Financial Statistics* NEER series.
[4] The cyclically adjusted budget balance series newly developed by the Commission and published in December 2003 suggests a structural tightening of 1.4 per cent of GDP in 2003 and 0.3 in 2004. As the Commission notes, cyclical adjustment of Irish budgetary series are "subject to a particularly large margin

In summary, the sharp slowdown in Irish inflation in 2003-2004 is in contrast to the recovery shown in various measures of economic activity and demand during the same period. Instead, it seems safe to interpret the deceleration in Irish inflation as a consequence of the very sizable depreciation of the US dollar and the relatively high exposure of the Irish economy to non-EMU trade.

Inflation and the Exchange Rate: EMU Panel Evidence

Annual Data

In Honohan and Lane (2003), we reported a variety of regressions to explain annual inflation differentials across the eurozone over the 1999-2001 period. We found a substantial role for the variation in nominal effective exchange rate movements in explaining divergent inflation rates during this period. In addition, there was support for a price convergence effect and an important role for the output gap, with little evidence of the fiscal stance being a significant factor.

Here, we extend the sample by a further two years (1999-2003) to revisit this issue. Table 1 shows the results for three different inflation measures, based on the HICP index, the GDP deflator and the import price deflator.[5] In the pooled least squares estimates in Panel A of Table 1, we report two specifications: a narrow specification that regresses inflation on just the lagged values of the PPP price level and the rate of appreciation of the nominal effective exchange rate; and a broader specification that also includes the output gap and the fiscal stance. The latter specification has two limitations. First, interpreting the broader specification runs into multi-collinearity problems. In particular, exchange rate appreciation and the output gap are strongly correlated over this sample period, such that the impact of the exchange rate on inflation may partially operate via its influence on the output gap. Second, the output gap and the fiscal stance are plausibly endogenous to the inflation rate: for this reason, Panel B of Table 1 reports GMM estimates that instrument for these potentially endogenous variables.

The results for the narrow specification in columns (1.1), (1.3) and (1.5) in Panel A of Table 1 show that the exchange rate channel is strongly significant for each of the inflation measures.[6] Moreover, there is considerable evidence of a price convergence effect. The broader specifications in columns (1.2), (1.4) and (1.6) confirm the latter result. However, once the output gap is included in the specification, the exchange rate variable is no longer individually significant for the HICP measure in column (1.2) and is also marginally insignificant for the import price deflator measure in column (1.6).

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of error". In addition, the Commission has chosen to make the adjustment relative to GDP growth rates, whose movements in 2001-2003 have been negatively correlated with those of GNP, which is a more relevant indicator for Ireland.

[5] Results for national CPI indices and for personal consumption deflators are broadly similar to those reported here for HICP indices.

[6] The t-statistics are calculated on the basis of Newey-West HAC standard errors: as is clear from the low Durbin-Watson statistics, a correction for autocorrelation is especially important.

The GMM results in Panel B of Table 1 boost the significance of the exchange rate for both the GDP price deflator and the import price deflator measures. With the exception of the import price deflator regressions, the output gap itself is generally significant. As in our earlier paper, the fiscal stance is marginally significant (but with a positive sign) for the HICP index. For the import price deflator, the fiscal stance is significantly negative: however, this result does not survive GMM estimation.

Relative to our earlier results for 1999-2001, the significance of the results for the exchange rate effect are weaker once the output gap is included in the regression specification.[7] However, as is shown by Angeloni and Ehrmann (2004), this is partly due to data revisions to the inflation and output gap data even for the 1999-2001 period.[8] At any rate, as was argued in the previous paragraph, it is not clear that the output gap should be held fixed in capturing the impact of the exchange rate on the inflation rate, since shifts in the exchange rate partly operate by influencing activity levels.[9] Moreover, even controlling for the output gap, the results for the GDP and import price deflators remain strong, especially in the GMM estimates.

In Table 2, we repeat the exercise but now allow exchange rate appreciations and exchange rate depreciations to have asymmetric effects on inflation differentials. Such asymmetries can be generated in a variety of theoretical models: for instance, if prices are downwardly rigid (for whatever reason), the pass through of exchange rate appreciation into lower inflation may be weaker than the pass through of exchange rate depreciation into higher inflation. Clearly, the limited degrees of freedom in our sample make it hard to identify such asymmetries: as such, the estimation in Table 2 should be regarded as an exploratory step.

In any event, the results in Table 2 broadly support the idea that exchange rate depreciations have a stronger impact on inflation differentials than do exchange rate appreciations.[10] The GMM estimates for the import price deflator in column (1.9) of panel B do provide an exception: in that case, exchange rate appreciation is more powerful than exchange rate depreciation.

[7] In terms of magnitudes, the estimated coefficients for 1999-2003 are broadly similar to our earlier results for 1999-2001. The major difference is that the output gap exerts a bigger influence on HICP inflation over the longer sample.

[8] These authors also extend our results for 1999-2002 (see Table 2 of their paper) and perform various robustness tests.

[9] Indeed, the multi-equation structural modeling pursued by Angeloni and Ehrmann (2004), may be a fruitful approach to disentangle the various channels by which the exchange rate may affect inflation. In their model, the exchange rate has both a direct effect on inflation and also operates via the output gap. Angeloni and Ehrmann (2004) highlight persistence in national inflation rates as an important factor in propagating inflation differentials across countries.

[10] Indeed, the HICP results in columns (2.1) and (2.2) of Panel A and column (2.6) of Panel B actually show a positive coefficient on exchange rate appreciations (although not significant). This might be explained by persistence in inflation rates, with depreciation during the early years of EMU still having inflationary effects in some countries even after the euro subsequently began to appreciate.

Quarterly Data

In this section, we supplement our previous analysis by analyzing the relation between exchange rates and inflation at the quarterly frequency over 1999.1 to 2004.1.[11] In particular, we highlight the pattern that the behaviour of national inflation rates varies with the level of national effective exchange rates.[12] This can be interpreted as a partial reduced-form relation that captures the role played by national inflation rates in a monetary union in correcting exchange rate misalignments: when the exchange rate is excessively weak, inflation rises in order to correct under-valuation; when the exchange rate is excessively strong, inflation decelerates in order to offset over-valuation; finally, if national effective exchange rates are at equilibrium levels, relative national inflation rates should also be stable.[13]

The correlation between inflationary trends and the strength of the US dollar is not confined to Ireland, as is shown for the mean and median EMU inflation (4-quarter) in Figure 3. As in the Irish plot, the visual impression is that the level rather than the change in the exchange rate provides the closer correlation. This is confirmed by regression analysis.

Table 3 reports regression estimates over 1999.1-2004.1 for the simple relation between the level of the exchange rate and inflation. Quarterly inflation in each country is explained by the (log-) level of its nominal effective exchange rate (NEER) index, or alternatively the EUR-USD exchange rate.[14] In a floating exchange rate regime, the exchange rate would be endogenous to the inflation rate. However, this is not so obvious for individual members of a currency union (especially the smaller countries), since the external value of the currency will depend on the aggregate union-wide fundamentals

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[11] This analysis complements that of Angeloni and Ehrmann (2004), who also show that the exchange rate channel is important for inflation. Their inflation equation (estimated over 1998.1-2003.2) also includes a significant exchange rate term and a marginally significant output gap term. The dynamic structure of our preferred regression equations are, however, different, notably (but not only) in our finding that the *level* of the exchange rate index is more significant than its quarterly rate of change. Interestingly, in their structural model, the *level* of the real effective exchange rate is an explanatory factor for the output gap but is not permitted to exert a direct influence on the inflation rate.

[12] In what follows, we focus on nominal effective exchange rates. It would make little difference if we employed real effective exchange rates, since nominal and real rates are highly correlated over this sample period. A pooled regression of changes in national real effective exchange rates on changes in national nominal effective exchange rate delivers an R2 of 0.90 if we use the IFS NEER series and an R2 of 0.95 if we use the European Commission nominal effective exchange rate series. (The real effective exchange rate is from the European Commission and is based on personal consumption deflators.)

[13] It follows that one possible source of persistence in national inflation rates in a currency union are prolonged departures of exchange rates from equilibrium values. It is also the case that the correction of an over-valued exchange rate may be asymmetric to the correction of an under-valued exchange rate (consistent with the evidence in Table 2 above). We leave the detailed investigations of these conjectures to future research.

[14] The nominal effective exchange rates have been rebased for the regressions so that the sample mean value for each country 1999Q1 to 2004Q1 is 100. By stripping out the country means, this implies that only the within-country variation in exchange rates is employed in the regressions.

rather than national circumstances. Moreover, as an empirical matter, the regression fit is as good even if Germany is omitted.

Either of the exchange rate variables is highly significant (Regressions 3.1, 3.3), but the NEER index has greater explanatory power (Regression 3.2); the lagged index works as well (Regression 3.5). A generalized least squares estimator using cross-sectional variances as weights gives similar results (Regression 3.4). A four-quarter first order autoregressive process serves to proxy for omitted variables. Inclusion of country fixed effects (Regression 3.6) does not remove the effect (and, conditional on the inclusion of country dummies, the restriction that country slope effects are the same is not rejected). The inclusion of the rate of change in exchange rate and various lags and/or a time trend does not significantly improve the fit.[15]

As was mentioned earlier, one important channel through which the exchange rate may affect inflation is the output gap. Although measurement of the output gap is problematic, it is worth investigating whether this is the only relevant channel by including the variable in the regression. The results of this exercise are shown in Table 4. Regressions 4.1 and 4.2 suggest that the output gap is not individually significant at a quarterly frequency.[16] Regressions 4.3 and 4.6 show that substituting the lagged for current exchange rate level makes little difference.

These findings confirm the importance of exchange rate movements in influencing European inflation rates, and we already know that a given euro-dollar exchange rate change translates into differing effective exchange rate movements for different member states. One way of detecting whether the exchange rate movements do explain *differential* EMU inflation rates is to strip out each quarter's common mean with time dummies. (This is the approach that we used on annual data). Here the results again confirm the remaining importance of the level of the exchange rate (Regressions 4.4, 4.5).

Of course, linking inflation *rates* just to the level of a nominal exchange rate is clearly incomplete as a long-term model of inflation. However, given modest inflation rates, short-term fluctuations in nominal exchange rates are highly correlated with real exchange rates. Indeed, substituting the REER series of the European Commission (based on relative consumer prices) for the NEER produces broadly similar, though slightly weaker results (Table 5). However, this introduces an obvious additional source of regressor endogeneity.

Moreover, we now have enough quarterly observations to run regressions on the time path of EMU inflation dispersion. There has been a sharp and evident convergence in inflation rates since 2002 as is shown in Figure 4. The standard deviation of annual inflation rates across the 11 EMU launch participants fell from 1.22 per cent at the end of 2002 to 0.69 per cent at the end of 2003. Thus the value of the US dollar has, once more,

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[15] Inclusion of the lagged PPP price level does help the fit, but not if country fixed effects are employed.
[16] Angeloni and Ehrmann (2004) found the output gap to be significant, but only at the 10 per cent level.

been positively associated with the dispersion of EMU inflation rates (Figure 5).[17] One interpretation of this is that the strengthening of the euro against the dollar has returned national nominal effective exchange rates close to equilibrium values, eliminating the need for significant inflation differentials. Were the euro to continue to strengthen against the dollar rate and enter "overshooting" territory, inflation differentials may re-emerge, with those countries most exposed to non-EMU trade then requiring below-average inflation rates in order to correct over-valuation against their EMU partners. (In addition, under this scenario, the aggregate over-valuation of the euro would have union-wide macroeconomic implications.)

The role of the exchange in narrowing inflation differentials is confirmed through the regression analysis reported in Table 6. The main effect is clearly visible in Regression 6.1. And the effect of exchange rate movements on inflation dispersion does not seem to pass fully or mainly through the output gap, as neither the mean nor the standard deviation across countries of this variable is correlated with inflation dispersion. The DW statistic is rather low, suggesting the need for future work on the dynamics as more data becomes available. Nevertheless, we may conclude from this evidence that dollar movements have had an important role in influencing the dispersion of EMU inflation rates.

The regressions we have estimated illustrate the role played by national inflation rates in correcting misalignments in effective exchange rates. We will have to wait for a longer span of data before working out the precise links between exchange rate levels, exchange rate changes, national price levels and inflation rates among EMU member countries.

Conclusions

This update and extension of our previous work confirms that exchange rates matter for EMU inflation rates during periods of euro appreciation (2002-2003) as well as periods of euro depreciation (1999-2001). The Irish case is dramatic: inflation fell to zero during 2003 in response to the strengthening of the euro vis-à-vis the dollar. The annual panel regressions also show that exchange rate movements and inflation differentials are linked over the 1999-2003 period, although the HICP data suggest that this largely operates via the influence of exchange rates on national output gaps. There is also some evidence of asymmetries in that exchange rate depreciation passes through into inflation more quickly than does exchange rate appreciation.

Finally, our analysis of quarterly data over 1999.1-2004.1 also confirms the powerful connection between exchange rates and inflation: with the passage of time, it should be possible to construct a more complete accounting of the dynamic structure of the relationship between these variables than is possible with only five years of data.

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[17] As noted in our (2003) paper, this may be related to the long-standing historical pattern of correlation between the level of the US dollar and European price level dispersion, referred to by Papell (2004) as the "panel purchasing power parity puzzle".

References

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Table 1: *Inflation differentials under EMU, 1999-2003 (Annual data)*

Panel A: Least Squares Estimates

	1.1		1.2		1.3		1.4		1.5		1.6	
	HICP		HICP		PGDP		PGDP		PIMP		PIMP	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Price Level (t-1)	-0.039	(3.9)***	-0.041	(5.4)***	-0.054	(3.9)***	-0.057	(4.4)***	-0.015	(0.9)	-0.02	(1.2)
DNEER(t-1)	-0.41	(2.7)**	-0.09	(0.7)	-0.7	(3.3)***	-0.43	(2.0)*	-0.45	(1.8)*	-0.43	(1.6)
Output Gap			0.4	(6.0)***			0.33	(2.9)***			0.037	(0.3)
Fiscal Stance			0.12	(1.9)*			0.007	(0.1)			-0.27	(2.1)**
Adj R2	0.21		0.56		0.44		0.52		0.84		0.85	
Countries/NOBS	10	50	10	50	10	50	10	50	10	50	10	50
DW	1.14		1.31		1.26		1.24		1.68		1.84	
Meth/SER	PLS	1.0	PLS	0.75	PLS	1.38	PLS	1.28	PLS	1.62	PLS	1.56

Note: ***, **, * denote significance at 1, 5 and 10 percent levels respectively. Dependent variable in columns (1)-(2) is the HICP inflation rate; it is the GDP deflator inflation rate in columns (3)-(4); and the import price deflator inflation rate in columns (5)-(6). Estimation is pooled OLS, with time dummies included. t-statistics in parentheses, based on Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors. Price level (t-1) is the lagged value of the PPP factor (from OECD); DNEER(t-1) is the lagged value of the rate of appreciation of the nominal effective exchange rate (from IFS); Output gap is from the OECD; Fiscal stance is deviation of the ratio of the primary surplus to GDP from its lagged five-year moving average (fiscal data from OECD).

Panel B: GMM Estimates

	1.7		1.8		1.9	
	HICP		PGDP		PIMP	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Lagged Price Level	-0.035	(3.6)***	-0.067	(6.6)***	-0.02	(1.0)
DNEER(t-1)	0.14	(0.0)	-0.52	(2.9)***	-0.54	(3.1)***
Output Gap	0.43	(8.4)***	0.37	(4.3)***	-0.08	(0.5)
Fiscal Stance	0.12	(1.2)	0.09	(0.9)	-0.32	(1.5)
Adj R2	0.57		0.54		0.84	
Countries/NOBS	10	50	10	50	10	50
DW	1.36		1.71		1.62	
Meth/SER	GMM	0.74	GMM	1.25	GMM	1.59

Note: ***, **, * denote significance at 1, 5 and 10 percent levels respectively. Dependent variable in column (1) is the HICP inflation rate; it is the GDP deflator inflation rate in column (2); and the import price deflator inflation rate in column (3). Estimation is pooled GMM, with time dummies included. t-statistics in parentheses, based on Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors. Price level (t-1) is the lagged value of the PPP factor (from OECD); DNEER(t-1) is the lagged value of the rate of appreciation of the nominal effective exchange rate (from IFS); Output gap is from the OECD; Fiscal stance is deviation of the ratio of the primary surplus to GDP from its lagged five-year moving average (fiscal data from OECD). Instruments are lagged values for output gap and fiscal stance.

Table 2: *Inflation differentials under EMU, 1999-2003 (Annual data): Exchange Rate Asymmetries?*

Panel A: Least Squares Estimates

	2.1		2.2		2.3		2.4		2.5		2.6	
	HICP		HICP		PGDP		PGDP		PIMP		PIMP	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Price Level (t-1)	-0.04	(4.3)***	-0.042	(5.7)***	-0.054	(3.9)***	-0.057	(4.3)***	-0.013	(0.8)	-0.02	(1.2)
DNEERPOS(t-1)	0.96	(1.7)*	0.71	(1.6)	-0,29	(0.4)	-0.48	(0.6)	-1.16	(1.2)	-1.11	(1.2)
DNEERNEG(t-1)	-0.50	(3.3)***	-0.17	(1.3)	-0.73	(3.3)***	-0.43	(1.8)*	-0.41	(1.6)	-0.36	(1.3)
Output Gap			0.37	(5.6)***			0.33	(2.8)***			0.06	(0.4)
Fiscal Stance			0.11	(1.7)*			0.008	(0.1)			-0.26	(1.9)*
Adj R2	0.30		0.58		0.43		0.51		0.84		0.85	
Countries/NOBS	10	50	10	50	10	50	10	50	10	50	10	50
DW	1.32		1.49		1.28		1.24		1.76		1.94	
Meth/SER	PLS	0.94	PLS	0.73	PLS	1.39	PLS	1.3	PLS	1.63	PLS	1.57

Note: ***, **, * denote significance at 1, 5 and 10 percent levels respectively. Dependent variable in columns (1)-(2) is the HICP inflation rate; it is the GDP deflator inflation rate in columns (3)-(4); and the import price deflator inflation rate in columns (5)-(6). Estimation is pooled OLS, with time dummies included. t-statistics in parentheses, based on Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors. Price level (t-1) is the lagged value of the PPP factor (from OECD); DNEERPOS(t-1) equals DNEER(t-1) if the appreciation rate is positive and zero otherwise; DNEERNEG(t-1) equals DNEER(t-1) if the appreciation rate is negative and zero otherwise; Output gap is from the OECD; Fiscal stance is deviation of the ratio of the primary surplus to GDP from its lagged five-year moving average (fiscal data from OECD).

Panel B: GMM Estimates

	2.7		2.8		2.9	
	HICP		PGDP		PIMP	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Lagged Price Level	-0.038	(4.1)***	-0.069	(5.8)***	-0.02	(1.1)
DNEERPOS(t-1)	0.53	(1.4)	-0.08	(0.1)	-1.01	(2.1)**
DNEERNEG(t-1)	-0.06	(0.8)	-0.57	(2.8)***	-0.48	(2.4)**
Output Gap	0.42	(7.4)***	0.36	(3.4)***	-0.06	(0.4)
Fiscal Stance	0.12	(1.5)	0.09	(1.0)	-0.32	(1.5)
Adj R2	0.58		0.53		0.84	
Countries/NOBS	10	50	10	50	10	50
DW	1.40		1.76		1.67	
Meth/SER	GMM	0.73	GMM	1.27	GMM	1.61

Note: ***, **, * denote significance at 1, 5 and 10 percent levels respectively. Dependent variable in column (1) is the HICP inflation rate; it is the GDP deflator inflation rate in column (2); and the import price deflator inflation rate in column (3). Estimation is pooled GMM, with time dummies included. t-statistics in parentheses, based on Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors. Price level (t-1) is the lagged value of the PPP factor (from OECD); DNEERPOS(t-1) equals DNEER(t-1) if the appreciation rate is positive and zero otherwise; DNEERNEG(t-1) equals DNEER(t-1) if the appreciation rate is negative and zero otherwise; Output gap is from the OECD; Fiscal stance is deviation of the ratio of the primary surplus to GDP from its lagged five-year moving average (fiscal data from OECD). Instruments are lagged values for output gap and fiscal stance.

Table 3: *Quarterly panel regressions linking CPI inflation to exchange rate strength*

	3.1		3.2		3.3		3.4		3.5		3.6	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Constant	0.612	12.8	0.653	7.9	0.660	7.3	0.592	14.3	0.642	7.8	Fixed	effects
EUR-USD (log)	1.54	5.5	-0.37	0.7								
NEER (log)			-6.27	2.3	-7.89	7.0	-5.90	6.7			-8.76	7.9
NEER(-1) (log)									-6.35	5.4		
AR(4)	0.565	9.4	0.572	10.4	0.686	11.5	0.585	9.8	0.641	9.8	0.516	7.0
RSQ w/uw	0.370		0.384		0.383		0.468	0.370	0.343		0.441	
Countries/NOBS	10	210	10	210	10	210	10	210	10	210	10	210
DW w/uw	2.07		2.08		2.08		2.03	2.07	2.18		2.32	
Meth/SER	PLS	0.403	PLS	0.399	PLS	0.399	GLS	0.403	PLS	0.411	PLS	0.388

Notes: All data from *International Financial Statistics* (*IFS*). Dependent variable is one-quarter log change in consumer price index (IFS 64); EUR-USD is no. of euros per US dollar quarterly average (*IFS* 136..rf); NEER is nominal effective exchange rate of each country quarterly average, rebased so that each country has sample mean=100 (*IFS* ..neu). Pooled cross-section and time series for 11 original adopters of the single currency except Luxembourg. Sample period is 1999Q1 to 2004Q1 (panel is complete). RSQ and DW w/uw denotes weighted and unweighted R-squared and Durbin-Watson statistics respectively; Countries is number of countries; NOBS is total number of observations; Meth is estimation method (EVIEWS): GLS Generalized Least Squares weighted by cross-sectional variances. [File HLQ 0704]

Table 4: *Quarterly panel regressions linking CPI inflation to exchange rate strength – robustness to addition of output gap & fixed time effects*

	4.1		4.2		4.3		4.4		4.5		4.6	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Constant	0.690	7.0	0.599	13.9	0.644	7.7	0.024	1.7	Fixed	effects	Fixed	effects
NEER (log)	-8.68	6.6	-5.99	7.0			-4.49	2.6	-13.6	3.0		
NEER(-1) (log)					-5.73	4.1					-11.6	2.2
OGAP (10x)	-0.16	0.9	-0.04	0.4	0.11	0.6	0.05	0.4	0.03	0.2	-0.01	0.6
AR(4)	0.700	11.9	0.584	9.6	0.628	9.3						
Time dummies	No		No		No		Yes		Yes		Yes	
RSQ w/uw	0.383		0.466	0.367	0.339		0.408		0.548		0.542	
Countries/NOBS	10	200	10	200	10	200	10	208	10	208	10	208
DW w/uw	2.09		2.01	2.07	2.20		2.24		2.87		2.88	
Meth/SER	PLS	0.402	GLS	0.408	PLS	0.416	PLS	0.409	PLS	0.367	PLS	0.369

Notes: All data from *International Financial Statistics* (*IFS*). Dependent variable is one-quarter percentage change in consumer price index (IFS 64); NEER is nominal effective exchange rate of each country quarterly average, rebased so that each country has sample mean=100 (*IFS* ..neu). Pooled cross-section and time series for 11 original adopters of the single currency less Luxembourg. Sample period is 1999Q1 to 2004Q1 (panel is complete except for Portugal and Spain, 1999 and 2004Q1). RSQ and DW w/uw denotes weighted and unweighted R-squared and Durbin-Watson statistics respectively; Countries is number of countries; NOBS is total number of observations; Meth is estimation method (EVIEWS): PLS Pooled Least Squares; GLS Generalized Least Squares weighted by cross-sectional variances. [File HLQ 0704]

Table 5: *Quarterly panel regressions linking CPI inflation to exchange rate strength – robustness to substitution of REER for NEER*

	5.1		5.2		5.3		5.4		5.5	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Constant	0.654	9.0	0.631	9.2	0.585	17.2	Fixed	effects	Fixed	effects
REER (log)	-4.88	5.6								
REER(-1) (log)			-4.50	4.9	-4.41	5.0	-3.68	3.2	-2.02	1.3
OGAP (10x)					0.01	0.1	0.01	0.1	0.02	0.0
AR(4)	0.582	7.7	0.545	7.3	0.541	7.6				
Time dummies	No		No		No		No		Yes	
RSQ	0.369		0.352		0.346		0.222		0.527	
Countries/NOBS	10	200	10	200	10	200	10	208	10	208
DW	2.06		2.21		2.21		2.66		2.78	
Meth/SER	PLS	0.403	PLS	0.408	PLS	0.414	PLS	0.456	PLS	0.375

Notes: All data from *International Financial Statistics* (*IFS*). Dependent variable is one-quarter percentage change in consumer price index (IFS 64); REER is nominal effective exchange rate based on private consumption deflator first month of each quarter, rebased so that each country has sample mean=100 (Source: European Commission q_rer_emu). Pooled cross-section and time series for 11 original adopters of the single currency less Luxembourg. Sample period is 1999Q1 to 2004Q1 (panel is complete except for Portugal and Spain, 1999 and 2004Q1). RSQ and DW w/uw denotes weighted and unweighted R-squared and Durbin-Watson statistics respectively; Countries is number of countries; NOBS is total number of observations; Meth is estimation method (EVIEWS): PLS Pooled Least Squares; GLS Generalized Least Squares weighted by cross-sectional variances. [File HLQ 0704]

Table 6: *Quarterly time series regressions: Inflation dispersion and exchange rate*

	6.1		6.2		6.3		6.6	
Dependent variable	std dev infl		std dev infl		std dev infl		max less min	
	Coeff	t-stat	Coeff	Coeff	t-stat	t-stat	Coeff	t-stat
Constant	0.964	25.2	0.985	24.5	0.999	6.0	3.55	12.5
EUR/USD (log)	1.12	2.7	1.49	3.0	1.16	2.6	2.63	4.4
OGAP (st dev)			-0.039	0.8			-0.136	1.0
OGAP (mean)					-0.017	0.2		
AR(1)	0.522	2.8	0.385	1.7	0.517	2.7	0.349	4.0
AR(4)	-0.269	1.6	-0.362	1.9	-0.280	1.5	0.604	8.1
RSQ /NOBS	0.671	21	0.674	21	0.672	21	0.918	21
DW	1.51		1.57		1.49		1.43	
Meth/SER	OLS	0.130	OLS	0.133	OLS	0.134	OLS	0.258

Notes: Dependent variable is the cross-sectional standard deviation (or the spread between max and min) of the FOUR-quarter log change in consumer price index (IFS 64); EUR-USD is no. of euros per US dollar quarterly average (*IFS* 136..rf); OGAP is the cross-sectional mean (or standard deviation) of the output gap (source: OECD). Data are computed for the original adopters of the single currency less Luxembourg.

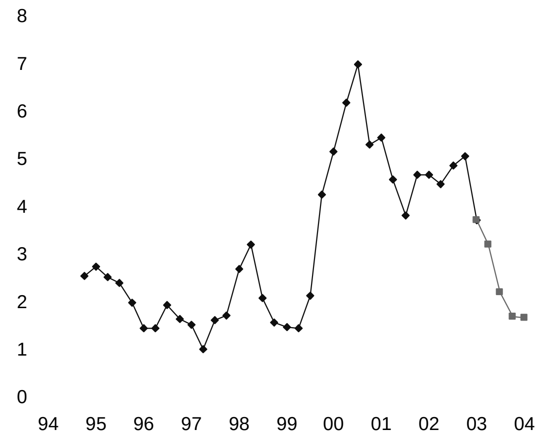

Fig 1: *Irish inflation 1995-2004*
Note: 12-month moving average of log-change in CPI plotted quarterly. Last observation is May 2004. Source: Central Statistics Office of Ireland

(a) (b)

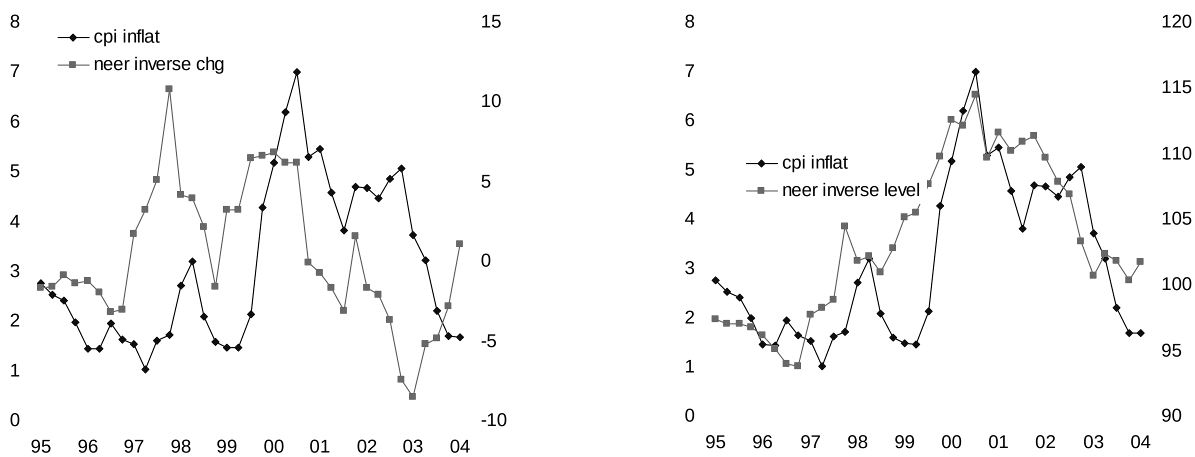

Fig 2: *Irish consumer price inflation and nominal effective exchange rate index1995-2004*
Note: 12-month moving average of percentage change (plotted quarterly) in CPI (left hand scale) and in nominal effective exchange rate index (right hand scale). Panel (b) shows level of exchange rate instead of change. (Source for CPI is Central Statistics Office of Ireland; for exchange rate index is Central Bank of Ireland's TWCI index, both monthly average).

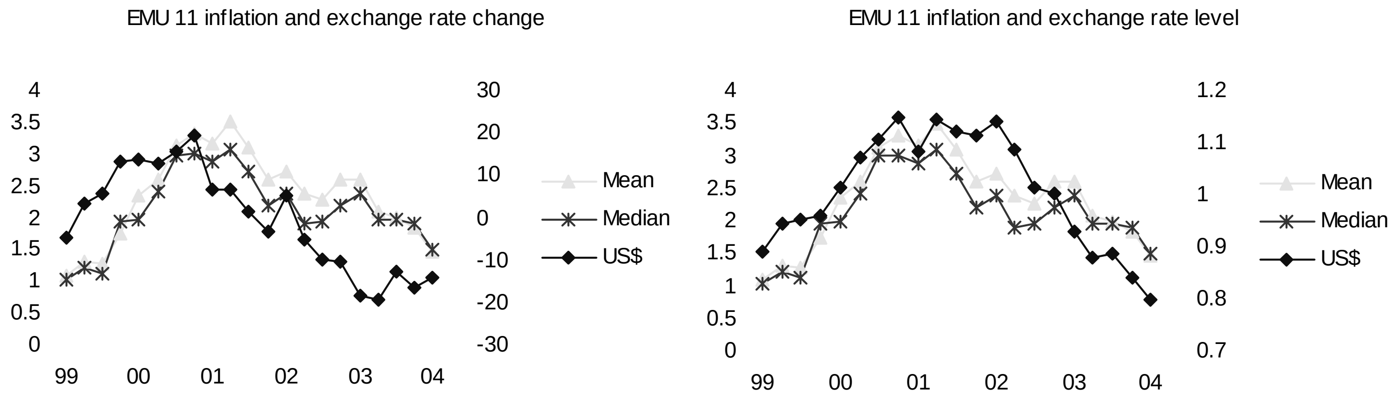

Fig 3: *EMU inflation and exchange rate (a) change (b) level 1999-2004*
Note: 12-month moving average of percentage change (mean and median across 11 EMU participants, plotted quarterly) in CPI (left hand scale) and in EUR-USD exchange rate (right hand scale). Panel (b) shows level of exchange rate instead of change. (Source: *International Financial Statistics* line 64 and line 136..rf).

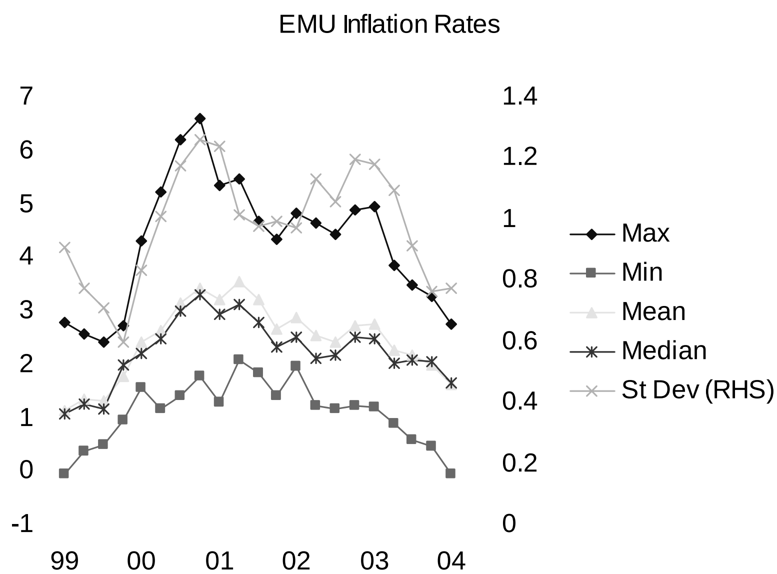

Fig 4: *EMU inflation rates: summary statistics 1999-2004*
Note: This plots for every quarter the max, min, mean, median and standard deviation across 11 EMU participants of 12-month CPI inflation. (Source: International Financial Statistics line 64).

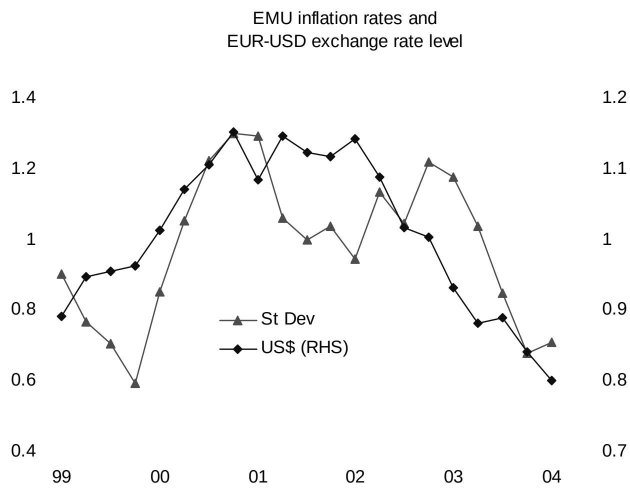

Fig 5: *EMU inflation dispersion and exchange rate 1999-2004*
Note: This plots the standard deviation across 11 EMU participants of 12-month CPI inflation (left hand scale) against the EUR-USD exchange rate (right hand scale). (Source: International Financial Statistics line 64 and line 136..rf).