Better Off without the Euro? Evaluating Monetary Policy and Macroeconomic Performance for Denmark, Sweden and the UK

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Abstract

This paper studies the contribution of independent monetary policy towards the improvement in macroeconomic performance experienced by Denmark, Sweden, and the U.K. in the post-Euro years. In particular, I analyze whether or not further declines in macroeconomic volatility could have been attained if these three countries would have instead adopted the Euro starting January 1999.

The results suggest that, while independent monetary policy has played a sizeable role in contributing to the reduction in inflation and real growth fluctuations, none of these countries would have experienced a larger macroeconomic performance gain if they had joined the EMU from 1999 onward.

JEL classification: E52, E58

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1 Introduction

Since the mid 1980s, industrialized and emerging economies alike have experienced a considerable decline in macroeconomic volatility. In the past 8 years, in particular, inflation and economic activity have reverted back to their levels of the 1960s - generally considered a decade of prosperity - for most countries. Western and central European countries are an example of this greater stability. To confirm this claim, it is useful to compare data on economic performance for 13 European countries: 10 which adopted the Euro as a common currency in 1999 (2001, in the case of Greece),[1] and the three countries which opted not to enter Stage III of the Maastricht Agreement (namely Denmark, Sweden, and the U.K.). For these 13 countries, median inflation decreased from 4.93% (with a median standard deviation of *1.74%*; henceforth in italics) in the period 1983:I-1990:IV, to 2.54% (*1.51%*) between 1991:I and 1998:IV, and further stabilized to 2.01% (*0.60%*) in 1999:I-2006:IV. While it is true that median GDP growth was lower (1.99% versus 2.88%) and more volatile (standard deviation of *1.81%* versus to *1.66%*), when comparing 1991:I-1998:IV to 1983:I-1990:IV; real growth has partially bounced back to a median rate of 2.17%, and has become substantially more stable (*1.33%*) in the period 1999:I-2006:IV.

Several studies have looked into the underlying causes of this reported reduction in macroeconomic volatility. Better monetary policy is generally associated with greater price stability; whether it is the a result of increased central bank independence (Alesina, 1988; Grilli, Masciandaro and Tabellini, 1991; Cukierman, 1992; Alesina and Summers, 1993; and Eijffinger, van Rooij and Schaling, 1996); a shift towards an inflation-targeting (IT) regime (Bernanke, Laubach, Mishkin and Posen, 1999; Corbo and Schmidt-Hebbel, 2001; Neuman and von Hagen, 2002; and Mishkin and Schmidt-Hebbel, 2002); or structural changes in the way that monetary authorities conduct policy (in particular, increased central bank transparency and accountability - see Walsh, 1995; Fry, Julius, Mahadeva, Rogers, and Sterne,

[1] We do not include Ireland and Luxembourg, since quarterly GDP data for these two countries is only available since 1997:I, and 1995:I, respectively.

2000; Faust and Svensson 2001; Jensen, 2002; Chortareas, Stasavage and Sterne, 2002; and Geraats, 2002).

Turning to the reduction in business cycle fluctuations, the literature has identified a plethora of reasons for the "Great Moderation" (Blanchard and Simon, 2001; Stock and Watson, 2003). Some of these are: *(i)* improved inventory management policies (McConnell and Pérez Quirós, 2000; McConnell and Kahn 2005; Herrera and Pesavento, 2005); *(ii)* financial innovation and improvements in risk sharing (Dynan, Elmendorf and Sichel, 2006; Beakaert, Harvey and Lundblad, 2006); *(iii)* reduction in the impact of shocks to the economy (Ahmed, Levin and Wilson, 2002; and Stock and Watson, 2002); and *(iv)* better monetary policy (Clarida, Galí and Gertler, 2000; Cecchetti, Flores-Lagunes and Krause, 2006).

The evidence therefore suggests that Central Banks have played a decisive role in reducing both the level and the variability of inflation; and have likely contributed (at least partially) to smoothing business cycles as well. In that spirit, this paper asks how much of the improvement in macroeconomic performance experienced by Denmark, Sweden, and the U.K. over the period 1999:I-2006:IV is due to increased efficiency in the conduct of independent monetary policy. In particular, this paper analyzes whether or not further declines in macroeconomic volatility could have been attained if these three countries would have instead adopted the Euro starting January 1999.

The pros and cons of joining a currency union (political considerations aside) have been oft studied and debated (see Alesina and Barro, 2002; and Engel and Rose, 2002; among others). The main objection to joining a monetary union is the resulting loss of an independent monetary policy, and the ability to set a different inflation target (the U.K and Sweden adopted an IT regime in October of 1992, and January 1993, respectively; while Denmark's inflation has been close to 2% since the early 1990s); while the primary benefit consists of the elimination of exchange rate uncertainty for trade with countries forming part of the currency union (for all three countries, mostly Denmark and Sweden, the share of trade with Euro-Area countries is quite substantial).

In order to establish whether or not Denmark, Sweden, and the U.K. have been better off without joining the 3rd stage of the European and Economic and Monetary Union (EMU), I perform a counterfactual exercise to establish how the dynamics of inflation and output growth would have evolved if these three countries would have set a fixed exchange rate vis-a-vis the Euro and, more importantly, if the relevant policy instrument would have been the European Central Bank (ECB) interest rate. To this end, I replicate 1,000 "alternate economies" for each country for the period 1999:I-2006:IV, and compare the macroeconomic performance (in terms of inflation and GDP growth variability) to the actual data for that period.

The remainder of the paper is organized as follows. Section 2 compares the macroeconomic performance changes experienced by Denmark, Sweden, and the U.K. between the pre- and post-Euro periods. Section 3 details the set-up and estimation of an aggregate demand - aggregate supply (AD-AS) model, that will later be employed to gauge the role monetary policy has played in the observed changes in macroeconomic performance in Section 4. Section 5 presents the counter-factual analysis to measure macroeconomic performance under the Euro. The results from these two sections suggest that, while independent monetary policy played a key role in contributing towards the reduction in inflation and real growth fluctuations for Denmark, Sweden, and the U.K., none of these countries would have experienced larger macroeconomic performance gains if they had joined the EMU in 1999. Finally, Section 6 presents some concluding remarks.

2 Changes in Macroeconomic Performance

Figures 1.1 and 1.2 document the decline in macroeconomic volatility that Denmark, Sweden, and the U.K. have experienced between the pre- and the post-Euro period. The top part of Figure 1.1 reports the standard deviation of the real GDP growth rate, after applying an HP-filter to the series, while the bottom part reports the standard deviation from the actual data series. Overall, real volatility has decreased almost by 50% for all countries in the 1999:I-2006:IV period, compared to the 1991:I-1998:IV period; with the actual series presenting the sharpest reduction, as expected.

Figure 1.1: Change in real GDP growth volatility
(1991:I-1998:IV vs. 1999:I-2006:IV)

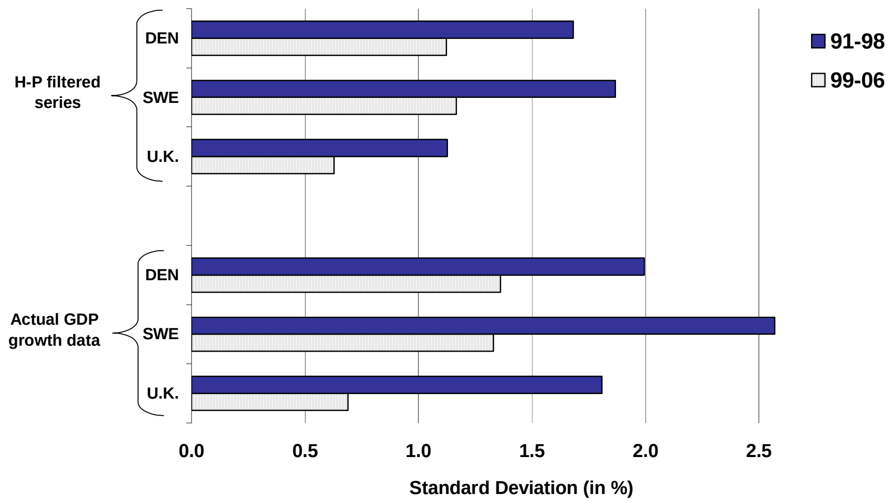
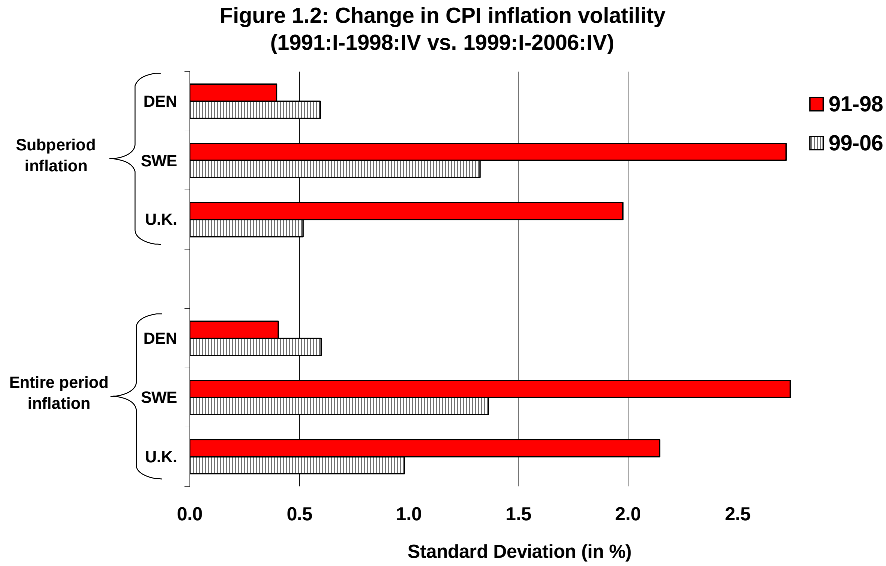


Figure 1.2 shows how the standard deviation has changed between the two periods, with the top part reporting the volatility measure using each period's average inflation as the center point, and the bottom part reporting it centering average inflation for the entire 1991:I-2006:IV period as the center. Given the relatively low levels of inflation prevalent for these three countries since the beginning of the 1990s, the magnitudes of the standard deviations are very similar, with the exception of the U.K., for which average inflation in the first period was over 1.6% higher than in the latter period. Still, the general observation is that for Sweden and the U.K., inflation volatility has fallen by more than 50%, while for Denmark it increased slightly (and remained relatively low when compared to the other two countries).



The above figures serve not only to show the actual improvement in macroeconomic performance that the three countries experienced in the most recent period, but also help to illustrate that the measured change in the volatility of both inflation and output growth does not change perceptibly with a different choice of center points or targets. I will return to this last point later in the paper.

3 Model Specification

3.1 Estimating the AD-AS Model

Estimating the dynamics of output growth and inflation assists in performing the two tasks of interest: First, the estimated coefficients are used to derive the Taylor (1979) frontier for each country and each subperiod; this *efficiency frontier* is the main identification tool I employ to determine how much of the observed changes in macroeconomic performance are due to more efficient policy, as in Cecchetti et. al. (2006). I describe this in more detail in Section 4. Second, the specification will serve to perform the counterfactual analysis, and generate alternative scenarios for the dynamic behavior of real growth and inflation under the adoption of the Euro, as I explain in Section 5.

The AD-AS model should be general enough for all three countries of interest, to allow for direct comparisons; and meet all model specification criteria. With this in mind, I estimate the following specification:

$$y_t = \sum_{l=1}^{4} \alpha_{1l} y_{t-l} + \phi(\iota_{t-1} - \pi_{t-1}) + u_{yt} \ , \tag{1}$$

$$\pi_t = \sum_{l=1}^{4} \alpha_{2l} \pi_{t-l} + \gamma y_{t-1} + \sum_{k=0}^{1} \psi_{k+1}(e_{t-k} + \pi^x_{t-k}) + u_{\pi t} \ . \tag{2}$$

The first equation represents an aggregate demand or IS curve. It relates real GDP growth, y, to four of its own lags to account for the persistent nature of output growth; and one lag of the real interest rate, $i - \pi$, which captures the effect of intertemporal substitution in consumption (Clarida, Galí and Gertler, 1999). The second equation is an aggregate supply or Phillips curve. Here, inflation is assumed to be a function of four of its own lags, representing inflation expectations, one lag of GDP growth accounting for the pressure on prices of increased economic activity. Since this implies are dealing with open economies, I augment this equation with the contemporaneous and one-lagged values of external price inflation, to account for the inter-relation between the economy of interest and that of its main trading partner.[2] The error terms u_y and u_π are assumed to be mean zero and constant variance. This formulation is based on the empirical observation that monetary policy actions affect industrial production before inflation (see, for instance, the empirical model in Rudebusch and Svensson, 1999; and the theoretical model of Svensson, 1997; among others).

I estimate equations (1) and (2) for each country separately for the entire period and both subperiods, using quarterly data taken from the OECD Main Economic Indicators. The results are shown on Tables 1.1 - 3.2.

[2] External price inflation is measured as the sum of the annualized devaluation rate and the inflation of the main trading partner: the U.S. for the case of the U.K.; and Germany for the case of Denmark and Sweden.

(((Tables 1-3 about here)))

Tables 1.1 and 1.2 report the estimates for Denmark, with the first column of each table displaying the coefficients for the entire sample, and columns 2 and 3 show the ones for each subperiod. The estimates from the growth equation confirm that real GDP growth is highly persistent, and that increases in the lagged value for the real interest rate are associated with a reduction in aggregate economic activity. Turning to the inflation equation, only the own first lagged value is significant, while the remaining variables appear with the expected coefficients but are insignificant for the entire period and the subperiods.

The results for the growth equation in the cases of Sweden and the U.K. in Tables 2.1. and 3.1, respectively, are analogous to the ones for Denmark: there is strong evidence suggesting a negative and significant effect of the real interest rate on aggregate activity. For these two countries, external inflation does enter with a positive and significant coefficient in the inflation equation in most of the subperiods, as documented in Tables 2.2 and 3.2.

It is important to add that the general model specification fits the data well. Adjusted R-squared statistics range between 0.51 and 0.80 for the case of Denmark; 0.68 and 0.92 for Sweden; and 0.67 and 0.93 for the U.K. I discuss some further diagnostics tests in the following subsection.

3.2 Diagnostic and Specification Analysis

In this section I undertake several diagnostic and specification tests of the two-equation AD-AS model in equations (1) and (2). Specifically, I discuss the time-series properties of the data, and the characteristics of the estimated residuals.

A first test of model adequacy is to establish that the estimated residuals are independent. Autocorrelation would be evidence of misspecification. Using a Durbin-h test applied to the residuals of the two-equation model, there is no evidence to reject the null hypothesis of no autocorrelation at a 10% level or higher for all of the countries in the sample. The lag structure was chosen to satisfy this criteria. There is also no evidence of autoregressive conditional heteroskedasticty: for all countries and all periods at the 5% significance level, and for all but two at the 10% level, which suggests that the residuals are spherical.[3]

Finally, for the derivation of the efficiency frontier and the application of the simulation method proposed in Section 5, it is necessary for the residuals be stationary. This requires either that the endogenous variables be stationary themselves, or for some cointegrating relationship to be present among them. Since the distinction between these two is immaterial for the purposes of the analysis I conduct in Section 5, I perform a test for the non-stationarity of the estimated residuals. Using the Phillips-Perron (1988) test leads to rejecting the null hypothesis of non-stationarity at the 1% significance level in all countries for both subperiods and the entire period. This is strong support for the compatibility of the model specification with the integration properties of the data.

4 Measuring Monetary Policy Efficiency

4.1 Estimating the Efficiency Frontier

Following Taylor (1979) and the method by employed by Cecchetti et al. (2006), the *efficiency frontier* can be derived by minimizing a central bank's objective function, subject to the constraints imposed by the dynamic structure of the economy in equations (1)-(2). The derivation of the frontier follows directly from the method by Cecchetti et al. (2006); therefore, I will only briefly describe it and modify it accordingly to account for the structural model estimated above.

I begin by expressing the model in equations (1)-(2) using its state-space representation:

$$Y_t = BY_{t-1} + ci_{t-1} + DX_t + v_t \tag{3}$$

[3] The only exceptions are the growth equation for the second subperiod in the case of Denmark (p-value of 0.09); and the growth equation for the entire period in the case of Sweden (p-value of 0.07).

$$\text{where: } Y_t = \begin{bmatrix} y_t \\ y_{t-1} \\ y_{t-2} \\ y_{t-3} \\ \pi_t \\ \pi_{t-1} \\ \pi_{t-2} \\ \pi_{t-3} \end{bmatrix}; \; B = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} & \alpha_{14} & -\phi & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ \gamma & 0 & 0 & 0 & \alpha_{21} & \alpha_{22} & \alpha_{23} & \alpha_{24} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix};$$

$$c = \begin{bmatrix} \phi \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}; \; D = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ \psi_1 & \psi_2 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}; \; X_t = \begin{bmatrix} e_t + \pi_t^x \\ e_{t-1} + \pi_{t-1}^x \end{bmatrix}; \; \upsilon_t = \begin{bmatrix} u_{yt} \\ 0 \\ 0 \\ 0 \\ u_{\pi t} \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

The policy maker's problem is to choose a path for the interest rate, i_t, in order to minimize the following loss function:

$$\mathcal{L} = \lambda var(\pi_t) + (1 - \lambda) var(y_t), \tag{4}$$

subject to the constraints imposed by (3), where λ represents the relative weight the monetary policy maker places on stabilizing inflation. The solution for the interest rate can be written as:

$$i_t = \Gamma Y_t + \Psi \tag{5}$$

where Γ is the vector of reaction coefficients of the monetary authority to inflation and output changes, and Ψ is a constant term which depends on B, c, and D. The control problem is solved by finding Γ such that:[4]

$$\Gamma = -(c'Hc)^{-1}c'HB \tag{6}$$

and

$$H = \Lambda + (B + c\Gamma)'H(B + c\Gamma) \tag{7}$$

where Λ is an 8x8 matrix containing the relative weights given to GDP growth and inflation variability on the first and fifth diagonal elements, respectively, and zeros elsewhere. The efficiency frontier is then derived by applying this procedure for different values of λ ranging between 0 and 1.

4.2 Contribution of Monetary Policy to Macroeconomic Performance Improvements

Figures 2.1-2.3 display the estimated frontiers for the two subperiods of interest, 1991:I-1998:IV and 1999:I-2006:IV, for Denmark, Sweden, and the U.K., respectively. In each of these graphs I also include the macroeconomic *performance point* for each subperiod, which is given by the pair of standard deviations of real GDP growth and inflation. The standard deviation of real economic activity is measured by applying an H-P filter to the original GDP series, and the computing the variance of the resulting growth rates. It is worthwhile to note that the results are similar to the ones obtained when using the standard deviation of the actual growth rates, and are analogous up to a re-scaling factor when measuring the volatility of the output gap instead of the growth rate. Similarly, given the low levels of inflation for the three countries over the entire period, the choice of the central point to compute the standard deviation of inflation does not significantly affect the results.

[4] For a more detailed technical exposition of this procedure, see Chow (1975), pp. 156-160.

Figure 2.1: Efficiency Frontiers and Performance Points
(Denmark: Comparison across subperiods)

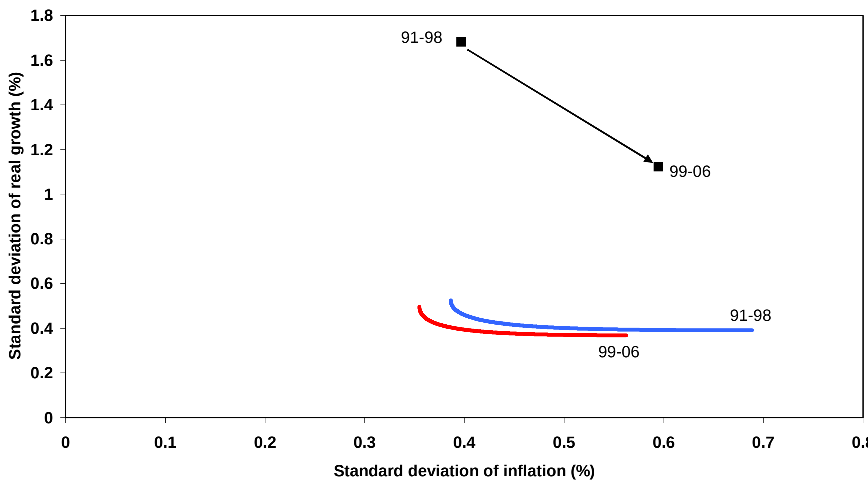


Figure 2.2: Efficiency Frontier and Performance Point
(Sweden: Comparison across subperiods)

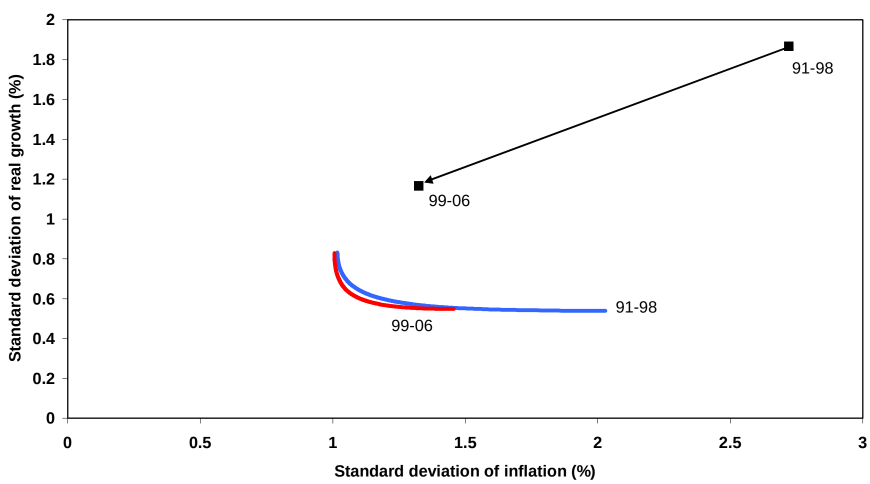
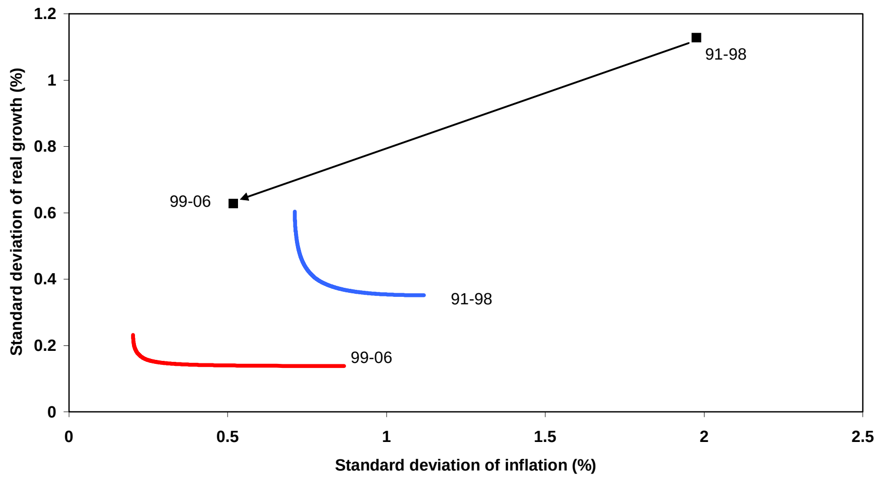


Figure 2.3: Efficiency Frontier and Performance Point
(UK: Comparison across subperiods)



The graphical comparison across subperiods leads to some interesting observations. First, since a point moving closer to the origin is associated with both inflation and economic activity having become more stable, there is no ambiguity that Sweden and the U.K. have experienced a macroeconomic performance improvement, which is consistent with Figures 1.1 and 1.2. For Denmark this is not clear, since the volatility of inflation has increased, at the same time as GDP growth has become more stable. A second observation is that for all three countries (and mainly for the U.K.) the efficiency frontiers have moved towards the origin in the most recent period, which is an indication of a reduction in the magnitude of supply shocks to these economies (Cecchetti et. al, 2006).

In order to determine the relative importance monetary policy has played in assisting the observed changes in macroeconomic volatility, I apply the *measures of performance and policy efficiency* developed by Cecchetti et al. (2006). The authors employ the loss function in equation (4) and define changes in macroeconomic performance as:

$$\Delta P = \lambda \left[Var(\pi_1) - Var(\pi_2) \right] + (1 - \lambda) \left[Var(y_1) - Var(y_2) \right], \tag{8}$$

where subscript 1 in the current context represents the subperiod 1991:I-1998:IV and subscript 2, the subperiod 1999:I-2006:IV. Changes in policy efficiency are captured by:

$$\Delta E = \lambda \left\{ [Var(\pi_1) - Var(\pi_1)^*] - [Var(\pi_2) - Var(\pi_2)^*] \right\} + (1-\lambda) \left\{ [Var(y_1) - Var(y_1)^*] - [Var(y_2) - Var(y_2)^*] \right\}, \tag{9}$$

where $Var(\pi_i)^*$ and $Var(y_i)^*$ are the variabilities of inflation and output under optimal policy for period $i = 1, 2$, respectively. These optimal variances are obtained from the corresponding values of the variance pair in the efficiency frontier.

From the two above measures, the proportion of macroeconomic performance improvement that can be accounted for by improved policy is given by:

$$Q = \frac{\Delta E}{|\Delta P|} \tag{10}$$

Table 4 reports the estimates of ΔP (and its percent change); ΔE; and Q for Denmark, Sweden and the U.K., for three different values of the parameter λ. In the case of Denmark, the performance improvement has been relatively modest: ΔP ranges from -0.02 to 0.33. The small change in macroeconomic performance makes it difficult to assess the policy contribution. While more efficient policy accounts for 92% and 84% when choosing a value for λ of 0.7 and 0.8, respectively, setting the preference parameter to 0.9 would signify a negative (yet small) contribution of the central bank's actions to the reduction of macroeconomic volatility.

(((Table 4 about here)))

For Sweden and the U.K., the findings paint a more clear-cut picture. Improvement in macroeconomic performance for Sweden is in the order of 76%-78%, and, given that the efficiency frontier only experienced a slight inward shift, almost all of this performance improvement is the result of more efficient policy. Finally, for the U.K., the percent gain in macroeconomic performance ranges between 93% and 94%, with the central bank being responsible for more than nine tenths of the improvement in inflation and real growth stability that the country experienced in the subperiod of 1999:I-2006:IV.

These results confirm that Sweden, the U.K., and, to a lesser extent, Denmark, have accomplished a successful stabilization of inflation and economic activity since 1999, much of it due to the implementation of an efficient, independent monetary policy. Could these countries have done even better if they had adopted the Euro? This is the question I intend to answer in the following section.

5 Macroeconomic Performance under the Euro

5.1 Generating the "alternate economies"

Now I turn to the question of examining how macroeconomic performance for Denmark, Sweden, and the U.K. would have changed, if these three countries would have joined the 3rd stage of the EMU. To answer this, it is necessary to model the dynamics that inflation and real economic activity would have followed if these three countries would have adopted the Euro on January 1999. In other words, I need to project alternative paths for inflation and GDP growth starting 1999, assuming that these three countries had a fixed exchange rate with respect to the Euro, and that their respective central banks had set their interest rate equal to the ECB rate.

The particular counterfactual analysis I conduct is based on a recursive bootstrap technique.[5] The following two assumptions are sufficient to apply the parametric recursive bootstrap: First, the estimated model for each country in equations (1) and (2) must be correctly specified. In Section 3.2, I have provided evidence about the validity of the model by running a series of specification tests. Second, the corresponding errors, u_{yt} and $u_{\pi t}$, must be independent but not (necessarily) identically distributed (*inid*). This latter assumption is satisfied

[5] For a detailed discussion of the procedure see Li and Maddala (1996).

by the evidence of stationarity and lack of serial correlation in the estimated residuals.

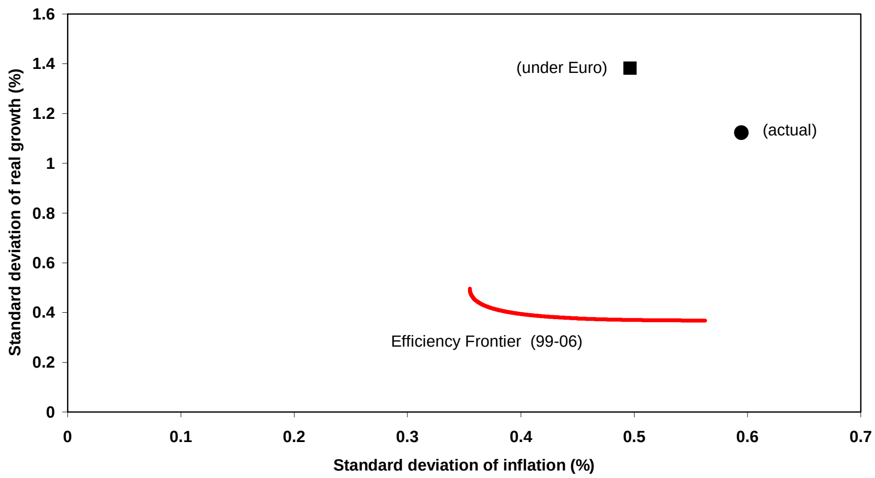
For each country, the bootstrap sample of real GDP growth and inflation is obtained in a recursive fashion, using the resulting parameters from estimating equations (1) and (2), while replacing each country's central bank rate with the ECB interest rate, and assuming a fixed exchange rate with respect to the Euro. I take the first four initial values of both real GDP growth and inflation as given, thus employing the respective original values for 1998:I-1998:IV. Finally, the error terms in each period for the generated paths of inflation and real growth are obtained by resampling with replacement from the matrix consisting of the estimated residuals from both equations of the structural model.

I iterate the above described process to obtain 1,000 bootstrap samples of "alternate economies". These replications allow me to generate 1,000 different values for the relevant measures of volatility (i.e., the standard deviations of both inflation and GDP growth) for the three economies of interest between 1999:I-2006:IV. I choose the average value (out of the 1,000 replications) of the pair of volatility measures, and set it as the estimate of the *performance point under the Euro.* It is worthwhile to note that the analysis conducted below would remain mainly unchanged if I chose the median value instead of the average.

5.2 Better or worse off without the Euro?

Figures 3.1-3.3 include the "new" performance point under the Euro, alongside the actual performance point and the efficiency frontier for the period 1999:I-2006:IV. Interestingly enough, the graphical analysis does not provide a definitive answer as to whether or not the three countries of interest would have been better off, had they adopted the Euro. For Denmark, as shown in Figure 3.1, the counterfactual exercise suggests that joining the EMU would have resulted in lower inflation volatility, at the expense of an increase in the volatility of real GDP growth.

Figure 3.1: Efficiency Frontier and Performance Points
(Denmark: Second subperiod)



As for Sweden and the U.K., the converse appears to be the case: both countries would have experienced a slightly more stable growth, but higher inflation volatility under the Euro, as depicted in Figures 3.2 and 3.3, respectively.

Figure 3.2: Efficiency Frontier and Performance Points
(Sweden: Second subperiod)

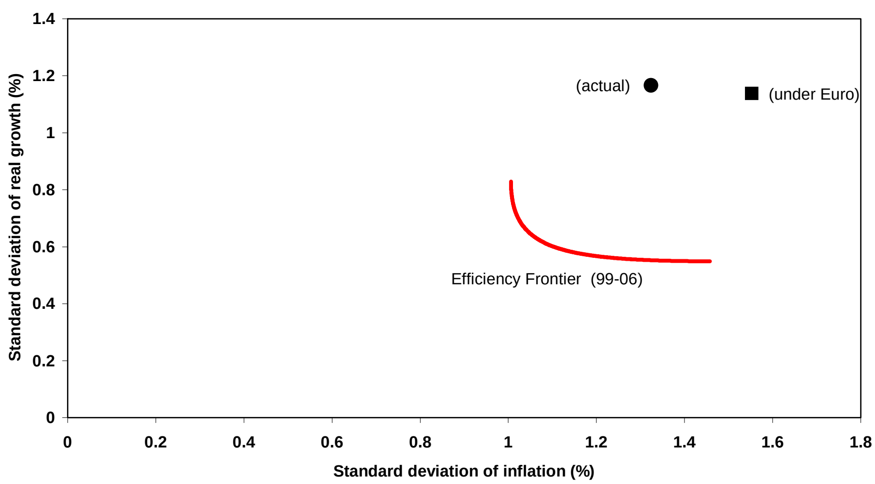
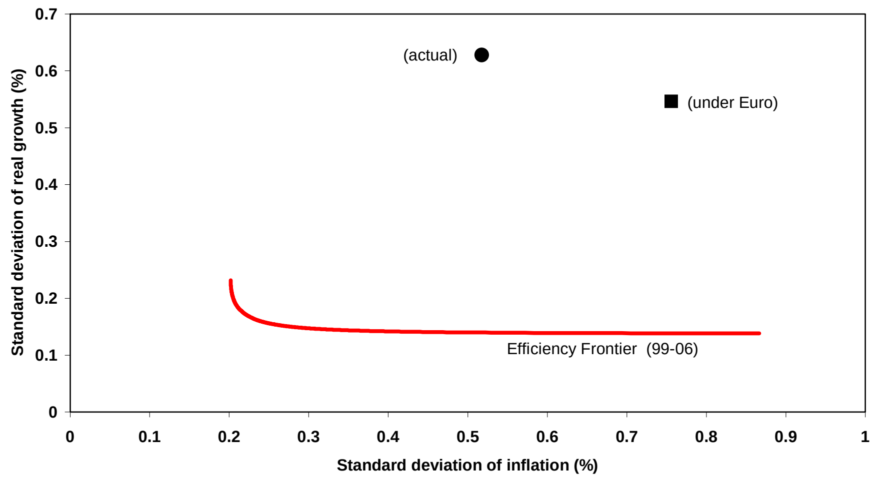


Figure 3.3: Efficiency Frontier and Performance Points
(UK: Second subperiod)



Since the graphical comparison does not provide unambiguous evidence as to whether joining the EMU might have proven to be beneficial or detrimental in terms of overall macroeconomic volatility, it is useful to again employ the performance measures to gauge the effect of adopting the Euro. Table 5 reports the macroeconomic performance change for all three countries, using the values of the variance of inflation and real growth from the performance point under the Euro. As in Table 4, I compute the measures for the three different values of λ, and I then compare this potential performance change with the actual change reported in Table 4.

(((Table 5 about here)))

For Sweden and the U.K. the outcome of this exercise is quite clear: If these two countries had joined the EMU, the reduction in macroeconomic volatility would have not been as successful as it was under independent monetary policy. The gain in macroeconomic performance from adopting the Euro would have been lower by about 10-11% for Sweden, and roughly 7-8% in the case of the U.K., irrespective of the choice made for λ. For Denmark, as before, the relatively small performance change leads to a mixed conclusion: When choosing λ as either 0.7 or 0.8, adopting the Euro would have resulted in a smaller performance gain, while for λ equal to 0.9, joining the EMU would have meant a slight performance gain.

Overall, these results suggest that Sweden and the U.K. have been better off stabilizing inflation and real growth fluctuations while conducting independent monetary policy, than they would have if they had decided to enter the 3rd stage of the Maastricht Agreement. For Denmark, one cannot conclude that it would have benefited at all by joining the EMU, unless its relative preference for inflation stability were in the order of 0.9 or higher. Even in this case, the measured benefits are quite insignificant.

6 Conclusions

In this paper I study the changes in macroeconomic volatility between the pre- and post-Euro periods for the three countries who opted out of joining the EMU: Denmark, Sweden and the U.K. I assess the role their respective independent monetary authorities have played in the stabilization process and then proceed to compare this outcome with a scenario in which these three countries would have adopted the Euro.

The two main observations that can be extracted from this analysis are: *(i)* monetary policy played a sizeable role in contributing to the reduction in inflation and real growth fluctuations, mostly for Sweden in the U.K.; and *(ii)* none of these countries would have experienced a larger macroeconomic performance gain if they had joined the EMU in 1999.

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Table 1.1
Denmark – Growth Equation

	1991-2006	1991-1998	1999-2006
GDP Growth (-1)	0.581 (0.00)	0.509 (0.00)	0.401 (0.02)
GDP Growth (-2)	0.070 (0.60)	-0.041 (0.82)	0.496 (0.01)
GDP Growth (-3)	-0.074 (0.57)	-0.057 (0.76)	0.052 (0.76)
GDP Growth (-4)	-0.294 (0.00)	-0.413 (0.00)	-0.213 (0.19)
Real Interest Rate (-1)	-0.056 (0.15)	-0.099 (0.09)	-0.340 (0.04)
Adjusted R-squared	0.505	0.578	0.540
Durbin alt. for autocorrelation	0.464 (0.50)	0.126 (0.72)	0.212 (0.65)
LM test for ARCH	0.191 (0.66)	2.799 (0.09)	1.581 (0.21)
D-F unit root test on residuals	-7.489 (0.00)	-6.448 (0.00)	-4.166 (0.00)
No. of Observations	64	32	32

p-values are in parentheses.

Table 1.2
Denmark – Inflation Equation

	1991-2006	1991-1998	1999-2006
CPI Inflation (-1)	1.135 (0.00)	0.943 (0.00)	1.220 (0.00)
CPI Inflation (-2)	-0.280 (0.11)	-0.248 (0.28)	-0.372 (0.21)
CPI Inflation (-3)	-0.097 (0.40)	-0.076 (0.62)	-0.052 (0.78)
GDP Growth (-1)	0.001 (0.97)	0.026 (0.37)	-0.007 (0.88)
External inflation	0.019 (0.44)	0.019 (0.49)	0.021 (0.81)
External inflation (-1)	-0.027 (0.28)	-0.016 (0.55)	-0.118 (0.17)
Adjusted R-squared	0.739	0.572	0.797
Durbin alt. for autocorrelation	0.252 (0.62)	2.518 (0.11)	0.553 (0.46)
LM test for ARCH	0.836 (0.36)	0.048 (0.83)	1.238 (0.27)
D-F unit root test on residuals	-7.810 (0.00)	-6.034 (0.00)	-6.904 (0.00)
No. of Observations	64	32	32

p-values are in parentheses.

Table 2.1
Sweden – Growth Equation

	1991-2006	1991-1998	1999-2006
GDP Growth (-1)	0.949 (0.00)	0.623 (0.00)	0.871 (0.00)
GDP Growth (-2)	-0.013 (0.93)	0.091 (0.56)	-0.022 (0.93)
GDP Growth (-3)	-0.239 (0.03)	0.373 (0.02)	-0.076 (0.77)
GDP Growth (-4)		-0.553 (0.00)	-0.254 (0.20)
Real Interest Rate (-1)	-0.021 (0.40)	-0.106 (0.00)	-0.109 (0.56)
Real Interest Rate (-2)	-0.058 (0.02)	-0.100 (0.00)	0.232 (0.19)
Adjusted R-squared	0.769	0.915	0.682
Durbin alt. for autocorrelation	0.551 (0.46)	0.121 (0.73)	1.798 (0.18)
LM test for ARCH	1.344 (0.25)	0.041 (0.84)	3.314 (0.07)
D-F unit root test on residuals	-8.231 (0.00)	-3.656 (0.00)	-7.199 (0.00)
No. of Observations	64	32	32

p-values are in parentheses.

Table 2.2
Sweden – Inflation Equation

	1991-2006	1991-1998	1999-2006
CPI Inflation (-1)	0.871 (0.00)	0.749 (0.00)	0.850 (0.00)
CPI Inflation (-2)	0.001 (0.99)	-0.091 (0.67)	0.075 (0.79)
CPI Inflation (-3)	0.154 (0.33)	0.298 (0.13)	-0.033 (0.90)
CPI Inflation (-4)	-0.154 (0.18)	-0.049 (0.77)	-0.047 (0.81)
GDP Growth (-1)	0.054 (0.40)	0.011 (0.86)	0.124 (0.52)
External inflation	0.046 (0.00)	0.053 (0.01)	0.017 (0.68)
External inflation (-1)	-0.023 (0.20)	-0.022 (0.34)	-0.012 (0.79)
Adjusted R-squared	0.887	0.934	0.693
Durbin alt. for autocorrelation	1.012 (0.31)	0.688 (0.41)	0.039 (0.84)
LM test for ARCH	0.148 (0.70)	0.131 (0.72)	0.051 (0.82)
D-F unit root test on residuals	-7.608 (0.00)	-6.052 (0.00)	-7.113 (0.00)
No. of Observations	64	32	32

p-values are in parentheses.

Table 3.1
U.K. – Growth Equation

	1991-2006	1991-1998	1999-2006
GDP Growth (-1)	1.091 (0.00)	1.115 (0.00)	0.982 (0.00)
GDP Growth (-2)	-0.245 (0.18)	-0.263 (0.35)	-0.211 (0.41)
GDP Growth (-3)	0.078 (0.66)	0.109 (0.68)	0.043 (0.86)
GDP Growth (-4)	-0.211 (0.06)	-0.224 (0.18)	-0.267 (0.16)
Real Interest Rate (-1)	-0.098 (0.01)	-0.110 (0.10)	-0.060 (0.39)
Adjusted R-squared	0.843	0.866	0.718
Durbin alt. for autocorrelation	0.922 (0.34)	0.004 (0.95)	2.268 (0.13)
LM test for ARCH	0.089 (0.77)	0.004 (0.95)	0.357 (0.55)
D-F unit root test on residuals	-7.557 (0.00)	-7.633 (0.00)	-6.147 (0.00)
No. of Observations	64	32	32

p-values are in parentheses.

Table 3.2
U.K. – Inflation Equation

	1991-2006	1991-1998	1999-2006
CPI Inflation (-1)	0.851 (0.00)	0.815 (0.00)	0.923 (0.00)
CPI Inflation (-2)	0.200 (0.21)	0.387 (0.07)	0.040 (0.87)
CPI Inflation (-3)	0.155 (0.33)	0.061 (0.78)	0.338 (0.16)
CPI Inflation (-4)	-0.325 (0.00)	-0.400 (0.01)	-0.354 (0.11)
GDP Growth (-1)	0.064 (0.44)	0.090 (0.52)	0.093 (0.36)
External inflation	0.020 (0.04)	0.048 (0.00)	-0.008 (0.52)
External inflation (-1)	-0.002 (0.84)	-0.001 (0.97)	0.007 (0.57)
Adjusted R-squared	0.923	0.925	0.670
Durbin alt. for autocorrelation	1.511 (0.22)	0.099 (0.75)	0.787 (0.38)
LM test for ARCH	0.003 (0.95)	0.070 (0.79)	0.237 (0.63)
D-F unit root test on residuals	-7.222 (0.00)	-5.512 (0.00)	-7.648 (0.00)
No. of Observations	64	32	32

p-values are in parentheses.

Table 4
Performance Improvement and Policy Contribution

Country	Measure	Preference for Inflation Stability (lambda)		
		0.7	**0.8**	**0.9**
Denmark	Macroeconomic Performance Change	0.333 [47.3%]	0.157 [27.1%]	-0.020 [-4.9%]
	Monetary Policy contribution	0.308 [92.3%]	0.132 [84.1%]	-0.044 [neg.[1]]
Sweden	Macroeconomic Performance Change	4.592 [77.6%]	4.945 [76.3%]	5.297 [75.9%]
	Monetary Policy contribution	4.563 [99.4%]	4.919 [99.5%]	5.273 [99.5%]
United Kingdom	Macroeconomic Performance Change	2.810 [93.6%]	3.086 [92.7%]	3.362 [92.6%]
	Monetary Policy contribution	2.575 [91.6%]	2.825 [91.5%]	3.077 [91.5%]

Table 5
Potential Performance Improvement under Euro

Country	Measure	Preference for Inflation Stability (lambda)		
		0.7	**0.8**	**0.9**
Denmark	Performance Change under Euro	0.213 [30.3%]	0.113 [19.4%]	0.012 [3.0%]
	Additional Gain (+) / Loss (-) under Euro	-0.120 [-36.0%]	-0.044 [-28.3%]	0.031 [pos.[1]]
Sweden	Performance Change under Euro	4.153 [70.2%]	4.433 [68.4%]	4.713 [67.6%]
	Additional Gain (+) / Loss (-) under Euro	-0.440 [-9.6%]	-0.512 [-10.4%]	-0.584 [-11.0%]
United Kingdom	Performance Change under Euro	2.626 [87.5%]	2.862 [86.0%]	3.098 [85.4%]
	Additional Gain (+) / Loss (-) under Euro	-0.184 [-6.5%]	-0.224 [-7.3%]	-0.264 [-7.8%]