The Sterling Pound and the Euro
What does empirical assessment based on OCA theory say on the justification for UK to join the Euro Zone?

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Abstract:
Based on optimal currency area theories, this paper applies the empirical methodology of structural VAR to revisit the question of whether UK should join or not the Euro zone. Correlations of effective exchange rates between UK and US on one side and between UK and its major European partners (Germany and France) on the other side are first estimated. Correlations between macro-structural shocks are then estimated and results of both approaches are combined to provide conclusions on the appropriateness of a floating regime of the British Pound or of the integration to the Euro zone. A dynamic analysis shows that, from an OCA point of view, UK structural evolution over the period 1970-2008 tends to favor the option of integration to the Euro zone. These results have to be qualified by taking into account the specific position of UK with London as a global financial center and political issues which dominate the debate.

Keywords: Sterling Pound, Euro, Optimal Currency Area

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1. Introduction

The question of whether UK will join the Euro zone, at some stage, is predominantly a political issue. It is debated in political programs periodically and settled in pools. The historical alliance with the US, the singularity of the City as a global financial center explained the reluctance to join the European Union to begin with, and then to participate to the process of monetary union achieved with the adoption of the Euro.

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Yet the question remains open.

Recent financial and monetary disturbances affected both economies members of the Euro zone and outsiders, whether willing to join or to remain outside. Members of the Euro zone, deprived of the adjustment mechanism by an exchange rate of a national currency are severely constrained in the conduct of their macroeconomic policies, while on the other hand European countries outside the Euro zone experience dangerous instability of their exchange rates, menaces of uncontrollable speculation and risks of disruption of their links with countries of the Euro zone to which they are economically closely integrated.

The dilemma between independence with instability and a strait jacket providing a more stable environment is present more than ever. The menace of a cumulative process of competitive devaluations increases uncertainty and probably justifies the willingness to participate to a bloc of stability, as provided by the Euro zone, even though it is surrounded by instability in its external relationships.

Yet from an economic point of view, integration to a monetary union has also to be judged in terms of costs of adjustment born by the joining country when structural characteristics of both parts are too dissimilar.

In fact the optimal currency area theories (OCA) often consider economic convergence as a prerequisite for regional monetary integration. In recent approaches based on economic shocks’ characteristics, an OCA is defined as an economic block consisting of countries affected symmetrically by shocks. If this condition is not fulfilled, according to OCA approaches, it is exchange rate flexibility that absorbs asymmetric shocks. In this sense, observed exchange rate variability can be considered as a standard measure of the intensity of these shocks (von Hagen and Neumann, 1994, De Grauwe and Heens, 1993, Vaubel, 1976).

In other words, with free floating, a relative stability of observed exchange rate between two blocs (here UK and the Euro zone) would be an a priori indicator of the viability of the enlargement, while an important volatility of the observed exchange rate would reveal the necessity of exchange rate flexibility as adjustment tool.

By looking only at exchange rates behavior one is yet probably missing essential structural characteristics that can be blurred by discretionary exchange rate policies in contradiction with macro-structural shocks.

In order to assess the viability, from an OCA methodology point of view, of the joining of UK to the Euro zone, we therefore propose an empirical approach combining two analyses:

-We observe on the long run (1970-2008) the characteristics of the Sterling Pound (GBP) effective exchange rate, as compared to the effective exchange rate of the monetary unit of the main commercial partners of UK, i.e. USA (USD) on the one hand, Germany and France (DM and then Euro and FF and then Euro) on the other hand. By using correlation method we measure the degree of co-movement between GBP and each of these three monetary units. These results, assumed to reflect indirectly symmetric or asymmetric structural shocks, can in fact be in discordance with the direct measure of the phenomenon.

-We consequently propose to measure directly structural shocks over the same period, by using the structural vector autoregressive (VAR) model proposed originally by Blanchard & Quah (1989) and comparing likewise co-movement of structural shocks between UK and its main partners.
Comparison of both approaches provides information on the appropriateness of free floating of the Sterling or stabilization either with the USD or eventual fixity with the monetary unit of its two major continental partners (Germany and France), which means presently integration to the Euro zone.

Over the period 1970-2008, the share of goods and services traded (X+M) with the USA in UK total trade declined from 15% to 11%, while the shares of trade with Germany and France increased respectively from 5.5% to 13.5% and from 4% to 8%. This indicates obviously a structural evolution disconnecting to some extent UK from its traditional link with the US and deepening integration with continental Europe, as represented by UK’s major European partners. But it remains to confirm that macro-structural characteristics of both UK and its continental partners followed an evolution compatible with the joining of UK to the Euro zone.

In section 2 we will discuss the methodology used to assess dynamically the evolution of structural characteristics of UK as compared to its main commercial partners over the period 1970-2008.

Empirical results are presented and discussed in section 3. Section 4 concludes on the contribution of OCA methodology to the debate over the joining of UK to the Euro zone, these conclusions requiring qualifications to take into accounts political issues, as well as economic dimensions not being dealt with by OCA approaches.

2. Methodology

In order to examine if the UK would better join the Euro from an economic viewpoint, we measure the degree of disconnection of the Sterling Pound’s behavior from the UK’s economic fundamentals. To measure this disconnection, correlation coefficients are estimated between variables of the UK on the one hand, the USA, Germany and France on the other hand. Based on these correlation coefficients, a synthetic approach is then presented. These steps being described later in this section, the correlation methodology used in this paper should be specified first.

In this paper, correlation coefficients are used to measure co-movement between pairs of effective exchange rates, but also in order to assess similarity of macro-structural shocks. Among several correlation coefficients, Pearson’s is often used. But this coefficient does not fit our present analysis, because it imposes the hypothesis of normal distribution of the series, which for exchange rate series is not likely to be the case generally. To avoid imposing an inappropriate hypothesis for our series, Spearman’s rank-ordered correlation is preferred. To estimate this type of correlation, first, the value of each observation is reclassified in terms of rank. The differences between these ranks (noted D) and the number of observation pairs (noted N) are then used to estimate the correlation coefficient. Then, significance level is tested by a t-statistics \( t = \frac{\rho \sqrt{N-2}}{\sqrt{1-\rho^2}} \) which follows a distribution of Student with a degree of freedom equal to (N-2), under the null hypothesis of zero correlation. For example, Spearman’s correlation coefficient between a variable of the UK and that of Germany, noted \( \rho_{uk,bd} \), can be expressed as follows:
\[ \rho_{ak,bd} = 1 - \frac{6 \sum D^2}{N(N^2 - 1)} \]

where \( D \) represents the difference between the two ranks of the corresponding values of the UK’s and Germany’s variables, while \( N \) indicates the number of observation pairs.

This rank-ordered correlation is then estimated in a dynamic approach:
A sliding correlation is used, instead of estimating only one coefficient covering all the examined period. In this paper, one correlation coefficient is obtained for a period of 8 years, and the period slides, quarter by quarter, from 1970Q1 to 2008Q4. This approach allows to observe evolutions of the examined correlation and its dynamic adjustments over time.

### 2.1 Characteristics of exchange rate’s behavior

The first step of the analytical framework is to examine UK’s nominal effective trade-weighted exchange rate’s co-varying behavior with its three main trade partners, mentioned above. The objective of this analysis is to check if there is a currency to which the GBP is more closely linked, despite its free-floating exchange rate regime.

In general, one can consider two methods aiming at determining if a currency is related to another one. The first one consists in examining stability of the nominal bilateral exchange rate between the two currencies. If the rate is stable, one can argue that the two currencies are closely related to each other. But on the contrary, if the rate’s volatility is high, the two currencies are considered unrelated to each other. Although this method seems to be useful, there are some shortcomings in its use. First, it is very difficult to quantify the degree of stability or that of volatility. Furthermore, it is often ambiguous to interpret correctly results on the stability or volatility because of measure-unit-related problems.

The second method is to analyze co-varying characteristics between two currencies’ nominal effective exchange rates. In this approach, one can argue that the more the two effective exchange rates are co-varying, the more the two currencies are closely related to each other. This method seems particularly useful in analyzing two currencies’ co-varying behavior when they are not fixed to each other but related to each other to some extent, and when each of them has its own bilateral links with other currencies, of which the combination is too complicated to take into account precisely for each of the two currencies. One main difficulty in using this method however lies in calculating exactly the most-widely used effective exchange rates, the trade-weighted one, which should take into account all the time-varying weights of each of trade partners.

In this paper we prefer the second method, combined with Spearman’s correlation, in order to examine if the GBP has some co-varying characteristics with currencies of its main trade partners: the higher the correlation, the stronger its nominal exchange rate’s link.

### 2.2. Structural characteristics

This step consists in characterizing economic fundamentals of the UK, to which the GBP’s exchange rate behavior will be compared. In an OCA approach, exchange rate flexibility is considered as the principal adjustment mechanism to economic shocks affecting countries in an asymmetric way. Thus, characteristics of these shocks and exchange rate variability are at the core of an OCA analysis. In this paper, essential macro-structural shocks to the UK and its main trade partners will be estimated and characterized for an assessment of the similarity of
their economic conditions. For the UK, the nature of these shocks could clarify the necessity of its exchange rate flexibility, or on the contrary, could plead in favor of joining the Euro.

Yet macro-structural shocks not being directly observable, it should be estimated empirically. Among others, the structural Vector Auto-Regressive (VAR) system proposed by Blanchard and Quah (1989) and extended by Clarida and Gali (1994) allows to define, identify and generate these time series. Following them, we use a structural VAR model in order to estimate three types of macro-structural shock series for the UK, the USA, France and Germany: aggregate supply shocks (AS), real demand shocks (IS) and monetary demand shocks (LM). Our VAR model contains three variables: real GDP, real trade-weighted effective exchange rate and Consumer Price Index. Data on these variables are on a quarterly basis (data sources: BIS, IMF/Datastream) and the examined period goes from 1970Q1 to 2008Q3. Preliminary tests indicate that all these variables are characterized as I(1), and that they are not co-integrated with each other. The model’s elements can be described as follows, with difference operator (Δ), lag operator (L) and L indicating the number of lags:

\[
X_t = \begin{bmatrix}
\Delta \text{GDP} \\
\Delta \text{REX} \\
\Delta \text{CPI}
\end{bmatrix} = \begin{bmatrix}
\epsilon_{\Delta \text{GDP}} \\
\epsilon_{\Delta \text{REX}} \\
\epsilon_{\Delta \text{CPI}}
\end{bmatrix} = B(L) = B_L = \begin{bmatrix}
B_{11} & B_{12} & B_{13} \\
B_{21} & B_{22} & B_{23} \\
B_{31} & B_{32} & B_{33}
\end{bmatrix}, \quad C(L) = C_L = \begin{bmatrix}
C_{11} & C_{12} & C_{13} \\
C_{21} & C_{22} & C_{23} \\
C_{31} & C_{32} & C_{33}
\end{bmatrix} + \begin{bmatrix}
\epsilon_{\Delta \text{GDP}} \\
\epsilon_{\Delta \text{REX}} \\
\epsilon_{\Delta \text{CPI}}
\end{bmatrix} = \begin{bmatrix}
\epsilon_{\epsilon_{\Delta \text{GDP}}} \\
\epsilon_{\epsilon_{\Delta \text{REX}}} \\
\epsilon_{\epsilon_{\Delta \text{CPI}}}
\end{bmatrix}
\]

with: \(X = \text{variable vector; REX = real effective exchange rate; } e = \text{vector of disturbances; } \epsilon = \text{vector of structural shocks; } \epsilon_{\Delta \text{GDP}} = \text{AS shocks; } \epsilon_{\Delta \text{REX}} = \text{IS shocks; } \epsilon_{\Delta \text{CPI}} = \text{LM shocks. As } X_t = B(L)e_t \text{ and } X_t = C(L)e_t \text{ with } \{L = 0, 1, 2, \ldots, k\}, \text{ the system equations are written then as follows:}

\[
X_t = \sum_{L=0}^{L=k} \begin{bmatrix}
B_{11} & B_{12} & B_{13} \\
B_{21} & B_{22} & B_{23} \\
B_{31} & B_{32} & B_{33}
\end{bmatrix} \epsilon_{\Delta \text{GDP}} + \sum_{L=0}^{L=k} \begin{bmatrix}
C_{11} & C_{12} & C_{13} \\
C_{21} & C_{22} & C_{23} \\
C_{31} & C_{32} & C_{33}
\end{bmatrix} \epsilon_{\epsilon_{\Delta \text{GDP}}}
\]

Long run theoretical assumptions used here as identification restrictions are: (1) impact of IS shocks on real GDP variation is null; (2) impact of LM shocks on real GDP variation is null; and (3) impact of LM shocks on real exchange rate variation is null. Given that \(\{C_S = C_0 + C_1 + C_2 + C_3 + \ldots + C_k\} \text{ with } k \text{ as the time horizon, these restrictions imply respectively } \{C_{S12} = 0\}, \{C_{S13} = 0\} \text{ and } \{C_{S23} = 0\}.

Once the series of AS, IS and LM shocks estimated for each of the examined countries, the similarity of economic fundamentals between UK and the other countries will be measured by correlation coefficients. For the three bilateral relations, correlation coefficients can be computed for each of the three pairs of shocks, but the average of the three correlation coefficients is retained as global indicator of the economic fundamentals similarity. If the UK is experiencing symmetric shocks with another country, the global correlation will be close to 1. In this case, fluctuations of the GBP vis-à-vis the partner country’s currency are not required. Furthermore, these fluctuations will be interpreted as exchange rate’s behavior disconnected from economic fundamentals, while the two countries will be considered as forming an OCA, which is an economic block consisting of countries affected symmetrically by shocks.

2.3. Synthesis: Indicator of mismatch

The OCA theories assume that exchange rate variations absorb asymmetric shocks. If this assumption holds for a pair of countries, it means that the bilateral exchange rate regime is appropriate. Then, important exchange rate variability should imply that shocks are asymmetric, while exchange rate stability might indicate that shocks are symmetric. In this case, the bilateral exchange rate behavior fits economic fundamentals. But, what if exchange rate is stable while economic shocks are asymmetric? If the OCA assumption doesn’t hold, it’s clear that there is exchange rate behavior mismatch with economic fundamentals. In order to test this OCA assumption and examine the compatibility of the GBP’s behavior with UK’s economic fundamentals, the next step of the analytical framework consists in synthesizing the characteristics of nominal effective exchange rate and those of macro-structural shocks described in the previous sections. To simplify this synthesis, it is possible to use an indicator measuring the difference between exchange rate co-movement and economic shock symmetry. This allows to quickly observe degree of incompatibility between those two characteristics of the economy. The indicator is defined as follows:

\[
\text{Indicator of mismatch} = \rho_n - \rho_r
\]

with \( \rho_n \) = nominal correlation (co-movement) between nominal effective exchange rates; 
\( \rho_r \) = real correlation (symmetry) between macro-structural shocks

Correlation being between -1 and 1, the indicator’s theoretical value will be between -2 and 2. But in practice, it will be hard to obtain an indicator higher than 1.5 or lower than –1.5. A higher absolute value indicates a more important mismatch.

Combined with sliding approach, this indicator shows evolutions of exchange rate co-movement and shocks symmetry and it allows to observe dynamic adjustment. Chart 1 below illustrates any possible theoretical position of the indicator and allows to distinguish different zones according to the necessity of adjustments. For instance, point A represents a situation in which exchange rate is completely flexible and shocks are asymmetric. Point B reflects that the exchange rate is fixed and economic shocks are perfectly symmetric. Point C indicates that two countries variables change in a completely opposite sense. However, these three points are on the curve connecting the two points B and C, on which each point represents a situation where exchange rate behavior is perfectly compatible with economic fundamentals. In other words, this curve represents all points of equilibrium between nominal exchange rate co-movement and macro-structural shock symmetry. The region superior to the curve represents ‘excessive-nominal-fixity zone’ and indicates a situation where the nominal exchange rate behavior should adjust, for instance, by appropriate policy decisions, towards less co-movement of nominal exchange rates. On the contrary, the region inferior to the curve may be called ‘excessive-nominal-flexibility zone’ or ‘excessive shock symmetry shock zone’ requiring adjustments towards more nominal exchange rate fixity. This situation will justify an exchange rate policy, which aims at strengthening the nominal exchange rate co-movement or fixity.
Chart 1. Zero-Mismatch curve (from B to C)

- Perfect shock asymmetry
- Perfect shock symmetry
- Excessive nominal flexibility zone
- Nominal adjustment towards less nominal fixity
- Nominal adjustment towards more nominal fixity
- Real adjustment towards less real shock symmetry
- Real adjustment towards more real shock symmetry
- Nominal & Real adjustment
- Perfectly opposite nominal fixity
- Perfect nominal fixity
3. Empirical results

For the empirical application, monthly and quarterly data are used on the UK, the USA, France and Germany for the period from 1970Q1 to 2008Q3. Monthly data on trade-weighted effective exchange rates are provided by the Bank for International Settlements, while quarterly data on GDP and CPI are provided by IMF International Financial Statistics (Datastream).

3.1. Correlation of nominal exchange rates

In order to see if the Sterling Pound’s behavior is more of the free-floating type or related to the US Dollar or to the currency unit of Germany and France, Graph 2 below compares the UK’s nominal effective exchange rate with those of the USA, Germany and France. Descriptive statistics show that the Sterling Pound has always been more related to the USD than to German and French currencies (DM and then Euro / FF and then Euro).

Chart 2. UK’s nominal effective exchange rate compared to USA, France & Germany (1970 to 2008)
3.2 Correlation of macro-structural shocks

Before obtaining UK’s indicators of mismatch, we estimate three types of economic shocks – aggregate supply shock (AS), real demand shock (IS) and monetary demand shock (LM) – for four countries – UK, USA, France and Germany, using the structural VAR system presented above. Chart 3 below shows the series of AS, IS and LM shocks estimated for each of the four examined countries.

Chart 3. Series of estimated macro-structural shocks to UK, USA, France and Germany (1970 to 2008)

3.3 Economic assessment of compatibility of the exchange rate regime of GBP with economic fundamentals

Using the series of nominal effective exchange rates and macro-structural shocks described above, it is possible to compute UK’s indicators of mismatch regarding its relation vis-à-vis the USA, Germany and France. As explained above, in order to estimate indicators of mismatch, a general symmetry measure is used, which is the average of the three correlations of AS, IS and LM. Chart 4 below shows evolutions of the UK’s nominal effective exchange rate co-movement, economic shock symmetry and absolute values of indicators of mismatch.
In addition, dynamic evolutions of indicators of mismatch plotted in the two-dimensional framework presented in Chart 1 are given in appendix. It confirms that UK/US relationship is very significantly different from the relationship of UK with its two partners from the Eurozone.

The mainly positive values of UK’s indicator of mismatch vis-à-vis the USA mean that the Sterling Pound has been co-varying with the US Dollar, while its economic fundamentals were not in favor of a fixed exchange rate regime. On the contrary, the very significant negative values of UK’s indicator of mismatch vis-à-vis Germany and France show that the UK has been experiencing similar macro-structural shocks with these countries, and thus would recommend closer coordination of exchange rate policies and even to consider joining the Euro in order to reduce disconnection of its exchange rate regime from general economic conditions.

Chart 4. UK’s exchange rate co-movement, macro-structural shocks symmetry and indicator of mismatch vis-à-vis USA, France & Germany (1970 to 2008)
4. Conclusion

Empirical evidence shows that UK, although its currency is apparently floating freely and displays significant instability in its relations with monetary units of its main European partners (Germany and France, and then presently with the Euro zone), do not display, as expected by OCA theory, asymmetries in macro-structural shocks (i.e. strong negative correlations).

This disconnection of the two measures suggests that floating of the Pound and high instability of its relations with the currency unit of its European partners is not justified by macro-structural characteristics. From an OCA approach point of view, there are no empirical evidences favoring the option of keeping UK out of the Euro zone, while ever closer economic links and growing instability at the world level are strong arguments in favor of the joining. Symmetrically, apparent similarity in the evolution of UK and US effective exchange rates is not explained by significant symmetry of macro-structural shocks of the two countries.

There is no strong argument in favor of exchange rate policies targeted towards priority to stabilization with USD, targeting contradictory with the option of joining of UK with the Euro zone.

This paradoxical situation is probably to be explained by the stakes of the British financial sector, closely related to the global financial system where the USD still plays the dominant role. Yet closer financial integration with the Euro zone could enter in contradiction with this option of remaining disconnected with the Euro zone in terms of exchange rate.

Of course this matter can only be settled politically and issues such as debates over sovereignty can interfere with the logic of evaluation of costs and benefits of the two options.

References

Appendix

Chart A. Dynamics of indicator of mismatch UK vs USA
Chart B. Dynamics of indicator of mismatch UK vs France
Chart C. Dynamics of indicator of mismatch UK vs Germany