Financial Integration and the Construction of Historical Data for the Euro Area*

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Abstract

Time series analysis for the Euro Area requires the availability of sufficiently long historical data series, but the appropriate construction methodology has received little attention. The benchmark dataset, developed by the European Central Bank for use in its Area Wide Model (AWM), is based on fixed-weight aggregation across countries with historically distinct monetary policies and financial markets of varying international importance. This paper proposes a new methodology, based on the historical distance from monetary integration between core and periphery countries, for producing back-dated monetary and financial series for the Euro Area. The impact of using the new methodology versus the AWM data is illustrated through VAR analysis and estimates of an international DSGE model. An important advantage of the new methodology is that it can be applied to develop appropriate series as new member countries join the Euro Area.

Keywords: Data aggregation, Euro Area, monetary integration, financial market indicators, international DSGE models

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1 Introduction

Analysis of the macroeconomic behaviour of the Euro Area is a key topic of interest not only for economists in Europe, but also for the global economy. No monetary union of this magnitude has previously occurred in the modern world, and the formation of the Euro Area raises many issues that need to be confronted in attempting to understand the economic characteristics of this coalition.

One key issue is historical analysis, which involves constructing appropriate data. The common euro currency has existed only since 1999 (with euro notes and coins becoming available in 2002), and the period since then does not provide sufficient observations to enable detailed empirical macroeconomic analyses to be undertaken. Nevertheless, historical data is crucial for the contemporary development of economic policy, so that its construction is important for future economic progress; see, for example, the discussion of data formation in ECB (2001: p.35). There is also a broader need for historical Euro Area data as researchers attempt to analyse the impact of this monetary union on both Europe and the global economy, see for example Rudebusch and Svensson (2002) and Dees et al (2007).

The issue of constructing appropriate historical Euro Area data is a deep one, involving the history of European monetary integration. Although there is no clear date that unambiguously marks the beginning of this integration, important milestones include the beginning of operation of the European Monetary System (EMS) in March 1979, the beginning of stage one of the European Monetary Union in 1990, the signing of the Treaty on European Union (the "Maastricht Treaty") in 1992 and the 1998 events of eleven countries[1] meeting the conditions for admission to the Euro Area and the establishment of the ECB (Scheller, 2004). This route has not always been smooth. Even relatively recently, the EMS crises of 1992 and 1993 marked a period of considerable uncertainty about the prospects for continued movement towards monetary integration (Ungerer, 1997, pp.260-271). Further, the countries

[1] This excludes Greece, which became the twelth member of the Euro Area in January 2001.

participating in the European Exchange Rate Mechanism(ERM), which preceded the euro, changed over time and not always in the direction of continued integration[2].

Indeed, the Euro Area itself is not fixed, with the expansions of the European Union in 2004 and 2007 being reflected in additional Euro Area members as and when these countries meet the convergence requirements of the original Euro Area countries[3]. The question of how to construct data appropriate for modelling the expanded Euro Area is an important topical problem, as this on-going process involves new member countries which typically have very different historical macroeconomic policies and characteristics from the original members. The recent literature that addresses historical aggregate Euro Area economic behaviour almost invariably considers the twelve Euro Area members as at 2001, with a variety of techniques used to construct cross-country aggregates for earlier periods. The most common approach is to aggregate across these countries using a constant pre-specified set of weights, with a prevalent alternative being to use German data pre-1999 and a Euro Area aggregate subsequently. However, we consider neither to be appropriate for many analyses. The former assumes an economic and financial homogeneity across countries that did not exist over most of this historical period, manifested for example in the use of constant GDP weighted interest rates in the AWM database. This fails to reflect the ERM crises and the changing monetary policies of countries that are now members of the Euro Area. The use of German data assumes that Germany is representative of the Euro Area. Neither method appears appropriate to deal with the expanding membership of the Euro Area.

This paper discusses the various approaches that have been used, and proposes an alternative method which we believe to be particularly appropriate for capturing increasing monetary integration. The impact of constructing

[2]For example, Spain joined the ERM in 1989, while Austria did not become a member until 1995 despite the fact that it had pegged its currency to the Deutschmark from the 1970s. Further, the UK (a Euro Area non-member) joined the ERM in 1990 but withdrew during the September 1992 EMS crisis, while Italy also withdrew from the ERM during this crisis and rejoined only in 1996 (Ungerer, 1997, pp.301-306).

[3]Slovenia joined the Euro Area from January 2007, while Cyprus and Malta have also met the criteria and will join in January 2008.

monetary and financial variables for the Euro Area using this methodology are then illustrated in the context of the types of models frequently used for contemporary macroeconomic analyses, namely a structural VAR for the Euro Area and a two-country DSGE model for the US and the Euro Area.

The outline is as follows. Section 2 discusses the current methods of construction for historical Euro Area aggregates and outlines their uses to date. Section 3 sets our alternative approach, based on the idea of quantifying convergence of periphery countries towards a set of core countries, such that the former have increasing weights in aggregation as integration progresses. Section 3.3 also implements this methodology using exchange rates, with interest rates and inflation discussed in an appendix. The consequences of applying the new aggregation methodology in macroeconomic modelling, in comparison with the prevailing methodology based on fixed weights, are explored in Section 4. Finally, Section 5 concludes.

2 Methods for Constructing Euro Area Data

As just noted, there are essentially two approaches used to construct historical Euro Area data. This section discusses these in more detail, together with extant comparisons of the impact of different choices on empirical results.

2.1 Current methodologies

2.1.1 Cross-country aggregation

AWM database

The most prominent example of historical Euro Area data obtained from cross-country aggregation is the Area Wide Model (AWM) database, which provides quarterly measures of many economic and some financial variables, backdated to 1970. Constructed by the European Central Bank (ECB) in the process of building a model for the Euro Area (see Fagan et al., 2001 and 2005), this database is now "standard" when undertaking academic and central bank based research on the Euro Area (see Dieppe, 2005). Apart from serving its original purpose, AWM data has now been used in the study of New Keynesian models of the Euro Area (see, eg, Gali et al., 2001), and in recent Dynamic Stochastic General Equilibrium (DSGE) models of Europe (see eg Smets and Wouters, 2003 and 2005). It has played a role in the development of coincident and leading indicators for Europe (see, eg, Giannone and Reichlin, 2004, and Banerjee et al., 2005), and it has also been used in studies of money demand and inflation (see, eg, Gerlach and Svensson, 2003), and in estimating monetary policy reaction functions (Gali et al., 2001). Details regarding the construction of AWM data are provided in Fagan et al. (2001), with aggregation being over the twelve Euro Area countries that defined the area from 2001 to the end of 2006[4]. For most series, aggregation is performed on log levels, using weights based on real GDP in 1995, adjusted for purchasing power parity (PPP). This involves an implicit (and unrealistic) assumption of constant real exchange rates, but the aggregation of log levels using constant weights preserves the growth rates of aggregate variables. The AWM weights are given in Table 1.

Interest rates are aggregated in levels (rather than log levels), and although the AWM weights of Table 1 are used when individual country data is available for the entire historical period, substantial portions of the relevant raw interest rate data are unavailable. When data are missing, the weights on the available series are rescaled so that they sum to unity. One consequence of this rescaling is that the resulting aggregate series reflect time varying "composition effects", as well as simple time variation in the interest rates themselves.

The consumer price series in the AWM database is the Harmonised Index of Consumer Index (HICP) provided by Eurostat from 1990 onwards. The HICP uses its own set of weights, and the AWM historical values for the 1970s and 1980s are calculated by applying the 1995 HICP weights to growth rates in prices, and then using this series to construct a price index.[5]

[4]The original AWM database, outlined in Fagan et al. (2001), aggregated the eleven original Euro Area members as of 1999. However, subsequent versions of the database include Greece.

[5]Personal communication with Jose Emilio Gumiel from the ECB.

Other approaches

Eurostat compiles many Euro Area aggregates, by transforming the national series into the euro currency and then aggregating (ECU currency is used prior to the euro). In contrast to the AWM data, the Eurostat approach maintains the consistency of the national accounts, but time variation reflects variation in exchange rates as well as variation in the underlying series. A different methodology is used for HICP, which (from 1995) has its own set of annual time-varying weights drawn from "household final monetary consumption expenditure" in each country (European Commission, 2004). However, Eurostat series are available only from the 1990s onwards, so they are not widely used for academic research purposes.

A feature of the Eurostat database is that several Euro Area aggregates are available, reflecting the differing membership of the area. Thus, in 2007, data series for a specific macroeconomic aggregate (such as GDP) are published for the twelve Euro Area members of 2001-2006 or the 13 current members, with a third series using a time-varying membership reflecting actual membership at the specific date. The same starting date (generally 1995) applies in all cases, so that they differ only in the countries being aggregated, hence leaving the researcher to select which is the most appropriate for a particular purpose.

OECD data for the Euro Area is compiled using fixed GDP weights adjusted for PPP, but the weights are based on 1990, and therefore differ from those used in the AWM database. These data are available from 1970, but have not received extensive use in the literature, probably because the methodology is similar to that of the AWM but its coverage is less extensive. For an example of its use, see Gerlach and Schnabel (2000).

In order to avoid the perverse feature that a common currency aggregate of levels can fall even when all countries experience growth, Beyer, Doornik and Hendry (2001) aggregate variables using growth rates. Additionally they propose a time varying weight methodology, which ensures consistency between movements in the components of the area wide aggregate and the behaviour of the aggregate, so that "the aggregate of the deflators corresponds to the deflator of the aggregates" to paraphrase Beyer et al (2001, p.F103).

The time varying weights in their construction of GDP are given by the share of GDP in the previous period valued in current ECU, and with constant exchange rates, this aggregation would be analogous to the aggregation of log levels in the AWM data base. Artis and Beyer (2004) uses aggregation in growth rates in a study of money demand, but this aggregation technique has not been widely adopted.

2.1.2 Representative country

Some researchers (see, for example, Brüggemann and Lütkepohl, 2006, Brüggemann et al, 2006, Corsetti and Pesenti, 1999) argue that the use of synthetic Euro Area data prior to the common currency is inappropriate because such data does not represent the outcome of a meaningful economic process. Typically, these researchers suggest the use of German data prior to the euro, since Germany is widely regarded as the leading continental European economy during the period, and early ECB monetary policy was largely designed to follow the successful example of the German Bundesbank. Additionally, Germany had the least adjustment to the convergence criteria of the Maastricht Treaty so that its data process is less distorted by policies designed to meet those criteria.

The use of German data as "representative" effectively places a weight of one on Germany prior to 1999 and then assigns weights across all twelve euro countries for subsequent data. Where required, such as for real output or monetary aggregates, shift dummies are used to account for the implied structural break (following earlier work that often uses a shift dummy to account for East/West German unification). Brüggemann and Lütkepohl (2005) find support for the uncovered interest parity (UIP) and the expectations hypotheses in Europe when they use this approach, and they also find little evidence of model instability when building a VAR model for M3, GDP and the long term interest rate (Brüggemann and Lütkepohl, 2006). Some authors use German interest rates in models alongside Euro Area aggregates of other variables (such as inflation and or output). This practice is not common, but it can be justified by the view that German interest rates represent the European policy stance (Gerlach and Smets, 1999), or that they "offer the maximum safe return adjusted for risk" (Artis and Beyer, 2004).

On the other hand, the evidence provided by Ehrmann and Fratzner (2005) that the relationship between European and US financial markets changed with the advent of the euro is doubtful, since the break they observe is synchronous with a change in their data, namely from German to weighted Euro Area series. Indeed, the existence of this break may be indicative that Germany pre-1999 is not fully representative of the later Euro Area.

2.2 Dataset comparisons and choice of data

Differences between the various available aggregates for the same underlying variable may be slight, or have little consequence for the analysis at hand; see, for instance, the European business cycle dating exercise undertaken by Artis et al. (2004) or Moneta's (2005) study of the leading indicator properties of European interest rates spreads. Conversely, the graphical comparison undertaken by Beyer et al. (2001) suggests there can be potentially important differences between aggregates, while the cointegration studies of money demand undertaken by Bruggeman et al. (2003) and Bosker (2006) show that the results can be very sensitive to the particular data set used. Hong and Beilby-Orrin (1999) provide a general illustration of how different weighting assumptions can lead to different relationships between variables. Considering four potential methods of aggregating Euro Area data, they demonstrate that it is possible for different weighting structures to induce a positive move in one aggregated total and a negative move in another, even though both are based on the same underlying national data.

The fact that aggregation method can influence an analysis implies that researchers working on the Euro Area economy need to consider what methodology suits their purpose, because no single data set is likely to satisfy all research needs. Policy analysis is especially tricky, because the nature of policy making in Europe has changed over the last thirty years. During the 1970s and 1980s policies were set by national governments, so that Euro Area aggregates for this period are irrelevant from a policy-making perspective simply because there was no area wide policy. Aggregates for this era can therefore, at best, reflect policy and its effects in a subset of countries that are deemed to be "representative" for the purposes of analysis. As discussed above, a number of authors have argued that German monetary policy during this period is representative of the subsequent Euro Area. Against this, however, Nautz and Offermanns (2006) find that modelling the pre-euro period using synthetic Euro Area aggregates (constructed using the Beyer et al., 2001 methodology) out-performs German data in an empirical exchange rate model used to forecast post-euro exchange rate behaviour against the US.

Particularly in the 1990s, the various national monetary policies evolved into arrangements designed to meet the agreed criteria for Euro Area membership, and international aggregates (based on a growing number of countries) become increasingly relevant for the analysis of policy, at least for those countries that were progressing towards Euro Area membership. As already noted, this issue is a current one, since the progression of the new member countries of the European Union towards Euro Area membership raises the issue of how their data should be incorporated into Euro Area aggregates.

Overall, it seems that aggregation based on a constant weighting scheme (such as the AWM benchmark) is unlikely to be appropriate for studying policy over the entire postwar period, as is the use of an abrupt structural break in weights (as in Brüggemann and Lütkepohl, 2005 and 2006). Our analysis in Section 3 illustrates that a simple historical aggregation over the euro twelve is distortionary for the analysis of exchange rates, and it is reasonable to anticipate that similar issues will arise in relation to the contemporary question of measuring the monetary and financial characteristics of the expanding Euro Area.

3 Proposed Data Construction Methodology

This section deals with our proposed methodology for constructing historical data for the Euro Area and applies it to construct a bilateral exchange rate series against the US dollar. This methodology is based on the idea of measuring the distance from monetary/financial integration between a set of core countries and ones that can (at least initially) be described as periphery. The core may be considered leading European countries with respect to their financial markets and monetary policy over the entire period, whereas this does not apply for the periphery countries. While financial markets in the latter were underdeveloped in the 1970s, the process of monetary integration in Europe has been associated with greater integration across financial markets; see Cappiello et al. (2006).

This core/periphery country distinction suggests that the use of constant weights for financial and monetary aggregates will tend to overweight the importance of the countries that were relatively unimportant in international financial terms in the early parts of the sample, and thereby underrepresent the role of the leading European markets. This point is illustrated very clearly by considering the AWM weights in Table 1. Spain, Italy, Portugal and Greece account for 36% of the AWM Euro Area weights. Comparing the (inverse) bilateral exchange rates for the German mark and French franc against the US dollar in Figure 1a with a corresponding AWM-weighted aggregate of the twelve Euro Area countries [6], the figure emphasises the role of periphery countries in financial aggregates computed using AWM weights during the 1970s and early 1980s.

3.1 Sliding Weights

Rather than employing constant weights, our method tapers (up) weights for the periphery countries so that they achieve their full weight only with full monetary integration, represented by the establishment of the Euro Area in January 1999. For the pre-euro period, our methodology depends on measuring the time-varying distance (in terms of monetary integration) of the periphery countries from those in the core, with the latter countries assumed to be integrated throughout. Although the discussion below is in terms of the pre-euro period, it can easily encompass the situation of new member countries joining the Euro Area. The pre-2007 euro twelve would constitute

[6] All individual country exchange rates were first converted to euro rates using the irrevocable exchange rates of 31 December 1998. To construct AWM equivalent series, the AWM weights are then applied.

the core, and new member countries the periphery, which are assumed to reach full integration on joining the area.

Our method is based on the existence of a variable x such that $x_{j,t}$ is the value at time t (prior to January 1999) for periphery country j, and $x_{core,t}$ is the corresponding value at t for the core countries, while $|x_{j,t} - x_{core,t}|$ measures the distance that country j is (at t) from monetary integration with the core. Since the periphery and core are in a monetary union from the establishment of the Euro Area, $x_{j,t} \equiv x_{core,t}$ for $t \geq$ January 1999. In order to render it measure-free, this distance at time t is scaled by the distance of j from the core at a date selected to represent the commencement of the process of integration. March 1979 is used for this purpose, due to its importance in the history of European monetary integration, namely as the date at which the European Monetary System began and the ECU was created[7]. Previous literature on European integration often selects this date as a watershed, as in Artis and Zhang (1997, 1999). Therefore, our measure of the relative distance from integration with the core for country j at time t is given by

$$d_{j,t} = \min\left\{\frac{|x_{j,t} - x_{core,t}|}{|x_{j,1979M3} - x_{core,1979M3}|}, 1\right\} \tag{1}$$

where $0 \leq d_{j,t} \leq 1$, with 0 representing full integration and 1 representing no integration. Where the distance exceeds the March 1979 value, $d_{j,t}$ is assigned the maximum value of 1. By construction, for a sample starting in the 1970s and ending after 1999, both extreme "regimes" will be present in the sample.

We also assume that we have available a weight $w_{j,F}$ that represents the importance of country j once integration has been achieved. In practice, for this purpose, we adopt the AWM weights of Table 1. Then, based on $w_{j,F}$ and the distance (1), the weight $w_{j,t}$ for country j at time t in constructing the historical Euro Area aggregate is computed as:

[7]The ECU weights were considered as alternative weights, but some ECU countries (UK and Denmark) are not currently part of the Eurozone. Additionally backdata is not available on this basis and would also need to be constructed.

$$w_{j,t} = w_{j,F} \times (1 - d_{jt})\,. \tag{2}$$

That is, the weight $w_{j,t}$ represents a fraction of the final weight for country j, where that fraction is inversely related to the relative distance from the core in relation to that of March 1979.

3.2 Implementation Issues

Implementation of the methodology of subsection 3.1 requires selection of the variable x measuring monetary integration and the classification of countries into core and periphery categories. For these purposes, we focus on the exchange rate, because one essential feature of the Euro Area is that it is a *currency union*, which leads us to define a periphery country's convergence to the Euro Area in terms of it approaching its irrevocable exchange rate as of 31 December 1998. To be more specific, we use the (inverse) bilateral exchange rate with the US dollar as x, with full integration represented by the \$/euro rate from January 1999. Values of $x_{j,t}$ for the earlier period are obtained as the periphery country's (inverse) bilateral rate with the US at t, expressed in the common euro currency using its irrevocable euro conversion rate. Through PPP and UIP arguments, the exchange rate also encompasses monetary integration measures based on inflation and interest rates.

We define the Euro Area core as consisting of Germany, France, Austria, Belgium, Luxembourg and Netherlands. Germany and France are considered core since their currencies were dominant in Europe over the historical period. The exchange rates of the Benelux countries have always been between those of their larger neighbours, pointing to their inclusion in the core. Finally, Austria pegged its currency to the Deutschmark during this whole period, making it part of the core for our purposes.

Our core countries are listed on the left hand side of Table 1, and it is interesting to note that our set of core countries is the same as that identified by Artis and Zhang (2001), although they used a broader set of macroeconomic criteria to determine which set of countries satisfied the theoretical criteria for the establishment of an optimal currency area[8]. Other definitions of core and distance from core might be considered, and a leading contender might be based on the so-called German leadership hypothesis for interest rates in Europe, which would place Germany alone in the core and define distance from the core in terms of short-term interest rates, eg see Brüggemann et al. (2006). However, the validity of the German leadership hypothesis remains an open issue (see, for example, Karfakis and Moschos, 1990, and Hassapis et al., 1999). On the other hand, our inclusion of other countries in the core is compatible with Dunne et al. (2006), who find interest rate leadership to be contested between France and Germany at the introduction of the euro, and with the conclusion of Nautz and Offermanns (2006) that the behaviour of the German mark alone does not forecast that of the euro.

These core countries account for a total of 61.3% of the total aggregation weight, with Germany and France contributing 28.3% and 20.1% respectively. The series $x_{core,t}$ is computed for the pre-euro period by aggregating the individual core country exchange rates (expressed in euros) using the AWM weights for these countries scaled up to total unity. Since only the euro currency exists for these countries from January 1999 onwards, $x_{core,t} = x_{j,t}$ for $t \geq$ January 1999. The resulting series is shown in Figure 1b.

In order to construct our synthetic Euro Area series, the sliding weights of (2) for the periphery are employed alongside the fixed weight of 0.613 for the core. This implies that the weights pre-1999 may sum to less than 1, in which case all weights are redistributed to ensure a sum of unity. By construction, through (2), no weight is allocated to the periphery, and hence all weight is allocated to the core, for March 1979.

The next subsection applies this methodology to construct a historical (inverse) bilateral exchange rate series for the euro with the US dollar, with interest rates and consumer prices discussed in an appendix. It is worth noting that the weights obtained from (2) are readily applicable to other Euro Area financial aggregates, such as equity returns. While they could also be used for real measures (such as real GDP), the impact will be much

[8]In fact, Artis and Zhang (2001) do not include Luxembourg in their analysis, presumably due to data limitations. Otherwise their core is idential to ours.

less marked than for financial series.

3.3 Euro Area Exchange Rates

The AWM data base includes several trade weighted indicators of historical exchange rates[9], but it does not include any bilateral series. We first construct a synthetic bilateral exchange rate series for the Euro Area currencies to US dollars using the AWM weights. Focussing on bilateral rates with the US is relevant, since it is the dominant world currency. Other Euro Area exchange rate series can, of course, be constructed from our US/euro exchange rate series using the no-arbitrage condition. This AWM weighted bilateral monthly exchange rate series is shown in Figure 1a for the period January 1970 to December 2003.

Along with our historical exchange rate series for the core countries against the US, $x_{core.t}$, Figure 1b shows the Italian, Spanish, Greek and Portugese exchange rate series $x_{j,t}$. A cursory glance at this figure explains the influence of the periphery countries on the AWM aggregate in Figure 1a. In particular, although the exchange rates of Italy and Spain were not of international significance, their combined weight of over 30% has a large influence on the aggregate. Further, although Portugal and Greece have very low weights, the fact that early in the sample period their currencies were far from their final euro exchange rate values implies that they also have a non-trivial influence on early values of the AWM aggregate. Indeed, Figure 1b shows that Greece and Portugal made substantial progress towards their eventual euro exchange rates during the first half of the 1980s, and this progress is reflected in our sliding weights.

To emphasise the differences, Figure 1c presents the series computed using (constant) AWM weights and our sliding weight methodology, where the large divergence in the 1970s is apparent. Our constructed "historical" series has reduced the exchange rate in the early 1970s relative to a method based

[9] This includes the ECB's Effective Exchange Rate (EER) which is based on trade with 12 countries (Australia, Canada, Denmark, Hong Kong, Japan, Norway, Singapore, South Korea, Sweden, Switzerland, United Kingdom and United States), as well as others based on groups of up to 42 countries.

on the AWM weights, downweighting the extreme values of the peripheral countries' exchange rates depicted in Figure 1b and moving closer to the exchange rates in the core countries. We believe that this new euro exchange rate with the US dollar provides a useful measure of a European exchange rate that was important for financial markets during the 1970s and 1980s. Finally, Figure 1d illustrates the (inverse) Deutschmark and French franc bilateral rates to the US dollar together with our constructed series.

4 Consequences of Alternative Aggregation Methods

This section presents two examples of the impact of data choices on outcomes for models that might be employed in a policy context, namely using a simple structural VAR model for the Euro Area and a two-country international DSGE model. The comparisons are undertaken for series constructed using our methodology in comparison to the AWM database, since this provides the benchmark dataset for Euro Area policy analyses.

4.1 A simple VAR for the Euro Area

Vector autoregressive (VAR) models are designed to allow the data to elucidate the dynamics in the economy, without the imposition of empirically binding theoretical constraints[10]. Sims (1992) develops a simple, but effective, structure for monetary/financial variables and output, together with an external commodity price index, and applies this structure to France, Germany, the UK, the US and Japan. To illustrate the potential importance of differences between AWM and sliding weights data, we here consider results from a slightly modified version of the Sims (1992) model for the Euro Area[11].

[10] More recently there is a move to reconcile empirical SVAR models with theoretical New Keynesian specifications of the type given in Section 4.2 below; see for example An and Schorfheide (2007) and Del Negro, Schorfheide, Smets and Wouters (2007).

[11] Our model does not employ money supply, as this series for the Euro Area is not available from the AWM database. The change from the Sims (1992) specification in omitting money supply reflect subsequent developments in monetary policy and changed views of the inflation process.

More explicitly, we include the short-run interest rate, the log exchange rate for the US vs Euro dollar, log commodity price index[12], log consumer prices and log GDP. Identification is achieved by orthogonalising the contemporary effects based on this variable ordering, so that interest rates are affected by all other variables in the current quarter. The commodity price index is an international variable, while all others relate to the Euro Area. All variables are used in levels at a quarterly frequency, with monthly data converted to this frequency by averaging. The VAR employs 4 lags, representing one year of data, consistent with Sims' 14 lags in monthly data.

Two datasets are used in estimation, with the commodity price and output growth data common to both. The only differences are in relation to the Euro Area monetary/financial variables. In one case these are drawn from the AWM database (the short term interest rate and inflation rate from the AWM database, with the exchange rate constructed using the AWM weights). In the second case these monetary/financial variables are constructed according to the methodology of Section 3. The distinctive features of these two sets of variables are illustrated in subsection 3.3 and the appendix. Parameter estimates from both sets of data do not produce problems with convergence or analysis, with the model well-behaved in that it provides eigenvalues within the unit circle and satisfactory impulse responses, although there is evidence of a price puzzle, discussed below. Nevertheless, these models produce important differences from the perspective of monetary policy. A selection of impulse responses for the VAR are shown in Figure 2.

Consider first the impact of a shock to inflation (the shocks in both VAR models are scaled to be the same as the standard deviations in the AWM database model). This produces a far greater monetary policy response (in terms of short run interest rates) in the sliding weights data than the AWM one, see Figure 2(a).

In terms of the effectiveness of monetary policy, the response of inflation to a shock to the short term interest rate are shown in Figure 2(b). Although the impact on inflation is initially similar in the two cases, with both showing

[12] The agricultural raw materials commodity price index from IFS (00176BXDZF) was used as it contains data for the entire sample.

price puzzle effects, the price puzzle lasts three and a half years in the case of the AWM dataset rather than two years in the sliding weights dataset. Indeed, the results of Sims (1992) for the G-7 countries indicate such price puzzle effects, especially for France. Recent work suggests that the transmission of exchange rate shocks may be important in untangling this effect, see Claus, Fry and Dungey (2007).

Output also declines slightly more in response to an interest rate shock in the model using the sliding weights data than the AWM data, but the differences are relatively slight - at the nadir the output growth is 0.7% lower under the sliding weights data and 0.6% lower with the AWM data, 2(c). However, a final analytically important difference is the response of the exchange rate to higher interest rates in the model. Figure 2(d) shows that the response to an interest rate shock is a depreciation of the euro when using the AWM dataset, but an economically more reasonable appreciation results from the use of the sliding weights data.

4.2 A Two-Country DSGE Model

Much modern macroeconomic modelling revolves around the so-called New Keynesian DSGE model, characterised as describing the essential features of a closed economy through a minimum of three equations: an IS curve, a New Keynesian Phillips curve and a monetary policy reaction function. The defining feature of this literature is the development of the model, and particularly the IS function, from assumptions about utility optimising representative consumers. A standard reference for this body of work is Woodford (2003).

Recently, and especially in the light of understanding the relationship between the Euro Area and the US, there has been increasing interest in simultaneously studying two open economies within the New Keynesian (NK) framework; for example Smets and Wouters (2003) and Lubik and Schorfheide (2005). The Lubik and Schorfheide model (henceforth LS) involves the standard New Keynesian framework supplemented by a UIP condition, with the resulting model having a similar structure to that proposed by Gali and

Monacelli (2003) for a single open economy. Representative agents maximise utility based on consumption from both domestic and foreign sources, with habit formation. Domestic producers and importers in both countries employ Calvo pricing. The linkages between economies occur via the UIP condition, and the inclusion of foreign output in the domestic IS curve, which is part of the replacement of net exports via the terms of trade conditions used in Gali and Monacelli (2003). A feature of the LS model is that, in order to ease the estimation burden, a number of assumptions are made about the structure of the two economies; in particular, that the representative agents in both economies have the same coefficient of relative risk aversion, the same habit formation parameter, the same intertemporal elasticity of substitution between domestic and foreign goods and the same import share in consumption. On the other hand, the proportions of domestic producers and importers who cannot set optimal prices, the weights in the Taylor rule and the evolution of each of the technology shocks, interest rate shocks and government expenditure shocks differ across the countries. The parameters estimated by LS, together with a brief description of each, are presented in Table 2[13]. For full details of the derivation of the model the reader is referred to both Lubik and Schorfheide (2005) and Gali and Monacelli (2003).

LS estimate their model over 1983Q1 to 2002Q4[14]. However, the LS dataset also provides data covering the same period as the AWM data for all series (with the exception of US GDP but this was fairly easy to match with their existing data from the usual sources). The Euro Area data employed by LS is obtained from the AWM database, with the addition of a few series constructed by LS from other sources. In particular, they construct a historical euro/US dollar exchange rate series prior to 1999 from the individual euro country exchange rates and the AWM weights of Table 1 (see Lubik and Schorfheide, 2005, pp.357-358).

[13] We adopt the LS notation, except that that we replace "home" and "foreign" by US and Euro Area respectively.

[14] The documentation of LS on Schorfheide's database provides a comprehensive set of Dynare codes and datasets to replicate their estimation results, which we were able to do. Our new dataset provides similar results to theirs over this period (results available from the authors on request).

In order to explore the different implications of the choice of historical Euro Area data, Table 3 presents estimation results from the LS model over 1971Q1 to 2003Q4, using both the LS dataset and also replacing the Euro Area data in LS with our sliding weights data for interest rates, exchange rates and inflation. The table also includes the prior distributions employed in the Bayesian estimation and the LS results over 1983Q1 to 2002Q4, with these taken from LS[15].

Some notable differences are evident across the two sets of estimates for the extended sample. Perhaps the most striking of these differences occur in the proportions of Euro Area producers who cannot optimally set prices in the Euro Area market; the posterior mean of θ^*_{EA} is substantially higher for our data than for the original LS data. The elasticity of substitution between foreign and domestic goods (η) is also much higher in the model based on the sliding weight data. Habit persistence (h) differs markedly across the two sets of estimates, with lower habit persistence of 0.36 estimated using the new dataset, compared with 0.65 for the LS/AWM dataset. It is interesting to note that the new data set provides an estimate for h that is closer to that for the LS/AWM data for the shorter period. The import share α changes markedly, from 0.16 in the LS/AWM dataset to 0.08 in the sliding weights dataset. This may be indicative of the stress in the model caused by imposing the same import share across both countries, and is worthy of further research efforts.

The weights in the Taylor rules are particularly interesting. Although the inflation weights (ψ_1 and ψ_1^*) and exchange rate weights (ψ_3 and ψ_3^*) do not change across the data sets, the output gap coefficient for each country is much higher for the sliding weights dataset than for the LS/AWM dataset for the 1971Q1 to 2003Q4 sample, with the differences for the each being nontrivial. These differences caused by simply changing the data would have important implications for policy analysis - the model based on the sliding weights scheme gives far greater emphasis to output gaps than the model based on the fixed wieght LS/AWM data for a comparable sample period.

[15]It might be noted that LS use their 1970Q1 to 1982Q4 data to motivate many of their priors.

Our purpose here has been to point out that the choice of methodology for creating a Euro Area wide data is not without consequence, and data needs to be fit for purpose. In particular, while it may be sensible to cumulate real economic variables on the basis of GDP weights as in the AWM database, we believe this is not the case for monetary or financial variables. The consequences of these changes may lead to quite different policy implications, as witnessed in the example of the LS model in this section.

5 Conclusions

In an introductory discussion of monetary policy in the Euro Area, the ECB (2001: p52) refers to the importance of "long runs of *backdata*" to underpin econometric analysis essential to understand the operation of the economy in which monetary policy operates. The Area Wide Model project detailed in Fagan et al. (2005) provides such series, and this has become the benchmark for historical analyses of the Euro Area. However, this database will not be suitable for all purposes. It does not cover all series that a researcher may wish to include, nor is its method of aggregation using fixed weights appropriate in all circumstances.

This paper has focussed on the issue of constructing backdata for monetary and financial variables, first showing the rather dramatic changes in the levels of the historical euro exchange rate implied by using alternative weighting mechanisms. We propose a sliding weight methodology to represent the convergence of exchange rates in periphery countries to their irrevocable weights during the development of the current Euro Area. Our methodology addresses the Rudebusch and Svensson (2002) suggestions for ensuring that synthetic backdata are appropriate. We construct historical Euro Area series for short and long interest rates, and consumer prices, in addition to exchange rates. The methodology could, of course, be applied to other series, including stock market prices. Although we recognise that other methods might have more desirable properties in alternative applications, we believe that our approach gives a more realistic view of the historical evolution of monetary and financial variables associated with the Euro Area than a fixed weight aggregation. Further, our sliding weight methodology recognises that, while some countries (such as Germany) may have had a particular role in the development of Euro Area monetary policy, the use of German data alone pre-1999 may not be an adequate proxy for the later Euro Area (see also Nautz, and Offermanns, 2006).

Our applications to a simple VAR model of the Euro Area and a two-country DSGE model for the US and the Euro Area demonstrate that substntially different results are obtained when an historical analysis is undertaken using our data rather than the benchmark AWM dataset for the Euro Area. Indeed, the use of the sliding weights data in the latter case sometimes leads to estimates closer to the original estimates of Lubik and Schorfheide (2005) using a shorter sample from 1983, suggesting that structural breaks may be less evident than with the AWM data. An investigation of this issue is beyond the scope of the present paper, but it indicates the need for further research on appropriate methods of historical aggregation in the context of increasing monetary integration.

Constructing historical data for the Euro Area is an important practical issue, which is also a contemporary one as new member countries join the area. Our sliding weight methodology can handle this situation of time-varying membership, without distorting analysis of policy in the Euro Area between 1999 and 2006 by the unrealistic assumption that the new members participated from the initial adoption of the euro currency. The alternative assumption of a structural break as each new member joins is unattractive, not only due to the number of such breaks that may apply, but it also because it fails to recognise the increasing role of such countries in Euro Area policy-making as they prepare to join the area.

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6 Appendix: Other Constructed Historical Series

Here we briefly discuss the impact of the use of sliding weights on interest rate and consumer price aggregates, compared with series constructed from AWM weights. The series discussed here, like the bilateral exchange rates, are monthly.

6.1 Interest Rates

Considerations relating to the aggregation of interest rates are that the short term interest rate in the Euro Area is set by the ECB and is common to all member countries, whereas the long term interest rate is market determined and can differ between countries. Cross country variations in the latter reflect the degree of commitment that market participants believe that countries might have with respect to meeting the Euro Area targets for fiscal and monetary probity, different institutional structures, different country and sovereign risk factors, and different inflationary outlooks brought about by supply side and other factors.

Figures 3a and 3b show our constructed short and long term interest rates, together with the German short and long term interest rates, and corresponding rates that have been constructed using the AWM weights throughout. In constructing our historical rates, we used the same set of sliding weights as those used for the exchange rates in section 3, and when country specific observations on interest rates are not available for a given month, we redistribute these weights across the available interest rates in proportion. The Euribor is used for the short rate from its inception in December 1998. However, long rates remain country-specific and we use the AWM weights to construct this series from January 1999.

The divergence between our sliding weight interest rate series and those based on AWM weights is most pronounced in the period between 1976 and 1980. During this period, our series shows a much greater decline in interest rates (corresponding to the fall in German rates) than the AWM series. Subsequent to this date our interest rate series have similar patterns to the corresponding AWM aggregates, although the levels of the corresponding series converge only in the late 1990s. The series are also close at the beginning of the 1970s, but this proximity is partly a consequence of data availability, since Italian and Spanish short rates are unavailable for this period, as are long rates for Spain. Note that this unavailability has less influence on our aggregate than on the AWM series, because the exchange rate series were further from the core at that time and hence these periphery countries have little weight in our aggregation (see Figure 1b).

6.2 Consumer Prices

The ECB uses the HICP (constructed by Eurostat) as the basis of monetary policy decisions, and as observed in Hill (2004), the aggregation involved to produce this series is temporally consistent, but not spatially consistent. The HICP starts from 1990, but cross-country aggregation for dates prior to 1990 needs to address a series of problems, because different countries constructed their price indices differently, and some, but not all countries have produced seasonally adjusted indices. Diewert (2002) provides a comprehensive critique of the construction of the HICP, which he describes as neither consumer nor producer theory based, but an amalgamation of the two. A further concern, but a side-issue in our context, is the apparent change in seasonality from 1999 onwards, which possibly pertains to treatment of sales data in the construction of the underlying indices. Given that price and inflation levels are often important in the construction of real interest rates, real returns and purchasing power parity tests, we construct prices and inflation series that are consistent with the financial data. More specifically, we aggregate the individual Euro Area country CPI (all items) series by aggregating the monthly growth rates using the sliding weights obtained from (2), and then converting the growth rates to a price index setting January 1970 as 100.

Figure 4a shows the Euro Area annual inflation rate (observed on a monthly basis) that results from these calculations, along with corresponding German and French inflation rates. To show the differences implied by our approach, Figure 4b compares our calculated Euro Area annual inflation rate for each quarter (calculated as the average of the monthly rates), against the AWM inflation rate data. The inflation rate via the sliding weights method is somewhat lower in the 1970s and higher in the 1990s. Since the AWM inflation is based on HICP weights, some differences persist between these series even at the end of the sample.

Table 1:
Aggregation weights for Euro Area countries

country	AWM weight	country	AWM weight
Core		Periphery	
Germany	0.283	Italy	0.195
France	0.201	Spain	0.111
Netherlands	0.060	Greece	0.025
Belgium	0.036	Portugal	0.024
Austria	0.030	Finland	0.017
Luxembourg	0.003	Ireland	0.003

Notes: Our classification places countries on the left hand side of the table in our "core", and those on the right as "periphery". The weights are taken from the explanatory notes accompanying the August 2004 update of the AWM database.

Table 2:
Parameter names and definitions for the Lubik and Schorfheide (2005) open economy model for the US and Euro Area

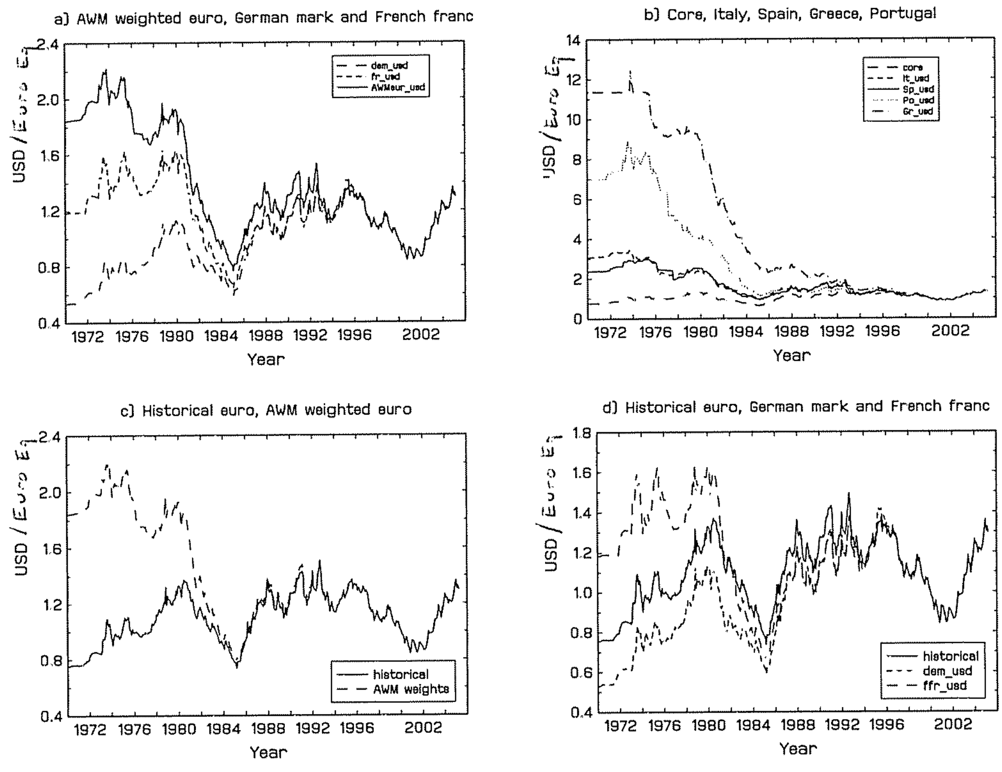
parameter names and definitions	
θ_{US} :	proportion of domestic US producers who cannot optimally price set
θ_{EA} :	proportion of US importers (Euro Area producers) who cannot optimally price set
θ^*_{US} :	proportion of Euro Area importers (US producers) who cannot optimally price set
θ^*_{EA} :	proportion of domestic Euro Area producers who cannot optimally price set
τ :	coefficient of relative risk aversion
h :	habit formation parameter
α :	import share in consumption
η :	intratemporal elasticty of substitution between domestic and foreign goods
ψ_1 :	Taylor rule for the US, weight on inflation
ψ_2 :	Taylor rule for the US, weight on output gap
ψ_3 :	Taylor rule for the US, weight on exchange rate
ψ^*_1 :	Taylor rule for the Euro Area, weight on inflation
ψ^*_2 :	Taylor rule for the Euro Area, weight on output gap
ψ^*_3 :	Taylor rule for the Euro Area, weight on exchange rate

Table 3:
Parameter estimates for Lubik and Schorfheide model

	Prior		Posterior LS data 1983Q1:2002Q4		Posterior LS data 1971Q1:2003Q4		Posterior Sliding weights 1971Q1:2003Q4	
θ_{US}	0.50	$[0.25, 0.75]$	0.66	$[0.53, 0.80]$	0.73	$[0.65, 0.77]$	0.74	$[0.69, 0.81]$
θ_{EA}	0.50	$[0.25, 0.74]$	0.56	$[0.28, 0.86]$	0.73	$[0.56, 0.87]$	0.72	$[0.57, 0.85]$
θ^*_{US}	0.75	$[0.53, 0.98]$	0.86	$[0.73, 1.00]$	0.84	$[0.72, 0.92]$	0.89	$[0.85, 0.96]$
θ^*_{EA}	0.75	$[0.53, 0.98]$	0.76	$[0.67, 0.85]$	0.60	$[0.56, 0.65]$	0.93	$[0.92, 0.95]$
τ	2.00	$[1.19, 2.79]$	3.76	$[2.81, 4.69]$	3.32	$[2.97, 3.55]$	3.67	$[3.33, 3.96]$
h	0.30	$[0.14, 0.46]$	0.41	$[0.15, 0.67]$	0.65	$[0.57, 0.73]$	0.36	$[0.20, 0.54]$
α	0.12	$[0.04, 0.20]$	0.13	$[0.04, 0.23]$	0.16	$[0.11, 0.17]$	0.08	$[0.06, 0.09]$
η	1.00	$[0.23, 1.73]$	0.43	$[0.07, 0.80]$	0.51	$[0.14, 0.91]$	0.66	$[0.17, 0.96]$
ψ_1	1.50	$[1.09, 1.89]$	1.41	$[1.03, 1.75]$	1.10	$[1.10, 1.10]$	1.08	$[1.08, 1.08]$
ψ_2	0.50	$[0.12, 0.87]$	0.66	$[0.38, 0.96]$	0.40	$[0.25, 0.55]$	0.61	$[0.54, 0.74]$
ψ_3	0.10	$[0.02, 0.17]$	0.03	$[0.01, 0.05]$	0.02	$[0.02, 0.02]$	0.03	$[0.03, 0.03]$
ψ^*_1	1.50	$[1.09, 1.89]$	1.37	$[1.08, 1.65]$	0.96	$[0.96, 0.96]$	0.97	$[0.97, 0.97]$
ψ^*_2	0.50	$[0.12, 0.87]$	1.27	$[0.80, 1.73]$	0.69	$[0.59, 0.76]$	0.88	$[0.75, 0.97]$
ψ^*_3	0.10	$[0.02, 0.17]$	0.03	$[0.01, 0.05]$	0.05	$[0.05, 0.05]$	0.05	$[0.05, 0.05]$

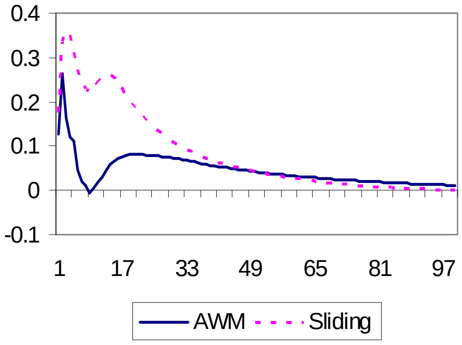
Note: Values shown in each case are the mean, with the 90% confidence interval in parentheses. The priors and the posterior results over 1983Q1 to 2002Q4 are from Lubik and Schorfleide (2005, Table 5.2). Their dataset and code were used to estimate the period 1971Q1 to 2003Q4. The sliding weights dataset uses series identical to those of the LS dataset, except for exchange rates, short and long interest rates and inflation, which are constructed by the methodology of Section 3 and shown in Figures 1, 3 and 4.

Figure 1: Exchange Rates

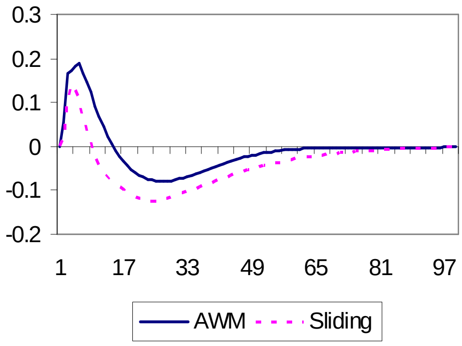


Note: The series marked "historical" is constructed using the sliding weights of Section 3.1.

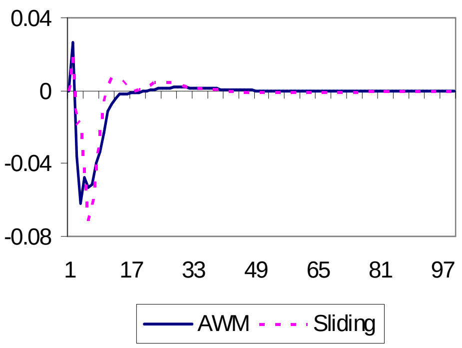
Figure 2: SVAR impulse responses



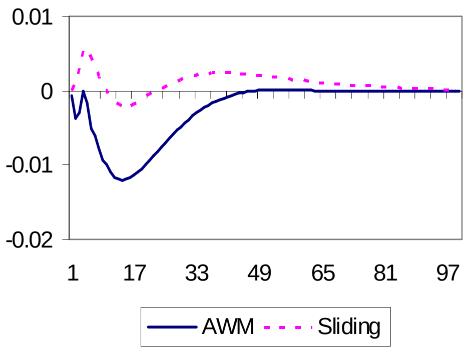
(a)Interest rate response to inflation shock.



(b)Inflation response to interest rate shock.

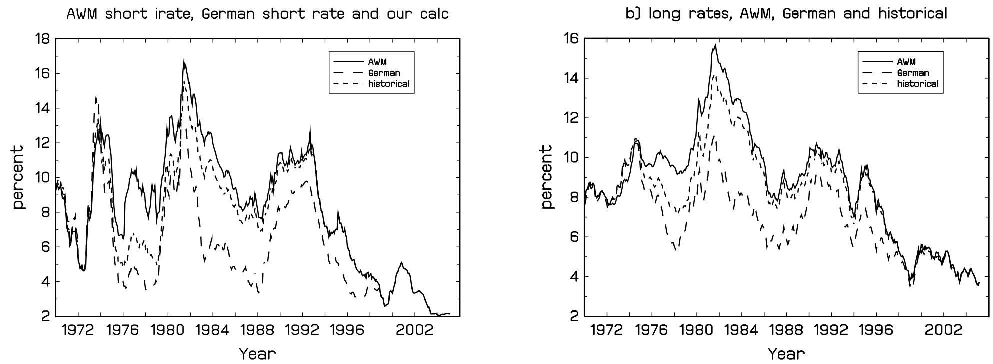


(c) Output growth response to interest rate shock.



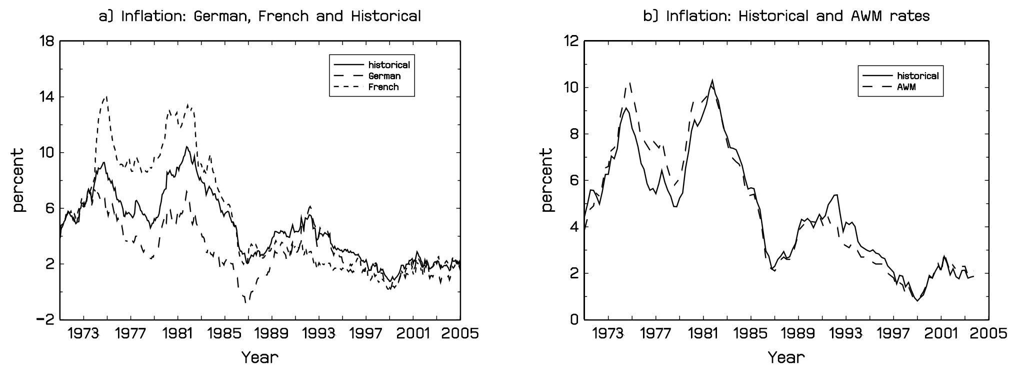
(d) Exchange rate response to interest rate shock.

Figure 3: Interest Rates



Note: The series marked "historical" is constructed using the sliding weights of Section 3.1.

Figure 4: Inflation



Note: The series marked "historical" is constructed using the sliding weights of Section 3.1.