THE BACK CALCULATION OF NOMINAL. HISTORICAL SERIES AFTER THE INTRODUCTION OF THE EUROPEAN CURRENCY

(An application to the GDP)

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ABSTRACT

Monetary union in Europe raises the problem of converting into euros nominal historical series calculated in the respective national currencies. The aim of this paper is to evaluate alternative conversion procedures, including use of the rates fixed at the start of Stage Three between the national currencies and the euro, historical market exchange rates series and PPS series. These alternatives are ranked according to the ability of the transformed series to approximate the rates of growth of the original series and the real weight of each country's series within the aggregate.

1. INTRODUCTION

Monetary union in Europe raises the problem of converting into euros historical nominal series calculated in the respective national currencies. Using the conversion rates between the national currencies and the euro may appear to be the simplest and most sensible solution, since the series could be inmediately linked into the future and their original dynamics (i.e. growth rates) would be preserved intact. However, when applying this procedure to multicountry comparisons or aggregations within the single currency area, an additional concern emerges which is absent in individual country studies: given the divergent inflationary past of the countries entering EMU, conversion rates would provide overly low (high) values for the nominal series of those countries with higher (lower) inflation rates, so that their individual weights in the aggregate would be distorted. Consequently, the need arises to search for alternative conversion procedures.

This paper is organised as follows. The next section deals more formally with the problems associated with selecting appropriate convertors for nominal series denominated in national currency into euros and presents the criteria for ranking possible candidates, including historical market exchange rate series and PPS series. Section 3 sets out the results of applying the criteria, while sections 4 and 5 address, respectively, their robustness and their interpretation. The final section has three aims: to summarize the previous reflections, to develop the main proposals and to highlight the limitations of the exercise.

2. THE DESCRIPTION OF THE PROBLEM

Formally, assume without loss of generality that EMU will be composed of just two countries. A nominal series in national currency (say, nominal GDP) for country i is represented by $Y_{i,t} = p_{i,t} \cdot y_{i,t}$, where $p_{i,t}$ is the price deflator, $y_{i,t}$ the real magnitude, and $t \leq t_N$, any time period prior to monetary union (which takes place at $t = t_N$). The (inverse of the) conversion rate against the euro fixed in period t_N is given by $\bar{e}^{euro,i}$ $(i = 1,2)$.

Now, building the whole series in euros backwards using $\bar{e}^{euro,i}$, amounts simply to a rescaling of the original series without any impact on its growth rates. However, under such a transformation, the change in the weight of country i within the aggregate (w_i) between any period $t<t_N$ and $t=t_N$ will be given by

$$w_{i,t_N} - w_{i,t} = \frac{\bar{e}^{euro,i} \cdot p_{i,t_N} \cdot y_{i,t_N}}{\sum_{j=1,2} \bar{e}^{euro,j} \cdot p_{j,t_N} \cdot y_{j,t_N}} - \frac{\bar{e}^{euro,i} \cdot p_{i,t} \cdot y_{i,t}}{\sum_{j=1,2} \bar{e}^{euro,j} \cdot p_{j,t} \cdot y_{j,t}}$$

Using the implicit fixed parity between the currencies of the two countries derived from $\bar{e}^{euro,1}$ and $\bar{e}^{euro,2}$ ($\bar{e}^{2,1} = \bar{e}^{euro,1} / \bar{e}^{euro,2}$) and rearranging, we obtain for country 1:

$$w_{1,t_N} - w_{1,t} = \frac{y_{1,t_N}}{y_{1,t_N} + \frac{p_{2,t_N}}{\bar{e}^{2,1} \cdot p_{1,t_N}} \cdot y_{2,t_N}} - \frac{y_{1,t}}{y_{1,t} + \frac{p_{2,t}}{\bar{e}^{2,1} \cdot p_{1,t}} \cdot y_{2,t}} \quad [1]$$

where it can be easily checked that if country 1 recorded higher (lower) cumulative inflation between periods t and t_N, then its weight is being artificially lowered (increased) back in the past.

Assume now that the conversion is done using market exchange rates instead. Let B be any possible currency or basket of currencies and $e_t^{B,i}$ its historical exchange rate series against the currency of country i (i=1,2). Then, the nominal series in euros for country i can be expressed as:

$$Y_{i,t}^{euro,B} = \bar{e}^{euro,B} \cdot e_t^{B,i} \cdot p_{i,t} \cdot y_{i,t} \qquad \text{for } t \leq N$$

where $\bar{e}^{euro,B}$ is the exchange rate between the euro and B at the start of Stage Three, when parities for EU currencies entering EMU are fixed.

The change in the weight of country 1 in the aggregate between periods t and t_N will be given by:

$$w_{1,t_N} - w_{1,t} = \frac{\bar{e}^{euro,B} \cdot \bar{e}^{B,1} \cdot p_{1,t_N} \cdot y_{1,t_N}}{\sum_{j=1,2} \bar{e}^{euro,B} \cdot \bar{e}^{B,j} \cdot p_{j,t_N} \cdot y_{j,t_N}} - \frac{\bar{e}^{euro,B} \cdot e_t^{B,1} \cdot p_{1,t} \cdot y_{1,t}}{\sum_{j=1,2} \bar{e}^{euro,B} \cdot e_t^{B,j} \cdot p_{j,t} \cdot y_{j,t}} \quad (1)$$

Using $e_t^{2,1} = \frac{e_t^{B,1}}{e_t^{B,2}}$ and $\bar{e}^{2,1} = \frac{\bar{e}^{B,1}}{\bar{e}^{B,2}}$, simplifying and rearranging:

$$w_{1,t_N} - w_{1,t} = \frac{y_{1,t_N}}{y_{1,t_N} + \frac{p_{2,t_N}}{\bar{e}^{2,1} \cdot p_{1,t_N}} \cdot y_{2,t_N}} - \frac{y_{1,t}}{y_{1,t} + \frac{p_{2,t}}{e_t^{2,1} \cdot p_{1,t}} \cdot y_{2,t}} \quad [2]$$

If, for any period t, PPP were to hold in its absolute version,

$$e_t^{2,1} \cdot p_{1,t} = p_{2,t}$$

then [2] equals:

$$\frac{y_{1,t_N}}{y_{1,t_N} + y_{2,t_N}} - \frac{y_{1,t}}{y_{1,t} + y_{2,t}} \quad [3]$$

so that the change in the weight of country 1 would equal the change in real terms.

Were PPP to hold in its relative -rather than its absolute- version,

$$\frac{p_{2,t_1}}{e_{t_1}^{2,1} \cdot p_{1,t_1}} = \frac{p_{2,t_2}}{e_{t_2}^{2,1} \cdot p_{1,t_2}} = h \qquad t_1, t_2 \leq t_N$$

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(1) Note that the weights are the same regardless of the B used. In fact, using B' instead of B would amount to substituting $\bar{e}^{euro,B'} \cdot e_t^{B',B} \cdot e_t^{B,i}$ and $\bar{e}^{euro,B'} \cdot \bar{e}^{B',B} \cdot \bar{e}^{B,i}$ for $\bar{e}^{euro,B} \cdot e_t^{B,i}$ and $\bar{e}^{euro,B} \cdot \bar{e}^{B,i}$, respectively, so that numerators and denominators would be multiplied by the same factor.

then [2] could be rewritten as:

$$\frac{y_{1,t_N}}{y_{1,t_N} + h \cdot y_{2,t_N}} - \frac{y_{1,t}}{y_{1,t} + h \cdot y_{2,t}} \qquad [4]$$

so that some distorsion would still exist, although unlike in [1], this would not be induced by cumulative inflation differentials, but rather by the fact that market exchange rates possibly do not equalize price levels across countries(2).

In any case, using market exchange rates in the conversion does not provide a conclusive answer to the problem. First, empirical evidence rejects the absolute PPP hypothesis that national price levels are equal in any period when converted to a common currency. However, a certain consensus has been reached that long-run convergence to relative PPP takes place, although deviations from it tend to be corrected very slowly (Rogoff, 1996).

Besides, PPP compliance does not guarantee that the dynamics of the original series (in terms of growth rates) are preserved. Let $\hat{Y}_{i,t}$ and $\hat{Y}^{euro,B}_{i,t}$ be, respectively, the growth rates of country i's nominal series in national currency and in euros, where

$$\hat{Y}_{i,t} = \frac{p_{i,t} \cdot y_{i,t}}{p_{i,t-1} \cdot y_{i,t-1}} - 1$$

and

$$\hat{Y}^{euro,B}_{i,t} \quad \frac{e^{B,i}_t \quad p_{i,t} \quad y_{i,t}}{e^{B,i}_{t-1} \quad p_{i,t-1} \quad y_{i,t-1}} - 1$$

Both rates will only coincide when $e^{B,i}_t = e^{B,i}_{t-1}$ as in the case where the conversion parities are used to calculate the series from the

(2) Note that neither absolute nor relative PPP would be of any help in preserving the original weights in [1].

conversion period backwards. Moreover, if PPP (absolute or relative) holds, then

$$\hat{Y}_{i,t}^{euro,B} = \frac{p_{B,t} \cdot y_{i,t}}{p_{B,t-1} \cdot y_{i,t-1}} - 1$$

so that real magnitudes are expressed in the prices of the B area[3].

Still, since retaining the original weights is to be seen as a desirable outcome of the chosen conversion procedure and this appears to be worse accomplished by the fixed parities than by historical exchange rate series, it seems justified to reject the use of the former and to search among any possible B (currency or basket of currencies) for those which minimise the deviations between $\hat{Y}_{i,t}^{euro,B}$ and $\hat{Y}_{i,t}$. Thus, to evaluate basket performance, similarity between the dynamics of the original and converted series is the main criterion used. More precisely, consider country i's nominal GDP series in euros built using a given basket B as:

$$Y_{i,t}^{euro,B} = \bar{e}^{euro,B} \cdot e_t^{B,i} \cdot Y_{i,t}$$

where i is now any EU Member State.

The rate of growth of $Y_{i,t}^{euro,B}$ can be expressed as:

$$\hat{Y}_{i,t}^{euro,B} = \hat{e}_t^{B,i} + \hat{Y}_{i,t} + \hat{e}_t^{B,i} \cdot \hat{Y}_{i,t}$$

where $\hat{e}_t^{B,i}$ is the rate at which currency i appreciated or depreciated against B between periods t-1 and t.

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(3) Consequently, $\hat{Y}_{i,t}^{euro,B}$ will tend to be more similar to $\hat{Y}_{i,t}$ the closer the price dynamics of the basket area are to those of country i. In fact, a bit of algebra shows that, under PPP, $\hat{Y}_{i,t}^{euro,B} - \hat{Y}_{i,t}$ is zero if $\hat{p}_{i,t} = \hat{p}_{B,t}$, where hats denote rates of growth of the respective price indices.

Thus,

$$\hat{Y}^{euro,B}_{i,t} - \hat{Y}_{i,t} = \hat{e}^{B,i}_{t}(1+\hat{Y}_{i,t}) \qquad [5]$$

A measure of the appropriateness of basket B as a conversion factor for i's nominal GDP can be provided by the standard deviation of [5], std^B_i [4]. Consequently, the overall performance of basket B is evaluated by computing the unweighted sum of the std^B_i for i = 1,2,...,15 (i.e., for all 15 EU Member States), $std^B = \sum_{i \in EU-15} std^B_i$. The best performing basket B^* can be chosen as the one for which $std^{B^*} = \min_B std^B$ [5].

In this paper, the Bs for which std^B is computed are either currencies or baskets of currencies. Among currencies, std^B has been computed for each of the 14 currencies of the EU Member States and for the US dollar. Baskets are any combination of two or more EU currencies in which the weights are given by the relative shares of the issuing countries' GDP in the GDP of the whole basket area[6]. Results obtained with an already existing basket -the ecu- are also provided. Ecu recompositions in the past addressed the fact that appreciating (depreciating) currencies tended to become overweighted (underweighted) between any two recompositions. As a result, between recompositions the weights in the ecu tended to depart from the criteria used to define them. In order to avoid this problem, the std^B measure is

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[4] An alternative would have been to compute, for a given i, the sum of the squared deviations in [5] for all t. However, computing std^B_i has been prefered for reasons which are explained later.

[5] It is debatable whether the std^B_is should be weighted or not. For a given B, it might appear warranted to weight the respective std^B_h on the grounds that a bad adjustment distorts the aggregate more if it affects a large rather than a small country. However, it has been prefered here to treat all countries equally irrespective of their size.

[6] Details on the construction of the baskets are provided in the annex.

obtained for any basket B -other than the ecu- with the national currency amounts in B being recalculated every year ("yearly recomposition")[7].

Finally, as has been pointed out, it can hardly be believed that, in practice, market exchange rates truly equalize price levels among countries (so that absolute PPP does not hold and the real weights are not preserved as in [3]). Besides, short-term market exchange rate movements do not respond just to inflation differentials (so that relative PPP does not hold either in the short-run). For these reasons, series converted through purchasing power standards (PPS) are also considered. PPS are constructed exchange rates which equalize the price levels for a given nominal aggregate in all countries considered and thus, unlike actual exchange rates, do not move in response to factors independent of relative price variations. Consequently, nominal series converted through PPS are able to preserve the real weights of every country as in [3].

3. COMPARISON BETWEEN DIFFERENT CURRENCIES AND BASKETS

The data used in the exercise relate to the nominal GDP for the period 1970-96 and stem from Eurostat's AMECO database. The results obtained for the different currencies and baskets are presented in table 1. The basket which provides the lowest sum of standard deviations (B*) contains the same currencies irrespective of whether the currency amounts are allowed to change every year ("yearly recomposition") or only when the ecu composition was revised ("ecu recomposition"). These currencies are the BLF, DKR, IEP, HFL, ÖS and SKR[8], which jointly account for only around 15% of total EU GDP. Indeed, one would probably

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[7] Results are also obtained for every basket revising national currency amounts only when the ecu composition was changed -i.e., 1979, 1984 and 1989- ("ecu recomposition").

[8] The following abbreviations are used throughout the paper: BLF (Belgian and Luxembourg franc), DKR (Danish crown), DM (German mark), DRA (Greek dracma), PTA (Spanish peseta), FFR (French franc), IEP (Irish pound), LIT (Italian lira), HFL (Dutch guilder), ESC (Portuguese escudo), GBP (British pound), ÖS (Austrian schilling), SKR (Swedish crown), FIM (Finnish mark).

have expected a larger number of currencies in the basket, as well as a higher share of those currencies in the GDP of EU-15. Both basket recomposition procedures offer very similar results.

The basket in which all fourteen currencies are included (the "all currencies" basket) has a somewhat larger sum of standard deviations[9]. However, this total sum is more evenly split among the different Member States, so that the goodness of the fit of the nominal GDP growth rates is more similar -according to the std_n^B criterion- when the "all currencies" basket is employed as compared to the B*. Losers under the former include Germany, Greece and all countries whose currencies are included in B* (except Ireland and Sweden), while for the latter two countries, Spain, France, Italy, Portugal and the UK the "all currencies" basket is preferable.

Compared to the all currencies basket, the ecu provides aggregate results which are similar or even a bit better (if the "ecu recomposition" version of the former is considered). Taking instead for comparison the all currencies basket where currency amounts are determined in every period, the ecu is seen to produce somewhat more "unfair" results in the sense that differences tend to sharpen among those countries for which the differences between the rates of growth of nominal GDP expressed in terms of the all currencies basket and in national currencies tend to be, respectively, more and less volatile.

Among individual currencies, the lowest sum of standard deviations is obtained for the Dutch guilder, which is not very useful however for capturing the dynamics of nominal GDP in national currency for such countries as Spain, Italy, the United Kingdom, Sweden, Finland and even France or Ireland, although it performs very well for Germany and Austria. Of course, this must be reflecting the much lower stability over the past two and a half decades of the exchange rate of the guilder against the first group of currencies as compared to the second, which

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[9] It is very difficult to derive statistical tests which are able to check whether the std^Bs obtained with different Bs are statistically different from each other.

translates into the volatility of the rates of appreciation or depreciation. Conversion through the German mark shares many features with conversion through the guilder.

For comparison purposes, the worst performing EU currency is also included in table 1. This proves to be the Portuguese escudo, which is unable to capture the dynamics of the nominal GDP growth rates of any country (except Portugal, of course) better than any other of the previously mentioned measures.

The performance of the US dollar is also very poor. Indeed, the variability of the difference between the growth rates of nominal GDP expressed in dollars and in national currency is greater than the variability of the corresponding difference between growth rates in escudos and national currency for all countries other than the United Kingdom.

Finally, PPS exchange rates clearly outperform any other B, although results are somewhat worse for Ireland's and Luxembourg's nominal GDP than under some other possible conversion series.

Table 2 contains the best performing basket for any individual country's GDP (B_h^*), when the currency amounts in the basket are allowed to change every year and the currency from that country itself is excluded from the calculations. The results in this table provide an indication as to which currencies are best able to capture the movements in the growth rates of the original series.

Some points are noteworthy. First, there is a certain degree of "transitivity", in the sense that whenever the currency of country i belongs to the optimal basket for h (B_h^*), the currency of h tends also to be included in B_i^*. However, this is not true in quite a large number of cases. Second, it is also not always true that the optimal basket for a country with a history of low inflation is composed only of currencies with an analogous past (and vice versa). It is somewhat surprising that the escudo belongs to five of the optimal baskets B_h^* while Portugal's GDP dynamics themselves tend to be the worst tracked by any basket B.

Finally, and most importantly, B_h^* performs worse than PPS for two thirds of the countries' nominal GDPs. So, even if for a nominal series denominated in a given national currency, those currencies are taken with the lowest bilateral volatility against it, it is still preferable to use exchange rates which only take price developments into account in their calculation (PPS).

What about the weight of the converted series of a given country within the aggregate for a given basket B ($w_{i,t}^B$) ? We assume that the weights when B is the PPS series are the "true" real weights of every country. To see this, note that the conversion through PPS amounts, for every single year, to valuing the nominal GDP of each country at the same prices. Consequently, for each year, a cross-section comparison between the resulting aggregates is equivalent to a comparison between real values (recall also [3])[10].

For any other basket B composed of one or more currencies, the resulting weights differ from the ones obtained under the PPS conversion. However, they are the same regardless of the composition of the basket (see footnote (1)). Table 3 presents for selected years the weights corresponding to PPS and to any other basket. Differences in the weights of some countries under both conversion procedures are in some cases rather large, but what is more relevant is the greater volatility of the weights for baskets constructed through market exchange rates, reflecting the volatility of the latter.

Finally, some calculations were done computing weighted std^B s, with results which point crudely towards the resulting trade-off: better treatment of the country with the higher weight amounts to worse treatment of nearly every other country[11].

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[10] However, note that time-series of PPS aggregates are purely nominal series in which real magnitudes are valued at each year's prices.

[11] Specifically, the Dutch guilder was substituted as the best performing currency by the German mark, with the result that $std^{DM}_{(weighted)}$ was reduced a bit to 0,722017 (as compared to $std^{HFl\ (unweighted)} = 0,746047$). However, $std_h^{DM\ (weighted)}$ was lower than $std_h^{HFl\ (unweighted)}$ only for the nominal GDP of Austria and -obviously- Germany, and higher

4. ROBUSTNESS

In order to check the robustness of the results to the criterion used to rank the different baskets according to their ability to track as closely as possible the growth rates of the original series, alternative criteria are used. First, dt_1^B is computed disregarding the two observations with the highest and lowest absolute value differences between the rates of growth of the converted and original series. Second, standard deviations are replaced by variances.

Under the first of these alternatives, the composition of the optimal basket remains unaltered. PPS keep on being preferable to any basket, but now the ecu performs somewhat better than the all currencies basket. Overall, results are very reassuring about the robustness of the previous findings.

Matters are different as far as the second alternative is concerned. The composition of the optimal basket under the new criterion changes extensively, with the Austrian schilling leaving the basket and seven other currencies entering it. PPS remains the best option, although now the all currencies basket -and, of course, the new optimal basket- are preferable to the former optimal basket (and this, to the ecu). If, besides the adoption of variances instead of standard deviations, the largest and smallest differences between the original and converted rates of growth are disregarded, the optimal basket obtained changes again (becoming more similar to the original B^*), although the basket ordering remains the same.

These results point towards an insufficient robustness of the standard deviation criterion. However, some of the main conclusions remain unaffected, namely, the superiority of PPS, the difficulties in justifying the composition of any of the optimal baskets, and the relatively good performance -compared to the optimal baskets- of the all currencies and the ecu basket.

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for those of the Netherlands -also obviously- and the remaining countries.

5. INTERPRETATION OF THE RESULTS

How should these results be interpreted? Note first, from [5] that std^B_h is lower, the less volatile $\hat{e}_t^{B,h}$ has been historically[12]. For instance, assume that $\hat{e}_t^{B,h} = -0,02$ in every period (that is, the national currency of country h has been depreciating against basket B at the constant annual rate of 2%). Then std^B_h would be equal to zero, so that one would conclude that B is indeed a very good convertor for $Y_{h,t}$[13].

Of course, no market bilateral or multilateral nominal exchange rate changes at a constant pace in the real world. Take for instance $e_t^{DM,USD}$ for the period considered here. In the last 25 years, the US dollar has tended to depreciate against the DM in a long-run perspective. However, from period to period, $e_t^{DM,USD}$ variations have been far from uniform. A sharp US dollar appreciation between 1981 and 1985 was followed by an equally sharp depreciation until 1988. Now, the question is what factors explain such nominal exchange rate dynamics. The long-run US dollar depreciation can be satisfactorily explained by developments in the inflation differential between the two countries, so that it is acceptable to think of relative PPP as being fulfilled in the long-run. However, to explain the behavior of this particular bilateral exchange rate in the 80s and, in general, the behaviour of market exchange rates over a horizon of a few years, one must rely upon economic policies applied, agents' reaction to such policies, market bubbles and so on. Such behaviour is often unrelated to inflation differentials[14].

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[12] This interpretation is ignoring the term $\hat{e}_t^{B,h} . \hat{Y}_{h,t}$ in $\hat{Y}_t^{euro,B} - \hat{Y}_{h,t}$. Although somewhat large for certain periods and countries, this term is in general of a second order of magnitude compared to $\hat{e}_t^{B,h}$.

[13] Note, however, that this does not mean that the resulting growth rates for h's nominal GDP in terms of B (or equivalently in euros) would coincide with those in national currency, but rather that the latter would be lowered uniformly by 2% in any period.

[14] Precisely, what inflation differentials can be useful for, is to say whether nominal exchange rates are misaligned and the size of the required adjustment.

Consequently, std_D^{USD} has a high value in this exercise, which leads us to conclude that the US dollar is not a good choice to convert German nominal GDP into euros. Had the market exchange rate moved more smoothly, then it would have been found more appropriate for the conversion. This would have been so if $\hat{e}_t^{USD,DM}$ had moved in line with the bilateral inflation differential, but even in this case, std_D^{USD} would have been positive, since although inflation rates were higher in the US than in Germany throughout the period (except after German reunification), the differential was not constant. Indeed, std_D^{USD} would have been still lower if $\hat{e}_t^{USD,DM}$ had shown less volatility than the inflation differential. However, this would have been rather unusual.

The US dollar overshooting in the 80s helps to explain why the US dollar performance in converting the nominal GDP series of the EU Member States into a common currency is so poor for all of those series. At the other extreme, the best overall performance according to the criterion established in the current exercise is provided by PPS exchange rates. This is consistent with the way PPS are calculated. By eliminating that part of nominal exchange rate variability which is not due to inflation differentials, PPS are much less volatile. However, the performance of PPS is uneven across Member States. This reflects the fact that, while for some countries -for instance, Belgium or France- inflation differentials against the other 14 Member States have shown little departure from their average, for some others -especially Portugal- such deviations have been large.

Consequently, PPP fulfillment serves as a guide to provide for an adequate choice of B, but only imperfectly captures the dynamic behaviour of the original series (in the sense that original growth rates are preserved, albeit possibly augmented or diminished by a constant amount).

An alternative in order to select B^* would have been to compute the sum of squared deviations between the growth rates of the converted and original series ssd_i^B (where $ssd_i^B = \sum_{t=1}^{T} (\hat{Y}_{i,t}^B - \hat{Y}_{i,t})^2$) instead of std_i^B. Intuitively, for a given basket B and a given country i, both options would provide similar results in the case in which inflation differentials

between country i and the countries whose currencies compose B have been historically reduced. However, if this were not the case, results could be substantially different and, more importantly, it would not be so obvious which measure would be more suitable. If inflation differentials had remained high, but more or less constant, the std^B_i measure would remain adequate, since there would exist a well-defined average difference between $\tilde{Y}^B_{i,t}$ and $\hat{Y}_{i,t}$. On the contrary, such an average would be less meaningful under high and volatile inflation differentials, so that possibly ssd^B_i could be preferable. Indeed, this issue deserves to be further investigated.

6. CONCLUSIONS

In this paper, exchange rate series have been sought which allow for an appropriate conversion of nominal series in national currency into euros when the aim is to aggregate or compare series across countries. While the problem has no obvious solution, the two criteria employed for selecting the conversion exchange rate series have been, trying to preserve as accurately as possible, on the one hand, the relative real weight of each country in the aggregate and, on the other hand, the original dynamics of the series (in the sense that the resulting growth rates tend to maintain the profile of the original rates, although possibly shifted by a fixed amount). The focus is on nominal GDP series, although the results obtained for them need not hold for other series.

PPS appear to be the best choice according to both criteria. Let us start with the second one. PPS are non-market exchange rates which equalise the price levels in different countries when expressed in a common currency. Thus, by their very construction, PPS comply with absolute (and relative) PPP. Matters are different for market exchange rates which empirically have been found to fulfill PPP only in its relative version and only in the long-run.

Consequently, PPS rates of growth reflect inflation differentials. If these have kept constant between the country whose nominal series is converted and the reference group of countries, the rates of growth of the converted series will differ from those of the original one by a

constant amount (equal to the inflation differential). If, more realistically, inflation differentials diverge over different periods, the conversion will amount, approximately, to adding (or subtracting) from the original rate the inflation differential in every period.

Market exchange rate movements do not track inflation differentials very well in the short-run. Rather, they show a markedly higher volatility, and thus perform rather worse for conversion purposes, since converted rates of growth will tend to differ to a greater extent from the original ones.

As to the first criterion, PPS are also preferable, since it can easily be shown that PPP fulfillment guarantees that the weight in the aggregate after conversion through PPS coincides with the weight in real terms.

The use of PPS has further advantages. There already exist available PPS series, they are intuitively simple (although their calculation is complicated) and they do not tend to fit some countries' series better at the expense of others'. The main disadvantage is that PPS series for frequencies less than yearly do not exist, so that procedures would have to be devised in order to create them. Besides, PPS are specific for every aggregate. For the sake of simplicity, it would probably be preferable to employ the same PPS series for conversion of all nominal series. This would be clearly wrong if the main interest were to lie in volume comparisons for a given period. However, this is not the aim of the current exercise. The obvious candidate then would be to use for every aggregate PPS computed for GDP[15].

If, in spite of these considerations, it is regarded as more suitable to convert nominal series using market exchange rates, the B^* basket (that which provides the lowest overall volatility of the deviations between the rates of growth of the transformed and original series for all countries) should be discarded. The reason lies in the difficulty in

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[15] In fact Eurostat uses the PPS for GDP in international comparisons of various aggregates (Eurostat, 1995, page 28).

justifying the selection of the currencies composing the basket, which might appear artificial and arbitrary.

A basket including all EU currencies or the ecu basket offer aggregate results (in terms of the measure of volatility) which are only marginally worse. However, compared to B^*, usage of such baskets is easier to justify and treats different countries more evenly. Were the all currencies basket chosen, some issues would remain to be solved. First, whether the national currency amounts should change each period (which seems reasonable); second, whether other criteria -besides the country shares in the area GDP or GNP- should be used to determine the currency weights in the basket (which might also appear warranted, but might heavily complicate the calculations). Finally, whether the all currencies basket should contain just the currencies of the countries entering the first wave of EMU or those of all Member States instead. The latter option seems more justified in order to avoid the problem of having to decide a few years afterwards between recalculating the series or permanently leaving out of the basket the currencies of the countries initially remaining outside.

As to the ecu, there exist good arguments for selecting it. First, broader criteria are taken into account in determining the weights from which national currency amounts are derived (even if a certain degree of arbitrariness exists). Second, it is an already existing basket for which series are available -so that there would be no need to calculate a new basket- and, finally, it has a symbolic value in the process to monetary union.

Conversions through any single currency should also be ruled out, since they either show an overall bad performance or are particularly unsuitable for certain countries' GDP.

Finally, it is important to note that these proposals do not constitute an optimal solution in terms of the proposed selection criteria, but just second best solutions. Besides, the criteria themselves might be called into question. First, the definition of the maintenance of the original dynamics is rather narrow and, second, it is even possibly not so

obvious why the dynamics of the transformed series should approach those of the original series.

TABLE 1: PERFORMANCE OF ALTERNATIVE BASKETS AND CURRENCIES

Basket	std^B	std_h^B														
		B	DK	D	G	E	F	IRL	I	L	NL	P	UK	Ö	SV	SF
B^*																
"yearly recomposition"	0.684	0.021	0.021	0.023	0.065	0.064	0.034	0.053	0.061	0.024	0.020	0.092	0.068	0.022	0.059	0.062
"ecu recomposition"	0.683	0.022	0.021	0.024	0.060	0.064	0.034	0.052	0.060	0.024	0.020	0.092	0.069	0.023	0.056	0.062
All currencies included																
"yearly recomposition"	0.706	0.034	0.033	0.038	0.068	0.069	0.033	0.040	0.068	0.037	0.034	0.088	0.055	0.037	0.053	0.062
"ecu recomposition"	0.727	0.038	0.030	0.068	0.065	0.056	0.035	0.035	0.043	0.061	0.037	0.068	0.059	0.041	0.055	0.062
Ecu	0.710	0.028	0.029	0.030	0.064	0.068	0.033	0.041	0.051	0.037	0.028	0.095	0.059	0.030	0.061	0.065
PPS	0.460	0.019	0.019	0.026	0.053	0.037	0.018	0.046	0.035	0.026	0.019	0.064	0.032	0.030	0.021	0.027
Dutch guildar (best performing currency)	0.746	0.030	0.028	0.012	0.065	0.075	0.045	0.058	0.069	0.022	0	0.102	0.077	0.010	0.072	0.071
German mark	0.773	0.031	0.030	0	0.066	0.077	0.048	0.063	0.073	0.033	0.012	0.105	0.079	0.009	0.074	0.073
Portuguese escudo (worst performing currency)	1.452	0.106	0.100	0.115	0.102	0.086	0.092	0.111	0.110	0.105	0.111	0	0.114	0.114	0.086	0.099
US dollar	1.815	0.126	0.121	0.120	0.104	0.133	0.127	0.119	0.132	0.130	0.117	0.144	0.101	0.119	0.111	0.110

Note: For all single currency baskets, "yearly recomposition" is used.

TABLE 2: BEST PERFORMING BASKET ("YEARLY RECOMPOSITION") FOR EACH COUNTRY'S NOMINAL GDP SERIES (B_h^*)

Country	std_h	Component currencies of the basket B_h^*												
		BLF	DKR	DM	DRA	PTA	FFR	IEP	LIT	HFL	ESC	GBP	ÖS	SKR	FIM
Belgium	0.023		X	X			X			X				X	
Denmark	0.019	X		X			X			X	X			X	
Germany	0.009												X		
Greece	0.055									X	X			X	
Spain	0.049		X					X			X			X	X
France	0.029	X	X					X			X				
Ireland	0.027	X	X						X	X		X			
Italy	0.044							X							
Luxembourg	0.026		X	X	X		X			X				X	
Netherlands	0.010												X		
Portugal	0.076				X	X								X	
United Kingdom	0.046							X							
Austria	0.008			X						X					X
Sweden	0.046	X			X	X					X				X
Finland	0.052												X	X	

TABLE 3: WEIGHTS OF THE CONVERTED NOMINAL GDP SERIES WITHIN THE AGGREGATES FOR SELECTED YEARS (% of total)

Country	Conversion series					
	PPS			B other than PPS		
	1975	1985	1995	1975	1985	1995
Belgium	3.13	3.00	3.07	3.68	2.92	3.20
Denmark	1.64	1.69	1.60	2.23	2.10	2.06
Germany	21.09	20.97	23.96	24.67	22.42	28.65
Greece	1.71	1.81	1.81	1.49	1.46	1.36
Spain	8.30	7.83	8.02	6.21	5.99	6.64
France	17.79	17.91	16.70	20.23	18.94	18.26
Ireland	0.60	0.68	0.92	0.52	0.72	0.76
Italy	15.84	16.98	16.12	12.54	15.33	12.91
Luxembourg	0.16	0.15	0.18	0.15	0.14	0.20
Netherlands	4.51	4.36	4.32	5.24	4.64	4.70
Portugal	1.44	1.54	1.81	1.00	0.86	1.21
United Kingdom	17.12	16.49	15.48	13.82	16.56	13.09
Austria	2.34	2.36	2.43	2.23	2.36	2.77
Sweden	2.98	2.77	2.32	4.33	3.64	2.72
Finland	1.38	1.46	1.27	1.66	1.94	1.48

ANNEX: THE CONSTRUCTION OF THE CURRENCY BASKETS

Baskets are constructed using an analogous procedure to the ecu methodology. However, two main differences arise. First, the weights of the different currencies in the ecu were determined according to the share of the respective countries in total EU GNP, in intra-EU trade and in the EU financial support mechanisms[16]. In this exercise, weights are solely determined by the shares of the different countries' GDP in the total GDP of all countries whose currencies belong to the basket (both measured in -current- PPS).

Second, new currencies were included in the ecu basket when the weights were revised in 1984 and 1989. Here, the currencies belonging to any basket B remain the same during the whole period.

Let t_o be the period in which the composition of the basket is initially fixed; i, a country whose currency belongs to the basket B (denoted $i \in B$); and w_{i,t_o} , the share in period t_o of country i's GDP in the GDP of the basket area so that $\sum_{j \in B} w_{j,t_o} = 1$. These shares are taken as the equivalent value in US dollars of the national currency quantities in the basket. Note then, first, that consequently, the exchange rate between the basket and the USD when the basket composition is determined for the first time is given by $e^{B,USD}_{t_o} = \sum_{j \in B} w_{j,t_o} = 1$ (a normalization without any impact on the growth rates).

Second, from t_o until the next change in the composition of the basket in period t_1, the fixed amounts of the currencies belonging to the basket are:

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[16] An additional criterion was the importance of the country's financial markets.

$$N^{B}_{i,t} = e^{i,USD}_{t_o} \cdot w_{i,t_o} = N^{B}_{i,t_o} \qquad \text{for } t_o \le t < t_1 \quad (17)$$

and the exchange rates of the USD dollar and currency i against the basket are given, respectively, by

$$e^{USD,B}_{t} = \sum_{j \in B} \frac{e^{j,USD}_{t_o} \cdot w_{j,t_o}}{e^{j,USD}_{t}} = \sum_{j \in B} \frac{N^{B}_{j,t}}{e^{j,USD}_{t}}$$

$$e^{i,B}_{t} = e^{i,USD}_{t} \cdot e^{USD,B}_{t} = e^{i,USD}_{t} \cdot \sum_{j \in B} \frac{N^{B}_{j,t}}{e^{j,USD}_{t}}$$

regardless of whether or not currency i is included in the basket (i.e., $i \in$ EU-15 , although possibly $i \notin B$).

At t_1, the amounts of the national currencies in the basket B are changed, according to the new shares of their GDP in the basket area GDP (w_{i,t_1}) . More precisely, since the $e^{USD,B}_{t_1}$ obtained using the old basket composition must be the same under the new basket composition, the equivalent value in US dollars of the national currency quantitites must now be

$$w_{i,t_1} \cdot \sum_{j \in B} \frac{e^{j,USD}_{t_o} \cdot w_{j,t_o}}{e^{j,USD}_{t_1}}$$

and the national currency amounts in the basket themselves will be given, until the next change in the composition , by:

$$N^{B}_{i,t} = e^{i,USD}_{t_1} \cdot w_{i,t_1} \cdot \sum_{j \in B} \frac{e^{j,USD}_{t_o} \cdot w_{j,t_o}}{e^{j,USD}_{t_1}} = N^{B}_{i,t_1} \qquad (\text{for } t_1 \le t < t_2)$$

---

(17) In fact, these are also the national currency amounts used to extend the $e^{i,B}_{t}$ series back to periods prior to the establishment of the basket ($t < t_0$).

Finally, also for $t \in [t_1, t_2)$:

$$e_t^{USD,B} = \sum_{i \in B} \frac{N_{i,t_1}^B}{e_t^{i,USD}}$$

$$e_t^{h,B} = e_t^{h,USD} \cdot \sum_{i \in B} \frac{N_{i,t_1}^B}{e_t^{i,USD}} \qquad h \in EU-15$$

In general, for $t \in [t_{n-1}, t_n)$, where t_{n-1} and t_n are recomposition periods

$$N_{h,t}^B = e_{t_{n-1}}^{h,USD} \cdot w_{h,t_{n-1}} \cdot \sum_{i \in B} \frac{N_{i,t_{n-2}}^B}{e_{t_{n-1}}^{i,USD}}$$

$$e_t^{h,B} = e_t^{h,USD} \cdot \sum_{i \in B} \frac{N_{i,t_{n-1}}^B}{e_t^{i,B}}$$

Inverting the resulting $e_t^{h,B}$ series, nominal series in euros can be constructed as

$$Y_{h,t}^{euro,B} = \bar{e}^{euro,B} \cdot e_t^{B,h} \cdot Y_{h,t}$$

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