Annex 9 – Competition, markups and the influence of the euro

Introduction

This paper considers the proposition that markets in the Euro area economies have become more competitive with the advent of the Euro.[1] The increased competition stems from more transparent price comparisons and the removal of both exchange rate risk and the buying and selling spreads in foreign exchange markets. These changes lower the total cost and uncertainty to consumers of purchasing goods produced or sold in other Euro area countries and make markets more integrated.

The proposition is not easily examined as standard theories of the firm do not explicitly define the concept of 'competition'. Instead the theories make the distinction between perfect and imperfect competition depending on whether or not the firm's output price is equal to, or not equal to, marginal costs respectively.[2] In this way, competition is either perfect or imperfect and is not a continuous variable. This is in stark contrast with the more common use of the term by economists and general commentators where competition is considered to vary continuously.[3] Furthermore, standard models are unhelpful in terms of defining a metric by which competition can be measured directly.

Instead, economists measure competition indirectly in two broad ways. The first describes, or measures, characteristics of the market or industry that are thought to be correlated with competition. For example, one might describe the economic and legal barriers to entry and exit with the idea that lower barriers are commensurate with more contestable, and therefore, more competitive markets.[4] Another example follows from the assertion that the level of competition is related to the number of firms. A simple measure of the raw number of firms in the market would then be considered positively correlated with competition. More complicated measures, such as concentration ratios and Herfindahl indexes focus not only on

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1 Eleven countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain) fixed their exchange rates irrevocably to the Euro on 1 January 1999 and introduced Euro banknotes on 1 January 2002. Greece adopted the Euro on 1 January 2001.

2 Standard theories argue that the type of competition and the relationship between price and marginal cost are linked as necessary conditions for the other to exist. For example, perfect competition is a necessary condition for price to equal marginal cost. Conversely, price equal to marginal cost is necessary for there to be perfect competition.

3 For example, it is valid in general discussion to say that one market or firm is more competitive than another. In the standard model the prefixes, 'more', 'less' and 'un' are not relevant.

4 This approach has its formal basis in the work of Baumol (1982) on contestable markets.

the number of firms but also on how sales or production are distributed among the firms.[5] The second broad way to proceed is to focus on the 'market outcomes' of the change in competition. In this case the focus is the performance of the firm relative to the perfectly competitive profit maximising model. In particular, the divergence of price from marginal costs is considered *prima facie* evidence that a market is uncompetitive.[6]

Measuring competition by the characteristics of the market is not helpful when examining our proposition above. The introduction of the Euro is unlikely to have affected the legal or economic barriers in any way that is measurable. Furthermore, measures of industry concentration are likely to indicate either no change or an increase in concentration after the introduction of the Euro *even if competition in the general sense has increased.*

As an example, consider the effects that introducing the Euro may have had upon competition in the market for a hypothetical Good 'X'. Suppose that prior to January 1999 there was a single firm producing Good X in each of the 11 countries in the Euro area. Measures of industry concentration calculated on a production basis would indicate that the market in each country had one monopoly supplier. If the measure of concentration is calculated by sales within the country (i.e. some sales are satisfied by foreign suppliers) then how close the market in each country is to a monopoly depends on the dominance of each domestic producer. In contrast, concentration ratios calculated on the basis of the Euro area where there are 11 firms would suggest that the market is considerably away from a monopoly even though each firm may be the monopoly supplier in each country (i.e. there are no imports) or nearly the monopoly supplier. Day one after introducing the Euro, concentration measures of competition will not have changed but if consumers are now more willing to purchase Good X (now relatively cheaper due to the decrease in uncertainty and exchange rate costs) from a 'foreign' supplier then competition in a 'real' sense will have increased.

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[5] For a straightforward explanation of concentration ratios and how they are calculated see Henley (1994). Similarly see Hay and Morris (1991) for details of the Herfindahl Index.

[6] Ostroy (1980) proposes the 'no-surplus allocation' as an alternative to the perfectly competitive (or Walrasian) definition of competitive equilibrium. This allocation is equivalent to agents facing Walrasian prices and perfectly elastic demand schedules for the goods they sell. Unfortunately, this approach suffers in the same way as standard theories as it does not define (or explain) the relationship between competition and surplus so that it can become a metric for competition.

How might the increased competition manifest itself? In response to the now relatively cheaper imports, firms may lower their prices and markup. One could imagine the extreme case where prices and the markup fall so that relative prices in each country are unaffected by the introduction of the Euro meaning that the distribution of sales remains the same and measures of industry concentration are unaffected. Another response may be for firms to merge which would reduce competition and lead to an increase in prices and the markup. Therefore, there may be two opposing forces on both the markup and competition following the introduction of the Euro.[7]

The difficulty is to judge if competition has on balance increased in the face of these opposing forces. One way to proceed is to focus on the market outcome in terms of the firm's surplus profit, or in practical terms, the markup. A fall in the markup implies that there is a net benefit to consumers and a net loss to firms which is consistent with the outcome that would ensue if there was an increase in competition.[8] Therefore, one indirect measure of competition would be the markup such that a decrease in the markup, all else equal, is concomitant with a net increase in competition.

The advantage of using the markup as an indirect measure of competition is that it is monotonically decreasing with increases in competition. This is in contrast with measures of industry concentration that may either increase or decrease following the introduction of the Euro even though competition in a real sense has unambiguously increased. However, a number of problems arise with this indirect measure of competition. First, there are difficulties concerning how the markup is defined. Second, structural changes in the production process over time may lead to structural shifts in the markup. Third, as we will see below in Section 3, the level of the markup partly depends on the rate of inflation as well as the level of demand over the business cycle. These problems are controlled for in the empirical analysis that follows.

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[7] This example indicates why industry concentration may be a poor measure of 'competition' when the framework of the industry is altered.

[8] This is not devoid of value judgement. First we are implicitly saying that consumers are valued more highly than firms in the transfer of surplus. Second, there are other aspects, such as product diversity, that are not captured by the markup but may be a result of increased competition.

1. THE MARKUP AS AN INDICATOR OF COMPETITION

A number of practical problems arise concerning the markup as an indicator of competition. First, marginal costs are difficult (or impossible) to measure along with the prices associated with them.[9] It is more convenient therefore to consider the markup on unit or average costs. While it is not necessarily the case that reductions in the marginal cost markup corresponds to a reduction in the unit cost markup it is reasonable to consider movements in the latter to approximate movements in the former.

Second, it is important that the price and cost series have the same coverage of items in their construction and this reduces our choice of the available data series considerably. For example, the price series and the cost series must be related to the same good or basket of goods, otherwise changes in the markup may simply be due to differences between the markets for the different goods. This is also the case when using aggregate data where the price and costs series need to have the same coverage. We could use industry data to calculate the markup but this is not available for most Euro area countries other than at the annual frequency. Given the short time span since the introduction of the Euro, it is necessary to use data more frequent than data measured at an annual frequency and we have settled for the purposes here to use quarterly aggregate price and cost data.

The two panels in Graph 1 show the aggregate unit cost markup of the GDP implicit price deflator on unit labour costs for eight of the eleven Euro area countries in January 1999. The line labelled 'Euro area 7' on each graph is a weighted average markup of the eight markups less that of Finland.[10] The graphs indicate that this measure of the markup (which is the

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[9] While marginal costs are straightforward to economists dealing with continuous production functions and homogeneous goods, they are less straightforward in a world with joint products and inputs that cannot be clearly identified as marginal or fixed. For example, the slaughter of a sheep produces a range of products from the sheep itself and the labour used in slaughtering the sheep. How the cost of the sheep and the labour is allocated to each of the joint products of the slaughtered sheep is arbitrary and therefore, the marginal cost of a leg of lamb is also arbitrary. Furthermore, even the simple question of whether or not the labour is fixed or marginal is not easily answered and, depending on the assumptions made, would affect any calculation of marginal costs. There may well be a set of prices for the joint products that would maximise the profits from the slaughtered sheep but this does not imply that we may be able to measure marginal costs or that they are uniquely defined.

[10] The countries in the graphs and subsequent empirical analysis are chosen on the basis of data availability. Details concerning the data and its sources, as well as the construction of the 'Euro area 7' series, are set out in the data appendix.

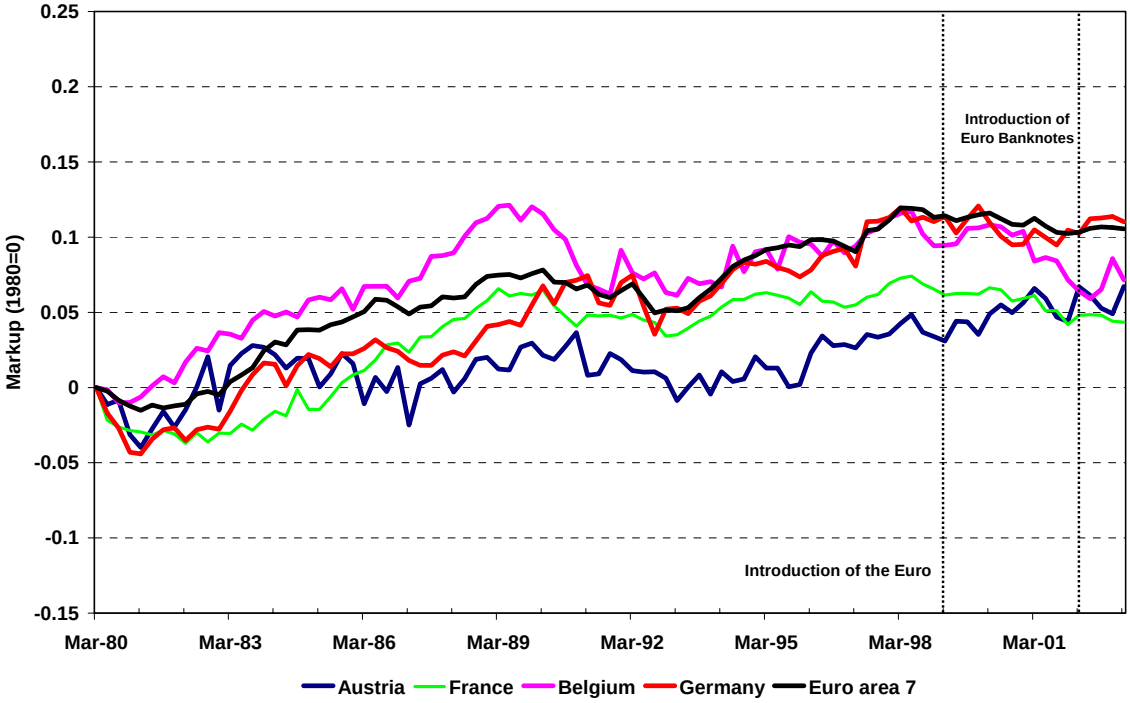
inverse of labour's income share) has varied widely over the past twenty or so years but has in general increased by between 5 per cent (France) and 20 per cent (Italy). Even though there are long periods of decline in the markup for some counties (notably Finland and Spain in the late 1980s and early 1990s), the markup does in general increase for all the countries. This results in the weighted average markup represented as 'Euro area 7' to increase by around 10 per cent between March 1980 and March 2003. Of some interest is the relative stability of the markup for the countries in the top panel of the graph (Austria, Belgium, France and Germany) compared with the countries in the lower panel (Finland, Italy, Netherlands and Spain).

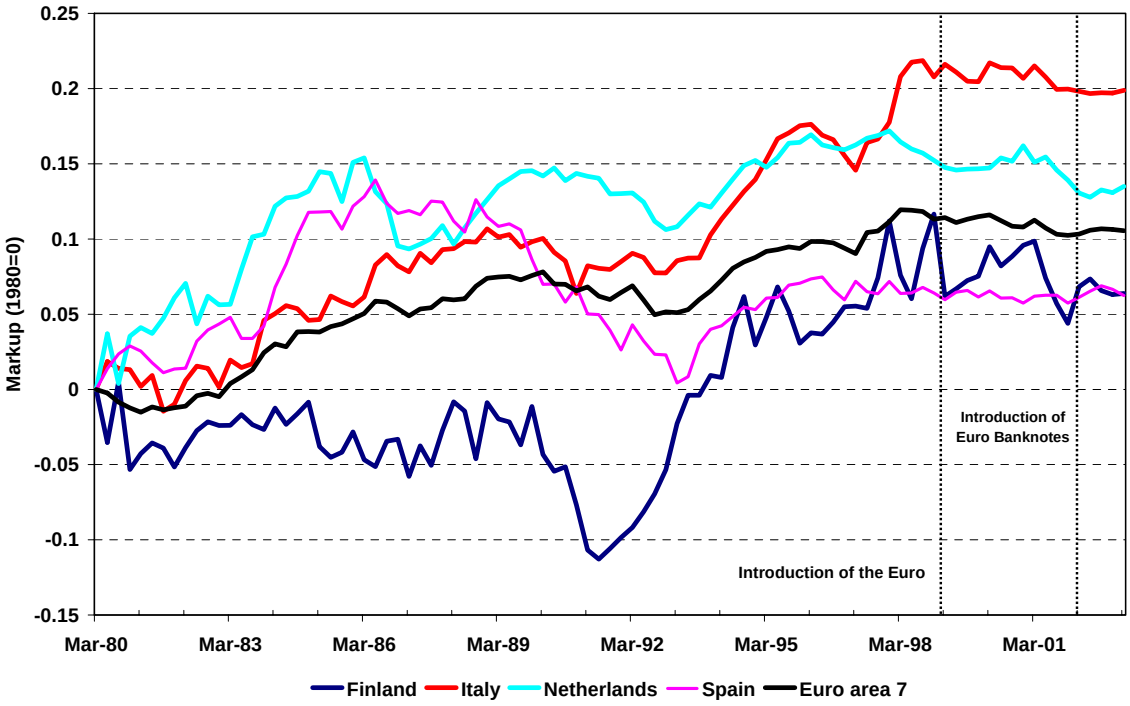
Of more interest for our purposes is the general decline in the markup that is evident in the graphs since the introduction of the Euro in January 1999. Table 1 reports the total change in the level of the markup after the introduction of the Euro and shows the markup increased by 3 ¼ per cent in Austria, largely unchanged in Germany and fell in the remaining countries. Overall the weighted average markup, 'Euro area 7', has fallen by ¾ of a percentage point between December 1988 and March 2003.

The decline in the markup since the introduction of the Euro can be demonstrated more formally by estimating a static model of the markup where the markup is regressed on a constant and two linear trends. The first trend is for the full sample and the other runs between March 1999 and the end of the sample. The results and details of the estimation are reported in Table 2. There are a number of similarities in the estimates for each country. Except for Spain where the trend over the whole sample is insignificant, it is estimated that the markup for the remaining countries increased over the sample at an annual rate of between 0.2 of a percentage point (Austria) and 1 percentage point (Italy). Overall the weighted average increase in the markup as indicated by the 'Euro area 7' model was 2/3 of a percentage point per annum. This trend increase in the markup over the last 20 years may have been due to persistent changes in the underlying structure of the economies although we will argue below that the increase mirrors (and can be explained by) the trend decline in the rate of inflation.

Graph 1: Markup of Price on Unit Labour Costs

March 1980 – March 2003





Notes: The markup is measured as the logarithm of GDP implicit price deflator divided by unit labour costs. The calculation and data sources are discussed in the data appendix.

Table 1: Percentage Change in the Markup

Between December 1998 and March 2003

Austria	3 ¼	Finland	- 5 ¼	Netherlands	- 1 ¾
Belgium	- 2 ¼	Germany	0	Spain	- ¼
France	- 2 ¼	Italy	- 1	'Euro area 7'	- ¾

Table 2: Estimated Trends in the Markup

	Constant	Trend	Short-trend	Diagnostics
Austria	- 0.0095 (- 3.2)	0.0005 (7.4)	0.0016 (3.6)	$\overline{R}^2 = 0.63$, DW=0.84, SEE=0.02.
Belgium	0.0272 (6.1)	0.0012 (12.1)	- 0.0042 (- 6.3)	$\overline{R}^2 = 0.61$, DW=0.22, SEE=0.02.
France	- 0.0225 (- 6.8)	0.0014 (18.7)	- 0.0039 (- 7.9)	$\overline{R}^2 = 0.80$, DW=0.15, SEE=0.02
Finland	- 0.0678 (- 7.9)	0.0015 (7.5)	0.0009 (0.7)	$\overline{R}^2 = 0.52$, DW=0.24, SEE=0.04
Italy	- 0.0074 (- 1.7)	0.0026 (25.7)	- 0.0012 (-1.8)	$\overline{R}^2 = 0.91$, DW=0.22, SEE=0.02
Germany	- 0.0290 (- 11.3)	0.0019 (31.9)	- 0.0022 (- 5.7)	$\overline{R}^2 = 0.94$, DW=0.55, SEE=0.01.
Netherlands	0.0665 (13.4)	0.0014 (12.9)	- 0.0042 (- 5.6)	$\overline{R}^2 = 0.65$, DW=0.24, SEE=0.02
Spain	0.0643 (8.7)	0.0000 (0.3)	- 0.0004 (- 0.4)	$\overline{R}^2 = 0.02$, DW=0.08, SEE=0.03.
'Euro area 7'	- 0.0026 (- 1.0)	0.0016 (25.8)	- 0.0022 (- 5.5)	$\overline{R}^2 = 0.90$, DW=0.13, SEE=0.04.

Notes: (i) The estimated model is: $LMU = \delta_0 + \delta_1 Trend + \delta_2 ShortTrend + \varepsilon$ where LMU is the natural logarithm of the markup of price on unit labour costs, and 'Short-trend' is unity between March 1980 to December 1988 and then unit increases from March 1999 to March 2003; (ii) The models were estimated using ordinary least squares over the period March 1980 to March 2003 with n = 93; and (iii) t statistics reported in brackets.

Estimates of the short-trend for each country are also similar. In five of the countries (Belgium, France, Germany, Italy and the Netherlands) the markup declines after the introduction of the Euro. This leaves one country where the markup increased after January 1999 (Austria) and two where there is no significant change (Finland and Spain). The weighted average decrease in the markup after the introduction of the Euro, 'Euro area 7' is at a rate of around ¾ of a percentage point per annum.

We might conclude therefore from the graphs, Table 1 and the estimates reported in Table 2 that there is *prima facie* evidence that there has been a decline in the markup following the introduction in the Euro and that this decline is consistent with an increase in competition. However, to examine this issue more fully it is necessary to account for other influences that may have affected the markup since March 1999 so as to determine the extent of the decline in the markup that can be attributed to the introduction of the Euro alone. It is these other influences to which we now turn.

2. INFLATION, THE BUSINESS CYCLE AND THE MARKUP

Two major influences on the markup are considered extensively in the literature. The first is the business cycle and the second is inflation. The staggered pricing models of Calvo (1983) and Rotemberg (1982), elasticity-of-demand models of Gali (1994), customer market models of Phelps and Winter (1970), and the implicit collusion model of Rotemberg and Woodford (1992) all suggest that the markup is likely to be countercyclical. The macroeconomic models of Layard, Nickell and Jackman (1991), Lucas (1973), Kydland and Prescott (1988), and Blanchard and Kiyotaki (1987) also imply that the markup (equivalent to the inverse of the real wage in these models) is counter-cyclical.[11]

No less important is the influence of inflation on the markup. Three largely separate literatures have developed explaining the impact of inflation on the markup. The first is based on the 'menu' cost argument of Mankiw (1985) and Parkin (1986). Rotemberg (1983), Kuran (1986), Naish (1986), Danziger (1988), Konieczny (1990) and Bénabou and

[11] Rotemberg and Woodford (1991, 1999) argue in favour of counter-cyclical markups after systematically analysing the possible sources of the variation in the marginal cost markup over the business cycle in imperfectly competitive models. See also Johri (2001), Bils and Chang (2000) and Basu (2000).

Konieczny (1994) model the price setting behaviour of firms to show that inflation has a negative impact on the average markup.[12]

The second literature focuses on the difficulties that price setting firms face when coordinating price changes in an inflationary environment when information is missing. Russell (1998), Russell, Evans, and Preston (2002), and Chen and Russell (2002) also argue that the markup and inflation are negatively related and that the lower markup associated with higher inflation can be interpreted as the cost to firms of overcoming the missing information when setting prices.

The final literature considers the interaction of inflation with the demand for a firm's output. Bénabou (1988, 1992) and Diamond (1993) suggest that higher inflation increases price dispersion and, therefore, the returns to search by consumers increases. Consequently, higher inflation increases search which leads to an increase in competition and a subsequent fall in the markup.

A range of empirical work supports the conclusions of the theoretical papers that there is a negative relationship between inflation and the markup. Richards and Stevens (1987), Bénabou (1992), Franz and Gordon (1993), Cockerell and Russell (1995), de Brouwer and Ericsson (1998), Simon (1999) and Batini, Jackson, and Nickell (2000), Banerjee, Cockerell, and Russell (2001) and Banerjee and Russell (2001a, 2001b, 2003) all identify a negative relationship between inflation and the markup for a range of countries, levels of data aggregation and time periods. A rule of thumb for the magnitude of the inflation-markup relationship is that a fall in annual inflation of 1 percentage point corresponds to a rise in the markup of between ½ and 1 ½ per cent.

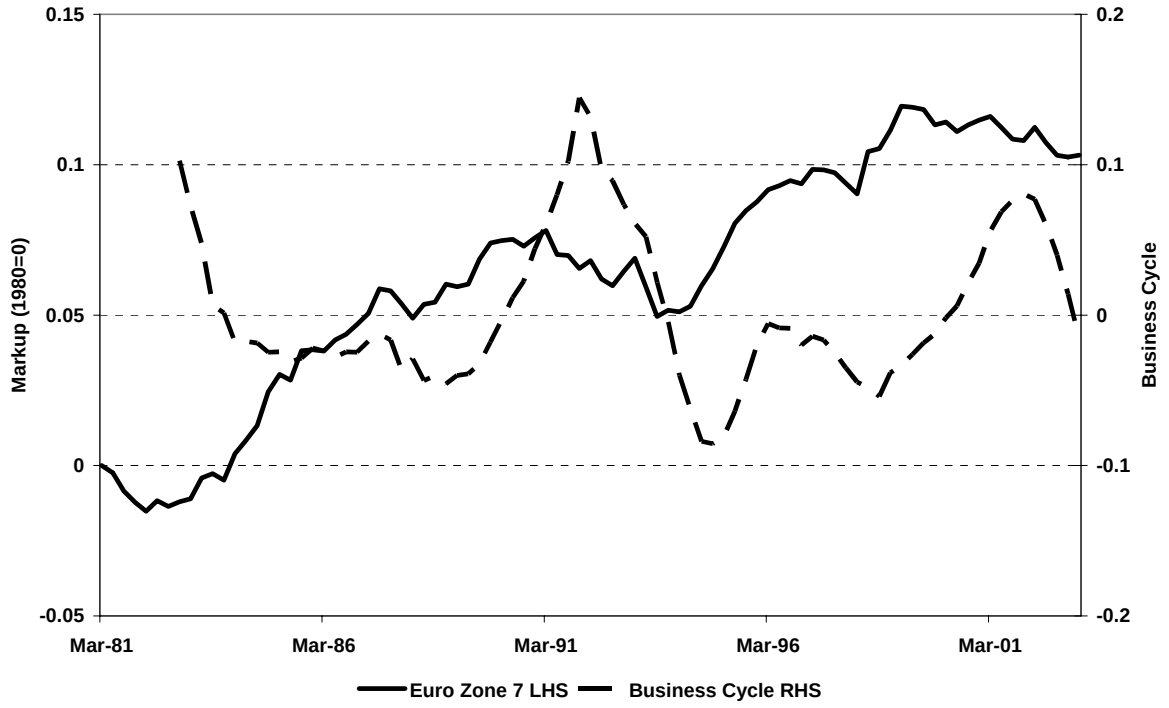
The influences of inflation and the business cycle on the markup are evident in the graphs below for the Euro area. In Graph 2 we can observe the counter-cyclical nature of the markup. In particular the strong upward movements of the business cycle variable coincide

[12] In an important paper, Bénabou and Konieczny (1994) set out an encompassing menu cost model and show that the relationship between inflation and the markup in the menu cost models may be either positive or negative depending on the relative size of inflation, the 'menu' costs, the discount rate, as well as whether the profit function is left-or right-skewed. They conclude that, under 'reasonable' assumptions it is likely the relationship between inflation and the markup is negative.

with falls in the markup series and *vice versa*. Furthermore, we see in Graph 3 that annual inflation declines over the sample by around 15 percentage points accompanied with an increase in the markup of around 10 per cent which is consistent with the 'rule of thumb' outlined above.

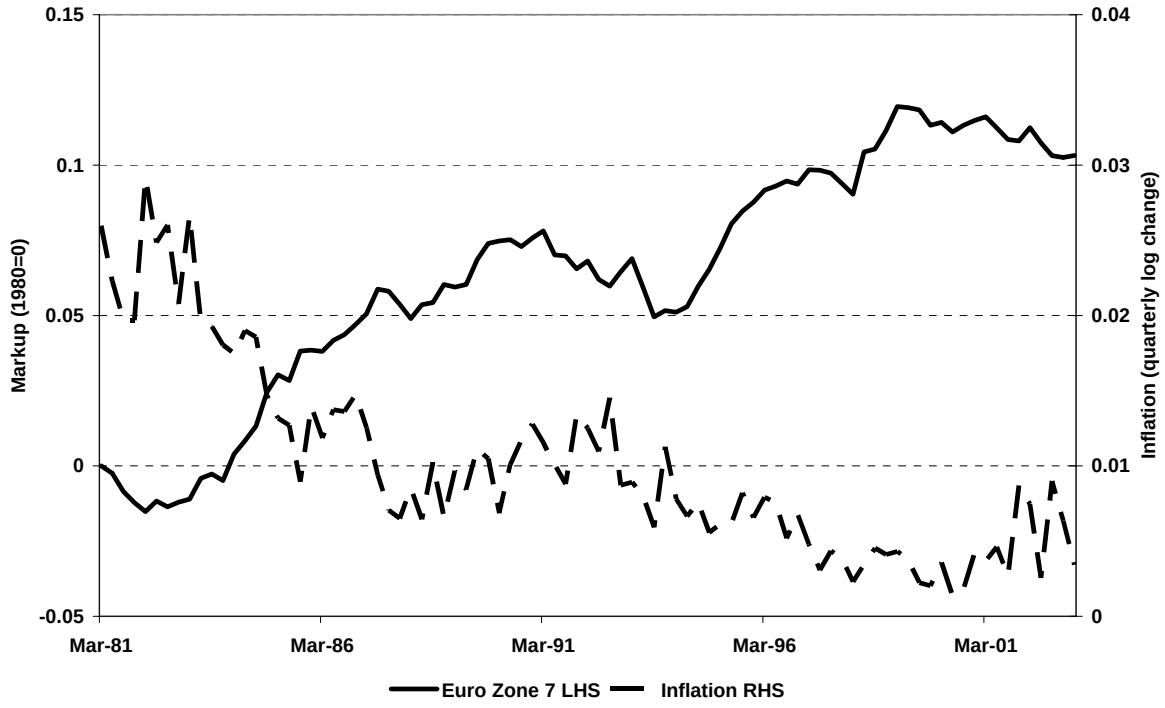
We therefore conjecture that the apparent trend increase in the markup over the whole period as described in Table 1 can largely be explained by the decline in inflation and does not necessarily reflect structural changes in the economy. Similarly, the change in the behaviour of the markup following the introduction of the Euro may also be explained by developments in inflation and the business cycle during this period. In the next section of the paper we devise methods to investigate these conjectures formally and find little evidence to support the original proposition that the markup has declined since the introduction of the Euro in some structural sense independently of movements in inflation and the business cycle.

Graph 2: The Business Cycle and the Markup
March 1980 – March 2003



Note: the business cycle is defined as actual unemployment rate less Hodrick-Prescott filtered unemployment rate.

Graph 3: Inflation and the Markup
March 1980 – March 2003



3. THE EMPIRICAL ANALYSIS OF THE MARKUP

The long-run structure of our model is given by:

$$mu = q - \lambda \Delta p \qquad (1)$$

where mu is the markup of price on unit labour costs, q is the 'gross' markup, λ is the parameter that measures the trade-off in the long-run between inflation and the markup and referred to as the inflation cost coefficient, and p is the price level.[13] Lower-case variables denote natural logarithms and Δ represents the first change in the series. The markup is calculated as $p - ulc$ where the price level, p, is the gross domestic product (GDP) implicit price deflator and ulc is a measure of unit labour costs.[14] The long-run can be nested within

[13] The general model estimated here is considered in detail in Banerjee, Cockerell and Russell (2000).

[14] The markup is measured as an index number and, therefore, it is unfortunate that analysis of the convergence or otherwise of the markup across countries is not possible. To make such analysis one would

a single equation error correction model which captures the short-run behaviour of inflation and the markup around the equilibrium. This leads us to estimating the following equation:

$$\Delta mu = \delta_0 + \delta_1 mu_{t-1} + \delta_2 \Delta p_{t-1} + \sum_{i=1}^{j} \Delta mu_{t-i} + \sum_{i=1}^{l} \Delta bc_{t-i} + t + \varepsilon_t \qquad (2)$$

where bc is the business cycle variable measured as the difference between the unadjusted and Hodrick-Prescott filtered unemployment series and t is a trend.[15] The model was estimated for the period December 1982 to March 2003 for seven Euro area countries: Austria, Belgium, France, Italy, Germany, Netherlands, Spain, and for a weighted average of these seven countries, 'Euro area 7' using quarterly data taken from the OECD data compendium.[16] These seven countries make up around 95 per cent of the Euro area measured at constant price GDP in 1995. As we are concerned about the endogeneity status of two of the right hand side variables, namely Δp_{t-1} and bc_{t-1}, we estimate (2) using instrumental variables where lagged values of the regressors are used as instruments.

Estimating (2) should account for the influences of inflation and the business cycle on the markup. Any trending behaviour of the kind discussed in Section 1 due to either structural changes in the economy or the introduction in the Euro should therefore remain in the estimated residual series, $\hat{\varepsilon}_t$. Thus regressing $\hat{\varepsilon}_t$ on a constant and shift variable, i.e.;[17]

$$\hat{\varepsilon}_t = \gamma_0 + \gamma_1 Shift + \nu_t \qquad (3)$$

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need to identify the markup associated with individual goods that are sold across different countries. Details of the data are provided in the data appendix.

[15] The model initially included the level of the markup of price on the price of exports as a proxy for the real exchange rate and to control for the impact of the terms of trade on the GDP implicit price deflator. However in all cases the term was insignificant and, to simplify the exposition, the term is omitted here. This finding is inconsistent with our expectation that changes in the real exchange rate will affect the markup of the GDP deflator on unit labour costs. However, the data is limited in that the export price deflator is not recalculated prior to the introduction of the Euro to account for intra European trade. The data limitation should make the subsequent empirical analysis more difficult although it appears this is not the case.

[16] Four countries (Finland, Ireland Luxembourg, and Portugal) that joined the Euro in January 1999 are excluded from the estimation due to the unavailability of all the necessary data. Greece subsequently joined the Euro in January 2001 but we have excluded it due to the short sample following the introduction to investigate.

[17] The shift variable is zero up to and including December 1998 and one thereafter.

should reveal significant coefficients for these right-hand-side variables if a structural component is missing from the model given by (2) which may be consistent with the change in the trending behaviour of the markup with the introduction of the Euro.

4. RESULTS

The results are reported in two stages. Table 3 reports the results from estimating equation (2) for each country and for 'Euro area 7'. Table 4 reports estimates obtained from regressing the residuals for each country on a trend and short-trend. Note that for five of the seven countries considered and for the 'Euro area 7' series, inflation and the business cycle have a significant role to play in explaining the behaviour of the markup. In more detail we see that that the annualised long-run coefficient on annual inflation range between 1.3 and 1.7, a result which is consistent with results reported in earlier empirical studies.[18] In particular, for the Euro area over this period, a fall in annual inflation of 1 percentage point corresponds to a rise in the markup of around 1.3 per cent. Note also that the specification tests indicate that the models are well specified. This is in stark contrast with the diagnostics presented in Table 1 which show, as expected, strongly correlated behaviour in the residuals.

Table 4 shows that in line with our conjecture above, we find that other than for Austria where the markup increases following the introduction of the Euro (at the 10 per cent level of significance), there is no significant shift in the residual series. Consequently, we cannot identify any change in the markup after March 1999 if we control for the effects of inflation and the business cycle. A final step we take to verify this conjecture is to estimate regression (4) as a pooled panel and the results in Table 5 confirms our finding from the single equation analysis. These results are robust to changing the date at which it is assumed that the introduction of the Euro may have affected competition in the Euro area.

Further work currently in hand is the analysis of inflation and the markup in a systems framework in order to model the dynamic interactions between these two variables more fully than a single equation framework allows. We also plan to extend our study by estimating the long-run and the break-in-trend effects for these countries explicitly in a panel, instead of

[18] The quarterly inflation cost coefficient, λ, in Table 3 needs to be multiplied by 0.25 to give the annualised inflation cost coefficient.

considering only the residuals derived from a previous estimation exercise. Both these extensions will lead to refinements of the estimates reported in the tables below, but we expect them to remain qualitatively unchanged and to verify the central result presented in our paper that there has been no decline in the markup in a structural sense since the introduction of the Euro after allowing for changes in inflation and the business cycle.

5. CONCLUSION

We show that although the markup has varied considerably since the introduction of the Euro most of this variation can be explained by the movement of inflation and the business cycle. Therefore if we take changes in the markup as a proxy for changes in competitiveness we do not find any evidence of a pro-competitive impact of the creation of the Euro area. This may be due to the fact that we are still in a period of transition or that the data are insufficient for making the kinds of distinctions necessary. The impact of the Euro on competition therefore remains an open question and one with considerable interest for policy makers in light of the aims of the Lisbon strategy. While our conclusions here are somewhat muted, a fuller study would examine more disaggregated data for industries or firms. While such a strategy would have to overcome a number of serious difficulties relating to the availability and consistently-measured series, it is a challenge well worth undertaking especially with the recent developments of panel techniques and the increased availability of panels of industry-level data. Another approach would be to look at the convergence of individual prices of homogenous traded goods, such as a McDonald's type index for each country.

Table 3: Single Equation Model of the Markup – March 1982 to March 2003

	λ	δ_0	mu_{t-1}	Δp_{t-1}	Δmu_{t-1}	$\Delta^2 p_{t-1}$	Δbc_{t-1}	t (iii)	Diagnostics
Austria	6.07	0.0224 (2.9)	- 0.3669 (- 3.4)	- 2.2282 (- 2.3)					DW=2.07, SEE=0.015.
Belgium		0.0103 (2.8)	- 0.1137 (- 3.0)	- 0.0466 (- 0.4)	- 0.1994 (- 2.0)				DW=1.95, SEE=0.009.
France	4.95	0.0137 (3.4)	- 0.1216 (- 2.8)	- 0.6019 (- 3.0)		0.4562 (2.4)		- 0.0664 (- 1.8)	DW=2.21, SEE=0.005
Germany		0.0103 (2.1)	- 0.0681 (- 2.2)	- 0.8744 (- 1.3)			0.1077 (3.6)		DW=2.06, SEE=0.009.
Italy	6.43	0.0248 (3.3)	- 0.1052 (- 3.2)	- 0.6761 (- 2.9)					DW=1.68, SEE=0.009
Netherlands		0.0177 (2.1)	- 0.0967 (- 2.7)	0.7741 (- 0.8)					DW=1.66, SEE=0.010
Spain		- 0.0008 (- 0.2)	- 0.0149 (- 0.3)	0.1318 (1.0)		0.5291 (2.7)	0.2010 (1.9)		DW=1.92, SEE=0.09.
Euro area 7	5.3	0.0140 (3.8)	- 0.1084 (- 3.9)	- 0.5730 (- 3.2)	0.2138 (2.1)	0.3309 (1.8)			DW=2.09, SEE=0.004.

Notes: (i) The models were estimated with two lags of the change in the markup, change in inflation and the business cycle. Insignificant variables excluded on the basis of a 5 per cent t-statistic criterion. (ii) t statistics reported in brackets. (iii) Trend coefficient multiplied by 1000. (iv) λ is the implied inflation cost coefficient from equation (1) for models where the markup and inflation are both significant.

Table 4: Shifts in the Estimated Residuals, $\hat{\varepsilon}$

	Constant[(i)]	Shift[(i)]	Diagnostics
Austria	- 1.1671 (- 0.7)	6.1099 (1.8)	$\overline{R}^2 = 0.02$, DW=2.14, SEE=0.015.
Belgium	0.3732 (0.3)	- 1.8219 (- 0.8)	$\overline{R}^2 = 0.01$, DW=1.97, SEE=0.009.
France	0.1647 (0.3)	- 0.8620 (- 0.8)	$\overline{R}^2 = 0.01$, DW=2.23, SEE=0.005
Germany	0.2191 (0.2)	- 1.9430 (- 1.0)	$\overline{R}^2 = 0.00$, DW=2.05, SEE=0.008.
Italy	- 0.0451 (- 0.0)	0.2363 (0.1)	$\overline{R}^2 = 0.01$, DW=1.67, SEE=0.010
Netherlands	- 0.4940 (- 0.4)	2.5863 (1.3)	$\overline{R}^2 = 0.00$, DW=1.67, SEE=0.010
Spain	0.1836 (0.2)	- 0.8243 (- 0.4)	$\overline{R}^2 = 0.01$, DW=1.93, SEE=0.009
'Euro area 7'	- 0.0162 (- 0.0)	0.0850 (- 0.1)	$\overline{R}^2 = 0.01$, DW=2.09, SEE=0.04.

Notes: 'Shift' is zero up to and including December 1988 and then one thereafter. *t*-statistics reported in brackets. (i) Constant and Shift coefficients multiplied by 1000.

Table 5: Panel Estimates of Trends in the Estimated Residual, $\hat{\varepsilon}$

Shift	Diagnostics
5.981×10^{-5} (0.1)	$\overline{R}^2 = 0.01$, SEE=0.009, Regression F(7,566)=0.047 Significance Level of F=0.99.

Notes: (i) *t*-statistics reported in brackets. See notes to Table 4 for definition of the 'shift' variable.

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A1 DATA APPENDIX

Seasonally adjusted data are for eight Euro area countries, namely, Austria, Belgium, Finland, France, Germany, Italy, Netherlands, and Spain. The source of most of the data is the OECD Data Compendium for the period March 1980 to March 2003 for the markup and inflation and March 1982 to March 2003 for the business cycle. Natural logarithms are taken of all variables before estimation. If not otherwise specified, the mnemonics are from OECD database.

Table A1: Calculations for the Markup, Inflation and the Business Cycle

Variable	*Details*
Markup	The markup is calculated as nominal gross domestic product (NGDP) divided by total labour compensation. The markup for Germany prior to March 1991 is derived by dividing the GDP implicit price deflator by unit labour costs from Banerjee and Russell (2001a).
Inflation	Change in the natural logarithm of the gross domestic product implicit price deflator.
Business Cycle	The business cycle is calculated as the actual unemployment rate less the Hodrick-Prescott filtered unemployment rate.

The 'Euro area 7' series are weighted averages of the individual series for the eight countries less Finland. The weights are taken from European Central Bank (2003) and represent the share of each country's constant 1995 market price GDP at purchasing price parity in total Euro area GDP. The weights used in calculating 'Euro area 7'are recalculated for the remaining 7 countries after excluding Finland, Greece, Portugal, Ireland and Luxemburg due to data difficulties that lead to their exclusion in the empirical work. The excluded countries account for 6.8 per cent of constant price GDP in 1995.

Fixed weights are used to calculate 'Euro area 7' and it may well be argued that variable weights should be used in the calculation. As the 'Euro area 7' results are very similar to the individual country results, it appears that using fixed weights has not compromised the aggregate results.

The recalculated weights used in calculating 'Euro area 7' series are:

Austria	0.032	Belgium	0.039	France	0.216	Italy	0.209
Germany	0.304	Netherlands	0.064	Spain	0.119		

Table A2: Sources and Details of the Data[(i)]

	Nominal GDP	Labour Compensation	GDP Implicit Price Deflator	Unemployment Rate
Austria[(ii)]	AUT1309R1 (March 1988 to March 2003) AUT1309R2 (prior to March 1988)	AUT1301R1 (March 1988 to March 2003) AUT1301R2 (prior to March 1988)	AUT610251	704117DSA (March 1993 to March 2003). 704115DSA (prior to March 1993) multiplicative splice in March 1993 of the ratio of the two series.
Belgium	BEL1309S1	BEL1301S1	BEL610251	222515DSA
France	FRA1309S2	FRA1301S1	FRA610251	142515DSA
Finland	FIN1309S1 (March 1995 to March 2003) FIN1309S2 (prior to March 1995)	FIN1301S1 (March 1995 to March 2003) FIN1301S2 (prior to March 1995)	FIN610251	S1140420400A0 (data from OECD Main Economic Indicators)
Italy	ITA1309S1	ITA1301S1	ITA610251	162515DSA
Germany	DEU1309S1 (March 1991 to March 2003)	DEU1301S1 (March 1991 to March 2003)	DEU610251 (March 1991 to March 2003) Prior to March 1991 spliced with the ipd is for West Germany derived as nominal GDP, DEW1019S1, divided by constant price GDP, DEW111951.	121239DSA
Netherlands	NLD1309S1	NLD1301S1	NLD610251	182515DSA
Spain	ESP1309S1	ESP1301S1	ESP610251	322515DSA

(i) Mnemonics from OECD database. (ii) Data for nominal GDP and labour compensation are seasonally unadjusted. The markup was calculated and then seasonally adjusted using 4 centred seasonal dummies.