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ABSTRACT/RÉSUMÉ

In this paper, we present estimates of the mark-up of product price over marginal costs for the US manufacturing industries over the 1970-1992 period. The paper extends the analysis used in previous studies based on nominal productivity residuals by considering intermediate inputs and cyclical fluctuations of price margins. The estimated steady-state mark-ups are positive but moderate, generally in the range of 10-20 per cent. The results also support the hypothesis of countercyclical price margins in most manufacturing industries, especially in the presence of downward rigidities of labour inputs. This offers an appealing interpretation of the otherwise puzzling procyclicality of real wages and enables to better estimate TFP. We also discuss the role of market structures on the levels and cyclicality of mark-ups. Finally, we compare the results for the United States with those of the other G-5 countries and distinguish between fragmented and segmented industries. The latter provides relatively robust evidence on the role of market structures on price-setting behaviour.

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Cette étude présente des estimations du taux de marge des prix sur les coûts marginaux pour les industries manufacturières sur la période 1970-92. On élargit ici l’analyse utilisée dans des études précédentes, fondées sur l’utilisation des résidus nominaux de productivité, en tenant compte des biens intermédiaires et les fluctuations cycliques des taux de marge. Les taux de marge estimés sont positifs mais modérés, entre 10 et 20 pour cent. Les résultats confortent l’hypothèse que le taux de marge sont contre-cycliques dans la plupart des industries, notamment en présence de rigidités à la baisse de l’emploi. Ceci offre une interprétation intéressante pour le puzzle bien connu de la pro-cyclicalité des salaires réels et permet d’améliorer l’estimation de la productivité totale des facteurs. En dernier, nous comparons les résultats obtenus pour les États-Unis avec ceux des autres pays du G-5 et introduisons la distinction entre industries fragmentées et segmentées. Cette comparaison tend à confirmer le rôle joué par les structures de marché dans les comportements de marge.

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THE LEVELS AND CYCLICAL BEHAVIOUR OF MARK-UPS ACROSS COUNTRIES AND MARKET STRUCTURES

Joaquim OLIVEIRA MARTINS and Stefano SCARPETTA[1]

1. Introduction

Over the past decade, there has been a growing interest in the macroeconomic literature on the identification of imperfect competition in product markets, by estimating the mark-ups of prices over marginal costs. Moreover, the existence of a positive and varying mark-up has implications for the interpretation of two major macroeconomic stylised facts: i) the observed *pro-cyclicality of total factor productivity* measures, such as the Solow residual; and, ii) the *pro-cyclicality of real wages.* On the one hand, a large mark-up could explain why productivity tends to be pro-cyclical (Hall, 1986). On the other hand, a counter-cyclical mark-up may reconcile pro-cyclical factor prices with aggregate-demand-driven business cycles, thereby offering an alternative to real business cycle theories (Rotemberg and Woodford, 1992, Chatterjee, Cooper and Ravikumar, 1993; Chevalier and Scharfstein, 1996).

In addition, to the extent to which the impact of macroeconomic policies on output and prices depends on the level and cyclicality of mark-ups (Silvestre, 1993; Aziz and Leruth, 1997), the identification of a mark-up behaviour is important for the design of policies. However, the existence of positive price-margins is not necessarily a sign of lack of competition so as to require a specific policy intervention. As discussed in the industrial organisation literature, certain industries, e.g. those characterised by intense competition through innovation or advertising, can only emerge and develop with positive price-margins over the long-run (Sutton, 1991). In this way, the analysis of mark-up behaviour bridges a natural gap between industrial organisation and macroeconomic research.

Different approaches to estimate the degree of market power have been suggested. Amongst them are those that relate the observed pro-cyclicality of the primal Solow residual to the existence of a positive mark-up (Hall, 1986 and 1988, Bils, 1987, Shapiro, 1987; Domowitz, Hubbard and Petersen, 1988; Caballero and Lyons, 1990; Domowitz, 1992; Haskel, Martin and Small, 1995). These studies refer to Hall (1986) who expressed the Solow residual as a function of the mark-up and the labour/capital ratio. However, this latter relation cannot be directly estimated by simple OLS because the error term includes productivity shocks that are correlated with the explanatory (cyclical) variables leading to upwardly biased mark-up coefficients. Hall proposed the use of instrumental variables to overcome this problem, but the choice of the instruments, as he also recognised, is an empirical challenge (see also Domowitz *et al.*, 1988; Haskel *et al.*, 1995). Moreover, in small samples, or when aggregation bias is a problem (Basu and Fernald, 1997), the relative merits of instrumental variable estimates over the simple OLS are not clear-cut. In addition, most studies that use Hall's approach rely on value added as a measure of output, which leads to a further upward bias in the estimates of the mark-up (Basu and Fernald, 1995). It can be stressed, in fact, that a firm operating in an imperfectly competitive market will set price margins also on material costs, so as the productive contribution of intermediate inputs is larger than their share in revenue. The two sources of upward bias are likely to explain the very high levels of the mark-ups obtained by using

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Hall's approach. Although, these large mark-up estimates offer an appealing explanation for the pro-cyclicality of the Solow residual, they contradict most micro-economic studies suggesting low profit margins in most OECD manufacturing industries. This gave a basis to scepticism about the overall possibility of obtaining reliable estimates of the degree of product market competition using this approach.

In this paper, we provide new empirical evidence and interpretation of the magnitude and cyclical variability of mark-ups in 3-digit and some 4-digit manufacturing industries in five OECD countries: United States, Japan, Germany, France and United Kingdom. We estimate the steady-state levels of mark-up using an alternative approach presented by Roeger (1995) that solves the first problem related to Hall's approach. The basic intuition of Roeger is that both the *primal* and the *dual* Solow residuals contain the same (unobservable) productivity term which can be cancelled out if one residual is subtracted from the other. Under the hypothesis of constant returns to scale, Roeger (1995) proposed an equation where the mark-up ratio can be estimated by usual econometric techniques. Moreover, to account for the second source of upward bias, we calculate the mark-up over *gross output* instead of *value added*, thereby accounting for intermediate inputs. In addition, we allow for the possibility that the mark-up pricing varies over the business cycle. We also assess the sensitivity of the cyclicality of mark-ups to different assumptions concerning the degree of downward rigidity and the elasticity of substitution between factors of production. Moreover, we calculate the mark-ups for the manufacturing industries in five OECD countries, which allows for cross-country comparisons in addition to the more usual cross-industry comparisons. Similar cross-industry differences in the five countries shed light on the role that market structure could play in the formation of mark-ups. This issue is explored in this paper by considering two main types of market structures: (i) *fragmented* markets characterised by small firms, low sunk costs and small entry barriers; and (ii) *segmented* markets displaying large average firm size and significant entry barriers associated with high sunk costs.

The plan of the paper is as follows. Section 2 briefly recalls the links between the mark-up and the productivity residuals. It also shows that Roeger's (1995) method can also be derived from the definition of a mark-up over average costs. In section 3, our estimates of the steady-state mark-ups for the US manufacturing industries over the period 1971-1992 are compared with those of previous studies. In the following section we analyse the fluctuations of price-margins over the business cycle. From our results, some important conclusions can be drawn for the interpretation of the two macroeconomic puzzles referred above. Section 5 discusses how the market structure in which firms operate affects the level and cyclicality of mark-ups, by relating our estimates with the two market structure prototypes described above. In order to provide further evidence on the robustness of our conclusions we also extended the mark-up estimates to the manufacturing industries in the other G-5 countries.

2. The productivity residuals and the mark-up

Under constant returns to scale, the primal Solow residual (*SR*) can be related to the mark-up of prices over marginal costs ($\mu = P/MC$), as follows (Hall, 1990):

$$SR = \Delta q - \alpha \cdot \Delta l - (1-\alpha) \cdot \Delta k = (\mu - 1) \cdot \alpha \cdot (\Delta l - \Delta k) + \theta \qquad (1)$$

where lower case letters denote natural logs and Δ stands for the first-difference. q, l and k correspond to real value added, labour and capital inputs, α is the labour share in valued added and θ is the Hicks-neutral rate of technical progress. Under the assumption of a constant mark-up, the dual of equation (1) can also be derived for the price-based productivity measure (see Shapiro, 1987 and Roeger, 1995), i.e. a *dual* Solow residual (*DSR*):

$$DSR = \alpha \cdot \Delta w - (1-\alpha) \cdot \Delta r - \Delta p = (\mu - 1) \cdot \alpha \cdot (\Delta w - \Delta r) + \theta \qquad (2)$$

where w and r are natural logarithms of the wage rate and the rental price of capital, respectively. Equations (1) and (2) are equivalent ways of stating that, under perfect competition (μ=1), both the primal and the dual Solow residuals can be considered as a correct measure for the (unobservable) rate of technical progress. The econometric estimation of these equations is complicated by the fact that the explanatory variables are correlated with the random productivity shocks (θ), thereby leading to inconsistent OLS estimates. Following Hall (1986), this problem has been generally overcome in the literature by using instrumental variable techniques. This approach, however, introduced additional empirical difficulties and often led to implausibly high mark-up estimates.[2]

Roeger (1995) had an important insight in this regard. He simply subtracted the dual (equation 2) from the primal Solow residual (equation 1) and noted that the productivity term cancels out leaving an equation with only observable variables. The resulting expression can be interpreted as a Solow residual in nominal terms (*NSR*). The NSR is a function of the mark-up, the labour share and the growth rate of the ratio of labour to capital costs:

$$NSR = \Delta(p+q) - \alpha \cdot \Delta(w+l) - (1-\alpha) \cdot \Delta(r+k) = (\mu - 1) \cdot \alpha \cdot [\Delta(w+l) - \Delta(r+k)] \qquad (3)$$

Equation (3) is a rather tractable expression for the estimation of the mark-up ratio. Adding an error term, the mark-up can be estimated by standard OLS techniques. Alternatively, a mark-up coefficient could even be calculated algebraically for each year and a simple average computed over a given period.

2.1. A more direct derivation of Roeger's equation

Without considering the relation between the mark-up and the productivity residuals, equation (3) can also be derived from the definition of the margin between value-added and total costs -- a rather straightforward microeconomic concept:[3]

$$\frac{P \cdot Q}{W \cdot L + R \cdot K} = \frac{\mu}{\lambda} \qquad (4)$$

where Q, L and K are real value added, labour and capital inputs, and P, W and R are their respective prices. The coefficient (λ) is an index of the degree of returns to scale (i.e., *average costs/marginal costs*). Let us assume that both the degree of returns to scale and the mark-up ratio are fixed. By taking the total differential and dividing by $P{\cdot}Q$, equation (4) can be re-written as:

$$\Delta(p+q) = \frac{\mu}{\lambda} \cdot \alpha \cdot \Delta(w+l) + \left(1 - \frac{\mu}{\lambda} \cdot \alpha\right) \cdot \Delta(r+k) \qquad (5)$$

By re-arranging equation (5), one gets an expression which is equivalent to equation (3) and where no specific assumption is made on the level of returns to scale:

2. Adequate instruments are variables that can be considered as pure aggregate demand shifters, i.e. variables that are correlated with the factor inputs but not with technological change and thus the disturbance term. In the case of the US, overall real GDP, the military spending, the world oil price and the political party of the president have generally been used, despite that their empirical relevance can be questioned.

3. In theory, a mark-up ratio could directly be estimated from equation (4). In practice, however, the series on capital stocks at the industry level is not highly reliable in level terms, although it can be safely used in terms of a variation index.

$$NSR = \left(\frac{\mu}{\lambda} - 1\right) \cdot \alpha \cdot \left[\Delta(w+l) - \Delta(r+k)\right] \qquad (6)$$

where all variables are defined as previously. From equation (6) it can be seen that with increasing returns to scale (λ>1), the Roeger's method produces a downward bias in the estimation of the mark-up.[4] Consequently, one has to bear in mind that the mark-ups estimates presented below should be interpreted as lower-bound values of the true mark-ups under increasing returns to scale.

Equations (3) and (6) can be easily extended in order to incorporate intermediate inputs and express the mark-up ratio over gross output instead of value added. This correction is important, insofar as the mark-up over value added induces a clear upward bias in the estimation (see Norrbin, 1993 and Basu, 1995). Taking into account intermediate inputs, equation (3) becomes:

$$\begin{aligned} NSR^{GO} &= \Delta\left(p^{GO} + q^{GO}\right) - \alpha^{GO} \cdot \Delta(w+l) - \beta^{GO} \cdot \Delta(p_m + m) - \left(1 - \alpha^{GO} - \beta^{GO}\right) \cdot \Delta(r+k) \\ &= (\mu - 1) \cdot \left[\alpha^{GO} \cdot \Delta(w+l) + \beta^{GO} \cdot \Delta(p_M + m) - \left(\alpha^{GO} + \beta^{GO}\right) \cdot \Delta(r+k)\right] \end{aligned} \qquad (7)$$

where p^{GO} and q^{GO} correspond to logarithms of gross output and its respective price, m and p_M to intermediate inputs and their prices, and α^{GO} and β^{GO} to the share of labour and intermediate inputs in gross output value, respectively. This extension for intermediate inputs illustrates an important advantage of Roeger's approach. As the latter only requires nominal variables, there is no need to gather price indexes for intermediate inputs, an information that is not readily available. However, the treatment of capital costs still requires a separate computation for the growth rate of the rental price of capital, *R*. Since there is no good measure of the rental rate of capital, the Roeger's approach may still present a drawback for its implementation.

The bottom-line of this debate is that choosing between the instrumental variable approach with doubtful instruments and a direct estimation approach based on a (perhaps) imprecise proxy for the rental rate of capital should be a matter of empirical investigation. The estimation results presented in the next section do suggest that the Roeger's method seems to produce more reasonable estimates of the mark-up than those obtained using Hall's methodology.

3. Steady-state mark-up estimates: a comparison with previous studies

The sources of data are described in the Annex 1. By including an additive error term, equation (7) was estimated by standard OLS for a set of manufacturing industries in the United States.[5] Our industry breakdown[6] is somewhat more detailed than the 2-digit US classification used in the studies of both Hall (1990) and Roeger (1995), yet it was possible to establish an approximate correspondence between them. First, we tried to replicate Roeger's results by using value-added data (equation 3).

Our results are in the same order of magnitude of those put forward by Roeger (columns two and three in Table 1) but they are generally lower than those estimated by Hall (first column). Indeed, in

4. For example, if the "true" mark-up coefficient is 1.33 and λ is equal to 1.2, the mark-up ratio estimated by means of the equation (3) would be 1.10. Conversely, the presence of decreasing returns to scale induces an upward bias in the estimation of the mark-up.

5. Following the remarks of Hylleberg and Jorgensen (1998), the mark-up estimates presented in this paper are robust to serial correlation of residuals and heteroskedasticity.

6. It corresponds to the OECD STAN database (OECD, 1996).

Hall (1990), the statistically significant mark-ups are typically close to, or over, 100 per cent. This does not seem very plausible for manufacturing industries, where extremely high mark-ups would tend to be contested by international competition.

[Table 1. Comparison of Mark-up estimates for the US manufacturing industries]

As expected, the correction for intermediate inputs (column four in Table 1) lowers significantly the mark-up estimates. For example, in the textile sector the mark-up ratio defined over value added was 1.32 (1.34 in Roeger's paper), whereas the estimates defined over gross output indicate a mark-up ratio of 1.08, fairly close to the competitive level. In broad terms, most of the sectoral mark-ups defined over value-added are in the range of 30-60 per cent while, when defined over gross output, the mark-ups are in many cases below or close to 10 per cent. High mark-ups (over 40 per cent) are only observed in a few sectors.

4. The dynamics of the mark-up and sectoral business cycles

Several empirical studies have indicated that price margins may vary over the business cycle.[7] Most of these studies rely on Hall's methodology which, as discussed above, often lead to very high price margins. These are likely to lead to a biased and/or inconclusive test as regards cyclicality. For example, firms may react differently to changes in demand when their margins are very high when they are positive but small.[8] In contrast, the mark-up estimates presented in this paper may offer a more solid ground to assess pricing behaviour of firms over the business cycle, as they are lower and more in line with evidence from micro-studies.

The theoretical literature does not offer a clear-cut answer as to whether price margins should be pro- or counter-cyclical. This is likely to depend on the specific product market conditions in which each firm operates. For instance, under a regime of monopolistic competition firms may find it efficient to set counter-cyclical mark-ups. Profit maximisation conditions imply that the mark-up is an inverse function of the elasticity of demand. The latter is likely to be pro-cyclical if, for example, product variety is also pro-cyclical (Kalecki, 1938; Weitzman, 1982). Likewise, if entry is possible, increases in demand would induce an increase in the number of firms, thereby raising the degree of competition in the market and lowering price margins (Chatterjee *et al.*, 1993). A similar outcome would also emerge if firms find it optimal to develop their customer base in periods of up-turns, as suggested by Bils (1987) and by Phelps in his "customer market" model (Phelps, 1994). Certain collusion models also hint at counter-cyclical mark-ups. For example, if firms defecting from a cartel are able to expand their market shares in booms, then the gains from defection may outpace the long-term losses from punishment (Rotemberg and Saloner, 1986; Chevalier and Scharfstein, 1996). In contrast, if firms operate in oligopolistic markets with homogeneous goods, the behaviour of each firm depends upon the conjectured responses of all other competitors[9]. Under these conditions, the cyclicality of mark-ups depends on specific market characteristics, such as the existence of capacity constraints. If firms operate under full capacity and, thus, are not able to raise their output in response to a competitor (i.e. a Cournot competition model), then mark-ups are likely to be pro-cyclical because capacity constraints are pro-cyclical.

7. Among others, see Bils (1987) ; Domowitz et al. (1988) ; Rotemberg and Woodford (1992) ; Morrison (1994) ; Haskel et al. (1995); Beccarello (1996).

8. See for example, the comments of Ramey (1991) to the analysis of the cyclical behaviour of the mark-ups presented by Rotemberg and Woodford (1991).

9. It can be demonstrated that in a market characterised by oligopolistic competition, the profit-maximising mark-up level of a firm is a function of the degree of concentration in the market and the firm's conjecture of the output responses of other firms to a change in its output.

Assessing whether the mark-up is pro- or counter-cyclical has important implications for different theories of business cycle. For example, a counter-cyclical mark-up offers an appealing explanation for the observed pro-cyclicality of employment and real wages. The cyclicality of the mark-up can also play an important role for the evaluation of the effects of macroeconomic policies (see for example Aziz and Leruth, 1997).

4.1. A first approximation of a time-varying mark-up

A simple way to measure the variability of the mark-up over the business cycles is to postulate a linear relationship between price margins and a variable which captures the cyclical fluctuations of demand (e.g. Domowitz *et al*., 1988, Haskel, 1995 and Beccarello, 1996). As shown in Annex 2.1, in our case where we have to combine the primal and the dual Solow residuals, it is preferable to define the relation, between price margins and cycle using the *Lerner index* (*B = (P-MC)/P*). It can be mapped easily into the mark-up (i.e. $B = 1-1/\mu$) and has the advantage of leading to an estimating equation which is linear in the parameters. Let us then assume the following relation between the Lerner index and the business cycle :

$$B_t = \overline{B} + \gamma \cdot CYCL_t \qquad (8)$$

where *CYCL* is an appropriate measure of the demand fluctuations. One must take account of the fact that a variable Lerner index has different implications for the primal and the dual Solow residuals (see Annex 2.1 for details). Drawing from (8) and maintaining the simplifying assumption of constant returns to scale, it can be shown that the new estimating equation with a cyclical mark-up is as follows:

$$NSR_t = \overline{B} \cdot \Delta x_t + \gamma \cdot \left[\Delta x_t \cdot CYCL_t - \Delta CYCL_t\right] \;, \quad where \quad \Delta x_t = \Delta(p+q) - \Delta(r+k) \qquad (9)$$

The empirical literature has used different proxies for product demand at either the aggregate or the sectoral level. For example, Haskel *et al.* (1995) used aggregate unemployment and capacity utilisation, while Bils (1987) used sectoral employment. In this paper we use deviations of industry output from its long-term trend, mainly because of its higher correlation with the nominal Solow residual.[10]

The estimates of the cyclical mark-up are provided in Table 2. The γ parameter is negative in most cases, implying a counter-cyclical variation of mark-ups. This is consistent with a growing body of empirical literature showing that economic booms tend to increase competition or decrease the incentives for collusion, thereby creating downward pressures on price margins. Noteworthy, the introduction of the cyclical variable does not affect the values and the statistical significance of the fixed component of the mark-up $\overline{\mu} = 1/\left(1-\overline{B}\right)$ as shown in the second column of Table 2.

[Table 2. Cyclicality of the mark-up: first approximation]

4.2. An estimation of mark-up variations taking into account second-order effects

The problem with the above estimation of the time varying mark-up is that it is based on a first-order Taylor approximation (in logs) of the primal (equation 1) and dual (equation 2) Solow residuals. In principle, this approximation would only allow to estimate the steady-state mark-up. Since the cyclicality of the mark-up is a second-order effect it also requires a full second-order approximation (see

10. Trend output was obtained on a smoothing approach based on the Hodrick-Prescott filter. The weighting factor was set to 100.

Rotemberg and Woodford, 1992 and Morrison, 1992). As shown below, this more accurate specification raises in turn identification problems, requiring simplifying assumptions that limit the scope for its practical implementation.

The starting point for the derivation of a full second-order approximation is the specification of the production function. In accordance with our estimates of the mark-up, which take into account intermediate goods, we use a production function with three inputs rather than just capital and labour as it is usually the case in other studies. Moreover, we assume a two-level production function in order to keep it under a tractable form, without imposing a strong separability across production inputs: capital and labour are nested in a value-added function (G), which is then combined with intermediate inputs using a Leontief specification.[11] With a Hicks-neutral technical progress the production function can then be written as follows:

$$Q = \Theta \cdot F\left[\, G\left(K, L - \bar{L}\right), M \,\right] \tag{10}$$

where all variables are defined as previously and Θ is the state of technology at time t ($\Delta\, ln\, \Theta_t = \theta_t$). We also assume the possibility of downward rigidities in the adjustment of labour inputs that are captured by $\bar{L}$, the amount of labour devoted to fixed costs. For a profit-maximising firm under imperfect competition, the mark-up of prices over marginal costs is equal to:

$$\mu_t = \frac{\Theta_t \cdot F_L\left[G\left(K_t, L_t - \bar{L}\right), M\right]}{W_t / P_t} \tag{11}$$

where F_L is the partial derivative of F with respect to L (or the marginal productivity of labour). By taking a log-linear approximation of equation (11) around a steady-state growth path and doing some algebraic transformations (see Annex A2.2 for details), a relation for the variable mark-up can be derived as follows:

$$\begin{aligned}\Delta \log \mu = (\Delta q + \Delta p) - \Delta w - \left[\left(\Delta p_G + \Delta g\right) - \left(\Delta p_M + \Delta m\right)\right] \cdot \bar{\mu} \cdot s_M \; + \\ + \left(\frac{1}{\sigma_G} \cdot \frac{s_K}{s_L + s_k} - \mu \cdot s_K\right) \cdot \Delta k + \left(\frac{1}{\sigma_G} \cdot \frac{s_K}{s_L + s_K} \cdot \frac{L}{L - \bar{L}} + \bar{\mu} \cdot s_L\right) \cdot \Delta l - \bar{\mu} \cdot s_M \cdot \Delta m\end{aligned} \tag{12}$$

where s_L , s_K and s_M are the shares of labour, capital and material inputs in gross output, and σ_G is the elasticity of substitution between capital and labour in the value-added function. The ratio $L/(L - \bar{L})$ in equation (12) can be interpreted as an indicator of the degree of downward rigidities in labour adjustment. It varies from 1 (no rigidity) to infinity (complete rigidity). Despite its apparent complexity, equation (12) is actually sober in terms of data requirements. Notably, it does not require a price deflator for gross output as the latter only appears in nominal terms. Moreover, under the Leontief specification, the growth rate of the volume of intermediate inputs can be proxied by the growth rate of the value-added at constant prices. The input shares are directly observable, except the share of capital in gross output s_K, which can be easily derived, consistently with our assumptions, from the Euler's equation:

11. This assumption is usual in the literature and does not seem overly stringent. Using the original Rotemberg and Woodford (1992) specification, Linemman (1998) provided numerical simulations suggesting that the degree of counter-cyclicality of the mark-up is inversely related to the value of the elasticity of substitution between value-added and intermediate inputs.

$$\bar{\mu} \cdot s_L \cdot \frac{L - \bar{L}}{L} + \bar{\mu} \cdot s_K + \bar{\mu} \cdot s_M = 1 \qquad (13)$$

As our base case, we assumed the absence of downward rigidities (i.e., $\bar{L} = 0$) and a Cobb-Douglas aggregate between capital and labour ($\sigma_G = 1$). We then tested the results of this case against the alternative assumptions concerning the elasticity of substitution and the degree of downward rigidities in labour adjustment. We considered the alternative values of 0.5 and 2 for the elasticity of substitution between capital and labour. Concerning the degree of downward rigidities, we tested for the cases where the fixed amount of labour represents respectively 20% and 40% of the total labour inputs.

The results are presented in Table 3. The columns display the correlation between the logarithmic deviation of the mark-up from the trend and the sectoral cyclical variable. Figure 1 plots the evolution of the mark-ups and the sectoral cyclical variable for some representative manufacturing industries in the US over the 1971-1992 period. The first observation that can be drawn is that this more accurate approximation reinforces the results presented in Section 4.1. Indeed, most of the statistically significant mark-ups display a counter-cyclical behaviour. These broad results are also in line with the conclusions of other papers (e.g. Rotemberg and Woodford, 1992, Bils 1987 and Galeotti and Schiantarelli, 1998), despite the fact that these papers used Hall's approach to estimate the steady-state mark-ups. Moreover, the results are relatively robust with respect to the different assumptions concerning the elasticity of substitutions and the degree of downward rigidity in the use of labour. An increase of the degree of downward rigidity and a lower degree of substitution between capital and labour reinforce the counter-cyclicality of the mark-up.

[Table 3. Cyclicality of the mark-up: estimates with second-order effects]
[Figure 1. Deviations from trend of the mark-up and output in the US, 1971-92]

4.3 How these results help to interpret the macroeconomic puzzles?

As recalled in the introduction, the existence and cyclicality of mark-ups can provide an appealing interpretation for two major stylised facts that have puzzled macroeconomists, namely the procyclicality of the Solow residual and that of real wages. To assess the role of mark-ups on the procyclicality of the Solow residual, we recalculated total factor productivity (TFP) taking into account our estimates of price margins and their cyclical variability.[12] Broadly speaking, we did not find a substantial bias. This is due to the fact that our estimate of mark-ups are fairly low compared with previous estimates (e.g. Hall, 1990). Only for some specific industries, such as office and computing, radio & TV, the corrected Solow residual is markedly higher. Consequently, not accounting for imperfect competition does lead to a significant under-estimation of productivity gains: on average, for the U.S. manufacturing industries the Solow residual understates the "true" productivity by roughly 0.5 per cent per year over the 1970-1992 period. Therefore, the explanation for the procyclical productivity puzzle is likely to lie elsewhere (e.g., in the presence of labour hoarding or external effects).

In contrast, the largely counter-cyclical price margins estimated in this paper can account for the observed procyclicality of real wages at the industry level, as shown in the first column of Table 4. We computed a new price deflator net of the effects related to the varying mark-up $(\dot{p} - \dot{\mu})$. Then, using this deflator, we re-calculated the correlation between real wage and the business cycle. We found that, in all but one sector, the correlations were no longer significant. This suggests that the main cause for procyclical real wages could indeed be the presence of countercyclical mark-ups. This result offers an interesting insight for business cycle theory.

12. The formula for the adjusted productivity residual can be derived from equation (1) in the text.

[Table 4. Mark-ups, the procyclicality of the Solow residual and real wages]

5. Does market structure matter?

The results presented in this paper have shown that, even under constant returns to scale, persistent pure profits can be observed in most US manufacturing industries. On the basis of this evidence, the existence of imperfect competition in product markets can be hardly disputed. This, however, is hard to reconcile with the observed trends towards market deregulation and stronger import competition that took place over the past decades, especially in the manufacturing sector. Hence, despite such a competitive pressure, other factors should lie behind the existence of pure profits as an equilibrium long-run configuration. The micro-economic literature provides several possible explanations for this.

A starting point is the observation that differences in market power across manufacturing industries must in part be due to differences in entry conditions into each industry. Traditionally, entry conditions and the resulting market structures have been related to technological conditions, such as economies of scale and scope. Another avenue is the existence of product differentiation. For example, under a regime of Chamberlinian monopolistic competition, a limited market power can arise from the combination of returns to scale and horizontal product differentiation. However, the entry of new firms can be expected to bring prices down to average costs over the long run. More recent research has focused on so-called "vertical" product differentiation where firms are able to influence the perceived quality of their products. In industries where firms engage in such product differentiation, product strategies may be able to influence entry conditions in the market; this influence could generate endogenous sunk costs, e.g. large advertising or R&D expenditures. These industries could not simply exist under a regime of perfect competition.

Along these lines, the rationale for persistent mark-ups is likely to differ according to the type of industry and form of competition. Following Sutton (1991) and a subsequent discussion by Schmalensee (1992), two major types of industries (or types of competition) can be identified. Industries with typical small average establishment size (type I) were termed "fragmented" industries. In these industries, the number of firms typically grows in line with the size of the market. Sectors characterised by the existence of large establishments, covering a large proportion of employment and output, were termed "segmented" industries (type II). In these sectors, concentration remains relatively stable or converges towards a finite lower bound. This market structure taxonomy can also be related to more direct indicators of sunk costs and product innovation and to qualitative information about the different industries[13].

Adding a cross-country dimension to our analysis allows testing for the hypothesis that certain types of industries display similar behaviour -- due to specific market structure characteristics -- independent from specific conditions prevailing at the national level. In order to investigate this issue, we extended our estimates on both the level and cyclicality of the mark-up to the group of the G-5 countries (Table 5). The results broadly confirm the conclusions drawn for the US manufacturing industries. While the level of mark-ups tends to be higher than for the United States, they are still in the average range of 10-30 per cent.

Confirming the role of market structure, it turns out that mark-ups tend to be on average lower in fragmented industries than in segmented industries in all the G-5 countries. Higher mark-up levels in segmented industries could be taken as a sign of market power in industries with a low degree of product differentiation, although it may also be an indication of innovation rents in industries with high product differentiation. However, level differences emerge across countries. In the United Kingdom and the

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13. See Oliveira Martins, Scarpetta and Pilat (1996) for more details on the set of market structure indicators used to group industries into market structure prototypes.

United States mark-ups are around 10 per cent in fragmented industries and roughly 20 per cent in the segmented ones. In France and Germany the relative difference is maintained between type I and type II industries, but with a significantly higher mark-up levels. In this regard a notable exception is Japan, where no difference emerges between the two types as both display a comparable and high level of mark-ups. Moreover, it should also be borne in mind that the variation across countries may partly be due to the impact of specific policies (regulations or trade protection) that may create entry barriers in a particular country or industry, thus reinforcing market power and contributing to raise price margins.

[Table 5. Mark-ups in the G-5 countries: levels and correlation with the cycle, 1970-92]

Within each market-structure group, some elements deserve to be noted. First, even in fragmented markets, industries that are characterised by strong product differentiation (e.g. quality) also display above-average mark-ups. This is the case of precision instruments, notably in Germany, and chemical products in all countries. In segmented markets, this pattern is also verified in industries with high advertising and R&D expenditures, e.g. drugs and medicines and office and computing equipment. At the same time, tobacco industries, where firms often enjoy a high degree of market power, have among the highest mark-ups across the entire manufacturing sector in all countries.

Concerning the cyclicality of the mark-up two interesting points emerge from the international comparison. First, as in the United States, mark-ups are generally negatively correlated with the sectoral business cycle. Nevertheless, their correlation is often weaker than in the United States. This, taken together with the generally lower level of mark-ups in the US manufacturing sector, lends support to one of the possible interpretation of counter-cyclical mark-ups: the degree of competition in the market *via* higher entry rates in expansion drives down price margins of incumbent firms.

6. Conclusions

In this paper we presented estimates of price mark-up ratios for a set of US manufacturing industries and compared them with those of previous studies and of the other G-5 countries. To calculate the steady-state mark-ups, we used an extension of the approach put forward by Roeger (1995) where price margins are defined over gross output instead of value added. The results are statistically robust and the mark-ups estimated are in the range of 10-15 per cent for the US manufacturing in the 1970-92 period, with only some cases displaying values higher than 40 per cent. While these results are more in line with micro-economic evidence -- suggesting low profit margins in most manufacturing industries -- than previous estimates based on Hall's method, they cannot account for the observed procyclicality of the Solow residual.

Moreover, we provided estimates of the cyclical behaviour of price margins across manufacturing industries and related them to different market structures. The tests for the cyclicality of the mark-up was carried out using two different methods and strongly support the hypothesis of counter-cyclical variations in price margins in most US manufacturing industries and, to a lesser extent in the other G-5 countries. We also showed that the degree of downward rigidities and elasticities of substitution between labour and capital affect the cyclicality of the mark-up. The finding of counter-cyclical mark-ups offers an appealing and plausible explanation for the observed procyclicality of real wages. Indeed, the latter vanishes once the price deflator is corrected for the cyclical variations of the price margins.

The extension of our estimates to the group of G-5 countries highlighted two additional important points. First, the evidence on mark-up behaviour in the other countries is broadly supportive of the results found for the United States. Mark-ups tend to be higher in the large European countries and Japan, but are still within a relatively moderate range of 15-30 per cent. Like in the United States, mark-ups tend to display a counter-cyclical behaviour. Second, the cross-country comparison of the sectoral mark-ups supports the interpretation that persistent profit margins in the manufacturing sector may be due to the presence of entry barriers, probably due to sunk costs, that are not eroded by competitive pressures even in the long-run. However, further research in this area seems to be required to better understand the relationship between industry price behaviour and market characteristics, a research that calls for a higher level of integration between macroeconomic and industrial organisation theories.

ANNEX 1: DATA SOURCES

The main data source used in this study is the OECD-STAN data base. The latest version of STAN (OECD, 1996) covers 21 OECD Member countries and 36 manufacturing sectors (at the 3-4 ISIC digit-level) for the period 1970-1994. STAN provides data on the following variables: production, value added in current and constant prices, gross fixed capital formation, employment (number of persons engaged), labour compensation, exports and imports.

a) A proxy for the rental price of capital

Following Hall (1990), the rental price of capital can be defined:

$$R = (\rho + \delta) \cdot \frac{1 - \kappa - \tau \cdot d}{1 - \tau} \cdot p_k$$

where ρ is the firm's real cost of funds, δ the economic rate of depreciation, k the effective rate of the investment tax credit, *d* the present discounted value of tax deductions for depreciation, τ the tax rate on capital and p_k the deflator for fixed business investment. The terms related to investment taxes, capital taxes and deductions for depreciation enter in a log-additive way in the equation and do not have a strong variability through time. Therefore, while they are important to compute the *level* of capital costs, these terms are not expected to have a strong influence on the *growth rates* of the rental price of capital. Also, several of these variables are not available for each industry or country. Therefore, the rental price of capital was defined more simply as follows:

$$R = ((i - \pi_e) + \delta) \cdot p_k$$

where *i* is the representative long-run nominal interest rate and π_e is the expected inflation rate. Nominal long-term interest rates were proxied by yields on benchmark public sector bonds of around 10 years maturity. Inflation expectations are generated using the low-frequency component of the annual percentage change in the GDP deflator using a Hodrick-Prescott filter. In the filtering process, a lambda value of 1600 was used. The nominal long-term interest rates and GDP deflators are both derived from the OECD Analytical Database (OECD-ADB).The difference between these two terms represents the expected real cost of funds for the firm. The δ coefficient can be interpreted here as the discard rate corresponding to the gross capital stock. In accordance with the capital stock series, this coefficient was set at 5 per cent across all sectors which is equivalent to an average service life of 20 years. The final term p_k represents the economy-wide deflator for fixed business investment, and was derived from OECD's ADB database.

ANNEX 2: MATHEMATICAL DERIVATIONS

A2.1. First approximation for the variable mark-up

A variable mark-up does not affect the expression for the primal Solow residual (equation 1 in the text), but it does affect the dual Solow residual (equation 2). In order to show this point; let us recall the basic relationship between prices and marginal costs:

$$P = \mu \cdot MC \quad \textbf{or} \quad P = \frac{1}{1-B} \cdot MC \tag{A1}$$

where μ is the mark-up ratio and B is the Lerner index (B=1-1/μ). By assuming the variable mark-up as:

$$\mu = \overline{\mu} + \gamma_1 \cdot CYCL \tag{A2}$$

where *CYCL* is the cyclical variable. By taking the total differential of (A1), putting it into a growth rate form and replacing μ by expression (A2) one gets:

$$\Delta mc = \Delta p - \gamma_1 \cdot \frac{\Delta CYCL}{\mu} \tag{A3}$$

where lower-case variables are natural logarithms. Under a fixed mark-up the second RHS term would be zero. Under constant returns to scale, the rate of growth of marginal costs can also be defined as (see Roeger, 1995) :

$$\Delta mc = \frac{W \cdot L}{C(.)} \cdot \Delta w + \left[1 - \frac{W \cdot L}{C(.)}\right] \cdot \Delta r - \theta \tag{A4}$$

By merging equations (A3) and (A4) one gets a new expression for the dual Solow residual:

$$DSR = \alpha \cdot \Delta w + (1-\alpha) \cdot \Delta r - \Delta p = -(\mu - 1) \cdot \alpha \cdot (\Delta w - \Delta r) - \gamma_1 \cdot \frac{\Delta CYCL}{\mu} + \theta \tag{A5}$$

The nominal Solow residual (equation 3 in the text) is then defined as:

$$DSR = \overline{\mu} \cdot \alpha \cdot [\Delta(w+l) - \Delta(r+k)] - \gamma_1 \cdot \left\{\alpha \cdot CYCL \cdot [\Delta(w+l) - \Delta(r+k)] + \frac{\Delta CYCL}{\mu}\right\} \tag{A6}$$

Equation (A5) is not linear in the parameters. In the context of a variable mark-up, an alternative and more tractable approach can be followed. Let us define a different functional form for the relationship between price margins and the cycle based on the Lerner index, as follows:

$$B = \overline{B} + \gamma_2 \cdot CYCL \tag{A7}$$

in this case equation (A3) becomes:

$$\Delta mc = \Delta p - \gamma_2 \cdot \frac{\Delta CYCL}{(1-B)} \tag{A8}$$

and equation (A5) can be re-written as:

$$DSR = \alpha \cdot \Delta w + (1-\alpha) \cdot \Delta r - \Delta p = -B \cdot (\Delta p - \Delta r) - \gamma_2 \cdot \Delta CYCL + (1-B) \cdot \theta \tag{A9}$$

and finally the nominal Solow residual can be expressed as:

$$DSR = \overline{B} \cdot [\Delta(p+q) - \Delta(r+k)] - \gamma_2 \cdot \{CYCL \cdot [\Delta(p+q) - \Delta(r+k)] + \Delta CYCL\} \tag{A10}$$

This equation is linear in both $\overline{B}$ and γ_2 parameters and can be easily estimated.

A2.2. Second order approximation of the cyclical mark-up

The derivation of the mark-up variations taking into account second order effects proceeds as follows. Recalling that under imperfect competition the mark-up of prices over marginal costs is:

$$\mu_t = \frac{\Theta_t \cdot F_L\left[G\left(K_t, L_t - \overline{L}\right), M\right]}{W_t / P_t} = \frac{\Theta_t \cdot F_G \cdot G_L}{W_t / P_t} \tag{A11}$$

assuming that w_t and θ_t have the same trend growth rates, taking the total differential, dividing by *(μ.W/P)* and simplifying (time indices are omitted):

$$\Delta \log \mu = \theta - (\Delta w - \Delta p) + \frac{1}{F_G} \cdot (F_{GG} dG + F_{GM} dM) + \frac{1}{F_G}(G_{LL} dL + G_{LK} dK) \tag{A12}$$

where by using the following relations:

- At the first-level the elasticity of substitution between capital and labour can be written as (Uzawa, 1962) $\sigma_G = G_L \cdot G_K / G_{KL} \cdot G$; and the elasticity between value-added and intermediate inputs as $\sigma = F_G \cdot F_M / F_{GM} \cdot F$
- Using the separability properties and by differentiating the Euler's equation of F and g, with respect to g and L, respectively, yields: $F_{gg} = -F_{gM} \cdot M / g$ and $G_{LL} = -G_{KL} \cdot K / (L - \overline{L})$;
- From the first-order conditions:
  $\frac{F_M \cdot M}{F} = \overline{\mu} \cdot s_M$ and $\frac{G_K \cdot K}{G} = \frac{s_K}{s_L + s_K}$

The above equation can be transformed into the following expression:

$$\Delta \log \mu = \theta - (\Delta w - \Delta p) - \frac{1}{\sigma} \cdot \bar{\mu} \cdot s_M \cdot \Delta g + \frac{1}{\sigma} \cdot \bar{\mu} \cdot s_M \cdot \Delta m - \frac{1}{\sigma_G} \cdot \frac{s_K}{s_L + s_K} \cdot \frac{L}{L - \bar{L}} \cdot \Delta l + \frac{1}{\sigma_G} \cdot \frac{s_K}{s_L + s_K} \cdot \Delta k \qquad \text{(A13)}$$

Finally, the unobservable productivity term θ can be derived from totally differentiating the production function (equation 10 in the text) and recalling that $\frac{F_K \cdot K}{Q} = \frac{\bar{\mu} \cdot s_K}{\theta}$; $\frac{F_L \cdot L}{Q} = \frac{\bar{\mu} \cdot s_L}{\theta}$; and $\frac{F_M \cdot M}{Q} = \frac{\bar{\mu} \cdot s_M}{\theta}$ which yields:

$$\Delta q = \theta + \bar{\mu} \cdot s_K \cdot \Delta k + \bar{\mu} \cdot s_L \cdot \Delta l + \bar{\mu} \cdot s_M \cdot \Delta m \qquad \text{(A14)}$$

By replacing (A14) into equation (A13), one gets:

$$\Delta \log \mu = (\Delta q + \Delta p) - \Delta w - \frac{1}{\sigma} \cdot \bar{\mu} \cdot s_M \cdot (\Delta m - \Delta g) + \left(\frac{1}{\sigma_G} \cdot \frac{s_K}{s_L + s_k} - \mu \cdot s_K \right) \cdot \Delta k + \left(\frac{1}{\sigma_G} \cdot \frac{s_K}{s_L + s_K} \cdot \frac{L}{L - \bar{L}} + \bar{\mu} \cdot s_L \right) \cdot \Delta l - \bar{\mu} \cdot s_M \cdot \Delta m \qquad \text{(A15)}$$

Noteworthy, the above equation does not require the volume of gross output, but only its growth rate in nominal terms. This advantage could overcome certain data availability problems. However, the equation still requires the volume for both for value-added and intermediate inputs. While the former is usually provided in sectoral statistics, the latter was not available in the database used in this study. In order to solve this data constraint, an additional assumption was required. We considered here the special case of a Leontief function between value-added and intermediate inputs. In that case, under cost minimisation, the volume of intermediate inputs can be identified with the volume of value-added, i.e.$\Delta m = \Delta g$. This simplifying assumption does not seem an excessively stringent one. Nonetheless, an additional problem arises. By inspecting equation (A15), it can be readily seen that if $\sigma = 0$ (the Leontief's assumption), the term:

$$\frac{1}{\sigma} \cdot \bar{\mu} \cdot s_M \cdot (\Delta m - \Delta g) \approx \frac{0}{0} \qquad \text{(A16)}$$

is indetermined. In order to solve this indetermination, let us consider the definition of the two-factor elasticity of substitution $\sigma = (\Delta g - \Delta m) / (\Delta p_M - \Delta p_G)$. By replacing this expression into (A16) and noting that under the Leontief's assumption $\Delta p_G - \Delta p_M = (\Delta p_G + \Delta g) - (\Delta p_M + \Delta m)$, the indetermined term above can be identified, as follows:

$$\frac{1}{\sigma} \cdot \bar{\mu} \cdot s_M \cdot (\Delta m - \Delta g) = [(\Delta p_G + \Delta g) - (\Delta p_M + \Delta m)] \cdot \bar{\mu} \cdot s_M \qquad \text{(A17)}$$

Using this result and replacing in equation (A15), one finally obtains equation (12) in the main text.

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Table 1. Comparison of Mark-up estimates, US manufacturing industries.

ISIC sectors	Hall (1990) [1]	Roeger (1995) [1]	This paper *value added*	This paper *gross output*
Food products and beverages	*5.29*	1.50	-	-
Food products	-	-	1.55	1.05
Tobacco products	2.77	2.75	4.84	1.56
Textiles	2.58	1.34	1.32	1.08
Wearing apparel	0.82	1.15	1.31	1.10
Leather products and footwear	*2.10*	1.19	1.38	1.08
Wood products	1.80	1.75	1.86	1.22
Furniture	1.98	1.28	1.22	1.06
Paper products and pulp	3.72	1.57	1.52	1.13
Printing and publishing	*14.26*	1.40	1.53	1.19
Chemical products	*20.11*	2.11	-	-
Industrial chemicals			2.22	1.18
Drugs and medicines			2.65	1.44
Chemical products, nec.			2.36	1.26
Rubber and plastic products	1.51	1.36	-	-
Plastic products			1.27	1.07
Non-metallic mineral products	2.54	1.59	-	-
Pottery, china, etc.			1.21	1.09
Glass products			1.46	1.17
Non-metallic min. prod.			1.63	1.18
Basic metal products	2.17	1.58	-	-
Iron and steel			1.46	1.10
Non-ferrous metals			2.00	1.14
Metal products	1.65	1.33	1.30	1.09
Machinery and equipment	1.43	1.41	-	-
Machinery and equipment, nec.			1.25	1.06
Office and computing machinery			2.97	1.54
Electrical machinery	3.09	1.34	-	-
Radio, TV and comm. equipment			1.86	1.40
Motor vehicles	1.76	2.06	1.59	1.09
Other transport equipment	0.95	1.22	-	-
Motorcycles and bicycles			1.74	1.13
Aircraft			1.37	-
Professional goods	*1.40*	1.47	1.29	1.09
Other manufacturing	*4.49*	1.62	1.46	1.08

1. For the period 1953-84. Italicised mark-ups are not statistically significant.
2. For the period 1970-92. Estimates are based on value added adjusted for indirect taxes. All reported mark-ups are significant at the 5% level.
3. For the period 1970-92. Estimates are based on gross output adjusted for indirect taxes. All reported mark-ups are significant at the 5% level.

Table 2. Cyclicality of the mark-up: first approximation, US Manufacturing industries

ISIC sectors	Steady-state Mark-up[1] *(gross output)*	Cyclical mark-up[2] $\bar{\mu}=\frac{1}{(1-\bar{B})}$	Cyclical mark-up[2] γ
Food products and beverages	-	-	-
Food products	1.05	1.07	-0.13
Tobacco products	1.56	1.39	-0.41
Textiles	1.08	1.08	
Wearing apparel	1.10	1.11	-0.13
Leather products and footwear	1.08	1.08	
Wood products	1.22	1.22	
Furniture	1.06	1.07	
Paper products and pulp	1.13	1.14	
Printing and publishing	1.19	1.19	-0.16
Chemical products	-	-	-
Industrial chemicals	1.18	1.20	
Drugs and medicines	1.44	1.45	-0.35
Chemical products, nec.	1.26	1.27	-0.20
Rubber and plastic products	-	-	-
Plastic products	1.07	1.09	-0.11
Non-metallic mineral products	-	-	-
Pottery, china, etc.	1.09	1.08	
Glass products	1.17	1.18	-0.31
Non-metallic min. products.	1.18	1.18	
Basic metal products	-	-	-
Iron and steel	1.10	1.08	
Non-ferrous metals	1.14	1.13	
Metal products	1.09	1.10	-0.06
Machinery and equipment	-	-	-
Machinery and equipment, nec.	1.06	1.09	-0.14
Office and computing machinery	1.54	1.58	-0.19
Electrical machinery	-	-	-
Radio, TV and comm. equipment	1.40	1.43	
Motor vehicles	1.09	1.08	
Other transport equipment	-	-	-
Motorcycles and bicycles	1.13	1.10	-0.19
Aircraft	-	-	-
Professional goods	1.09	1.12	-0.11
Other manufacturing	1.08	1.08	

1. For the period 1970-92. Estimates are based on gross output. All reported mark-ups are significant
2. For the period 1970-92. Estimates are based on gross output. The Lerner index (*B*) is assumed to vary over the business cycle according to the relationship: $B_t = \overline{B} + \gamma \cdot CYCL_t$. Only statistically significant coefficients are reported.

Table 3. Cyclicality of the mark-up: estimates with second-order effects, US manufacturing industries [1]

	Elasticity of substitution (K,L) σ = 1						Elasticity of substitution (K,L) σ = 0.5						Elasticity of substitution (K,L) σ = 2					
	Share of fixed labour						*Share of fixed labour*						*Share of fixed labour*					
ISIC sectors	*No rigidity*		*20%*		*40%*		*No rigidity*		*20%*		*40%*		*No rigidity*		*20%*		*40%*	
Food Products	-0.31		-0.31		-0.30		-0.32		-0.30		-0.29		-0.30		-0.30		-0.30	
Textiles	-0.29		-0.38	*	-0.43	**	-0.34		-0.41	*	-0.41	**	-0.43	**	-0.32		-0.39	*
Wearing	-0.51	***	-0.56	***	-0.60	***	-0.54	***	-0.58	***	-0.60	***	-0.60	***	-0.53	***	-0.57	***
Leather	-0.43	**	-0.52	***	-0.61	***	-0.47	**	-0.61	***	-0.66	***	-0.61	***	-0.46	**	-0.51	***
Footwear	-0.32		-0.37	*	-0.41	*	-0.33		-0.36	*	-0.35		-0.41	*	-0.36	*	-0.41	*
Wood Products	0.54	***	0.44	**	0.20		0.42	**	0.07		-0.35		0.20		0.54	***	0.48	**
Furniture	-0.54	***	-0.59	***	-0.59	***	-0.57	***	-0.56	***	-0.52	***	-0.59	***	-0.57	***	-0.61	***
Printing & Publishing	-0.53	***	-0.56	***	-0.60	***	-0.54	***	-0.57	***	-0.57	***	-0.60	***	-0.55	***	-0.58	***
Plastic products	-0.55	***	-0.63	***	-0.67	***	-0.58	***	-0.63	***	-0.56	***	-0.67	***	-0.58	***	-0.64	***
Non-metal Products	-0.28		-0.43	**	-0.59	***	-0.30		-0.53	***	-0.65	***	-0.59	***	-0.35	*	-0.46	**
Metal Products	-0.41	**	-0.48	**	-0.51	***	-0.46	**	-0.50	**	-0.50	***	-0.51	***	-0.43	**	-0.48	**
Chemical Products	-0.71	***	-0.69	***	-0.65	***	-0.65	***	-0.60	***	-0.52	***	-0.65	***	-0.72	***	-0.71	***
Machinery & Equipment	-0.20		-0.33		-0.46	**	-0.26		-0.44	**	-0.56	***	-0.46	**	-0.25		-0.34	
Motorcycles & Bycicles	-0.41	*	-0.47	**	-0.55	***	-0.43	**	-0.54	***	-0.64	***	-0.55	***	-0.43	**	-0.47	**
Professional goods	-0.51	***	-0.55	***	-0.59	***	-0.53	***	-0.58	***	-0.59	***	-0.59	***	-0.52	***	-0.56	***
Other manufacturing	-0.44	**	-0.50	***	-0.57	***	-0.51	***	-0.57	***	-0.63	***	-0.57	***	-0.44	**	-0.49	**
Beverages	.		.		.		.		.		.		.		.		.	
Tobacco	-0.58	***	-0.59	***	-0.59	***	-0.54	***	-0.53	***	-0.52	***	-0.59	***	-0.61	***	-0.61	***
Paper & Pulp	0.06		-0.03		-0.16		-0.04		-0.20		-0.34		-0.16		0.07		0.00	
Petroleum Refineries	-0.64	***	-0.64	***	-0.63	***	-0.63	***	-0.61	***	-0.55	***	-0.63	***	-0.64	***	-0.64	***
Petroleum & Coal Products	-0.45	**	-0.48	**	-0.51	***	-0.49	**	-0.52	***	-0.51	**	-0.51	***	-0.43	**	-0.46	**
Rubber Products	.		.		.		.		.		.		.		.		.	
Pottery & China	-0.36	*	-0.53	***	-0.64	***	-0.30		-0.58	***	-0.62	***	-0.64	***	-0.48	**	-0.57	***
Glass	-0.66	***	-0.70	***	-0.72	***	-0.66	***	-0.72	***	-0.69	***	-0.72	***	-0.68	***	-0.70	***
Iron & Steel	0.19		0.03		-0.18		0.15		-0.16		-0.48	**	-0.18		0.13		0.02	
Non-ferrous metals	0.12		0.04		-0.09		0.00		-0.17		-0.40	*	-0.09		0.13		0.08	
Shipbuilding & Repair	.		.		.		.		.		.		.		.		.	
Other transport equipment	.		.		.		.		.		.		.		.		.	
Industrial Chemicals	-0.04		-0.09		-0.16		-0.11		-0.20		-0.32		-0.16		-0.03		-0.07	
Drugs & Medecines	-0.65	***	-0.64	***	-0.63	***	-0.60	***	-0.57	***	-0.53	***	-0.63	***	-0.68	***	-0.67	***
Office & Computing Machinery	-0.41	*	-0.48	**	-0.56	***	-0.46	**	-0.56	***	-0.61	***	-0.56	***	-0.41	**	-0.47	**
Radio & TV	-0.20		-0.10		0.07		0.09		0.23		0.26		0.07		-0.28		-0.22	
Electrical Apparatus	.		.		.		.		.		.		.		.		.	
Railroad Equipment	.		.		.		.		.		.		.		.		.	
Motor Vehicles	-0.42	**	-0.53	***	-0.62	***	-0.44	**	-0.59	***	-0.63	***	-0.62	***	-0.46	**	-0.53	***
Aircraft	.		.		.		.		.		.		.		.		.	

1. For the period 1970-92. The variable mark-ups are based on equation (12) in the text. The columns display the correlation between the variable markup and the sectoral cyclical variable CYCL(t) defined in the text. Correlation coefficients were calculated only for those sectors for which the estimates of the steady-state mark-ups were available.

* = statistically significant at the 10 per cent level; ** = at the 5 per cent level; *** = at the 1 per cent level.

Table 4. Mark-ups, TFP and the procyclicality of real wages, US 1970-1992

	correlation between the output gap and real wages. [1]				*estimated TFP growth (annual growth rate)*	
ISIC sectors	*wages deflated by sectoral output prices*		*wages deflated by sectoral output prices adjusted for markups*		*measured by the Solow-residual.* [2]	*measured by the adjusted Solow-residual.* [3]
Food Products	0.29		-0.01		1.4	1.5
Textiles	0.19		-0.04		2.6	2.7
Wearing	0.50	**	0.09		2.3	2.5
Leather	0.44	**	0.27		0.9	1.0
Footwear	0.37	*	0.27		-1.2	-0.7
Wood Products	-0.59	***	-0.47	**	0.6	0.8
Furniture	0.43	**	-0.18		1.1	1.2
Printing & Publishing	0.53	***	0.13		-1.0	-0.7
Plastic products	0.43	**	0.05		2.2	2.1
Non-metal Products	0.28		0.05		1.2	1.4
Metal Products	0.27		-0.05		0.9	1.2
Chemical Products	0.62	***	-0.06		2.4	3.1
Machinery & Equipment	0.06		-0.45	**	3.0	3.2
Motorcycles & Bycicles	0.34		-0.05		3.6	2.6
Professional goods	0.49	**	0.22		2.0	2.3
Other manufacturing	0.46	**	0.24		0.2	0.5
Beverages	.		.		.	.
Tobacco	0.49	**	-0.07		-5.2	-4.5
Paper & Pulp	-0.19		-0.38	*	0.8	1.1
Petroleum Refineries	0.64	***	0.31		-1.3	-1.4
Petroleum & Coal Products	0.32		-0.19		-1.0	-0.8
Rubber Products	.		.		.	.
Pottery & China	0.31		0.17		1.7	1.8
Glass	0.59	***	-0.23		1.3	1.5
Iron & Steel	-0.08		0.26		0.0	0.2
Non-ferrous metals	-0.07		0.11		-0.2	-0.2
Shipbuilding & Repair	.		.		.	.
Other transport equipment	.		.		.	.
Industrial Chemicals	0.08		0.10		2.0	2.3
Drugs & Medecines	0.63	***	0.03		0.6	0.9
Office & Computing Machinery	0.33		-0.03		0.7	1.4
Radio & TV	0.53	***	0.57	***	1.0	2.3
Electrical Apparatus	.		.		.	.
Railroad Equipment	.		.		.	.
Motor Vehicles	0.43	**	0.04		-0.7	-0.6
Aircraft	.		.		.	.

1, The columns display the correlation between observed and corrected real wages and the cyclical variable CYCL(t).
2. Without correction for the presence of a positive and time-varying mark-up.
3. With correction for the presence of a positiveand time-varying mark-up.
* = statistically significant at the 10 per cent level; ** = at the 5 per cent level; *** = at the 1 per cent level,

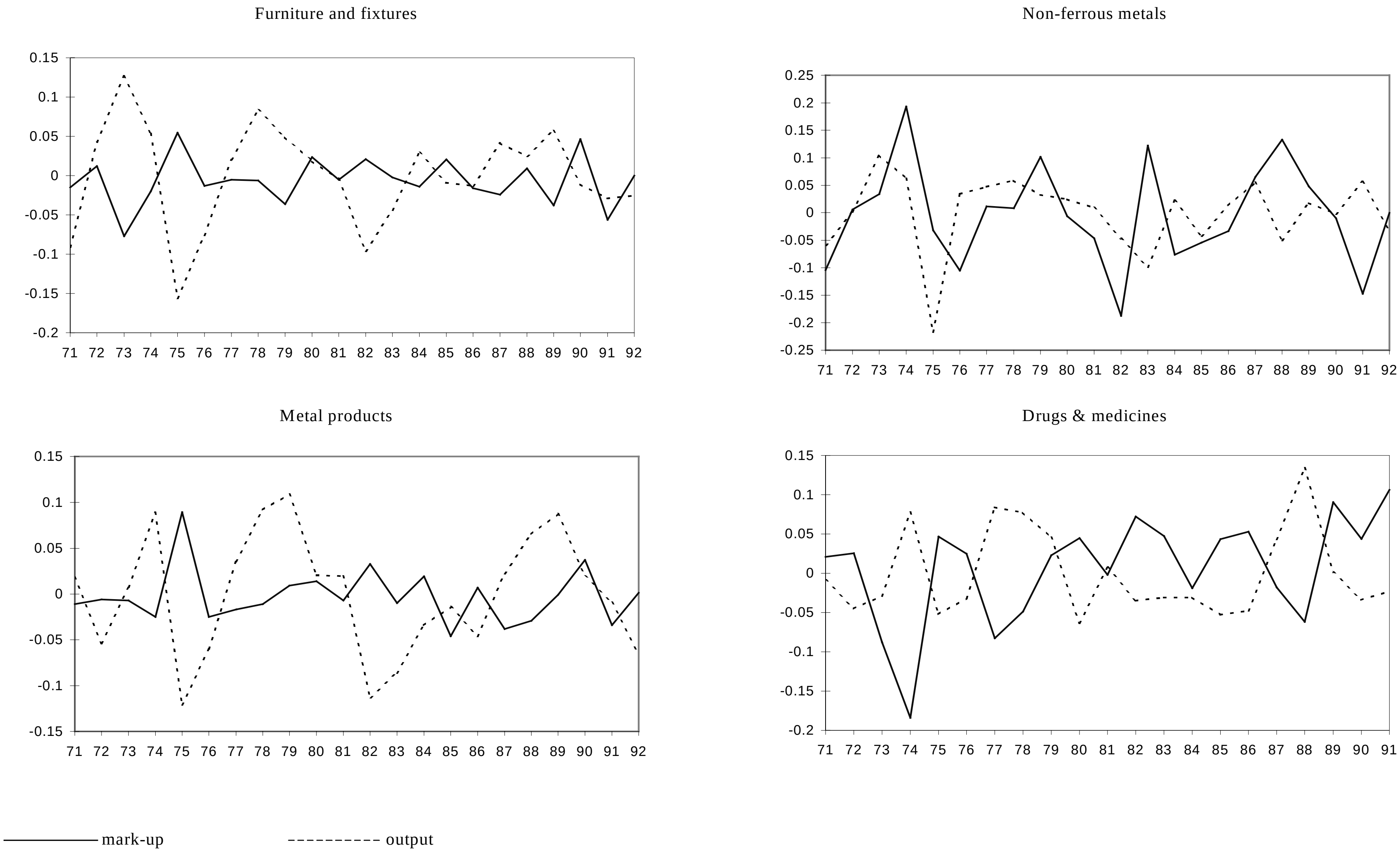
Table 5. Levels, cyclicality of mark-ups and market structures : an international comparison [1]

Market structure prototypes	**France**		**Germany**		**Japan**		**United Kingdom**		**United States**	
	μ	cycl.[2]	μ	cycl.[2]	μ	cycl.[2]	μ	cycl.[2]	μ	cycl.[2]
Type 1: fragmented markets										
Food Products	1.11		1.12	-0.56	1.32		1.20	-0.38	1.05	
Textiles	1.10		1.15	-0.44	1.19	-0.44	1.03		1.08	
Wearing	1.15		1.11	-0.58	.	.	1.03		1.10	-0.51
Leather	1.11		1.18	-0.54	.	.	1.06		1.08	-0.43
Footwear	1.13		.	.	.	.	1.04		1.08	
Wood Products	1.15		1.20		.	.	1.18		1.22	0.54
Furniture	1.21		1.15	-0.38	1.25		1.19		1.06	-0.54
Printing & Publishing	1.24	-0.48	1.09	-0.48	1.10		1.09	-0.43	1.19	-0.53
Plastic products	.	.	.	.	1.15	-0.49	.	.	1.07	-0.55
Non-metal Products	1.24		1.26		1.26		1.15		1.18	
Metal Products	1.18	0.40	1.20	-0.64	1.11	0.41	1.03		1.09	-0.41
Chemical Products	1.19		1.24		1.26	-0.79	1.08	-0.59	1.26	-0.71
Machinery & Equipment	1.12		1.06	-0.59	1.09		.	.	1.06	
Motorcycles & Bycicles	.		.	.	.	.	.	.	1.13	-0.41
Professional goods	.		1.67	-0.42	1.22		1.16		1.09	-0.51
Other manufacturing	.		1.30	-0.49	1.38		.	.	1.08	-0.44
Average mark-up	***1.16***		***1.21***		***1.21***		***1.10***		***1.11***	
Type 2: segmented markets										
Beverages	1.68		1.33		1.26		1.54	-0.48	.	.
Tobacco	3.12		1.52	-0.51	.	.	1.56	-0.45	1.56	-0.58
Paper & Pulp	1.13		1.29		1.20		1.05		1.13	
Petroleum Refineries	1.19	-0.43	.	.	1.04	-0.52	1.07	-0.51	1.03	-0.64
Petroleum & Coal Products	.	.	1.09		1.10	-0.49	1.06	-0.54	1.11	-0.45
Rubber Products	1.20	-0.53	.	.	1.15	-0.53	.	.	.	.
Pottery & China	1.29	-0.41	.	.	1.22	-0.42	.	.	1.09	-0.36
Glass	1.22		1.23	-0.52	1.41		1.06		1.17	-0.66
Iron & Steel	1.16	-0.43	1.14		1.19		.	.	1.10	
Non-ferrous metals	1.26	-0.51	.	.	1.26		1.05		1.14	
Shipbuilding & Repair	.	.	.	.	1.27		.	.	.	.
Other transport equipment	.	.	.	.	.		.	.	.	.
Industrial Chemicals	1.21	-0.45	.	.	1.23	-0.60	1.06	-0.51	1.18	
Drugs & Medecines	1.04	-0.52	1.45		1.54	-0.77	1.16	-0.54	1.44	-0.65
Office & Computing Machinery	1.17		1.58	-0.59	1.24		1.47	-0.47	1.54	-0.41
Radio & TV	1.11	-0.54	1.34	-0.67	1.13		1.25	-0.60	1.40	
Electrical Apparatus	1.25	-0.48	.	.	1.05		.	.	.	.
Railroad Equipment	1.69		.	.	.	.	.	.	.	.
Motor Vehicles	1.13	-0.45	1.15		1.17	-0.45	.	.	1.09	-0.42
Aircraft	1.21		.	.	.	.	.	.	.	
Average markup	***1.36***		***1.31***		***1.22***		***1.21***		***1.23***	

1. For the period 1970-92. The mark-ups μ are based on gross output.
2. The correlation between the time-varying mark-up and the cycle is estimated under the assumption of no downward labour rigidity and σ =1. See text. Only statiscally significant mark-ups and correlation coefficients are reported.
NB: See text for the definition of market structure prototypes.

Figure 1. Deviations from trend of industry mark-up and output in the US, 1971-1992[1]

(selected manufacturing sectors)



1. Estimates of the cyclicality of the markup under the assumptions of $s = 1$ and no donward rigidities, seeTable 3.

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