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Market Power and Inflation

David Bowman*

Abstract: This paper examines the extent to which a decline in market power could have contributed to the general decline in inflation rates experienced in developed countries during the 1990s.

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The 1990s witnessed a widespread general decline in in°ation in most developed economies. While low in°ation in the early part of the decade is commonly thought to re°ect low rates of economic growth, in°ation continued to remain low in many countries as economic conditions strengthened. And, as documented in Andersen and Wascher (2001), in°ation remained below the rates forecast by standard econometric models and by survey participants. There are several possible explanations for these facts, including structural changes in the natural rate of unemployment and monetary authorities taking advantage of economic growth to focus on keeping in°ation low. This paper examines another explanation receiving popular attention and highlighted in recent work by Rogo® (2003), the claim that ¯rm's market power has been eroded by increased domestic and international competition.

Several factors could plausibly have led to increased competition during the 1990s, including:

- Globalization
- Deregulation
- \New economy"changes in market structure making use of information technologies (DeLong and Froomkin (1999)).
- Productivity increases temporarily bene¯ting only a subset of ¯rms, forcing other ¯rms to cut pro¯t margins to maintain long-run market share.

Although some of the evidence presented in the popular press might represent money illusion or be misleadingly anecdotal, increased competition may in fact help explain recently low in°ation. This paper will ¯rst examine the theoretical links between market power and in°ation, and then examine cross-country data for evidence that market power has declined. As described in more detail later, holding all else constant an increase in competition should reasonably be expected to have a short-run impact in lowering the rate of in°ation, but should not cause a permanent decline in in°ation. However, a simultaneous increase in competition and decline in in°ation does not necessarily imply a causal link from competition to in°ation. There are a number of theories pointing to channels through which lower trend rates of in°ation may increase competition; these theories are brie°y outlined as well.

After outlining the relevant theory, the paper then turns to examine empirical evidence that competition has increased. While there may be some evidence of increased competition in some countries or some sectors, on the whole there is little evidence that competition has increased, and in many cases

the reported measures of competition actually decreased. This should not be taken as a conclusive rejection of the \pricing power" hypothesis. We discuss a number of reasons as to why the degree of competition may be understated in recent data. The di±culties in measuring market competition make further work in this area desirable, but at present there is no strong empirical evidence for this channel as a key explanation of low in°ation in the 1990s. This mirrors the conclusion of the OECD Working Party on Macroeconomic and Structural Policy Analysis (2002), which examined detailed data for a large set of manufacturing industries and found \no systematic change" in competition in OECD countries as measured by pro¯t markups. It also is corroborated by previous estimates for the United States which have tended to indicate that on average U.S. ¯rms are already fairly competitive, leaving only limited room for an increase in competition at the aggregate level.

1 Theoretical links between market power and in°ation

1.1 The markup and its direct e®ects on in°ation

Empirical studies of market power attempt to either directly or indirectly measure the size of the gap between price and marginal cost (Bresnahan (1989) provides a survey of the industrial organization literature). The most prevalent measure of this gap is the markup,

$$\text{markup} = \frac{\text{price}}{\text{marginal cost}} \tag{1}$$

In a perfectly competitive market each ¯rm will produce up to the point where its marginal cost of production is equal to the market price, and the markup will be one. While there are a number of di®ering models of imperfectly competitive markets, including oligopolistic models such as Cournot or Stackelberg competition and monopoly or monopolistic competition models, in each of these theories the price that the ¯rm sets will exceed marginal cost and the markup will be greater than one.

De¯ning the pro¯t rate to be economic pro¯t[1] per unit of revenue, the following identity links the markup to pro¯ts:

$$\text{profit rate} = 1 - \frac{\text{returns to scale}}{\text{markup}}$$

[1]Economic pro¯ts are any pro¯ts retained by the ¯rm in excess of the amount needed to cover normal market rates of return on the ¯rm's capital and any ¯xed costs of production.

where the de¯nition of a ¯rm's returns to scale is the ratio of its average cost of production to its marginal cost of production. Holding the degree of returns to scale constant, a higher markup will lead to a higher pro¯t rate. However, a markup greater than one does not necessarily imply a positive pro¯t rate { if ¯rms are operating under increasing returns to scale (returns to scale greater than one), which for example could occur if there are ¯xed costs to production, then even imperfectly competitive ¯rms may have a zero pro¯t rate. Conversely, if there are decreasing returns to scale (returns to scale less than one) then even perfectly competitive ¯rms may have positive pro¯t rates, at least in the short-run if there is no entry into the market.

Taking logs and rewriting equation (1) yields

$$\ln price = \ln markup + \ln marginal\ cost \tag{2}$$

Holding costs constant, equation (2) implies that a permanent one percent decline in the level of the markup will cause a permanent one percent decline in the price level, but will have only a temporary e®ect on the in°ation rate. That is, reductions in the markup have level e®ects, but not growth rate e®ects. Increased competition can only have a sustained e®ect on in°ation if there are sustained declines in the markup { something that must be eventually impossible because the markup should not fall below one. If prices are sticky then ¯rm's actual markups may temporarily di®er from their desired markup and the reduction in in°ation from an increase in competitive pressures may be spread out over a few years, but it should nonetheless be only temporary.

How large might the markup be? We expect little or no economic pro¯t in the long-run in industries where ¯rms are allowed to freely enter, and indeed, most estimates of the level of economic pro¯ts earned by U.S. ¯rms indicate that they are close to zero (Rotemberg and Woodford (1995)). That is, most of reported pro¯ts are thought to cover normal market rates of return to capital and ¯xed costs of production. Estimates of the returns to scale in U.S. industries point towards constant or very small increasing returns to scale, indicating that we should be thinking about returns to scale near unity (Burnside, Eichenbaum, and Rebello (1995); Basu and Fernald (1997); Basu, Fernald, and Shapiro (2001)). If these are accurate then the markup should also be near unity, implying that we should not expect it to be possible for the markup to fall for an extended period of time. For example, Basu and Fernald (1997) estimate a pro¯t rate of at most 3% and returns to scale of 1.08 for U.S. manufacturing, 1.01 for the entire U.S. private economy, and decreasing returns to scale for nondurable manufacturing. Using these numbers the markup would be 1.08/.97=1.11 for manufacturing, 1.04 for the private economy as a whole, and near unity for nondurable manufacturing. If this

is accurate, a 2% annual reduction in the markup in manufacturing could be sustained for at most 5-6 years, a reduction in the markup for the private economy as a whole could be sustained for 2 years, and no reduction in the markup for nondurable manufacturing would be possible.

Of course if higher competitive pressures lead to higher rates of technological innovation, then a decline in markups could lead to a sustained decline in production costs and, depending on the response of monetary authorities, could lead to a sustained decline in in°ation. Evidence is mixed on whether higher competition leads to greater innovation (Cohen and Levin (1989)). Further, the evidence above indicates U.S. markets are already fairly competitive, and if higher global competition has led to higher innovation then it is puzzling that productivity increases were not enjoyed globally. Higher competition could also lead to one-time cost reductions if ¯rms had previously passed on some of their economic pro¯ts to workers through a willingness to pay higher than necessary wages or bene¯ts or to keep workers on the payroll. In this situation an increase in competitive pressure could lead ¯rms to operate more e±ciently, although shareholders would have had an incentive to realize the gains to e±ciency regardless of the degree of competition. This type of scenario is probably more plausible for certain European economies than for the United States in the 1990s.

Apart from its e®ects on in°ation, a decline in market power will tend to make price responses more °exible. Sticky price models imply that the degree to which ¯rms are willing to let relative prices become out of balance is positively related to their degree of market power; thus, if market power declines ¯rms become more likely to adjust their price in response to economic shocks. To the extent that monetary policy impacts the real economy because prices are sticky, a faster rate of price adjustment will tend to reduce the output effects of monetary policy, but will also lead to quicker private sector adjustment to shocks and smaller movements in the output gap. Rogo® (2003) argues that these e®ects can lessen the in°ationary bias of discretionary monetary policy. He argues that smaller movements in the output gap and quicker adjustment to shocks lower the central bank's incentives to react to the output gap, possibly leading to a less activist monetary policy with a greater focus on containing in°ation.

1.2 Channels linking in°ation to markups

While attention has been paid in the popular press to the e®ects of markups on in°ation, it is possible that causality runs in the opposite direction. There is some theoretical academic literature examining the possible e®ects of in°ation

on markups. Chirinko and Fazzari (2000) empirically document a positive relationship: they ¯nd that lower in°ation rates tend to be associated with lower markups. The possibility that in°ation can itself a®ect the degree of competition provides a cautionary warning in interpreting periods of low in°ation and higher competition as implying that the higher competition has caused the low rate of in°ation. If low in°ation was the cause rather than the e®ect of increased competition, then this would have very di®erent implications for the causes and consequences of the decline in in°ation.

Theories that predict a causal link from lower in°ation to increased competition are:

- Search markets. Models of the e®ects of in°ation on market structure when consumers must search across ¯rms for the lowest price include Benabou (1992), Benabou and Gertner (1993), Tommasai (1994), and Ball and Romer (2002). Benabou (1992) shows that in (S,s) pricing models lower in°ation is associated with lower price dispersion and it appears to be empirically true that low in°ation countries have lower relative price variance. A lower degree of price dispersion facilitates more e®ective search by consumers, thereby lowering the ability of ¯rms to keep prices high. Firms will respond to the increased e®ectiveness of consumer search by lowering markups.

- Customer markets. Firms may face a trade-o® between keeping prices low, which attracts a larger future customer base, and raising prices to exploit the current customer base. Low interest rates will raise the discounted value of a larger future customer base, making ¯rms less likely to raise prices.[2] Low in°ation is associated with low nominal interest rates, and because of lower in°ation variability is likely to also be associated with low ex ante real interest rates, hence these theories imply that low in°ation can cause ¯rms to lower markups.

- Persistence. Taylor (2000) argues that in°ation persistence has decreased as the level of in°ation has fallen. In sticky price models if ¯rms believe that a cost increase is less persistent then they will pass less of it on to prices. Of course, if the cost increase does turn out to be permanent then ¯rm's will eventually fully adjust their price, so that this channel can explain only a temporary decrease in the markup.

[2] Chevalier and Scharfstein (1996) present a variant of the customer market story in which a decline in liquidity constraints makes ¯rms less likely to raise short-term capital by raising prices.

While further empirical work testing for the existence of these channels is warranted before concluding that they are economically important, the theories described do provide an important counterpoint to the belief that an empirical relation between in°ation and competition must necessarily imply a causal relationship from changes in competition to in°ation. In this regard claims in the popular press that \pricing power" has diminished may be a result of the current low in°ation environment rather than a cause of it.

2 Measuring the markup

Measuring the markup is a nontrivial exercise. While disaggregated price data is available for many countries, data on marginal costs of production are rarely if ever available, and as a result it is di±cult to construct markup measures that can be tracked over time or across countries. In these contexts the markup is typically proxied by real unit labor cost. The equivalence of real unit labor cost to the markup, under certain conditions, can be derived from a standard neoclassical pricing model as follows. A ¯rm with production function $q = F(K; L)$ will choose capital and labor to maximize its pro¯ts:

$$¼ = p ¢ F(K; L) ¡ w ¢ L ¡ r ¢ K$$

If the ¯rm has market power it will face a downward sloping demand curve $p = p(q)$ where $p^0(q) < 0$ implies that the ¯rm must lower its price to sell a higher quantity of its output. (If the ¯rm is perfectly competitive then $p^0(q) = 0$.) The ¯rst order conditions for pro¯t maximization are:

$$\begin{aligned} (p^0(q) ¢ q + p) &= \frac{w}{F_L} \\ (p^0(q) ¢ q + p) &= \frac{r}{F_K} \end{aligned}$$

where F_L and F_K are the marginal products of labor and capital. The left-hand side of the two equations is marginal revenue; the right-hand sides are the ¯rm's marginal cost of production using either labor (top equation) or capital (bottom equation). In this example the marginal cost of producing one more unit of output using labor is the same as the marginal cost of producing one more unit of output using capital. This is a general principle: A pro¯t maximizing ¯rm will choose factor inputs so that the marginal cost of production using any of its variable inputs is equalized (if they were unequal, the ¯rm could raise pro¯ts by using more of the factor that had a lower marginal cost of production).

Noting that $\varepsilon = -\frac{p}{p'(q)\cdot q}$ is the definition of the firm's price elasticity of demand, the above equations imply that the firm will set its price as a markup over marginal cost

$$p = \left(\frac{\varepsilon}{\varepsilon - 1}\right)\frac{w}{F_L} = \left(\frac{\varepsilon}{\varepsilon - 1}\right)\frac{r}{F_K}$$

where the markup is $\mu = \frac{\varepsilon}{\varepsilon - 1} > 1$.

While in theory we could measure marginal cost from any variable factor of production, in practice people examine the marginal cost of production using labor because measures of labor productivity are most extensively reported. If we assume that the production function is Cobb-Douglas:

$$F(K; L) = K^{\gamma} L^{\alpha}$$

then the marginal cost of production using labor is

$$\begin{aligned} \frac{w}{F_L} &= \frac{w}{\alpha K^{\gamma} L^{\alpha - 1}} \\ &= \frac{wL}{\alpha q} \end{aligned}$$

and the markup is

$$\text{markup} = \frac{p}{w/F_L} = \alpha \frac{p \cdot q}{w \cdot L} \tag{3}$$

This is the most common measure of the markup. It is proportional to the inverse of \real unit labor cost," which is also labor's share of revenue.

3 Is there evidence that market power has fallen?

Figure 1 displays aggregate and non farm business markup measures for the U.S. based on equation (3). The cyclical swings in both series are the most prominent feature of the figure. This does not necessarily imply that there are cyclical swings in competition { there is a large literature outlining a number of competing theories of and evidence for the cyclical movement of mark-ups (Rotemberg and Woodford (1999)).[3]

[3] In addition to the sticky price models that are outlined in the text, other prominent models of countercyclical markups include the following. (1) Varying elasticity of demand: If periods of high demand are also periods when the price elasticity of demand is high then markups will fall during booms. Bils (1989) and Parker (2001) argue that increased purchases of durables during booms represent a source of high demand elasticity because households are likely to view these purchases as luxury goods rather than neccesities. (2)

New Keynesian sticky price models such as that outlined in Gali and Gertler (1999) are one of the prominent models in this class. These models imply a Phillips curve of the form

$$\pi_t = \pi^e_{t+1} - \kappa(\mu_t - \mu)$$

where π^e is expected in°ation, μ is the markup, and μ represents the long-run desired markup ¯rms wish to charge. In these models an unexpected reduction in marginal costs (either because of low demand or high technological progress) will leave realized markups above their desired level because prices are sticky and therefore unable to immediately match the decline in cost. As a result, in°ation will fall as prices slowly adjust down to restore balance. In this theory cyclical movements in markups represent slow price adjustment rather than a changing competitive structure. Some have pointed to slow price and wage adjustment in response to an acceleration of productivity as a signi¯cant explanation for low in°ation in the United States in the 1990s, arguing that marginal costs fell in the U.S. because wages did not increase at the same rate of growth as productivity in the second half of the decade; with sticky prices this will cause a rise in markups above their desired level, and hence a decline in in°ation. This theory predicts that the decline in in°ation will gradually lower the markup until it returns to its long-run level, which appears to be largely in agreement with the behavior of markups shown in Figure 1.

Importantly, other than the cyclical swings, there is no evidence of a trend decline in the markup over the 1990s. The aggregate markup measure ends the decade at a level virtually identical to its start, and the non farm business markup actually increases. These measures provide no support for the conjecture that competition has increased in the 1990s.

While \new economy" and productivity growth e®ects on competition are most likely to be relevant for the United States, conjectures that globalization or deregulation have increased competition are perhaps more relevant for other countries. Figures 2 and 3 display the aggregate markup measures taken from Ihrig and Marquez (2002) for the OECD. Their measure of real unit labor costs is simply the inverse of the measure of the markup derived above. The dashed lines indicate the level of the estimated markup in 1992, the year by which in°ation had fallen to lower levels in most OECD countries. With the

Customer markets: This theory was outlined in section 2.2 (3) Implicit Collusion (Rotmeberg and Saloner (1986) and Rotemberg and Woodford (1992): In oligopolistic markets periods of high demand will increase the incentives of individual ¯rms to break any implicit agreements to keep prices high. As a result markups will have to fall when demand is high to maintain a collusive agreement. (4) Variable Entry: Entry tends to be high in cyclical booms. This can weaken the degree of industry concentration and lead to lower markups.

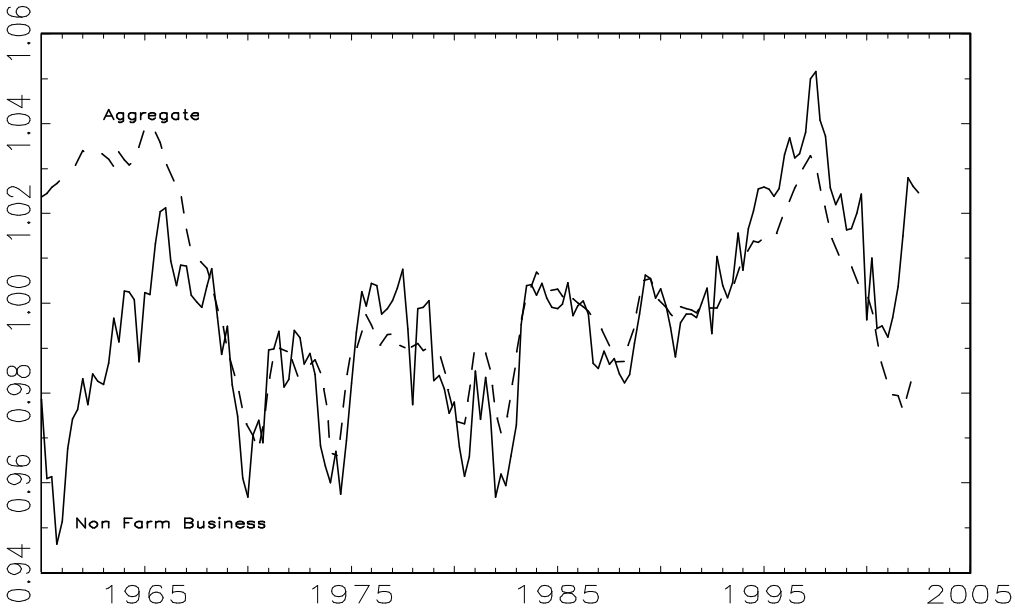

Figure 1: U.S. Aggregate and Non Farm Business Markups (Log Scale, 1992=1)

exceptions of Greece, Portugal, Japan, and Norway aggregate markups ended the decade close to or above where they began in the early 1990s. Again there is no compelling evidence of a widespread trend increase in competition.

Of course, globalization should a®ect market power in tradeables rather than nontradeables. This suggests looking at manufacturing data. As documented by Macklem and Yetlen (2001), ¯nal goods prices are chie°y responsible for the decline in in°ation in the US, which also suggests that manufacturing is a sector in which competition may have increased.[4] Measuring manufacturing markups by the ratio of the manufacturing producer price index to unit labor costs, Figure 4 shows that manufacturing markups have risen in most countries over the 1990s, reversing a trend in which markups either fell or were stable. BLS measures of unit labor costs for manufacturing have fallen over the second half of the 1990s, but producer prices have continued to rise (albeit at a slower rate than in earlier times), leading to a rise in the markup. This does not appear to be speci¯c to manufacturing { measuring the US markup for services by the ratio of GDP from services to compensation for services employment, the services markup shows the same pattern as manufacturing markups.

4 Have markups actually risen?

While the evidence certainly does not point to a decline in market power, its hard to believe that market power has actually risen substantially over the 1990's. The di±culty in measuring the markup is in measuring marginal cost. As discussed above, marginal cost is

$$\text{marginal cost} = \frac{\text{marginal labor cost}}{\text{marginal product of labor}}$$

However, estimated markups are based on unit labor cost, which is a measure of

$$\text{unit labor cost} = \frac{\text{average labor cost}}{\text{average product of labor}}$$

There are several possible factors that might cause unit labor costs to overstate the decline in marginal costs.[5] Measurement error of unit labor costs is possible. If average labor costs have become increasingly underestimated or the

[4] Another factor is that the BLS publishes measures of manufacturing hours worked for 14 countries on an annual basis, while most other data sources are based on employment. This may provide more accurate measurement of unit labor costs and the markup.

[5] The following identity breaks out the possible deviations of our measured markup from

average product of labor has become increasingly overestimated then the estimated markup will rise even though actual markups have not risen. However, the fact that similar markup behavior is found over a range of countries with di®ering labor market institutions and statistical reporting rules may lessen the argument that these results are purely the result of measurement error. We brie°y examine two other factors that may possibly have contributed to an overstatement of markups.

4.1 Marginal labor costs versus average labor costs

Blanchard (1997) documents rising markups in Europe and argues that they may be due to a decrease in the power of labor unions | arguing that previously unions may have practiced \featherbedding," in which unions forced ¯rms to keep payrolls unnecessarily high. This is an unlikely story for the United States. If this practice has decreased in Eurpoe then average labor cost will have declined relative to marginal labor cost as weaker unions are unable to expropriate ¯rm's pro¯ts. A decline in average labor cost relative to marginal labor cost would cause the estimated markup to be overstated.

While featherbedding may not describe the U.S. experience, a substantially similar e®ect would take place if there were substantial labor hoarding in the United States prior to the mid 1990s. In this case marginal labor costs would have been lower than average costs, and as demand expanded marginal labor costs would have risen, or perhaps even exceeded average costs if overtime use was involved, and therefore the estimated markup in the 1990s would be overstated.[6]

Adjustment costs provide another possible explanation for why estimated markups may be overstated for the United States. Firms may have been unable to immediately expand their workforce by as much as they desired when they realized that productivity growth had increased, or may have had training costs for the new employees they did hire; either factor would lead to a high

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the actual:

$$\frac{\text{estimated markup}}{\text{markup}} = \frac{\text{average product of labor}}{\text{marginal product of labor}} \frac{\text{marginal labor cost}}{\text{average labor cost}} \frac{\text{unit labor cost}}{\text{measured unit labor cost}}$$

The ratio of the average to the marginal product of labor is a measure of the degree of returns to scale, which is empirically small and seems unlikely to have risen substantially.

[6] This would raise pro¯ts unless labor's share of the ¯rm's total costs have fallen at the same time. Investment was abnormally high in the latter part of the 1990s, so it is indeed possible that the labor share fell.

short-run marginal cost of adding labor. Another possibility is that ¯rm's were forced to hire less skilled workers, and this could imply that the marginal product of newly hired labor was lower than the average product of labor of existing employees.

4.2 The elasticity of substitution between capital and labor

If the production function is CES

$$F(K;L) = \left[(1 - \alpha)K^{\frac{\sigma - 1}{\sigma}} + \alpha L^{\frac{\sigma - 1}{\sigma}}\right]^{\frac{\sigma}{\sigma - 1}}$$

then the log of the markup is

$$\ln(\text{markup}) = \ln\alpha + \ln\frac{p \cdot q}{w \cdot L} - \frac{\sigma - 1}{\sigma}\ln\frac{q}{L}$$

If $\sigma = 1$ then this reduces to the Cobb-Douglas production function. Estimates in fact usually point to a value of near one, however, Blanchard (1997) also uses a value of $\sigma = 2$ as an alternative to his baseline assumption of Cobb-Douglas. As a robustness check, Figure 5 displays the estimated markup when $\sigma = 2$ is chosen. This does lower the estimated markup, but in most countries the implied markup remains at or above the level it was at in the early 1990s. The exceptions contain some important economies: Japan, Germany, and the United Kingdom. The decline in the markup in these cases ranges from a low of 2% over 1992-2000 for the UK to 5% for Germany. This would explain a 0.25 to 0.63 percentage point drop in annual in°ation during the period in question, which is not negligible but is not enough to explain most of the decline in in°ation witnessed in these countries.

5 Conclusions

This paper has examined the extent to which a decline in market power could have contributed to the general decline in in°ation experienced in most developed countries in the 1990s. Increased competition should have at least a temporary e®ect in contributing to low in°ation. However, while several factors can be pointed to that could have plausibly caused some increase in competition over this period, measures of market power have either remained fairly constant or actually have decreased for most countries in the 1990s. It seems unlikely markets have become less competitive, but the data certainly do not substantiate claims that market power has actually fallen. While the evidence examined in this paper does not point to declines in market power as a key explanation for low in°ation in the 1990s, the di±culties in measuring market competition make further research on this topic desirable.

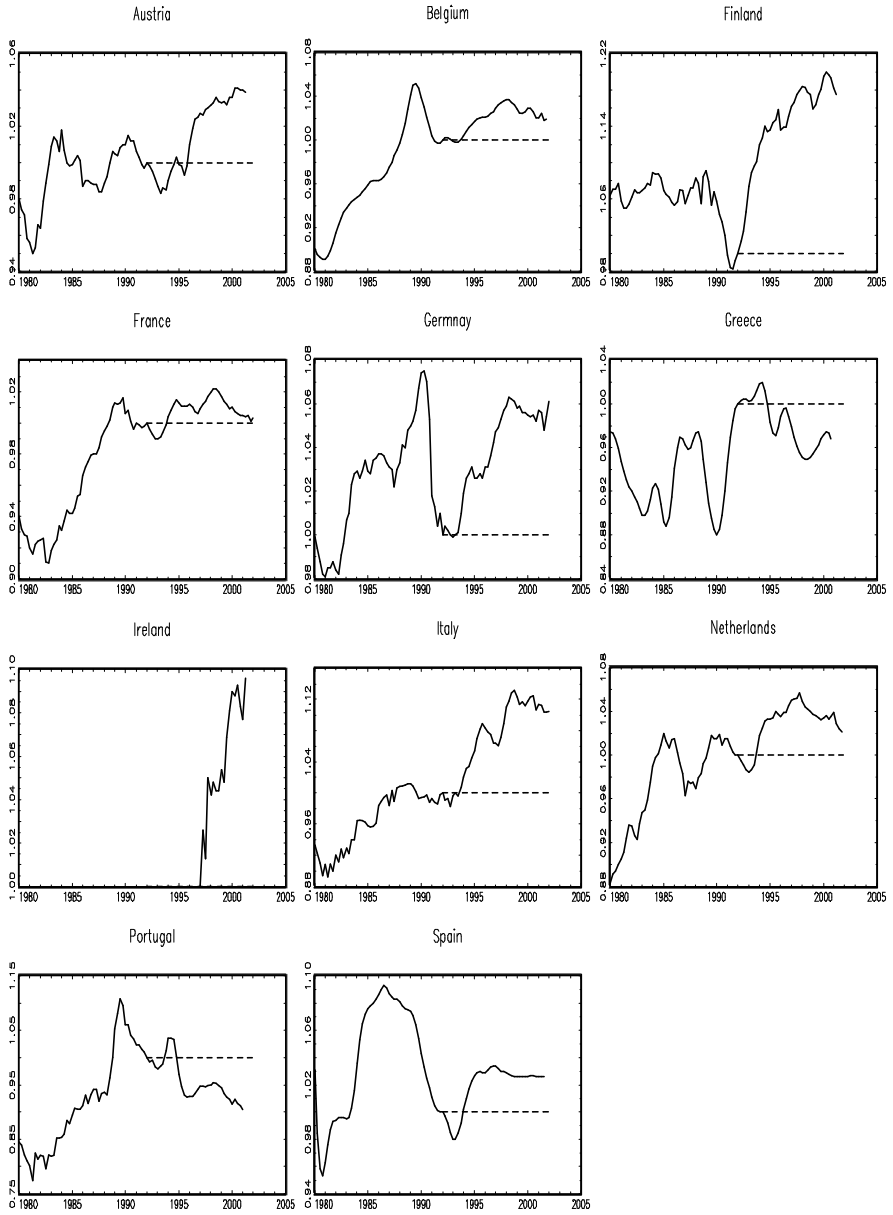

Figure 2: Aggregate Markups for OECD Euro Countries (Log Scale, 1992=1)

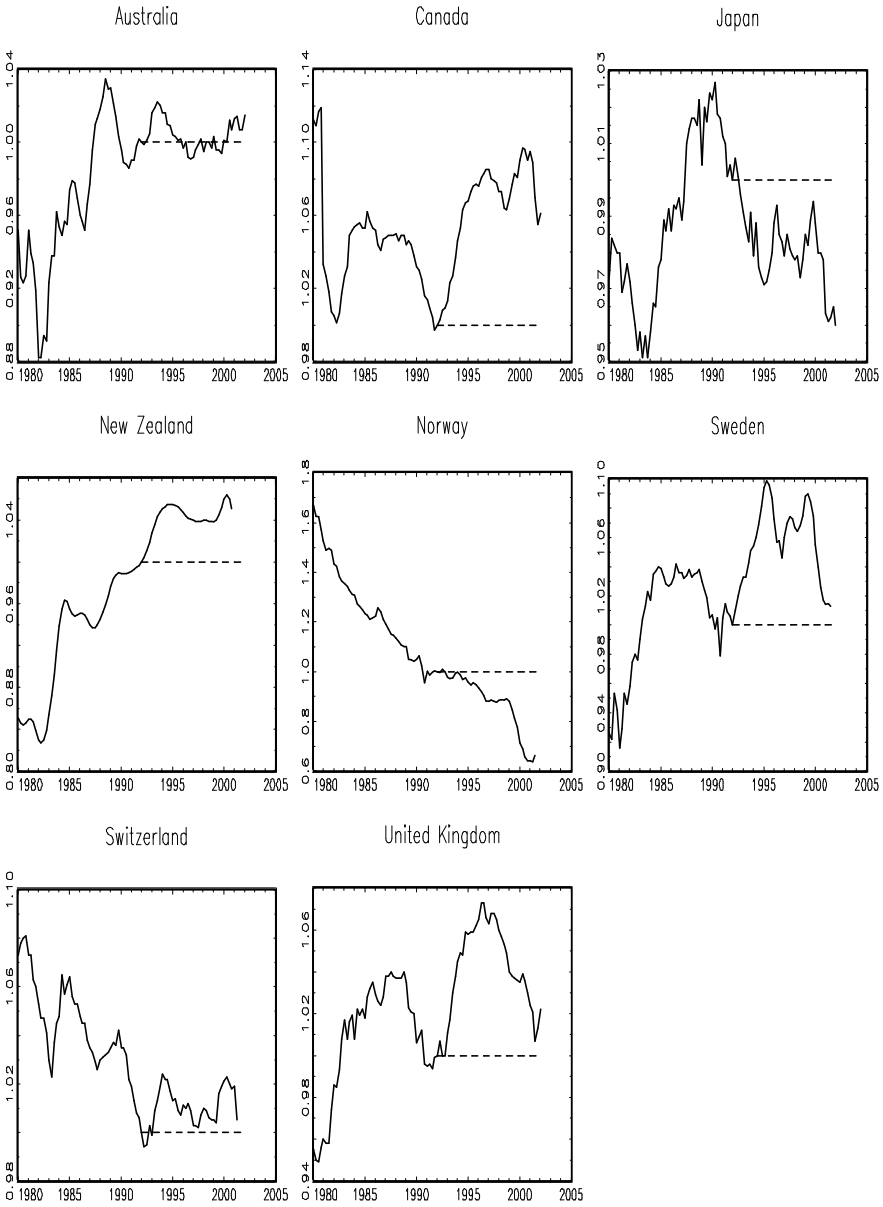

Figure 3: Aggregate Markups for Other OECD Countries (Log Scale, 1992=1)

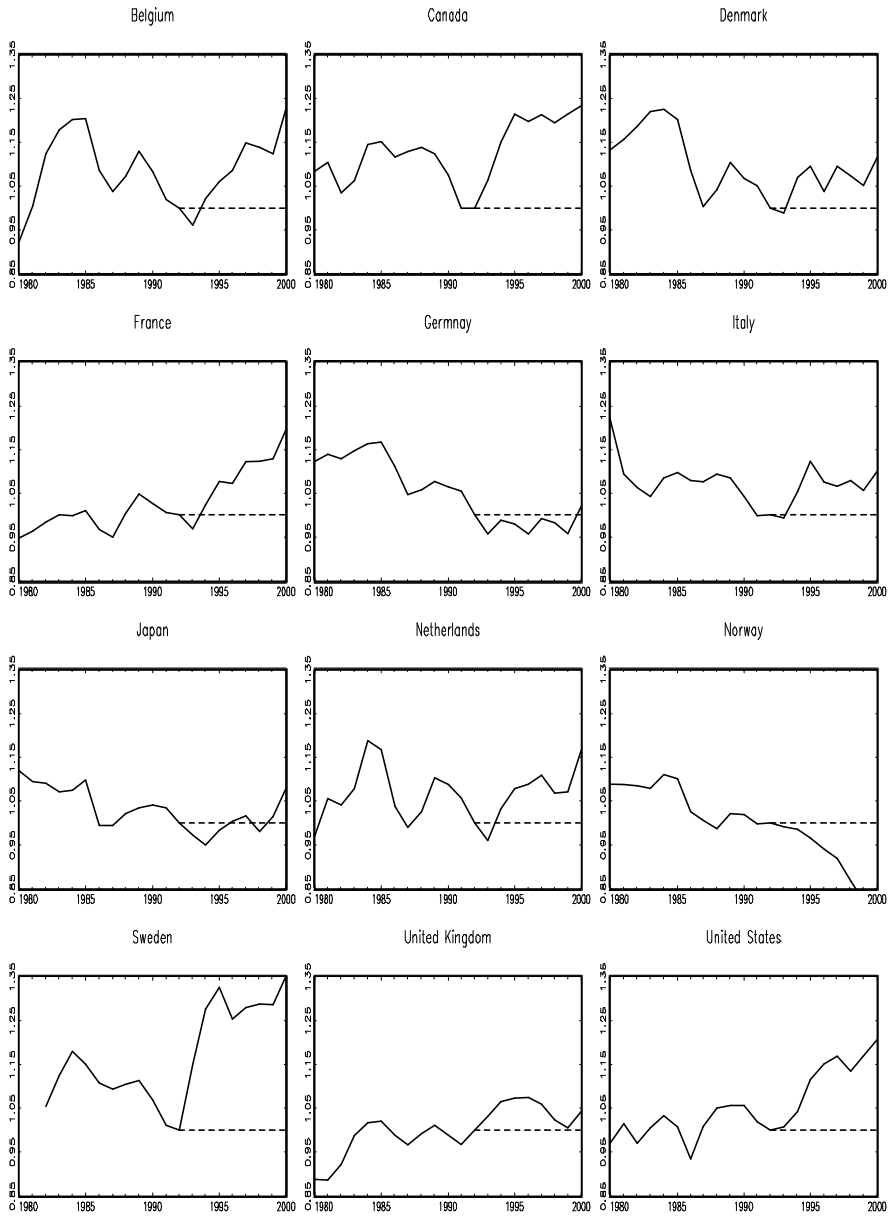

Figure 4: Manufacturing Markups (Log Scale, 1992=1)

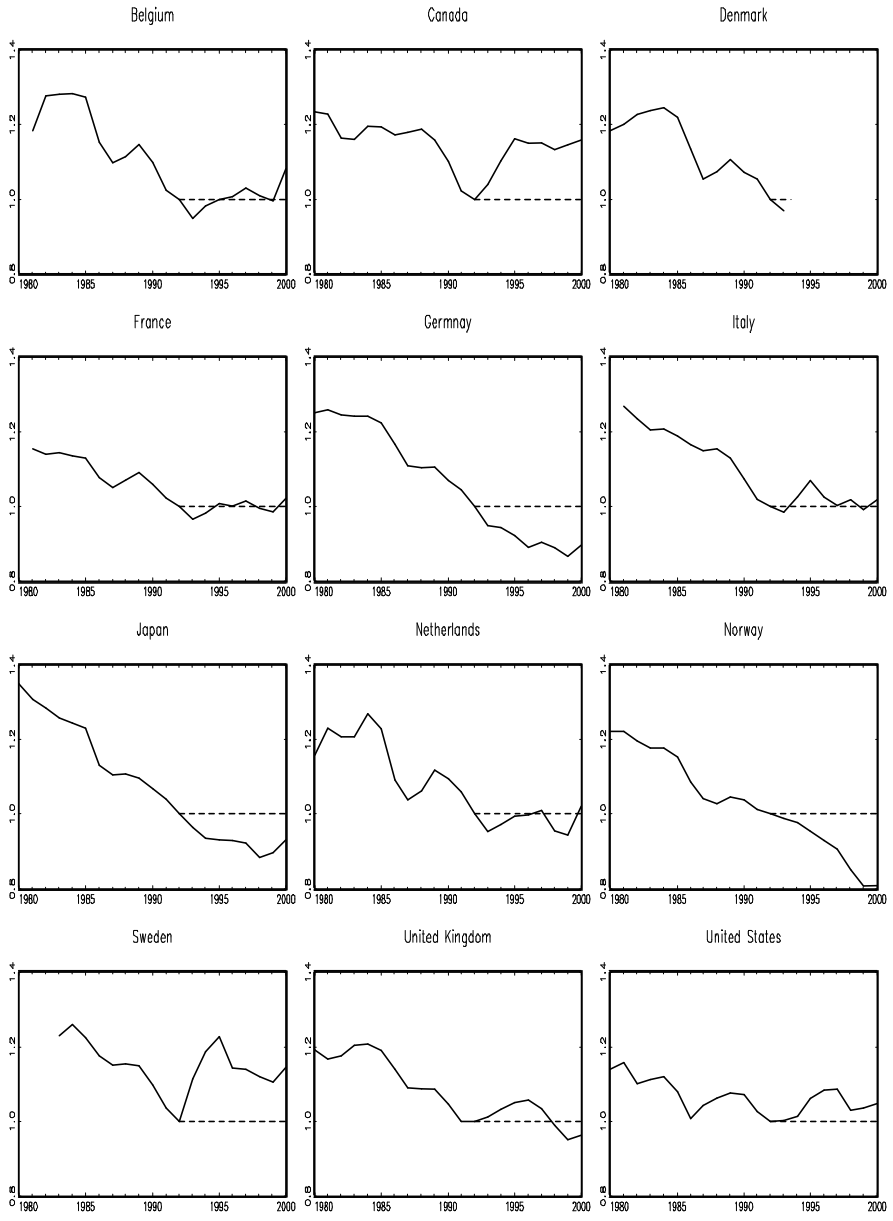

Figure 5: Manufacturing Markups, CES Case (Log Scale, 1992=1)

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