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Has Austria's accession to the EU triggered an increase in competition?
A sectoral markup study

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Abstract: We estimate the pro-competitive effects of Austria's participation in the Single Market after its EU accession in 1995 in terms of firms' market power as measured by the Lerner index, using a sample of 46 industries and 7 industry groups, covering the period 1978 to 2001. In the framework of the markup estimation method suggested by Roeger (1995), we test for both an instantaneous structural break between 1993 and 1998 and also estimate logistic smooth transition models to take up the proposition that the regime shift is likely to have occurred (to be occurring) gradually rather than as a big bang. In sum the results provide no reason for being euphoric: pronounced markup reductions were only found in three industry groups (mining and quarrying, wholesale and retail trade; financial services and real estate). At the more disaggregate level, the picture is mixed: both increases and reductions in market power were found.

JEL classification: L11, F15
Keywords: Austria, EU, markup, market power, Single Market

I. Introduction

With its accession to the European Union on 1 January 1995 Austria also entered EU's Single Market, which had come into force already on 1 January 1993. Significant micro- and macroeconomic effects were expected from the removal of all remaining barriers to trade and factor flows within the EU and the introduction of a common competition policy. In their well-known ex-ante study, Smith and Venables (1988) found the pro-competitive effect ("full market integration") to be the Single Market's most important consequence in generating positive welfare effects.

Up to now, there is no study testing for pro-competitive effects of Austria's EU accession.[1] Also for other EU Member states, ex-post evidence on the Single Market effects is still very limited. The Commission's review of the Single Market of 1996 (European Commission 1996) provides an analysis up to 1992; this was clearly too early to give a conclusive ex-post assessment. Only a few further studies were carried out since then. Allen et al. (1998), building on their work in the Commission's review, use data up to 1994; they derive the SM's effect on price cost margins from the estimation of price and demand functions for 15 'selected' industries (assumed to be particularly sensitive to the SM according to Buiges et al. (1990)) of the four largest EU countries (Germany, France, Italy, and the United Kingdom). Their analysis provides valuable insights by combining these estimates with a welfare analysis in a CGE framework. Nevertheless, in light of the fact that their sectors make up only one third of total manufacturing output, and the time period considered, their conclusion that the SM "has indeed had a substantial pro-competitive effect in European markets, and has led to significant reductions in price-cost margins" (p. 467) has to be interpreted with caution (see, for example, the comment by Flam (1998) for a criticism). At the country level Bottasso and Sembenelli (2001) use a similar industry classification and a large sample of Italian firms to test for a structural break due to the Single Market, using the markup-estimation method suggested by Hall (1988). Again, significant reductions in markups (and increases in productivity) are only found for the group of "most sensitive firms". A recent study by Sauner-Leroy (2003) covers 9 European countries (excluding Austria) and the period from 1987 to 2000. It uses data from firms' financial statements of the Commission's BACH database, aggregated at the manufacturing level. These data enable him to directly calculate price-cost margins and to test for the impact of the Single Market in a simple regression framework with further control variables. Though country-specific results

[1] An analysis of the macroeconomic effects of Austria's EU accession (along with that of Finland and Sweden) is provided by Breuss (2003).

differ somewhat, the analysis suggests that markups decreased in the period from 1987 to 1992, along with a decrease in prices; in the post completion period from 1993 to 2000, however, markups recovered in line with the realization of efficiency gains.[2] This is in contrast with the results by Badinger (2004), who uses a panel approach for 10 EU countries and 17 industry groups to test for structural breaks due to the Single market: the results suggest that markups have substantially decreased since 1993 in aggregate manufacturing and slightly in the real estate and renting etc. industry; at the same time increases in markups are found in many manufacturing industries between 1987 and 1990 – probably due to the increase in concentration at the EU level – making the net effect on markups appear to be zero (or positive). Summing up, the overall evidence on the Single Market's achievements is mixed at best and far from comprehensive.

In this paper we investigate the Single Market's pro-competitive effects for the case of Austria, which none of the aforementioned studies has investigated at the level of aggregation considered in this study. Using data on 46 Austrian industries (and seven industry groups), covering the period from 1976 to 2001 we employ the Roeger (1995) approach for markup estimation. Moreover, we do not only test for a discrete, instantaneous change but allow for a more general alternative hypothesis concerning the changeover using smooth transition analysis (see Granger and Teräsvirta 1997): thereby both the velocity and the timing of the changeover to the new regime are endogenously determined. This has considerable appeal for our question of interest, since it is plausible to assume that some of the effects of the SM already set in before 1995, and that the transition has occured gradually rather than being characterized by a discrete structural break.

Finally, we also check the sensitivity of the results in a panel framework which allows us to include time specific effects: this might be particularly important in the present context, given the ambiguity in the literature concerning the relationship between business cycles and markup ratios (see, for example, Rotemberg and Woodford 1991).

In sum there is no reason to be enthusiastic about the achievements of the SM so far. Only few sectors show a pronounced reduction in markups; in some sectors markups have even increased in spite of the participation in the Single Market. A substantial restructuring does not appear to have taken place so far in Austrian industries.

[2] Notaro (2002) attempts to estimate these productive gains from a production function, using a panel of 10 EU countries and 40 sensitive industries over the period 1973-1993. His results suggest a positive short-run productivity shock of some 2 per cent.

The remainder of the paper is organized as follows. Section II briefly discusses the theoretical background of the method used for the estimation of markups. Section III sets up the empirical model and describes the data used. Section IV presents the results of the estimations. Section V summarizes the main conclusions.

II. Markup estimation – methodological background

Our approach to estimating the markups factors relies on the paper by Roeger (1995), which is in turn an extension and variant of the seminal paper by Hall (1988) providing a method for the estimation of price cost margins of industries. Point of departure is a linear homogenous production function $Q = E\mathrm{F}(K,L,M)$, where Q is output, E is the level of Hicks-neutral technical progress relating output to all inputs, K is capital, N is labour, and M is the quantity of materials employed. Hall show's that the Solow residual under market power is given by[3]

$$\Delta\ln q_t - a_t\Delta\ln n_t - g_t\Delta\ln m_t = (m_t - 1)[a_t\Delta\ln n_t + g_t\Delta\ln m_t] + \Delta\ln E_t\,, \qquad (1)$$

where q_t is the output/capital ratio (Q_t/K_t), n_t is the labour/capital ratio (N_t/K_t), and m_t is the materials/capital ratio (M_t/K_t); a_t is the factor share of labour (i.e. the ratio of labour compensation N_tW_t to total revenue $Y_t = P_tQ_t$), g_t that of materials ($M_tP_{M,t}/Y_t$). Finally, m_t is the markup ratio P_t/MC_t (MC denoting marginal costs). Assuming a constant markup ratio, m can be estimated from (1). The problem, however, is the endogeneity of the right hand side variable; thus instruments, i.e. variables correlated with output which are neither the cause nor the consequence of technological change, are required for a consistent estimation and valid inference. Hall, in his empirical analysis of US industries, uses military expenditures, the political party of the president and the oil price; obviously, it is hard if not impossible to find good instruments that are exogenous under all views of macroeconomic fluctuations.

Roeger (1995) develops an approach that avoids some of these problems. First, note that the primal technology residual given by (1) (which is calculated from the production function), can also be written in extensive form as

$$(\Delta\ln Q_t - \Delta\ln K_t) - a_t(\Delta\ln N_t - \Delta\ln K_t) - g_t(\Delta\ln M_t - \Delta\ln K_t) =$$
$$B\,(\Delta\ln Y_t - \Delta\ln K_t) + (1 - B)\Delta\ln E_t\,, \qquad (2)$$

where the parameter B corresponds to the Lerner index which is directly related to the markup ratio via $m = 1/(1-B)$. He then derives the price based Solow residual (calculated from the dual cost function), which is given by[4]

[3] See Appendix A1 for the derivation.

[4] See Appendix A2 for the derivation.

$$a_t \Delta \ln W_t + (1 - a_t - g_t)\Delta \ln R_t + g_t \Delta \ln P_{M,t} - \Delta \ln P_t = -B(\Delta \ln P_t - \Delta \ln R_t) + (1 - B)\Delta \ln E_t, \quad (3)$$

where W_t and R_t denote the wage rate and the user costs of capital, respectively, and P_t is the output price. Under perfect competition ($m = 1$ or $B = 0$), both the primal and the dual Solow residual are an exact measure of technological progress (leaving measurement problems aside). Under imperfect competition, prices depart from marginal costs and the technology residual can be decomposed into a technical innovation term and i) the rate of change in the capital productivity, multiplied by B (primal residual, see (1)), or ii) the rate of change in output prices minus the rate of change in capital costs, also multiplied by B (dual residual, see (3)).

Substituting the expression for $\Delta \ln E_t$ implied by (3) into (2), Roeger derives the following expression suitable for the estimation of B:

$$(\Delta \ln Q_t + \Delta \ln P_t) - a_t(\Delta \ln N_t + \Delta \ln W_t) - g_t(\Delta \ln M_t + \Delta \ln P_{M,t}) - (1 - a_t - g_t)(\Delta \ln K_t + \Delta \ln R_t)$$
$$= B[(\Delta \ln Q_t + \Delta \ln P_t) - (\Delta \ln K_t + \Delta \ln R_t)] + u_t, \quad (4)$$

where u_t is a standard error term. The left hand side is the difference between the primal and the dual residual; under perfect competition it should equal zero. To simplify notation, we rewrite (4) as

$$z = Bx + u_t, \quad (5)$$

where z may be interpreted as the nominal Solow residual, and x is the growth rate of the nominal output/capital ratio; u_t is an error term reflecting the difference of the measurement errors from the two productivity terms. The attractive feature, at least at a first glance, is that the productivity term vanishes and that no instruments are needed for the estimation of B.

It should be noted that both (1) and (5) are derived under the assumption of constant returns to scale; there is, however, good reason to believe that in many cases, market power exists as a results of economies of scale. Martins et al. (1996) and Hylleberg and Jorgensen (1998), show that under increasing returns, (5) becomes[5]

$$z = [l(B - 1) + 1]x + u_t. \quad (6)$$

where l is an index of returns to scale, defined as ratio of average to marginal costs. It follows that the estimates of B and m are downward biased in the presence of increasing returns.[6] Similarly, the markup over marginal costs is underestimated in the presence of sunk costs, downward rigidities of the capital stock or labour hoarding; thus it has been suggested to

[5] See Appendix A3 for the derivation.

[6] This is easily seen from a comparison of B and the composite parameter $B^* = \lambda(B\text{-}1)+1$; under increasing returns ($\lambda > 1$), B^* is smaller than B.

interpret the markup implied by the estimate of B from (5) as lower bound (Martins et al. 1996).

III. Empirical model

The empirical model corresponding to (5) is given by

$$z_{i,t} = a_i + B_i x_{i,t} + u_{i,t} \, , \qquad (7)$$

where i denotes the respective industry, t denotes time (here: $t = 1, \ldots, 23$), and $u_{i,t}$ is a standard error term. As a point of departure, we run separate time series regressions for each industry. We use a sample of 46 two digit NACE Rev. 1.1 industries, which is taken from Statistics Austria. Nine industries (mainly service industries) had to be excluded because of missing data or because the goods they produce are not traded on (more or less) competitive markets (e.g. public defense). Additionally we provide results for seven larger industry groups. Our sample is described in Appendix B, which shows the industries and industry groups as well as the definition and sources of the variables used in the estimation.

As mentioned above, the Roeger approach was meant to overcome the (almost unsolvable) problems in finding good instruments in the Hall approach. Hylleberg and Jorgensen (1998), however, show that slightly relaxing the assumption of a constant markup (and scale factor) makes the Roeger approach vulnerable for similar lines of criticism, i.e. the endogeneity of x. However, as Hylleberg and Jorgensen (1998) we also step back from using an instrumental variable approach, given the absence of good instruments.[7] The results by Hylleberg and Jorgensen (1998), suggest that the problems induced by simultaneity and potentially non-spherical error terms, are fairly moderate. Given the absence of good instruments (and the likely presence of heterosedasticity and serial correlation), they suggest to use least squares with Newey-West standard errors. This is also the approach we will follow here. Nevertheless, these problems have to be borne in mind and our point estimates should not be overstressed; there is, however, no reason to believe that theses estimation problems systematically infer with our main goal to detect a structural break (if any), since they are likely to be the same under both regimes.

In the framework of the empirical model (7), the tests for an instantaneous structural break corresponds to testing the significance of an interaction term between $x_{i,t}$ and a level dummy D^T; thus we have

$$z_{i,t} = a_i + B_{1,i} x_{i,t} + B_{2,i} D^T x_{i,t} + u_{i,t} \, , \qquad (8),$$

[7] As Hylleberg and Jorgensen point out, in this situation the application of IV estimators may yield inferior estimates compared to least squares (see also Nelson and Startz 1998).

where D^T is zero for $t < T$, and 1 otherwise. The problem in choosing a proper D^T is twofold:

i) First there is considerable uncertainty, when the structural break (if any) shall be assumed to have occurred. In the EU, the Single Market came into force on 1 January 1993; although Austria joined the EU on 1 January 1995, the accession is likely the have been anticipated by forward looking agents. Thus it is not implausible to assume that some of the effects set in before Austria joined the EU. On the other hand there are still problems with the implementation of the Single Market, suggesting that part of the effects set in after the accession. To account for this uncertainty we will allow the break to occur between 1992 and 1998, i.e. we run regressions for each of the sectors, using T = 1992, 1993, .., and 1998.

ii) Irrespective the choice of T, (8) assumes that the structural break has occurred instantaneously. A gradual changeover, however, is a more likely scenario. This point can be addressed by the specification of a smooth transition model (Granger and Teräsvirta 1997). In this framework, the aforementioned issue can also be taken up, allowing the mid-point of the regime shift to be determined endogenously. The empirical model then takes the form

$$z_{i,t} = a_i + B_{1,i} x_{i,t} + B_2 \mathrm{F}(t) x_{i,t} + u_{i,t} \,. \tag{9}$$

where F(t) is a transition function, describing the transition process as a function of time and two parameters g and t. In particular, we opt for a simple form and use a symmetric logistic function, given by

$$\mathrm{F}(t) = \frac{1}{1+e^{[-g\,(t-t)]}} \,, \tag{10}$$

which maps t onto the interval (0,1) and allows for a smooth transition between the initial state ($t \to -\infty$)

$$z_{i,t} = a_i + B_{1,i} x_{i,t} + u_{i,t} \,, \tag{11}$$

and the final state ($t \to +\infty$)

$$z_{i,t} = a_i + (B_{1,i} + B_{2,i}) x_{i,t} + u_{i,t} \,. \tag{12}$$

The parameter g determines the speed of transition, while t is associated with the transition mid-point, i.e. F(t) = 0.5 for $t = t$. For $g \to \infty$, (9) collapses into (8) with a discrete, instantaneous structural break at $t = t$. Hence (9) is the more general model nesting (8) as a special case. Of course, more general forms of the transition function F(t) are conceivable, using higher order polynomials in t and including the dependent and/or the exogenous variables. However, for our purposes, a transition process described by such a logistic smooth transition model (LST, see Granger and Teräsvirta 1997, chapter 4) appears to be a reasonable choice and allows us to address our two main concerns: to allow for a gradual change and to endogenize the timing.

The problem in testing the hypothesis of a constancy regression parameter B (i.e. $H_0: g = 0$)[8] against the alternative of a continuous structural change is that t remains unidentified under the null. Lin and Teräsvirta (1994) suggest to approximate F(t) using a Taylor series around g = 0, which allows the reparameterization of (9) in terms of identified parameters. The null hypothesis $g = 0$ can then be tested using a Lagrange multiplier (LM) test of excluding restrictions applied to this reparameterized model. For those sectors, where the null of constant parameters is rejected, we will also estimate the smooth transition model given by (9).

IV. Estimation results

We start with presenting the smooth transition analysis (equation (9)), since it represents the most general approach to our question of interest in allowing an arbitrary time and velocity of the transitition. Table 1 gives the results for each of the 46 industries and the 7 industry groups considered. Column (1) shows the results of the c^2-tests of the null of constant parameters against a continuous parameter change. We use a third order Taylor series approximation of F(t) as given by (10), which implies the use of interaction terms between x and t up to the third order.[9] The null of no regime shift is rejected for 19 of the 46 industries and for 6 of the 7 larger industry groups (at least at the 10 per cent level).[10]

For the industries, where the null of constant parameters has been rejected, Table 1 also reports the estimation results for the smooth transition models. In principle, (9) can be estimated using non-linear least squares. However, for most industries we ran into convergence problems or obtained implausible if all parameters of (9) when all parameters (a_i, B_1, B_2, g, t) were estimated at the same time. We thus pursue a grid search strategy, imposing the velocity of transition (g) and estimating the other coefficients using nonlinear least squares; g was varied from 0.2 to 5 with a step size of 0.01 so that the sum of squares is minimized. As can be seen from Figure 1, which shows the corresponding transition functions for t = 18 (i.e. the transition mid-point in 1995), these values cover a broad spectrum, ranging

[8]As Lin and Teräsvirta (1994) show, F(t) can be transformed to F*(t) = F(t) - 0.5 without any loss of generality; in this case F*(t,0) = 0 for g = 0, making g = 0 the natural hypothesis for parameter constancy in (9).

[9] To be more specific: Column (3) of Table 3 reports, for each sector, the results of the LM-test of the joint hypothesis that $d_1 = d_2 = d_3 = 0$ in the test regression $z_{i,t} = a_i + B_{1,i}\, x_{i,t} + d_1 t x_{i,t} + d_2 t^2 x i_t + d_3 t^3 x_{i,t} + u_{i,t}$.

[10] Results are basically the same when the F-test variant (recommended by Lin and Teräsvirta 1995 for small samples) is used.

from a very slow transition process (g = 0.2) to the case of an almost instantaneous change (g = 5).[11] Using this approach, quick convergence was achieved for all industries.

< Table 1 here >

< Figure 1 here >

Of the 19 industries (6 industry groups) where a structural break is indicated by the χ^2-statistic we find a decrease in 5 (3) cases; in 9 industries (3 industry groups) an increase in the markup is found. In the remaining cases the coefficient is insignificant. A remarkable result is that that the velocity of the changeover implied by the estimates of g is very fast in de facto all models. Thus it may be argued that nonlinearities are very weak and that the hypothesis of an instantaneous regime shift is a reasonable approximation. This has the advantage of allowing us to sharpen our alternative hypothesis for testing for a structural break, and hence to improve the power of the test: if the assumption of an instantaneous change is approximately correct, using model (8) is more likely to detect a structural break. Hence, we do not go into the details of the results obtained so far but proceed with the estimation of model (8), which corresponds to the assumption of an instantaneous change.

While a fast changeover appears to be a justifiable assumption there is still a problem in choosing the exact date of the structural break, i.e. choosing the proper T in (8). The implementation of the Single Market was announced in the mid 80s by the Commission's White paper (European Commission 1985); it came into force on 1 January 1993. Austria joined the EU in 1995; in 1994 it entered the European Economic Area (EEA). On the one hand, rational agents are likely to have reckoned with the Austria's EU accession, so that some of the effects may have set in before 1995. On the other hand, there are still problems in the coverage and implementation of the Single Market in several areas (European Commission 2002). Thus we decided to use a time window of 6 years, from T = 1993 to T = 1998; this period should be sufficient to capture changes that are likely to be related to Austria's accession to the EU and the Single Market.

< Table 2 here >

[11] As obvious starting values the estimates of the discrete change model (4) were used; the starting value for t was set to 18, which implies the transition mid-point to coincide with the year 1995.

Table 2 shows the estimation results for model (8). Industries, where the coefficient B_2 turned out insignificant (for all values of T) were re-estimated using model (7). Where a structural break was found, we chose the value for T that yielded the smallest p-value. First, note that perfect competition is rejected for all industries[12], with markup ratios from de facto one up to 4.483. While there is no study on Austrian industries, these values are broadly consistent with the results of Martins et al. (1996), who also use the Roeger approach to estimate markup ratios for several OECD countries (excluding Austria), focussing on the pre-Single Market period 1970-1992, however.[13]

A structural break is detected now in 26 of the 46 industries and 5 of the 7 industry groups. Again, the direction of the regime shifts is ambiguous: in roughly two third (16) of the industries where a break was found, the coefficient B_2 is positive, indicating an increase in markups. At the more aggregate level, a decrease in markups is suggested for 4 of the 6 industries where a break was indentified. As expected due to the high values for g obtained in the smooth transition models, the results are consistent with that of Table 1.[14]

One further concern deserves attention: Our results may be distorted by business cycle effects, since it is argued that markups are related to the cycle (see Rotemberg and Woodford 1991). We therefore specify a panel (with heterogeneous parameters) including time specific effects; this mitigates this problem at least for that part of the business cycle that is common to all industries.[15] Thus, model (8) becomes

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[12] Only for industry 23 (manufacture of coke, refined petroleum products and nuclear fuel) the coefficient for B_1 is insignificant, suggesting perfect competition; however, a significant increase in the markup is found for that industry as of 1995; there is no convincing explanation for this results, which should thus be treated with caution.

[13] Aiginger et al. (1995) use a different approach based on Applebaum (1982) to estimate the degree of market power in two Austrian industries (glass and non-electrical machinery) over the period 1963-1990; the implied markups amount to some 41 per cent (glass) and 23 per cent (non electrical machinery) on average; while these values are of a comparable dimension with our results for manufacturing (d) and its subsectors, a comparison is difficult, since the level of aggregation and the time periods do not match (glass is a subsection of industry 26, non-electrical machinery is a subsection of industry 29).

[14] A conflicting results is found for industry 17 (manufacture of textiles); the smooth transition model suggests an increase as if 1985, while the discrete change model suggests a reduction as of 1998. The results will turn out fragile against inclusion of time specific effects and should not be overstressed.

[15] It suggests itself to estimate also the LST models in a panel framework using time-specific effects; however, since apriori restrictions on cross-country homogeneity of the parameters do not appear to be justified in light of the time series results, this would require the estimation of a completely heterogeneous nonlinear panel with 184 parameters (excluding intercepts and time-specific effects), which quickly becomes unwieldy without imposing (potentially unjustifiable) restrictions.

$$z_{i,t} = a_i + B_{1,i} x_{i,t} + B_{2,i} D^T x_{i,t} + h_t + u_{i,t} \ , \qquad (13),$$

where h_t denotes the time specific affects. We maintain the assumption that an instantaneous structural break provides a reasonable approximation; thus the dummy D^T is now constructed corresponding to the breakpoints obtained from the time series regressions (see column (4) in Table 2). The estimation results for model (13) are given in Table 3.

< Table 3 here >

Table 4 shows the markup ratios implied by the panel estimates (see the last two columns of Table 4), along with a summary of the results obtained so far. Columns two and three show the results for the smooth transition analysis (compare Table 1), columns six and seven the results from the time series analysis (compare Table 2).

< Table 4 here >

Comparing the results using the different methods it becomes apparent from Table 4 that that, for the sectors where a break was found with each approach, the markup ratios implied by the smooth transition models and the discrete change models are consistent (except the results for industry 17). This is plausible in the light of the high values obtained for the velocity of transition, which makes the transition function F(t) in (9) very much look like the level dummies used in (8).[16] Nevertheless, against the background of the ambiguity concerning the timing of the Single Market effects, this was an important issue to be clarified to rule out that the result are severely distorted by imposing strikingly wrong restrictions on the transition process. Controlling for time specific effects, in total 8 structural breaks turn out to be fragile against this robustness check; on the other hand, three more breaks are detected using the panel approach. For the remaining industries (industry groups) the inclusion of time-specific effects alters some of the magnitudes of the coefficients, but does not change the qualitative conclusions of our analysis. These can be summarized as follows (focussing on the panel results): First, the hypothesis of a zero markup is rejected for all industries. This is strong evidence against the existence of perfect competition in Austrian markets and suggests that monopolistic and oligopolistic competition prevail. Second, while many regime shifts appear to have taken place in the last fifteen years, we could not identify a pervasive pro-

[16] Also note that, for the industries where no break was found using a discrete change hypothesis, but a structural break was indicated by the c^2-tests, the estimates of B_2 turned out insignificant (industries 16, 40, 41, 61, 70).

competitive effect resulting from the Austria's EU accession. Of the 46 industries and 7 industry groups a structural break was found in half of the industries (3 industry groups). Of these, in turns, we find a reduction in markups in only 8 industries, an increase in 15 industries. At the more aggregate level, evidence is a little more favourable: the net effect at the aggregate manufacturing level is insignificant; in three industry groups pronounced markup reductions are found. The markup reduction in mining and quarrying, accounting for only 0.6 per cent of total output, is of less importance. The changes in the two other industry groups (wholesale and retail trade; financial services and real estate), however, are economically significant. The pro-competitive effect is also confirmed by the results for the industries that constitute these more aggregate groups (industries 50 to 52 and 65-67). Nevertheless, the absence of a pervasive effect, particularly in manufacturing and construction, are disappointing against the background of the Single Market's goal to trigger a substantial restructuring of European industries.

Though our results are difficult to compare to previous studies due to the different samples and level of aggregation, the failure to identify a pervasive effect of the Single Market shows up in several studies that take a broader perspective than the consideration of a few selected sectors. This appears to be a common result, not only for Austria but also the EU in general; it warns us of being too euphoric about the positive effects of the Single Market achieved so far and of generalizing the findings for a few selected sectors for the European economies.

V. Summary and conclusions

This paper investigates the pro-competitive effects of Austria's participation in the Single Market since its EU accession in 1995 in terms of firms' market power as measured by the Lerner index. Using a sample of 46 Austrian industries and 7 industry groups, covering the period 1978 to 2001, we test for structural breaks in the framework of the markup estimation method suggested by Roeger (1995). In order to address the uncertainty with respect to the timing and velocity of the regime shift induced by the Single Market we use different alternative hypotheses to test for a structural break: We test for both an instantaneous structural break between 1993 and 1998 and also estimate several (restricted) logistic smooth transition models to take up the proposition that the regime shift is likely to have occurred (to be occurring) gradually rather than as big bang. Results of the different approaches turn out to be very similar, since in industries where a regime shift was found, the transition process has taken place fairly quickly.

In sum the results provide no reason for being euphoric: pronounced markup reductions were only found in three industry groups (mining and quarrying, wholesale and retail trade; financial services and real estate). At the more disaggregate level, the picture is mixed: both increases in reductions in market power were found. Overall, a substantial restructuring in does not appear to have taken place over the last 10 years, neither in Austria as this paper has shown, nor in the EU as a whole as suggested by other studies.

Two interpretations of our result are possible: in the one hand it may be argued that the expectations concerning the Single Market effects were unrealistic and exaggerated anyway, so that these results were only to be excpeted. A more optimistic view might hold that the Single Markets is not working and an improvement in its functioning will deliver the positive effects expected. Industry-specific case studies might be a fruitful avenue for further research to help designing measures to improve the functioning of the Single Market, which is argued to be one of the chief requirements to improve the EU's growth performance (Sapir et al. 2003).

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APPENDICES

Appendix A1: Derivation of the primal technology residual ("Solow residual") under market power[17]

Solow (1957) showed that under the assumptions of constant returns to scale and perfect competition, the following relation between growth of output, factor inputs, factor prices and the product price can be derived

$$\Delta \ln q_t - a_t \Delta \ln n_t = \Delta \ln E_t , \tag{A1.1}$$

where q_t is the output/capital ratio (Q_t/K_t), n_t is the labour/capital ratio (N_t/K_t), and a_t is the (revenue based) factor share of labour (i.e. the ratio of labour compensation N_tW_t to total revenue $Y_t = P_tQ_t$).

Hall (1988, 1989) derives an expression for the Solow residual allowing for imperfect competition. Logarithmic differentiation of the production function $Q = EF(K,L)$ yields[18]

$$\Delta \ln Q = \frac{N}{F(K,L)} F_N \Delta \ln N + \frac{K}{F(K,L)} F_K \Delta \ln K + \Delta \ln E , \tag{A1.2}$$

where F_K and F_N denote the marginal products of capital and labour respectively.
Now consider the cost minimization of a firm that is a price taker in the labour and capital services market. The Langrangian is

$$\mathrm{L}(K, L, l) = KR + LW + l[\overline{Q} - E\mathrm{F}(K, N)]$$

and the first order conditions are

$$F_N = \frac{W}{lE} \quad \text{and} \quad F_K = \frac{R}{lE} \tag{A1.3}$$

with the Langrange multiplier l to be interpreted as marginal cost. Under constant returns, we have $Q = \mathrm{E}(KF_K + LF_L)$, which – together with (A1.3) – implies that

$$KR + NW = Ql \quad \text{or} \quad l = (KR + NW)/Q . \tag{A1.4}$$

Substituting this expression for l into the first order conditions, we obtain to following solutions for the marginal products

$$F_N = \frac{WF(K,N)}{KR + NW} \quad \text{and} \quad F_K = \frac{RF(K,N)}{KR + NW} \tag{A1.5}$$

which can also be written as

$$F_L = a' \frac{F(K,L)}{K} \quad \text{and } F_K = (1 - a') \frac{F(K,L)}{N} \tag{A1.6}$$

[17] This follows Hall (1988, 1989).

[18] For the sake of simplicity, the time subscripts are dropped in the following.

Here a' denotes the *cost-based* factor share of labour, that is $NW/(KR + NW)$, and $(1-a')$ is the cost-based factor share of capital, that is $KR/(KR + NW)$. Substituting (A1.6) into (A1.2) yields

$$\Delta \ln Q = a'\Delta \ln N + (1-a')\Delta \ln K + \Delta \ln E \,, \qquad \text{(A1.7)}$$

Note that no assumption of competition has been made so far. In the special case of perfect competition ($\lambda = P = MC$), where price are equal to marginal cost, the cost-based factor shares are equal to the revenue-based factor shares $a = NW/YP$ and $(1 - a) = (YP - NW)/YP$. Defining the markup ratio as $m = P/MC$, the (observed) revenue based factor shares can be related to the cost based factor shares by $a' = ma$.

Thus, under market power (A1.7) can be expressed in terms of revenue shares as

$$\Delta \ln Q = ma\Delta \ln N + (1-ma)\Delta \ln K + \Delta \ln E \,, \qquad \text{(A1.8)}$$

which can be rewritten in intensive form as

$$\Delta \ln q = ma\Delta \ln n + \Delta \ln E \qquad \text{(A1.9).}$$

This shows that (A1.1) is merely a special case of (A1.9), assuming perfect competition ($m = 1$). Now consider the case when intermediate inputs are used. The production function can be rewritten as $Q = EF(K,L,M)$, where M denotes intermediate inputs and E now denotes the Hicks neutral technological progress, relating output to all inputs. A straightforward extension of the derivation provided above for the case including intermediate inputs yields

$$\Delta \ln Q = ma\Delta \ln N + mg\Delta \ln M + (1-ma-mg)\Delta \ln K + \Delta \ln E \,. \qquad \text{(A1.8')}$$

where g is the revenue based share of materials MP^M/QP.

In intensive form we have

$$\Delta \ln q = m(a\Delta \ln n + g\Delta \ln m) + \Delta \ln E \qquad \text{(A1.9')}$$

which leads to equation (1) in the main text.

Appendix A2: Derivation of the dual technology residual under market power[19]

To derive the dual technology residual, Roeger (1995) postulates the following cost function for a representative firm operation under constant returns to scale:[20]

$$C(W,R,Y,E) = \frac{G(W,R)Y}{E} \qquad \text{(A2.1)}$$

Corresponding to the linear homogenous production function $Q = E\mathrm{F}(K,L)$, the function G is also homogenous of the first degree. Marginal costs are given by

[19] This follows Roeger (1995).

[20] Again, time indices are dropped to simpify the exposition.

$$MC = C_Y = \frac{G(W,R)}{E} \quad \text{(A2.2)}$$

which can be totally log-differentiated to yield

$$\Delta \ln MC = \frac{G_W W}{G(W,R)} \Delta \ln W + \frac{G_R R}{G(W,R)} \Delta \ln R - \Delta \ln E . \quad \text{(A2.3)}$$

Using Shephard's lemma[21] this can be rewritten as

$$\Delta \ln MC = \frac{ENW}{YG(W,R)} \Delta \ln W + \frac{EKR}{YG(W,R)} \Delta \ln R - \Delta \ln E . \quad \text{(A2.4)}$$

Since $C = G(W,R)Y/E$, it follows that

$$\Delta \ln MC = \frac{WN}{C} \Delta \ln W + \frac{RK}{C} \Delta \ln R - \Delta \ln E$$

or

$$\Delta \ln MC = a' \Delta \ln W + (1 - a') \Delta \ln R - \Delta \ln E , \quad \text{(A2.5)}$$

where a' and $(1-a')$ denote the *cost-based* factor shares of labour and capital, respectively. Instead of the markup-ratio m, Roeger uses the Lerner index $B = (P - MC)/P = (m-1)/m$ to relate the cost- and revenue-based factor shares. Since $m = 1/(1 - B)$, equation (A2.5) can be written as

$$\Delta \ln MC = \frac{a}{1-B} \Delta \ln W + (1 - \frac{a}{1-B}) \Delta \ln R - \Delta \ln E . \quad \text{(A2.6)}$$

Multiplying by $(1 - B)$ rearranging, and recognizing that – for a constant m – $\Delta \ln MC = \Delta \ln P$, the price-based technology residual can be derived:

$$a \Delta \ln W + (1 - a) \Delta \ln R - \Delta \ln P = -B(\Delta \ln P - \Delta \ln R) + (1 - B) \Delta \ln E . \quad \text{(A2.7)}$$

Again the extension for the case of intermediate inputs is straightforward, yielding

$$a \Delta \ln W + (1 - a - g) \Delta \ln R + g \Delta \ln P_M - \Delta \ln P = -B (\Delta \ln P - \Delta \ln R) + (1 - B) \Delta \ln E , \quad \text{(A2.8)}$$

which is equivalent to equation (3) in the main text.

Appendix A3: Alternative derivation of Roeger equation under increasing returns[22]

The insight provided by the derivation of Roeger is that market power may serve as an explanation of the difference between the primal and dual technology residual as given by (4). In the subsequent generalization of the Roeger equation for the case of increasing returns to

[21] Shephard's lemma states that the conditional factor demand can be obtained from the derivative of the cost function with respect to the factor price (see, for example, Jehle and Reney (2001, p. 129)). Here we have $C_W = N(W,R,Q)$ and $C_R = K(W,R,Q)$, which implies $G_W = EN/Y$ and $G_R = EK/Y$.

[22] This follows Hylleberg and Jorgensen (1998).

scale, we show an alternative derivation of the Roeger equation as provided by Martins et al. (1996) and Hylleberg and Jorgensen (1998).

Let increasing returns be measured by the ratio of average to marginal costs l_t (= AC_t/MC_t), where average costs are defined as $AC_t = (W_tN_t + R_tK_t)/Q_t$. Using the definition of the markup-ratio m, we can write

$$\frac{m_t}{l_t} = \frac{P_tQ_t}{W_tN_t + R_tK_t} \quad \text{or} \quad m_t(W_tN_t + R_tK_t) = l_tP_tQ_t \tag{A3.1}$$

Taking the log-differential of (A3.1) yields

$$\begin{aligned} &W_tN_t[\Delta\ln N_t + \Delta\ln W_t + \Delta\ln m_t] + R_tK_t[\Delta\ln K_t + \Delta\ln R_t + \Delta\ln m_t] \\ &= P_tQ_t\left[\frac{l_t}{m_t}\Delta\ln Q_t + \frac{l_t}{m_t}\Delta\ln P_t + \frac{l_t}{m_t}\Delta\ln l_t\right] \end{aligned} \tag{A3.2}$$

Dividing through by P_tQ_t, (A3.2) can be expressed in terms of revenue-based factor shares as

$$a_t[\Delta\ln N_t + \Delta\ln W_t] + b_t[\Delta\ln K_t + \Delta\ln R_t] = \frac{l_t}{m_t}[\Delta\ln Q_t + \Delta\ln P_t] + \frac{l_t}{m_t}[\Delta\ln l_t - \Delta\ln m_t] \tag{A3.3}$$

since $a_t + b_t = l_t/m_t$. Rewritting b_t as $b_t = l_t/m_t - a_t = b_t = (l_t/m_t - 1) + (1 - a_t)$, substituting this expression into (A3.3), and rearranging we obtain

$$z_t^* = \left[1 - \frac{l_t}{m_t}\right]x_t + \frac{l_t}{m_t}[\Delta\ln l_t - \Delta\ln m_t] \tag{A3.4}$$

where

$$z_t^* = (\Delta\ln Q_t + \Delta\ln P_t) - a_t(\Delta\ln N_t + \Delta\ln W_t) + (1 - a_t)(\Delta\ln K_t + \Delta\ln R_t)$$

$$x_t = (\Delta\ln Q_t + \Delta\ln P_t) - (\Delta\ln K_t + \Delta\ln R_t)\,.$$

Assuming a constant markup ratio ($m_t = m$) and a constant ratio of average to marginal costs ($l_t = l$), the second term in (A3.4) vanishes; moreover, recognizing that $B = 1/(1-m)$, equation (A3.4) becomes

$$z_t^* = [l\,(B-1)+1]x_t \tag{A3.5}$$

Adding an error term and adjusting the definition of z to account for intermediate inputs yields equation (6) in the main text.

Appendix B – Industry classification, data sources and definition of variables

< Table B1 here >

< Table B2 here >

Data sources and definitions of variables

$Q_{i,t}$ = real gross output in millions of Euros at 1995 prices.

$P_{i,t}$ = deflator of gross output, calculated as ratio of nominal to real gross output.

$K_{i,t}$ = real capital stock in millions of Euros, calculated using as $K_t = K_{t-1}(1-d) + I_{t-1}$. The depreciation rate (d_i) was calculated from data on average service life in the respective sector from the International Sectoral Database (ISDB) of the OECD (average value of subsample of OECD countries). Initial value of capital stock was calculated according to $K_{1977} = I_{1977}/(g_{I,77-02} + d)$, where I is investment in 1977 (real gross fixed capital formation), $g_{I,77-02}$ is growth of investment over the period 1977-2002 (see Grilliches 1980, Coe and Helpman 1995). $I_{i,t}$ is real gross fixed capital formation in millions of Euros at 1995 prices.

$R_{i,t}$ = user costs of capital, approximated by $R_{i,t} = (r+d)P^*_{i,t}$ as in Martins et al. (1996); r is the real interest rate (taken form the EU Commission's AMECO database), d_i is the depreciation reate and $P^*_{i,t}$ is the deflator for gross fixed capital formation, calculated as ratio of nominal to real gross fixed capital formation..

$N_{i,t}$ = total employment in million persons (full-time equivalents).

$W_{i,t}$ = average nominal wage rate in sector i, given by $LC_{i,t}/N_{i,t}$, where LC is labour compensation in millions of Euros.

$M_{i,t}$ = quantitiy of materials employed, calculated as difference between real gross output and real value added in millions of Euros at 1995 prices.

$P^M_{i,t}$ = average price of material inputs, given by $A_{i,t}/M_{i,t}$, where A is the difference between nominal gross output and nominal value added in millions of Euros.

$a_{i,t}$ = revenue-based factor share of labour ($LC_{i,t}/ Q_{i,t}P_{i,t}$).

$g_{i,t}$ = revenue based share of materials ($M_{i,t}P^M_{i,t} / Q_{i,t}P_{i,t}$).

Notes: i = industry index, t = time index. All data (except interest rates) were taken from Statistics Austria via the WIFO Database (Austrian Institute of Economic Research, WIFO, http://www.wifo.ac.at/). We wish to thank Christine Kaufmann for providing us with the sectoral data.

Table B1 – Detailed industries and their average share in total real production

Code[1)]	Industry	Per cent of total output[2)]
01+02+05	agriculture, hunting and forestry	2.17
10	mining of coal and lignite; extraction of peat	0.04
11+13	extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying / mining of metal ores	0.26
14	other mining and quarrying	0.29
15	manufacture of food products and beverages	4.53
16	manufacture of tobacco products	0.15
17	manufacture of textiles	1.12
18	manufacture of wearing apparel; dressing and dyeing of fur	0.55
19	tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.34
20	manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	1.54
21	manufacture of pulp, paper and paper products	1.38
22	publishing, printing and reproduction of recorded media	1.23
23	manufacture of coke, refined petroleum products and nuclear fuel	0.76
24	manufacture of chemicals and chemical products	1.95
25	manufacture of rubber and plastic products	1.07
26	manufacture of other non-metallic mineral products	1.74
27	manufacture of basic metals	2.19
28	manufacture of fabricated metal products, except machinery and equipment	2.13
29	manufacture of machinery and equipments n.e.c.	2.84
30	manufacture of office machinery and computers	0.05
31	manufacture of electrical machinery and apparatus n.e.c.	1.10
32	manufacture of radio, television and communication equipment and apparatus	1.44
33	manufacture of medical, precision and optical instruments, watches and clocks	0.38
34	manufacture of motor vehicles, trailers and semitrailers	1.52
35	manufacture of other transport equipment	0.43
36	manufacture of furniture; manufacturing n.e.c.	1.40
40	electricity, gas, steam and hot water supply	3.26
41	collection, purification and distribution of water	0.14
45	construction	8.25
50	sale, maintenance and repair of motor vehicles and motorcycles; retail of automotive fuel	1.97
51	wholesale trade and commission trade, except of motor vehicles and motorcycles	5.49
52	retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	4.03
55	hotels and restaurants	3.98

Table B1 (cont.) – Detailed industries and their average share in total real production

Code[1)]	Industry	Per cent of total output[2)]
60	land transport; transports via pipelines	3.01
61	water transport	0.04
62	air transport	0.45
63	supporting and auxiliary transport activities of travel agencies	1.52
64	post and telecommunications	1.77
65	financial intermediation, except insurance and pension funding	3.56
66	insurance and pension funding, except compulsory social security	1.31
67	activities auxiliary to financial intermediation	0.14
70	real estate activities	6.22
71	renting of machinery and equipment without operator and of personal and household goods	0.61
72	computer and related activities	0.54
73	research and development	0.13
74	other business activities	3.46
	Subtotal	82.49
Excluded industries		
37	recycling	0.04
75	public administration and defence; compulsory social security	5.71
80	education	3.83
85	health and social work	4.35
90	sewage and refuse disposal, sanitation and similar activities	0.83
91	activities of membership organisations n.e.c.	0.90
92	recreational, cultural and sporting activities	1.22
93	other service activities	0.50
95	activities of households as employers of domestic staff	0.14
	Total	**100.00**

[1)] Subsections of NACE Rev. 1.1 industries as defined in the Commission Regulation (EC) No 29/2002 of 19 December 2001. [2)] Shares refer to average of estimation period (1978-2001).

Table B2 – Some major industry groups and their average share in total real production

Code[1]	Industry		Per cent of total output[2]
c	mining and quarrying		0.60
d	manufacturing		29.88
e	electricity, gas and water supply		3.40
g	wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods		11.48
i	transport, storage, and communication		6.79
j	financial intermediation		5.01
k	real estate, renting, and business activities		10.96
		Subtotal	68.12
Excluded			
a+b	agriculture, hunting and forestry		2.17
f	construction		8.25
l	public administration and defence; compulsory social security		5.71
h	hotels and restaurants		3.98
m+n+o+p	other services		11.76
	Total		**100.00**

[1] Subsections of NACE Rev. 1.1 industries as defined in the Commission Regulation (EC) No 29/2002 of 19 December 2001. [2] Shares refer to average of estimation period (1978-2001). a+b, f, and h were excluded since they show up in Table A1.

Table 1 – Estimation results for smooth transition models (9), 1978 - 2001

	$\chi2$	*m* initial[1)]	*m* final[2)]	T	*a*	B_1	B_2	τ	γ	SEE	Adj. R^2
Detailed industries											
01+02+05	15.378***	2.784	1.480	1997.64	0.001	0.641***	-0.316***	19.639***	5.000	0.0170	0.9401
10	1.649										
11+13	6.582*	2.030	1.408	1995.33	0.004	0.507***	-0.217*	17.332***	5.000	0.0586	0.8145
14	3.115										
15	0.976										
16	6.258*	1.439	2.103	1995.44	-0.003	0.305**	0.220	17.441***	5.000	0.0421	0.7666
17	10.464**	1.038	1.206	1985.35	0.003*	0.036	0.135**	7.347***	5.000	0.0140	0.4921
18	2.680										
19	32.618***	1.164	1.615	1996.92	-0.002	0.141***	0.240***	18.920***	0.590	0.0188	0.7634
20	1.555										
21	6.543*	1.133	1.618	1995.44	0.002	0.117***	0.265***	17.439***	5.000	0.0197	0.5710
22	2.069										
23	16.215***	0.917	1.856	1995.64	0.010	-0.091	0.552***	17.641***	5.000	0.0583	0.3603
24	3.026										
25	2.196										
26	4.427										
27	2.628										
28	0.831										
29	2.370										
30	20.914***	1.038	1.573	1997.17	0.003	0.036	0.328***	19.166***	0.370	0.0639	0.7255
31	3.577										
32	0.317										
33	1.224										
34	1.427										
35	1.497										
36	5.474										
40	10.029**	1.296	1.224	1997.64	-0.001	0.228***	-0.046	19.637	4.960	0.0241	0.5104
41	6.558*	1.744	1.449	1996.52	0.002	0.427***	-0.117	18.524***	2.260	0.0205	0.8719
45	2.158										
50	13.906***	2.212	1.214	1992.81	-0.004	0.548***	-0.372***	14.815***	4.790	0.0305	0.8375
51	14.925***	1.950	1.319	1985.97	-0.004	0.487***	-0.245*	7.972***	0.340	0.0181	0.7573
52	17.428***	1.649	1.258	1993.94	-0.007**	0.394***	-0.188**	15.943***	0.250	0.0187	0.8062
55	1.187										
60	7.275*	1.248	1.440	1991.48	-0.002	0.199***	0.107*	13.476***	5.000	0.0145	0.7898
61	12.528***	1.514	1.724	1996.53	0.007	0.339***	0.081	18.530***	0.280	0.0588	0.6342
62	0.799										
63	1.561										
64	3.307										
65	6.741*	1.832	2.438	1992.31	-0.002	0.454***	0.136**	14.306***	5.000	0.0176	0.9105
66	5.822										

Table 1 (cont.) – Estimation results for smooth transition models (9), 1978 - 2001

	*c*2	*m* (initial)	*m* (final)	T	*a*	B_1	B_2	τ	γ	SEE	Adj. R^2
67	8.096**	2.071	4.600	1997.99	-0.023***	0.517***	0.265**	19.991***	4.470	0.0320	0.8474
70	29.374***	3.339	2.919	1996.60	0.002	0.701***	-0.043	18.603***	3.520	0.0162	0.9736
71	19.783***	1.832	2.995	1993.98	0.013***	0.454***	0.212***	15.978***	0.270	0.0196	0.9508
72	2.633										
73	0.153										
74	5.948										
Some major industry groups											
c	16.793***	1.856	1.245	1990.62	-0.002	0.461***	-0.264***	12.623***	5.000	0.0218	0.9048
d	6.935*	1.089	1.226	1996.73	0.002	0.082***	0.103***	18.734***	5.000	0.0063	0.7547
e	8.133**	---	---	---	---	---	---	---	---	---	---
g	31.346***	1.773	1.221	1989.91	-0.003	0.436***	-0.255**	11.911***	4.090	0.0170	0.8232
i	1.683										
j	9.165**	1.767	2.259	1994.04	-0.002	0.434***	0.123**	16.041***	1.980	0.0134	0.9333
k	16.717***	2.271	1.912	1993.07	0.001	0.560***	-0.083*	15.071***	2.620	0.0126	0.9737

All models were estimated for the time period 1978-2001. ***,**,* denote significance at the 1, 5, and 10 per cent level.

[1] mark-up ratio in initial state, calculated as $1/(1-B_1)$; see question (11). – [2] mark-up ratio in final state, calculated as $1/[1-(B_1+B_2)]$; see equation (12).

Table 2 – Estimation results for models with instantaneous structural change (8), 1978 - 2001

	m (t < T)	*m* ($t \geq$ T)	T	*a*	B_1	B_2	SEE	Adj. R^2
Detailed industries								
01+02+05	2.780	1.481	1998	0.001	0.640***	-0.315***	0.0166	0.9430
10	1.498			0.032***	0.352***		0.0430	0.6359
11+13	2.056	1.459	1993	0.003	0.514***	-0.199**	0.0582	0.8169
14	1.241			-0.005	0.223***		0.0196	0.6049
15	1.133			0.002	0.101***		0.0116	0.4634
16	1.422			-0.001	0.438***		0.0439	0.7460
17	1.165	0.983	1998	0.005*	0.142***	-0.159***	0.0144	0.4643
18	1.135	1.338	1997	0.004	0.119***	0.134***	0.0155	0.5511
19	1.140	1.513	1994	0.001	0.123**	0.216***	0.0178	0.7884
20	1.159			0.000	0.140***		0.0221	0.3077
21	1.132	1.632	1995	0.002	0.116***	0.271***	0.0190	0.6014
22	1.251	1.100	1994	0.002	0.200***	-0.110**	0.0217	0.4387
23	0.917	1.801	1995	0.010	-0.091	0.536***	0.0569	0.3897
24	1.155			0.002	0.132***		0.0153	0.5203
25	1.160			0.007**	0.142***		0.0176	0.4733
26	1.180	1.514	1995	0.003	0.152***	0.187***	0.0135	0.7408
27	1.151	1.328	1998	0.004	0.131***	0.116**	0.0287	0.3484
28	1.188	1.378	1996	0.000	0.158***	0.116*	0.0175	0.5320
29	1.078			0.001	0.097**		0.0233	0.0864
30	1.030	1.566	1994	0.005	0.029	0.332***	0.0617	0.7438
31	1.089	1.370	1995	0.000	0.082***	0.189***	0.0178	0.4113
32	1.106			0.003	0.079*		0.0254	0.0798
33	1.240			0.005	0.215***		0.0214	0.5901
34	1.180			-0.004	0.146***		0.0150	0.7388
35	1.073			0.004	0.094***		0.0321	0.1132
36	1.169	1.417	1997	0.007*	0.144***	0.150***	0.0156	0.5983
40	1.297			-0.002	0.221***		0.0231	0.5510
41	1.744			0.001	0.419***		0.0199	0.8791
45	1.188	1.402	1995	0.002	0.158***	0.129**	0.0117	0.6472
50	1.971	1.114	1998	-0.004	0.493***	-0.390***	0.0348	0.7890
51	1.634	1.229	1993	-0.004	0.388***	-0.202**	0.0185	0.7479
52	1.616	1.260	1994	-0.007**	0.381***	-0.175**	0.0186	0.8087
55	1.379	1.458	1994	0.000	0.275***	0.039*	0.0080	0.9363
60	1.352	1.193	1998	0.000	0.260***	-0.099***	0.0150	0.7759
61	1.485			0.009	0.351***		0.0564	0.6635
62	1.308			-0.006	0.227***		0.0263	0.6715
63	1.188			-0.002	0.180***		0.0193	0.5968
64	1.632	1.114	1996	0.017***	0.387***	-0.285**	0.0289	0.6471
65	1.896	2.387	1993	-0.001	0.472***	0.109*	0.0178	0.9092
66	1.832	1.277	1996	-0.001	0.454***	-0.237***	0.0223	0.8522
67	2.096	4.483	1998	-0.023***	0.523***	0.254**	0.0314	0.8536

Table 2 (cont.) – Estimation results for models with instantaneous structural change (8), 1978 - 2001

	m ($t < T$)	*m* ($t \geq T$)	T	*a*	B_1	B_2	SEE	Adj. R^2
70	3.612			0.001	0.694***		0.0156	0.9755
71	1.881	3.017	1994	0.015***	0.468***	0.200***	0.0198	0.9496
72	1.228			0.010	0.204***		0.0227	0.5005
73	1.392			0.000	0.309***		0.0458	0.3680
74	1.395	1.530	1997	0.001	0.283***	0.063**	0.0122	0.9256
Some major industry groups								
c	1.813	1.265	1993	-0.003	0.449***	-0.239***	0.0235	0.8892
d	1.089	1.219	1996	0.002	0.081***	0.098***	0.0062	0.7665
e	1.250			-0.002	0.232***		0.0225	0.5892
g	1.684	1.229	1993	-0.004*	0.406***	-0.220**	0.0180	0.8023
i	1.355			0.000	0.244***		0.0133	0.8176
j	1.767	2.127	1993	-0.002	0.434***	0.096**	0.0133	0.9342
k	2.260	1.914	1993	0.001	0.558***	-0.080*	0.0123	0.9748

All models were estimated for the time period 1978-2001. ***,**,* denote significance at the 1, 5, and 10 per cent level. T chosen according to maximum significance level.

Table 3 (Panel) – Panel estimation of (9) including time specific effects

	m ($t < T$)	m ($t \geq T$)	a	B_1	B_2	SEE	Adj. R^2
Detailed industries							
01+02+05	4.35065	1.64648	-0.02240	0.770***	-0.378***	0.02667	0.76547
10	1.62556	2.97460	0.00605	0.385***	0.279*		
11+13	2.26818	1.52951	-0.02055	0.559***	-0.213**		
14	1.51234		-0.02788	0.339***	-0.007		
15	1.34158		-0.02216	0.255***	-0.049		
16	1.65850		-0.02552	0.397***	0.172		
17	1.38226		-0.01796	0.277***	-0.140		
18	1.24025	1.52102	-0.01848	0.194***	0.149*		
19	1.28145	1.70739	-0.02342	0.220***	0.195***		
20	1.31353		-0.02490	0.239***	0.073		
21	1.25682	1.80563	-0.02242	0.204***	0.242***		
22	1.46105	1.26497	-0.02185	0.316***	-0.106*		
23	0.95170	1.80969	-0.01371	-0.051	0.498***		
24	1.31373		-0.02173	0.239***	-0.003		
25	1.31783		-0.01680	0.241***	0.069		
26	1.39726	1.87528	-0.02037	0.284***	0.182***		
27	1.27253	1.49893	-0.02087	0.214***	0.119**		
28	1.46129		-0.02263	0.316***	0.055		
29	1.26120	1.45857	-0.02631	0.207***	0.107*		
30	1.08979	1.58974	-0.01818	0.082	0.289***		
31	1.27841	1.68617	-0.02799	0.218***	0.189***		
32	1.26665		-0.01596	0.211***	-0.042		
33	1.46275		-0.02278	0.316***	0.049		
34	1.27553		-0.02877	0.216***	-0.004		
35	1.20141		-0.02150	0.168***	0.063		
36	1.35211	1.73535	-0.01569	0.260***	0.163***		
40	1.53255		-0.02797	0.347***	-0.055		
41	2.10948		-0.02368	0.526***	-0.057		
45	1.44822	1.95074	-0.02520	0.309***	0.178***		
50	2.23923	1.42644	-0.02870	0.553***	-0.254***		
51	2.07558	1.51718	-0.02858	0.518***	-0.177***		
52	1.98237	1.56846	-0.03220	0.496***	-0.133**		
55	1.71723		-0.02573	0.418***	0.027		
60	1.62249		-0.02486	0.384***	-0.079		
61	1.55016		-0.01475	0.355***	0.112		
62	1.42707		-0.02848	0.299***	-0.016		
63	1.35613	1.51941	-0.02948	0.263***	0.079*		
64	2.07704	1.23310	-0.00916	0.519***	-0.330*		
65	2.54224		-0.02687	0.607***	0.082		
66	2.27133	1.35358	-0.01984	0.560***	-0.299**		
67	2.61518		-0.04313	0.618***	0.192		

Table 3 (Panel) (cont.) – Panel estimation of (9) including time specific effects

	m $(t < T)$	m $(t \geq T)$	a	B_1	B_2	SEE	Adj. R^2
70	5.33231		-0.02323	0.812***	-0.066		
71	2.18235	4.17942	-0.00472	0.542***	0.219***		
72	1.45716		-0.01747	0.314***	0.074		
73	1.60693		-0.03020	0.378***	0.106		
74	1.61207	1.78879	-0.02566	0.380***	0.061**		
Some major industry groups							
c	1.99907	1.30099	-0.00916	0.500***	-0.268***	0.01603	0.89560
d	1.19257		-0.00422	0.161***	0.050		
e	1.37706		-0.00966	0.274***	0.032		
g	1.90244	1.28867	-0.01111	0.474***	-0.250***		
i	1.49319		-0.00518	0.330***	-0.135		
j	2.11476		-0.00878	0.527***	0.025		
k	2.60007	2.01299	-0.00605	0.615***	-0.112*		

Least square dummy variable estimates including time-specific effects.

Table 4 – Summary of results from the different approaches

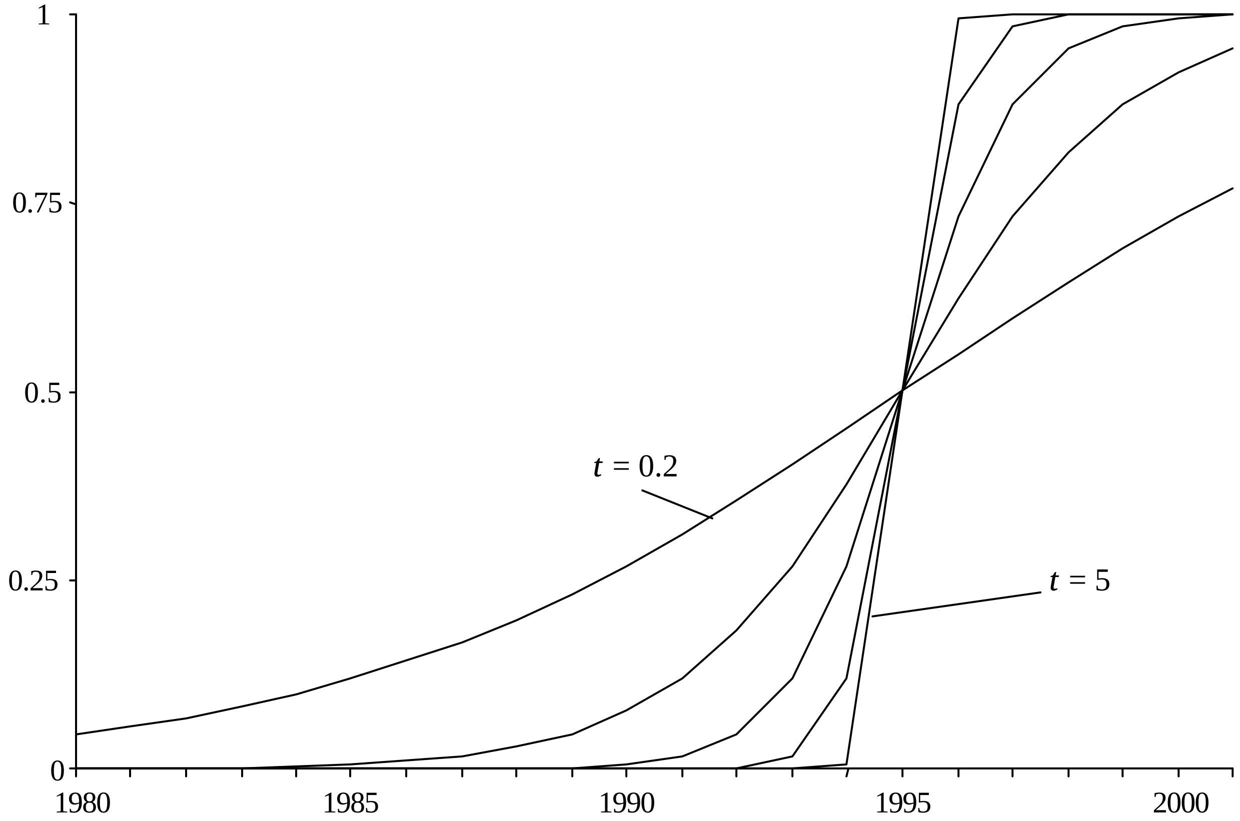
	LST[1)]			Instantaneous changeover				
					Time series		Panel	
	m (t < T)	m (t ³ T)	T	T	m (initial)	m (final)	m (initial)	m (final)
01+02+05	2.784	1.480	1997.64	1998	2.780	1.481	4.351	1.646
10					1.498		1.626	2.975
11+13	2.030	1.408	1995.33	1993	2.056	1.459	2.268	1.530
14					1.241		1.512	
15					1.133		1.342	
16	1.422				1.422		1.659	
17	1.038	1.206	1985.35	1998	1.165	0.983	1.382	
18				1997	1.135	1.338	1.240	1.521
19	1.164	1.615	1996.92	1994	1.140	1.513	1.281	1.707
20					1.159		1.314	
21	1.133	1.618	1995.44	1995	1.132	1.632	1.257	1.806
22				1994	1.251	1.100	1.461	1.265
23	0.917	1.856	1995.64	1995	0.917	1.801	0.952	1.809
24					1.155		1.314	
25					1.160		1.318	
26				1995	1.180	1.514	1.397	1.875
27				1998	1.151	1.328	1.273	1.499
28				1996	1.188	1.378	1.461	
29					1.078		1.261	1.459
30	1.038	1.573	1997.17	1994	1.030	1.566	1.090	1.590
31				1995	1.089	1.370	1.278	1.686
32					1.106		1.267	
33					1.240		1.463	
34					1.180		1.276	
35					1.073		1.201	
36				1997	1.169	1.417	1.352	1.735
40	1.297				1.297		1.533	
41	1.744				1.744		2.110	
45				1995	1.188	1.402	1.448	1.951
50	2.212	1.214	1992.81	1998	1.971	1.114	2.239	1.426
51	1.950	1.319	1985.97	1993	1.634	1.229	2.076	1.517
52	1.649	1.258	1993.94	1994	1.616	1.260	1.982	1.568
55				1994	1.379	1.458	1.717	
60	1.248	1.440	1991.48	1998	1.352	1.193	1.622	
61	1.485				1.485		1.550	
62					1.308		1.427	
63					1.188		1.356	1.519
64				1996	1.632	1.114	2.077	1.233
65	1.832	2.438	1992.31	1993	1.896	2.387	2.542	
66				1996	1.832	1.277	2.271	1.354

Table 4 (cont.) – Summary of results from the different approaches

	LST[1)]			Instantaneous changeover				
					Time series		**Panel**	
	m **($t < T$)**	*m* **($t \geq T$)**	**T**	**T**	*m* **(initial)**	*m* **(final)**	*m* **(initial)**	*m* **(final)**
67	2.071	4.600	1997.99	1998	2.096	4.483	2.615	
70	3.612				3.612		5.332	
71	1.832	2.995	1993.98	1994	1.881	3.017	2.182	4.179
72					1.228		1.457	
73					1.392		1.607	
74				1997	1.395	1.530	1.612	1.789
Some major industry groups								
c	1.856	1.245	1990.62	1993	1.813	1.265	1.999	1.301
d	1.089	1.226	1996.73	1996	1.089	1.219	1.193	
e	---	---	---		1.250		1.377	
g	1.773	1.221	1989.91	1993	1.684	1.229	1.902	1.289
i					1.355		1.493	
j	1.767	2.259	1994.04	1993	1.767	2.127	2.115	
k	2.271	1.912	1993.07	1993	2.260	1.914	2.600	2.013

[1)] In contrast with Table 1, for industries were the estimates of B_2 turned out insignificant (in spite of a significant χ^2-statistc) , the markup ratios implied by model (7) are shown here (16, 40, 41, 61, 70).

Figure 1 – Transition function F(t) as given by equation (10) for alternative values of g and transition midpoint in 1995 (i.e. t = 18)



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