Mergers and Economies of Scale: Volkswagen AG 1976 - 2000

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Abstract

The purpose of this paper is to study if the acquisitions of SEAT and Skoda has lead to increased economic efficiency for Volkswagen AG due to economies of scale. This is achieved by estimation of the VAG cost function, using a translog specification. The results indicate that the merger with SEAT did decrease the economies of scale available as production volumes increased due to the merger. No such effects was, however, found for the acquisition of Skoda.

Key Words: Automobile production, economies of scale, technological change.

JEL classification: D21, D24, L25

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1 Introduction

In 1982, VAG initiated a cooperation with the Spanish automobile producer SEAT S.A. (SEAT) concerning the production of the models WV Passat and VW Polo. The motives for this cooperation was that the management of VAG wanted to gain access to Spanish production plants in order to gain efficiency and reduce total production costs. This cooperation continued until 1986, when VAG acquired 51% of the shares in SEAT, thus becoming the majority shareholder of the Spanish firm. The reported motives for the final acquisition of SEAT, in addition to increased economic efficiency, was that VAG wanted to gain further access to the south-European automobile markets, and to incorporate another brand into the firm "portfolio" of automobiles.

When the markets in eastern-central and eastern Europe opened up in the beginning of the 1990-ties, VAG started planing for how they could gain access to these new markets. In December 1990, VAG received approval by the Czech government for the takeover of Skoda Auto (Skoda). The motive was mainly that the acquisition promised good access to the car markets of eastern-central and eastern Europe, but also that cooperation in production could lead to increased efficiency. The takeover was completed in April of 1991, when VAG assumed responsibility for the management of the Czech automobile producer, and acquired a modern production plant that was to assemble VAG middle-class cars and transmissions.

Economic efficiency in automobile manufacturing has been studied by several authors, see e.g. Womack et al (1990), Fuss and Waverman (1992) and Truett and Truett (2001). Both Womack et al (1990) and Fuss and Waverman (1992) discuss how Japanese car manufacturing has affected auto

manufacturers in other countries. Womack et al (1990) claimed that the so called "lean production technology" adopted by Japanese manufacturers made them superior in car manufacturing. This hypothesis has later been disputed (see e.g. Williams et al. 1992 and Papahristodoulou, 1994). Fuss and Waverman (1992), using a productivity index approach, found that efficiency had improved faster in Japanese production than in Canadian, German or US automobile production during the period 1961 to 1984. Finally, Truett and Truett (2001) use a translog cost function approach to study economies of scale and substitution possibilities among inputs in Spanish automobile manufacturing. Their results indicate that there are economies of scale in Spanish automobile production, particularly at the low and mean levels of output. It should, however, be noted that all of these previous studies have been performed on aggregate data, using the whole industry as the unit of analysis.

The purpose of this paper is to study if the acquisitions of SEAT and Skoda has lead to increased economic efficiency due to economies of scale for Volkswagen AG. Another purpose is to study if the production process for VAG has been characterized by economies of scale and/or disembodied technological change during the years 1976 to 2000. This will be achieved by estimation of the VAG cost function, using a translog specification. The paper contributes to the existing literature by being (at least to my knowledge) the first attempt to directly study the effects of mergers on economies of scale in automobile production using a cost function approach.

The paper is organized as follows; section 2 presents the model which is based on a translog cost function, while section 3 contains the empirical analysis. Section 3 thus presents the data used, estimation results and the

own- and cross price elasticities of demand for the different inputs. In addition, this section also presents the elasticities of scale, as well as the returns to expansion and the rate of cost diminution used to measure technological change. Finally, section three also presents the results concerning how the mergers with SEAT and Skoda affected the measures of elasticities of scale and returns to expansion. Section 4 summarizes the main results of the paper.

2 The model

I set out by assuming that Volkswagen AG is a cost minimizing producer of automobiles, and that the cost function can be described by the transcendental logarithmic (translog) cost function developed by Christiansen et al (1971), which can be seen as a second order Taylor series approximation to any arbitrary cost function. It is assumed that the VAG total cost function can be represented by the function

$$C = f(Y, \mathbf{I}, t) \tag{1}$$

where Y is the total output measured in thousands of units, i.e. thousands of automobiles, produced each year, $\mathbf{I}$ is a vector of inputs including labor, capital, material and investments in R&D. The inclusion of t and a set of interaction terms between input prices and t, allows the estimation of the rate and characteristics of disembodied technological change in VAG production. The term disembodied technological change is used because this type of technological change does not affect the inputs used in automobile production *per se*. For a thorough discussion concerning different types of

technological change, see Chambers (1988). All data used in the estimations of the cost- and cost share equations below have been collected from the official result reports presented by Volkswagen AG for the years 1976 to 2000, and all prices and costs are reported in millions of DM and in fixed 1990 prices. The translog cost function used in this study can be written:

$$\begin{aligned}
\ln C &= \alpha_0 + \sum_i \beta_i \ \ln P_i + \beta_Y \ \ln Y + \frac{1}{2}\sum_i \sum_j \delta_{ij} \ \ln P_i \ln P_j \qquad (2) \\
&+ \sum_i \delta_{iY} \ \ln P_i \ln Y + \frac{1}{2}\delta_{YY} \ (\ln Y)^2 + \phi_t t + \frac{1}{2}\phi_{tt} \ t^2 \\
&+ \phi_{tY} \ \ln Y + \sum_i \phi_{ti} t \ \ln P_i + \rho_1 \ D_{SEAT1} \ln Y \\
&+ \rho_2 \ D_{SEAT2} \ln Y + \rho_3 \ D_{SKODA} \ln Y + v
\end{aligned}$$

where C is the total costs for producing automobiles, P_i is the price of input i and Y is output measured as the number of units (automobiles) produced per year. The standard translog model have been modified to make it possible to study the effects on economies of scale in VAG production of the mergers with SEAT and Skoda by including the three $\rho_j D_j \ln Y$ terms, where D_j is a dummy variable equal to one for each year after the merger in question. This should be interpreted as that the rest term in the Taylor series approximation in this case includes an intercept, the interaction terms between the mergers and output, and the stochastic error term. In the standard translog model this rest term only includes the intercept and the error term. D_{SEAT1} represents the 1982 cooperation with the Spanish automobile producer SEAT concerning the production of the models WV Passat and VW Polo, D_{SEAT2} represents the 1986 acquisition of SEAT and D_{SKODA} represents the 1991

takeover of Skoda, when VAG assumed responsibility for the management of the Czech automobile producer. As shown below, the parameter estimate of ρ_j can thus be used to study the effects of the mergers with SEAT and Skoda on the measures of economies of scale and returns to expansion.

For the above cost function to be "well-behaved", the following restrictions must be imposed:

$$\sum_i \beta_i = 1 \tag{3}$$

$$\sum_i \delta_{ij} = \sum_j \delta_{ij} = \sum_i \sum_j \delta_{ij} = 0 \tag{4}$$

$$\sum_i \delta_{iY} = 0 \tag{5}$$

$$\sum_i \phi_{ti} = 0 \tag{6}$$

The cost share equations for each input will take the form

$$S_i = \beta_i + \sum_j \delta_{ij} \ln P_j + \delta_{iY} \ln Y + \phi_{ti} t + \upsilon_i \tag{7}$$

where $S_i = (P_i * q_i)/C$, and q_i is the quantity of input i, i = labor, capital, material and R&D. The cost function also contains an additive disturbance component, υ, reflecting factors in the cost function not observable for the researcher. This component should be interpreted as a realization from a distribution for a stochastic variable with zero mean and constant variance. In addition, each of the cost share equations includes an additive error term, υ_i, which is the result of optimization errors at the Volkswagen firm level. This additive error specification presented above coincides with, for example,

Bernt and Wood (1975) and Christiansen and Greene (1976). Note also that the error terms relating to the share equations do not contain the additive disturbance term of the cost equation. This follows because the cost share equations have been derived by differentiation of the translog cost function.

The main purpose of this paper is to study the effects of the mergers between VAG and SEAT and VAG and Skoda on the economies of scale in VAG production. Economies of scale ($SCALE$) can, according to Christiansen and Greene (1976), be expressed as the proportional increase in cost associated with a small proportional increase in output, i.e. the elasticity of total cost with respect to output. In the model estimated above, economies of scale can be calculated as

$$\begin{aligned} SCALE &= 1 - \partial \ln C / \partial \ln Y = 1 - (\beta_Y + \delta_{YY} \ln Y + \sum_i \delta_{iY} \ln P_i \\ &\quad + \phi_{tY}\ t + \rho_1\ D_{SEAT1} + \rho_2\ D_{SEAT2} + \rho_3\ D_{SKODA}) \end{aligned} \tag{8}$$

resulting in positive numbers when scale economies are present. When calculating this measure it is expected that economies of scale and returns to expansion should diminish after the mergers due to increases in VAG production volumes. Thus, if the parameter estimate of ρ_j is positive and statistically significant, the associated merger has contributed to decreased economies of scale due to increased production volumes.

However, as suggested by Vellturo et al (1992), the above measure might not be useful to measure economies of scale when mergers also affect the overall structure of the firm. According to Vellturo et al, this is so for two reasons; firstly, the $SCALE$ measure presented above treats all other arguments in the cost function as fixed. The mergers with SEAT and Skoda have,

however, affected both the labor composition and the total capital stock in the merged firm. Secondly, the conventional scale measure described above represents a measure of expansion at the margin, while the incorporation of SEAT and Skoda into VAG represent large changes in the scale of operations for VAG. As such, Vellturo et al suggests a more comprehensive measure in order to study economies of scale in firms who have been involved in large scale mergers, referred to as returns to expansion (RTE), defined as

$$\begin{aligned} RTE &= 1 - [\partial \ln C/\partial \ln Y_t + \partial \ln C/\partial \ln L_t + \partial \ln C/\partial \ln K_t] = \qquad (9) \\ & 1 - [(\beta_Y + \delta_{YY} \ln Y + \sum_i \delta_{iY} \ln P_i + \phi_{tY}\ t \\ & +\rho_1\ D_{SEAT1} + \rho_2\ D_{SEAT2} + \rho_3\ D_{SKODA}) \\ & +(\beta_L + \sum_j \delta_{Lj} \ln P_L + \delta_{LY} \ln Y + \phi_{tL} t) \\ & +(\beta_K + \sum_j \delta_{Kj} \ln P_K + \delta_{KY} \ln Y + \phi_{tK} t)] \end{aligned}$$

which is positive if there are any returns to expansion and where L represents the level of the labor force and K the level of the capital stock. As such, this alternative measure of the economies of scale incorporates changes in scale related variables which are likely to be affected by mergers. Note, however, that the effects of the merger on the two types of measurements will not differ, as these effects are measured by the ρ_i parameters.

If technology changes over time in a way which diminishes production costs, it would also be of interest to measure such effects. A practical measure is to calculate the rate of cost diminution (RCD), which is defined by Chambers (1988) as

$$RCD = \partial \ln C / \partial t = (\phi_t + \phi_{tt}\ t + \phi_{tY}\ \ln Y + \sum_i \phi_{ti}\ \ln P_i) \qquad (10)$$

which results in negative numbers if technological change reduces costs. Equation (10) can also be used to test whether VAG production were characterized by output- and/or factor augmenting technological change during the period under study. To test for output augmenting technological change, the size and statistical significance of the parameter estimate for ϕ_{tY} is studied. A positive and statistically significant parameter estimate indicates output augmenting technological change. In addition, a positive and statistically significant parameter estimate for any of the ϕ_{ti}-parameters would indicate that technological change had been factor augmenting for input i, while acceptance of the restriction $\sum_i \phi_{ti} = 0$ implies nonfactor augmenting technological change.

In order to make the model operational, one of the share equations is dropped (in my case the share equation for R&D) and the restrictions presented above are imposed on the cost function and the remaining share equations. This estimation method was suggested by Christiansen and Greene (1976), and the parameter estimates are invariant with respect to which share equation is dropped.

Finally, it will be assumed that Volkswagen acts as a price taker on the input markets, thus alleviating the potential problem of endogeneity in input prices. However, since output is clearly endogenous, i.e. this regressor and the error terms are correlated, an instrumental variable method is called for. By assuming that Volkswagen is small compared to the whole German economy, German GDP in local currency at 1995 fixed prices, as well as the square of German GDP, was used as instruments. The instrumental variable,

German GDP in DM and 1995 fixed prices, have been collected from official OECD-data. These instruments turned out to have a significant effect on output, and the explanatory power was high, $R^2 = 0.89$. In addition, the cost and cost share equations presented above are estimated simultaneously. Joint estimation of the cost- and cost share equations has two main advantages; it results in more efficient parameter estimates, and also makes it possible to determine if production is characterized by scale economies or learning effects.

3 Empirical analysis

The results from the estimation of the model described above is presented in Table 1. The parameter estimates are first used in order to test for alternative structures of the production technology. Homotheticity of the translog function requires that $\delta_{iY} = 0$ for all i, while homogeneity, in addition to the homoteticity restrictions, requires that $\delta_{YY} = 0$. If, in addition to these restrictions, it is found that $\beta_Y = 0$, then production is characterized by constant returns to scale. Finally, if it can be shown that all $\delta_{ij} = 0$, in addition to all restrictions above, the translog cost function reduces to a constant returns to scale Cobb-Douglas cost function. By studying the parameter estimates presented in Table 1, and their associated standard errors, all of the above restrictions can be rejected, and the translog model thus seem to be a reasonable representation of the VAG production technology.

Table 1 about here.

The parameter estimates presented in Table 1 are used to calculate the price elasticities described by equations (11) and (12) below, for the years 1976, 1980, 1985, 1990, 1995 and 2000, as well as at the mean of the cost shares, S_i. The own- and cross price elasticities are given by

$$\epsilon_{ii} = \frac{\delta_{ii} + S_i^2 - S_i}{S_i} \tag{11}$$

and

$$\epsilon_{ij} = \frac{\delta_{ij} + S_i S_j}{S_i} \tag{12}$$

and these elasticities measure the responsiveness of the demand for input i to a change in the price of input j, when output and all other input prices are held constant. The results can thus be used to study whether inputs i and j are substitutes or complements in the production of Volkswagen automobiles. The elasticities are presented in Table 2.

Table 2 about here.

The own-price elasticities are all negative and statistically significant at the 5 percent significance level when evaluated at the mean of the cost shares. However, the own-price elasticity for labor in the year 2000, and for capital in the years 1976, 1985 and 1990 are not significantly different from zero at the five percent significance level. In addition, the own-price elasticity for material has decreased in size during the studied period, from -0.067 to -0.025, in contrast to the other own-price elasticities who have been relatively constant during the period under study. The demand for materials in VAG production also seem to be much less elastic than the demand for the other inputs.

Note also that the own price elasticity of demand for capital is far greater in value that the elasticities for the other inputs. The same result was found by Truett and Truett (2001) when studying the Spanish automotive industry, and should be seen as an indication that Volkswagen has greater flexibility in its use of capital, that in its use of the other production factors, including labor.

Turning to the cross price elasticities, the estimated elasticities indicate that labor and R&D are complements in the production of automobiles, but also that the elasticity is small in size. All other pairs of inputs seem to be substitutes for each other in the production of automobiles, when evaluating them at the mean of the cost shares. The cross price elasticities also show a much larger heterogeneity when comparing the elasticities for different years than the own price elasticities of demand for the different inputs.

The elasticity of scale, as well as the returns to expansion and the rate of cost diminution, have been calculated for the years 1976, 1980, 1985, 1990, 1995 and 2000, as well as at the mean values of input prices, P_i, and output, Y. The results are presented in Table 3.

Table 3 about here.

The positive estimates of the elasticity of scale and the returns to expansion implies that the production of VAG automobiles has been characterized by economies of scale. Hence, Volkswagen has been producing on the downward sloping section of the cost curve during the years 1976 to 2000. It also seems that the economies of scale has increased in recent years, despite the VAG mergers with SEAT and Skoda. Another striking result is the large difference between the estimates of the elasticity of scale and the

returns to expansion. The estimates of the returns to expansion, which incorporates changes in output, labor and capital into the analysis, is about 40 percent lower than the estimates for the conventional elasticity of scale measure. The estimates are, however, well above zero, indicating that VAG automobile production could still exploit economies of scale by expanding operations. Finally, the elasticities of scale and the returns to expansion has also been calculated for the minimum and maximum levels of production during the studied period. The elasticity of scale equals 1.09 at the minimum level of production and 1.23 at the maximum level, while the returns to expansion equals 0.67 at the minimum level and 0.98 at the maximum level. All measures are statistically significant at the five percent level. As such, the automobile production at Volkswagen AG seem to be characterized by economies of scale at all production levels during the period under study.

Turning to the effects of the SEAT and Skoda mergers, the parameter estimate of ρ_j, $j = 1, 2, 3$ will be positive and statistically significant, if the associated merger has led to diminished economies of scale due to the increased scale of operations. A positive parameter estimate of ρ_j will, ceteris paribus, result in a decrease in the measure of economies of scale and returns to expansion as calculated by equations (8) and (9) above. The parameter estimate (presented in Table 1) for ρ_1, which is used to study the effects of the cooperation with SEAT on the economies of scale in VAG operations, is equal to $-0.90E^{-3}(0.27E^{-3})$ with the associated standard error in parentheses. As such, it seems that the cooperation led to increased economies of scale for VAG production, despite the increased scale of operations within VAG. One possible explanation for this result is that the production units incorporated in the production of VAG products had even larger economies of scale to

be exploited than previous VAG production plants. In 1986 VAG acquired 51% of the shares in SEAT. In this case, the parameter estimate for ρ_{SEAT2} equals $0.64E^{-3}(0.26E^{-3})$, and the final acquisition of SEAT thus resulted in a reduction in the economies of scale and the returns to expansion as the scale of operations increased. This can also be seen as an indication of the importance of gaining managerial control over the production plants in order to be able to exploit economies of scale in merger situations.

Turning to the effects of the merger with Skoda which is measured by ρ_3, the parameter estimate equals $-0.55E^{-4}(0.35E^{-3})$. As such, the merger with Skoda did not have any statistically significant effects on the measures of the elasticity of scale or returns to expansion. It should, however, be noted that the main reason for this merger was not to increase efficiency through economies of scale, but rather to get access to the newly opened east-European markets where Skoda was an established brand of automobiles.

Turning to the rate of cost diminution, it has been negative and significant during the studied period, indicating that Volkswagen has benefitted from disembodied technological change during the period under study. The parameter estimate for ϕ_{tY} (see Table 1 above) is, however, not statistically different that zero, indicating that technological change has been output neutral during the period under study. Turning to the different inputs, the only statistically significant result is that the parameter ϕ_{tR} (referring to the input of R&D in automobile production) equals $0.75E^{-3}(0.37E^{-3})$, indicating that technological change has been R&D augmenting during the period 1976 to 2000.

4 Summary and discussion

In 1982, VAG initiated a cooperation with the Spanish automobile producer SEAT concerning the production of WV Passat and VW Polo. The motive for this cooperation was that the management of VAG wanted to gain access to Spanish production plants in order to exploit economies of scale in production of the two models. The cooperation continued until 1986, when VAG became the majority shareholder of SEAT. The reported motives for the final acquisition of SEAT was that VAG wanted to gain further access to the south-European automobile markets, and to incorporate another brand into the firm "portfolio" of automobiles. The results from this study show, however, that it was first at the final acquisition of SEAT that VAG were able to exploit economies of scale. This could be seen as an indication that managerial control over the production process is important in order to exploit potential economies of scale in automobile production.

In December 1990, VAG received approval by the Czech government for the takeover of Skoda. The main motive for the acquisition was that VAG wanted access to the car markets of eastern-central and eastern Europe, but also that cooperation in production could lead to increased efficiency. In April 1991 VAG assumed responsibility for the management of Skoda and acquired a production plant that was to assemble VAG middle-class cars and transmissions. The results from this study show that the acquisition of Skoda did not significantly affect economies of scale at VAG. It should, however, be noted that in the case of Skoda scale economies was one, but not the main, reason for the merger. As such, it is less surprising that this acquisition did not affect the economies of scale in VAG automobile production.

Some other results are worth mentioning. The positive estimates of the elasticity of scale and the returns to expansion implies that the production of VAG automobiles has been characterized by economies of scale during the whole period under study. As such, the results show that Volkswagen has been producing on the downward sloping section of the cost curve during the years 1976 to 2000. This finding coincides with the findings of Truett and Truett (2001) in their study of the Spanish automobile industry. It also seems that the economies of scale and the returns to expansion has increased in recent years, despite the VAG mergers with SEAT and Skoda. Another interesting result is the difference between the estimates of the elasticity of scale and the returns to expansion. The estimates of the returns to expansion, which incorporates changes in output, labor and capital into the analysis, is approximately 40 percent lower than the elasticity of scale measure. This indicates the importance of taking changes in the composition of the labor/capital mix into account when the effects of mergers on economies of scale are to be evaluated.

Finally, turning to the rate of cost diminution, this has been negative during the studied period, indicating that Volkswagen has benefitted from disembodied technological change. The results also indicate that technological change has been output neutral, but R&D augmenting, during the period under study.

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Table 1. Parameter estimates

Parameter	Estimate	S.E.		Parameter	Estimate	S.E.	
α_0	-53.82	26.07	*	δ_{YY}	-0.61	0.25	*
β_L	1.08	0.26	*	δ_{LY}	-0.054	0.018	*
β_K	0.27	0.71		δ_{KY}	-0.011	0.049	
β_M	-0.29	0.75		δ_{MY}	0.056	0.052	
β_R	-0.065	0.078		δ_{RY}	0.0095	0.0053	
β_Y	8.84	3.59	*	ϕ_t	-0.13	0.12	
δ_{LL}	0.12	0.016	*	ϕ_{tt}	-0.22E^{-3}	0.13E^{-3}	
δ_{LK}	0.025	0.020		ϕ_{tL}	-0.79E^{-5}	0.0011	
δ_{LM}	-0.13	0.0068	*	ϕ_{tK}	0.0023	0.0022	
δ_{LR}	-0.018	0.0041	*	ϕ_{tM}	-0.0030	0.0019	
δ_{KK}	0.024	0.027		ϕ_{tR}	0.75E^{-3}	0.37E^{-3}	*
δ_{KM}	-0.060	0.0096	*	ϕ_{tY}	0.010	0.0079	
δ_{KR}	0.011	0.0062		ρ_1	-0.90E^{-3}	0.27E^{-3}	*
δ_{MM}	0.20	0.0076	*	ρ_2	0.64E^{-3}	0.26E^{-3}	*
δ_{MR}	-0.014	0.0046	*	ρ_3	-0.55E^{-4}	0.35E^{-3}	
δ_{RR}	0.021	0.0025	*				

The "*" sign indicates that the parameter estimate is statistically significant at the 5 percent significance level.

Table 2. Own- and cross price elasticities.

ϵ	1976	1980	1985	1990	1995	2000	@MEAN
ϵ_{LL}	-0.29	-0.29	-0.29	-0.26	-0.24	-0.096	-0.27
	(0.049)*	(0.050)*	(0.052)*	(0.061)*	(0.068)*	(0.094)	(0.059)*
ϵ_{LK}	0.13	0.20	0.16	0.18	0.19	0.26	0.19
	(0.061)*	(0.063)*	(0.064)*	(0.075)*	(0.084)*	(0.12)*	(0.074)*
ϵ_{LM}	0.17	0.11	0.15	0.12	0.080	-0.11	0.11
	(0.021)*	(0.022)*	(0.022)*	(0.026)*	(0.029)*	(0.04)*	(0.025)*
ϵ_{LR}	-0.016	-0.025	-0.022	-0.031	-0.036	-0.055	-0.029
	(0.013)	(0.013)	(0.013)	(0.016)*	(0.017)*	(0.024)*	(0.015)
ϵ_{KK}	-0.53	-0.68	-0.60	-0.63	-0.63	-0.67	-0.66
	(0.47)	(0.22)*	(0.36)	(0.33)	(0.31)*	(0.24)*	(0.28)*
ϵ_{KL}	0.76	0.51	0.64	0.56	0.53	0.40	0.53
	(0.34)*	(0.16)*	(0.27)*	(0.24)*	(0.23)*	(0.18)*	(0.20)*
ϵ_{KM}	-0.47	0.046	-0.23	-0.11	-0.073	0.12	-0.027
	(0.17)*	(0.077)	(0.13)	(0.12)	(0.11)	(0.088)	(0.10)
ϵ_{KR}	0.12	0.12	0.19	0.18	0.18	0.15	0.16
	(0.05)*	(0.050)*	(0.084)*	(0.076)*	(0.074)*	(0.057)*	(0.065)*
ϵ_{MM}	-0.067	-0.084	-0.065	-0.050	-0.040	-0.025	-0.060
	(0.013)*	(0.014)*	(0.013)*	(0.012)*	(0.011)*	(0.011)*	(0.013)*
ϵ_{ML}	0.096	0.066	0.081	0.049	0.029	-0.11	0.048
	(0.012)*	(0.013)*	(0.011)*	(0.011)*	(0.011)*	(0.040)*	(0.011)*
ϵ_{MK}	-0.046	0.011	-0.029	-0.015	-0.0096	0.020	-0.0043
	(0.017)*	(0.018)	(0.017)	(0.016)	(0.015)	(0.014)	(0.016)
ϵ_{MR}	0.017	0.0064	0.014	0.016	0.020	0.031	0.016
	(0.0080)*	(0.0087)	(0.0079)	(0.0075)*	(0.0072)*	(0.0069)*	(0.0077)*
ϵ_{RR}	-0.45	-0.33	-0.41	-0.42	-0.46	-0.55	-0.43
	(0.062)*	(0.077)*	(0.067)*	(0.066)*	(0.060)*	(0.048)*	(0.064)*
ϵ_{RL}	-0.13	-0.24	-0.18	-0.21	-0.20	-0.18	-0.20
	(0.10)	(0.13)	(0.11)	(0.11)*	(0.098)*	(0.078)*	(0.10)*
ϵ_{RK}	0.34	0.47	0.38	0.38	0.36	0.33	0.39
	(0.15)*	(0.19)*	(0.17)*	(0.16)*	(0.15)*	(0.12)*	(0.16)*
ϵ_{RM}	0.24	0.10	0.21	0.26	0.31	0.40	0.24
	(0.11)*	(0.14)	(0.12)	(0.12)*	(0.11)*	(0.089)*	(0.12)*

Table 3. Elasticities of scale and rate of cost diminution.

	1976	1980	1985	1990	1995	2000	@MEAN
SCALE	1.09	1.02	0.99	1.04	1.17	1.23	1.09
	(0.098)*	(0.092)*	(0.094)*	(0.096)*	(0.093)*	(0.091)*	(0.089)*
RTE	0.67	0.64	0.61	0.68	0.84	0.98	0.72
	(0.11)*	(0.094)*	(0.089)*	(0.093)*	(0.096)*	(0.097)*	(0.090)*
RCD	-0.012	-0.011	-0.010	-0.011	-0.013	-0.013	-0.011
	(0.0035)*	(0.0034)*	(0.0032)*	(0.0035)*	(0.0044)*	(0.0051)*	(0.0036)*