Labour Productivity and Profitability in the Dutch Flower Trade

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ABSTRACT. This paper makes an attempt to illustrate the use of econometric models as frame of reference for diagnosing small firm performance. For this purpose, two models are developed explaining differences in labour productivity and profitability among Dutch flower exporters. In addition, we show how these models can be used for inter-firm performance comparisons.

1. Introduction

The exporting flower trade is the forerunner of Dutch exporting industries. According to Jacobs (1990) in his application of Porter's (1990) analysis of the competitive advantage of nations, the Dutch cut-flower and potted plant industries occupy position one and four, respecively, in the top-10 of the most competitive industries in the Netherlands. Equally remarkable is the expansive growth of flower exports reaching an average annual rate of 10% during the last decade. Especially export to the Far East is rapidly growing at an average rate of 15% per annum. By way of contrast, it is noted that the exporting flower trade is a typical small business sector. Over 80% of flower traders employ 10 persons or less, whereas only a few traders employ 50 persons or more.

In the present study, two models are presented to describe labour productivity and profitability of Dutch flower exporters. The models allow us to determine the impact of firm specific characteristics on the height of the two performance measures. In particular, labour productivity is supposed to depend on scale, type of customers served, means of transportation, labour quality, etc. Similarly, profitability is expected to be influenced by export regions, assortment composition, buyer types, and other elements of the service package. The reason for considering these two features of the flower trade is three-fold. First, a considerable share of economic literature deals with matters of productivity and profitability.[1] Second, these performance measures have been given a lot of attention in studies on retailing, which is closely related to wholesaling if it comes to the nature of the production processes: both retailing and wholesaling provide a service capacity for the benefit of buyers.[2] The third reason for studying productivity and profitability is their practical use to people working in the area, who often use these measures to determine firm performance. The results of our analysis can be used to improve traditional methods of inter-firm performance assessment, which are almost invariably limited to calculating simple industry averages of financial ratios.

The outline of the paper is as follows. Sections 2 and 3 deal with the models of labour productivity and profitability. The use of these models as a means of diagnosing firm performance is illustrated in Section 4, and Section 5 concludes the paper.

2. Labour productivity in the exporting flower trade

2.1 *The model*

Labour productivity of flower traders is analyzed

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by means of a non-homogeneous linear relationship between labour and output. The non-homogeneity of the relationship is intuitively clear when considering that the service capacity offered by flower traders will not vanish if sales become close to zero.[3] Moreover, an overwhelming amount of empirical evidence in the retail trade suggests a linear relationship between labour volume and sales level, which is supported by theoretical evidence from queuing theory.[4] The similarity between wholesaling and retailing with respect to their production process makes it worthwhile to apply this model to the flower trade as well. The labour-output model is formalized as:

$$L = \alpha + \beta q, \quad (1)$$

where L denotes labour volume measured by the number of full-time equivalents, and q represents output of flower traders which is approximated by sales volume in million kg.[5] The parameter α is interpreted as the minimum amount of labour necessary to operate a wholesale firm. It is this threshold labour which causes labour productivity to depend on scale. This becomes clear by rewriting (1) in terms of labour intensity (i.e., the reciprocal of labour productivity):

$$\frac{L}{q} = \frac{\alpha}{q} + \beta. \quad (2)$$

Equation (2) shows that increasing sales levels cause labour intensity to decrease. It also shows that the effect of scale is relatively strong for small firms and becomes weaker when scale increases. Eventually, actual labour intensity will be close to β, which is accordingly interpreted as scale independent labour intensity.

2.2 *Differences in labour productivity*

Labour productivity will differ among traders because of the unique characteristics of each individual firm. Several sources of variation are discussed below: labour quality, dispersion of the selling market, assortment composition, buyer types, means of transportation, and degree of automation.

Labour quality, w/w_A. Various dimensions of labour quality, such as experience, educational level, knowledge of foreign languages and trade customs, can be expected to have a positive effect on productivity through more efficient management of wholesale activities and increased opportunities to explore new export markets. Labour quality is approximated by the relative wage rate (i.e., average wage costs per employee in relation to the sample average). A relatively high wage rate should therefore have a positive effect on productivity. Moreover, from a cost managerial perspective high wage rates necessitate more efficient management of order processing thereby providing an additional stimulation on productivity.[6]

Dispersion of selling market, H/H_A. Traders serving a geographically dispersed export market have less opportunities to combine shipments, which might allow them to benefit from scale effects in processing orders. We therefore expect a dispersed export market to have a negative impact on productivity. The degree of dispersion is measured by the Herfindahl index based on export shares.[7]

Degree of automation, A/A_A. The degree of automation differs between flower traders. Some traders have automated activities, like washing and packing, whereas others perform such activities by hand. Clearly, automation affects productivity in a positive way: the same level of sales can be handled with less employees. The degree of automation is approximated by the share of depreciation costs in total costs divided by its sample average, which is expected to have positive impact on labour productivity.

Assortment composition, a. Exporters provide a wide variety of flower types. However, only two broad assortment groups are distinguished: cut-flowers and potted plants. Potted plants involve less handling, like cutting, sorting and packing, than cut-flowers. Therefore, the share of potted plants in total sales is expected to have a positive influence on labour productivity.

Buyer types, b. Flowers are sold to local wholesalers, florists and other buyers. Sales to florists are expected to be relatively labour intensive in view of the small order sizes. The share of sales to retailers is expected to have a negative impact on productivity.

Transport, t. Flower transport is usually carried out by traders themselves. Yet, sometimes transport is contracted out to professional carriers or taken care of by the buyer. We expect a larger share of transport by specialized carriers or buyers to improve productivity for the obvious reason that less labour is required to ship the same amount of orders.

The scale independent part of labour intensity, β, is extended in a multiplicative manner to account for differences in labour quality, dispersion of the selling market, assortment composition, buyer types, modes of transportation, and degree of automation:[8]

$$\beta = \beta_0 \left(\frac{w}{w_A} \right)^{\beta_1} \left(\frac{H}{H_A} \right)^{\beta_2} \left(\frac{A}{A_A} \right)^{\beta_3}$$
$$(a_1 + \beta_4 a_2)(b_1 + \beta_5 b_2)(t_1 + \beta_6 t_2 + \beta_7 t_3), \quad (3)$$

with:

- w: average wage costs per employee; w_A is the sample average;
- H: Herfindahl index based on export shares; H_A is the sample average;
- A: share of depreciation costs in total costs; A_A is the sample average;
- a: assortment composition; a_1 = share of cut-flowers, a_2 = share of potted plants;
- b: types of buyers; b_1 = local wholesalers and other buyers, b_2 = florists;
- t: means of transportation; t_1 = own means, t_2 = specialised carriers, t_3 = buyers.

2.3 *Data and estimation results*

The data used to estimate the model were kindly made available by the "Trade Group Wholesale in Floricultural Products" in Aalsmeer and "Wholesale Management Consultants" in Rijswijk, the Netherlands. The data refer to 53 individual flower exporters scattered over the four-year period 1984 to 1987. Some traders appear only once in the data set, whereas other firms appear all four years yielding a total of 126 observations.[9]

The stochastic model follows by substituting the expression for labour intensity (3) in model (1) and adding a normally distributed disturbance term to account for measurement errors, omitted variables, et cetera. The model is estimated by non-linear least squares. The results are shown in the first column of Table I.

The estimation results are satisfactory. The correlation coefficient between actual and estimated labour volume is considerable (ρ = 0.94) and the parameter estimates generally confirm our hypotheses. Labour quality has the expected positive impact on labour productivity, whereas a dispersed export market has the opposite effect. The degree of automation has a positive influence on productivity, although its effect does not differ significantly from zero. A higher share of potted plants likewise results in higher productivity. Furthermore, sales to retailers appear to be relatively labour intensive, which is in accordance with our hypothesis that retail orders involve more personal attention and offer limited opportunities to benefit from scale economies in order processing. Finally, productivity is affected by the way transport is carried out. Productivity increases by putting out the transport function to customers. However, transport by professional carriers surprisingly results in lower productivity. An explanation of this unexpected result may be that the data do distinguish between types of transport. Especially air transport puts additional strain on the production process because of strict packing regulations and the time involved in transporting flowers to the airport, which causes lower productivity.

3. Profitability in the exporting flower trade

3.1 *The model*

The second performance indicator, profitability, is studied using a full costs mark-up model. According to the mark-up rule exporters determine their annual gross profit margin, μ, as a mark-up, ρ, on average full operating costs, κ:[10].

$$\mu = \kappa + \rho. \quad (4)$$

The mark-up model based on definition (4) is as follows:

$$\mu = \gamma_1 \kappa_{\text{Lab}} + \gamma_2 \kappa_{\text{Rem}} + \gamma_3 \kappa_{\text{Cap}} + \rho(X). \quad (5)$$

We discriminate three cost categories: labour costs, κ_{Lab} (wages and social premiums), remaining operating costs, κ_{Rem} (including expenditures on housing, transport, communication, etc.), and capital related costs, κ_{Cap} (depreciation and interest payments). This distinction into three cost categories makes it possible to examine the attitude of exporters towards these cost categories as a basis to determine gross profit margins. The coefficients γ_1, γ_2, and γ_3 will be equal to one, if the corresponding cost categories are fully taken into account.

3.2 *Differences in profitability*

The profit mark-up is influenced by numerous firm and market characteristics summarized by X. Below we examine the impact of assortment composition, buyer types, different export countries, sales growth and debt term.

Assortment composition, a. Different assortment groups may have different effects on profitability. On the one hand, potted plants are expected to positively influence profitability as a result of the possibility to store potted plants as long as they can not be sold at acceptable prices. On the other hand, selling potted plants may involve lower margins than cut-flowers in view of its appeal on international markets. Cut-flowers are a typical Dutch produce, whereas potted plants are largely available abroad. This implies that demand for potted plants is more elastic than demand for cut-flowers.

Buyer types, b. Flower exporters serve various types of customers: local wholesalers, retail chains, florists, and other buyers. The mark-up for each of these categories will vary for several reasons. First, average order sizes differ across buyers. Large buyers, such as local wholesalers and retail chains, probably buy relatively large quantities of flowers, which offers opportunities to increase efficiency. Secondly, larger buyers take a stronger bargaining position during price negotiations, since they usually are well-informed about auction prices and competing traders in the market.

Selling markets, c. Flowers are exported throughout the world. The profit mark-up on sales to various countries will differ for several reasons. First, the willingness of people to buy flowers differs across countries depending on, for instance, disposable income. Secondly, competition from other flower traders is more fierce in one country than another. Thirdly, a larger distance to selling markets causes unit transport costs to be higher putting profits under pressure at given selling prices.

Export growth, Δq. Rapidly growing export volume is expected to raise profitability.[11] Sales growth is assumed to lower unit operating costs due to increased capital utilization. In addition, sales growth may be attributed to increased demand which improves profitability through higher selling prices.

Debt term, d/d_A. The debt term is defined as the ratio of average annual debts to annual sales value. We assume that the debt term can be used as service instrument to stimulate flower demand. A relatively long debt term involves more intensive filling of the credit function of wholesaling,[12] which should be rewarded through the profit rate.

The profit mark-up, ρ, from equation (5) is extended to take account of differences in assortment composition, types of buyers, selling markets served, export growth and debt term, in the following way:

$$\rho = \rho_0(a_1 + \rho_1 a_2)(b_1 + \rho_2 b_2) \left(c_0 + \sum_{i=1}^{7} \rho_{3i} c_i \right) \exp(\rho_4 \Delta q) \left(\frac{d}{d_A} \right)^{\rho_5}, \qquad (6)$$

with:

- a: assortment composition;
- b: buyer types;
- c: export countries; c_0 = West-Germany, c_1 = Belgium and Luxembourg, c_2= France, c_3 = United Kingdom, c_4 = Italy, c_5 = Austria and Switzerland, c_6 = other European countries, c_7 = Rest of the World;
- Δq: export growth in excess of its sample average;
- d: average annual debt term; d_A is the sample average.

3.3 *Estimation results*

The estimation results for the mark-up model (5) including extension (6) are presented in the second column of Table I.

It follows that flower traders do not take their costs fully into account. The estimated coefficients of labour costs, remaining operating costs and capital related costs assume values which are significantly below one. The result for labour costs may be explained by a possible dependency of the remuneration system on performance. Firms that perform well in terms of profits may be inclined to pay their employees (or some of them, like managers and purchasers) higher wages. This correlation between labour costs and performance causes a (partial) break down of labour costs as a basis to calculate gross margins. The relatively small effect of capital related costs may be due to a tendency among relatively large, capital intensive firms to exploit new export markets which are less profitable than existing export markets. Other causes of this cost behaviour may be the degree of competition urging wholesalers to temporarily lower margins below justifiable levels or the occurrence of other pricing strategies than cost-based mark-up rules.[13] Yet another reason may be the presence of a simultaneity bias. This technical effect is elaborated in the next section.

Examining the estimation results for the mark-up variables, we find that increasing shares of potted plants lead to higher profitability. Sales to retailers appear to be relatively profitable. Exporting to Belgium leads to lower profit rates in relation to exports to West-Germany, while sales in Italy, Austria, Switzerland, and other European countries generally have a positive effect on the mark-up. Furthermore, we find that export growth and debt term positively affect profitability, which is in accordance with our expectations. The positive effect of export growth is attributed to increased capital utilization together with a demand pull on selling prices. The influence of the debt term is due to a more intensive filling of the

TABLE I

Estimation results for labour model (1) and mark-up model (5) using non-linear least squares, seemingly unrelated regression, and two-stage least squares

	OLS	OLS	SUR	2SLS
	Labour model[a]			
α Threshold labour	3.437		3.418	3.723
	(0.959)		(0.959)	(1.054)
β_0 Average labour intensity[b]	10.789		10.755	9.500
	(1.502)		(1.497)	(1.677)
β_1 Labour quality	−0.610		−0.600	−0.755
	(0.189)		(0.189)	(0.277)
β_2 Dispersion of export market	−0.644		−0.643	−0.674
	(0.076)		(0.076)	(0.125)
β_3 Degree of automation	−0.007		−0.0004	−0.109
	(0.064)		(0.064)	(0.108)
β_4 Sales of plotted plants	0.245		0.250	0.231
	(0.100)		(0.100)	(0.124)
β_5 Sales to retailers	2.249		2.278	2.273
	(0.338)		(0.340)	(0.407)
β_6 Transport by specialized carriers	1.152		1.157	1.278
	(0.169)		(0.169)	(0.247)
β_7 Transport by customers	0.647		0.645	0.755
	(0.202)		(0.201)	(0.269)
Observations	126		126	126
Mean square error	38.841		38.849	40.083
Correlation coefficient[c]	0.943		0.945	0.945

Table I (Continued)

		OLS	OLS	SUR	2SLS
		Mark-up model			
γ_1	Labour costs		0.799	0.837	1.054
			(0.107)	(0.107)	(0.200)
γ_2	Remaining operating costs		0.913	0.911	0.879
			(0.056)	(0.056)	(0.065)
γ_3	Capital related costs		0.507	0.504	0.413
			(0.173)	(0.173)	(0.185)
ρ_0	Average mark-up[d]		0.049	0.046	0.033
			(0.009)	(0.009)	(0.015)
ρ_1	Sales of potted plants		0.663	0.667	1.037
			(0.194)	(0.206)	(0.441)
ρ_2	Sales to retailers		1.475	1.517	1.611
			(0.210)	(0.228)	(0.364)
ρ_{31}	Export to Belgium and		0.666	0.630	0.601
	Luxembourg		(0.213)	(0.230)	(0.362)
ρ_{32}	Export to France		0.908	0.924	0.955
			(0.288)	(0.306)	(0.410)
ρ_{33}	Export to the United		1.050	1.030	1.015
	Kingdom		(0.170)	(0.179)	(0.247)
ρ_{34}	Export to Italy		1.362	1.503	1.316
			(0.596)	(0.634)	(0.777)
ρ_{35}	Export to Austria and		1.316	1.308	1.190
	Switzerland		(0.297)	(0.314)	(0.447)
ρ_{36}	Export to other European		2.436	2.564	2.814
	countries		(0.511)	(0.560)	(0.962)
ρ_{37}	Export to the rest of the		1.080	1.086	1.087
	world		(0.318)	(0.338)	(0.475)
ρ_4	Export growth		0.059	0.063	0.115
			(0.052)	(0.055)	(0.073)
ρ_5	Debt term		0.070	0.083	0.139
			(0.047)	(0.051)	(0.098)
Observations			126	126	126
Mean square error ($\times 10^4$)			4.919	4.929	5.255
Correlation coefficient[c]			0.943	0.945	0.945

[a] Asymptotic standard errors are given between parentheses.
[b] Average labour intensity is equal to the scale adjusted labour intensity if labour quality, dispersion, and degree of automation are equal to their sample average, and the other variables are equal to zero.
[c] Correlation coefficient between actual and estimated dependent variable.
[d] The average mark-up is equal to the actual mark-up if the variables determining the mark-up are equal to their sample average (in case of export growth and debt term) or equal to zero (in case of the other variables).

credit function of wholesaling which broadens the service package offered by flower traders and increases their risk.

3.4 *A simultaneous equations formulation*

Up to now, productivity and profitability have been treated as mutually independent measures of firm performance. It is likely, however, that both indicators are related for at least two reasons. First, the residuals from both models may be correlated due to common omitted variables, such as the quality of management and hours of sunshine. This information is taken into account by estimating the models by means of seemingly unrelated regression. The SUR estimates are presented in the third column of Table I. Secondly, productivity and profitability are related through average labour costs, C_{Lab}. Labour volume (and therefore labour costs) can not be assumed exogenous in the profitability model, because it is simultaneously determined with gross margin. Simultaneity has been considered by estimating both models by non-linear two stage least squares. The results are presented in the fourth column of Table I.

As shown by Table I, the SUR estimates hardly differ from the previously mentioned OLS results. The source of this similarity is obvious: the correlation between the residuals of both models is relatively small, namely −0.07. The 2SLS results are more interesting. In the labour model, two parameters are particularly affected by this estimation method: the effects of labour quality and degree of automation. Moreover, the amount of threshold labour has increased slightly. In the mark-up model, several parameters have changed. The average mark-up has become smaller, while the impact of various firm characteristics determining the mark-up increased, like the share of potted plants, sales to other European countries, export growth, and debt term. Most surprisingly, however, is the change in the effect of labour costs, which no longer differs significantly from one. As opposed to the OLS case, there appears to be no correlation between labour costs and profit mark-up. The results illustrate how misleading estimation of single equation performance models can be.

4. Econometric models and firm diagnostics

We shall now demonstrate how econometric models can be used to improve traditional methods of performance assessment of individual firms. An illustration is given using both the productivity model and the profitability model developed in previous sections.

4.1 *Inter-firm performance comparisons*[14]

Performance assessment of firms is usually carried out by comparing individual firm performance with industry performance. It is common practice to relate labour productivity, rentability, solvability, and profitability, of individual firms to industry averages for these variables. Clearly, the liability of industry norms depends on the way they are calculated. Traditional diagnostic methods simply use industry averages for this purpose, which are easy to implement and have intuitive appeal especially at the practical level. Yet, there are some problems with the traditional method. The basic problem is that simple industry averages do not take account of the unique characteristics of individual traders. As a consequence, it is difficult to interpret deviations from traditional industry norms in terms of superior or inferior performance. Some deviations can indeed be attributed to performance, whereas other deviations are due to the organization of wholesale activities, composition of assortment, types of buyers served, and other firm characteristics. For the traditional method to make sense, it requires homogeneous clusters of firms, i.e., groups of firms being sufficiently close to one another with respect to a specific number of characteristics. However, the clustering of firms is problematic. First, the classification of firms with respect to continuous variables, such as sales, imply the construction of categories with arbitrary bounds causing loss of information. Performance indicators based on continuous variables therefore can take very different values in the neighbourhood of boundaries, which is contrary to our expectations. Secondly, the number of clusters rapidly increases with the number of characteristics and categories. Given m characteristics and n classes per characteristic, the number of clusters is equal to n^m. Obviously, only a limited number of characteristics can be considered when making homogeneous groups and securing a minimum number of observations per cluster at the same time.

4.2 *A refined method of calculating industry norms*

The econometric models set up in previous sections allow for a refined method of determining industry norms by combining individual firm characteristics with information about all firms in the sample. In addition, these models explicitly handle heterogeneity with respect to firm characteristics thereby circumventing the clustering problem. Figure 1 displays an outline of the refined procedure.

The norm values derived with the aid of econometric models are based on information concerning the entire sample (through the estimated parameters) as well as individual firm characteristics (through the variables). The refined norms are applied in the usual way to assess performance.

4.3 *Some caveats*

The advantage of the proposed method of diagnosing firm performance over the traditional method is obvious. Yet, it is necessary to mention several problems concerning the use of this method.

First, deviations from norm values are used for different purposes. When estimating the model, the residuals are used to determine the performance of the model, whereas during the diagnostic stage the same residuals are used to assess firm performance. The problem results from the fact that all observations in the sample are used to estimate the unknown parameters of the model. The information of individual firms is therefore part of the industry norm. A solution to this problem would be to remove a particular observation from the sample before estimation. However, such a procedure is quite cumbersome in case of non-linear models. Moreover, it can be questioned whether the problem is serious. There is a problem indeed when the firm to be diagnosed assumes such a position in relation to the other firms in the sample that it has a significant disturbing influence on the estimation results, which is illustrated by firm *B* in Figure 2.[15] We expect this problem to be less prominent when relatively large samples are used without obvious outliers. Nevertheless, one should consider this issue when diagnosing firms based on inter-firm performance comparisons.

Secondly, conclusions with respect to performance are sensitive to model specification. Any inference concerning the position of individual firms in relation to the industry depends on the specification of the model used to determine industry norms. Different models may even result in opposite performance assessments, which is illustrated by firm *A* in Figure 2. In this figure the linear labour model from Section 2 as well as the labour-output relationship following from the traditional method of firm diagnostics are displayed.[16] Firm *A* is found to be less productive than expected when considering the traditional method, whereas *A* is more productive according the refined method. Obviously, inferences about firm performance will be more reliable if the models used to determine industry norms more closely reflect reality.

The remarks make clear that one has to be careful in applying inter-firm performance comparisons. Moreover, the problems are slightly more serious for the refined method, although the criticisms equally apply to traditional methods. In spite of this, we think that sophistically calculated industry norms can be of great help to advisors confronted by the task of assessing firm performance.

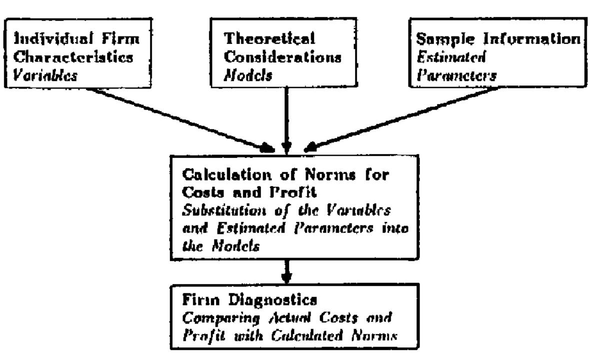

Fig. 1. Outline of the refined method of performance assessment.

4.4. *An example*

In Table II an illustration is given of the proposed

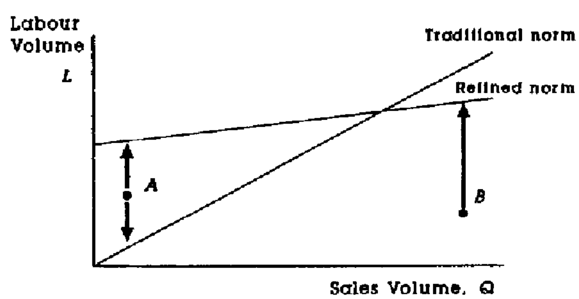

Fig. 2. Two specification of the labour-output relationship and their consequence on performance assessment.

diagnostic method using the estimation results for labour-output relationship (1) and mark-up model (5). Information is displayed concerning labour productivity, profitability, and related variables, like labour volume, labour costs and gross profit. Moreover, Table II presents traditional industry averages, which allows us to compare both methods.

The figures in Table II show that the fictitious firm is more profitable and productive than expected when the refined method of firm diagnostics is considered. Specifically, actual gross margin is 1% higher than expected, while labour volume is two employees lower which corresponds to almost 200,000 Dfl. wage costs. The implications from the traditional method are entirely reversed. In this case, the firm is characterized as less productive and profitable than expected. The gross profit rate is 2% below the industry average and the number of employees is two fte. higher which is also reflected by the relatively high wage costs.

Clearly, inference based on these two methods lead to conflicting recommendations. Following the traditional method the firm may be advised to reorganize labour management in order to lower labour volume and wage costs per employee as well as to improve profitability. However, according to the refined method, such a measure is not in the least necessary. On the contrary, making changes to an obviously efficiently operating organization may even lead to opposite effects. These contradictory conclusions emphasize the necessity of using adequate models when making inter-firm performance comparisons. Especially, when inferences concern real-world problems one cannot afford to apply methods that only partially account for typical firm characteristics.

5. Summary and conclusions

In this paper we have demonstrated the use of econometric models when studying Small Business phenomena. Two models are set up to explain differences in labour productivity and profitability among exporting flower traders. Labour productivity is studied in an implicit manner by means of a linear labour cost relationship. Several factors are found to have a positive effect on productivity: quality of labour, degree of automation, selling potted plants, and transport by customers. On the other hand, a dispersed export market, supplying

TABLE II

An example of firm diagnostics using the estimation results obtained two-stage least squares

Var. description	Actual value	Refined estimate	Difference	Traditional estimate	Difference
q/L Productivity	0.05	0.04	0.01	0.06	−0.01
μ Gross profit margin	0.21	0.20	0.01	0.23	−0.02
L Labour volume	12.00	13.90	−1.95	9.82	2.18
wL Wage costs	0.96	1.11	−0.15	0.79	0.17
<u>Individual firm characteristics:</u>					
Sales volume in mln. kg		$q = 0.60$			
Labour costs		$\kappa_{Lab} = 0.10$			
Remaining costs		$\kappa_{Rem} = 0.05$			
Capital related costs		$\kappa_{Cap} = 0.01$			
Wage rate		$w = 0.08$,	$w_A = 0.06$		
Assortment composition		$a_1 = 0.80$,	$a_2 = 0.20$		
Buyer types		$b_1 = 0.10$,	$b_2 = 0.90$		
Export shares		$c_1 = 0.70$,	$c_2 = 0.20$,		$c_3 = 0.10$
Dispersion selling market		$H = 0.54$,	$H_A = 0.57$		
Degree of automation		$A = 0.08$,	$A_A = 0.06$		
Transportation		$t_1 = 0.80$,	$t_2 = 0.10$,		$t_3 = 0.10$
Debt term		$d = 1.50$,	$d_A = 2.54$		
Export growth		$\Delta q = 0.11$			

retailers, and contracting out transport to specialized carriers tend to lower productivity. The second performance indicator, profitability, is examined with the aid of a full costs mark-up model. Selling to retailers, sales growth, and exports to various export markets appear to have a positive influence on profitability. Moreover, traders seem to take some costs only partly into account when determining selling prices. In case of labour costs this result may be explained by the presence of a simultaneity bias: estimation of both models by two-stage least squares restrains the coefficient of labour costs to one. It is not clear whether the effect of remaining operating costs and capital related costs should also be ascribed to this technical effect. More extensive model building is set forth to elucidate this point. However, the negative effect of capital costs may well be explained from economic considerations: capital intensive firms may involve in exploiting less profitable export markets to benefit from economies of scale. As a consequence, these firms will have relatively low profit rates.

In addition, we have shown how the analyses can be used for comparative performance assessment. The advantage of the proposed method over the traditional method of performance assessment is that individual firm-characteristics are implicitly taken into account. The merits of this econometric approach are not confined to this particular paper nor to the application to the flower trade. The Research Institute of Small and Medium-Sized Business has developed a computer package for inter-firm performance comparisons based on outcomes of similar econometric analyses.[17] The program is now being applied to various small business areas, like pharmaceuticals, camping and recreation services, several business lines from the retail trade and perhaps some day also in the flower trade.

Appendix A: Alternative pricing rules

The mark-up specification presented in Section 3 is one of many possible specifications. It has been applied in view of its intuitive appeal, the flexible way in which the impact of different cost categories can be studied, and the fact that it is frequently applied in retailing. However, flower traders may equally likely apply other pricing strategies. In this appendix we present estimation results of four alternative mark-up specifications. Basically, only two pricing models are involved which differ with respect to which magnitude is used as a basis to calculate profit margins. First, profit margins are supposed to follow from a multiplicative mark-up on average operating costs instead of an additive mark-up as used in the text. The following two specifications are used to reflect this hypothesis:

$$\mu = (1 + \rho)\kappa \qquad \text{(A.1)}$$

and

$$\mu = (1 + \rho^{-1})\kappa, \qquad \text{(A.2)}$$

where ρ is specified as in Eq. (6). Secondly, selling prices are assumed to emerge as a mark-up on purchasing prices. Denoting unit selling prices and unit purchasing prices by p_Q and p_I, respectively, this model can be written as:

$$p_Q = (1 + \rho)p_I. \qquad \text{(A.3)}$$

This formulation can be rewritten in terms of gross margin by subtracting the purchasing price from both sides of the equation and dividing the result by selling price:

$$\mu = \rho\iota, \qquad \text{(A.4)}$$

where ι is defined as the ratio of unit purchasing price to selling price which is approximated by the ratio of purchasing value to sales value. Likewise, its counterpart is written as:

$$\mu = \rho^{-1}\iota. \qquad \text{(A.5)}$$

Again, the specification of the mark-up ρ is given by Eq. (6). The four specifications are estimated by two-stage least squares. The results are presented in Table III.

The most important findings can be summarized as follows. First, the parameters of the productivity model are only sensitive to the structure of the mark-up relationship. Alternative specifications of the mark-up itself (i.e., ρ or ρ^{-1}) appear to be of no consequence. Secondly, the multiplicative mark-up specification (A.1) leads to peculiar estimation results. The impact of selling potted plants and supplying retailers are contrary to the corresponding effects in the additive mark-up model as well as in its variant (A.2). Several export markets are predicted to have a negative impact

TABLE III
Estimation results for four alternative pricing rules using two-stage least squares

		A.1 $\mu=(1+\rho)\kappa$	A.2 $\mu=(1+\rho^{-1})\kappa$	A.3 $\mu=\rho\iota$	A.4 $\mu=\rho^{-1}\iota$
		Labour model[a]			
α	Threshold labour	3.726	3.725	4.150	4.147
		(1.054)	(1.054)	(1.136)	(1.135)
β_0	Average labour intensity[b]	9.493	9.497	8.793	8.800
		(1.677)	(1.677)	(1.756)	(1.756)
β_1	Labour quality	−0.755	−0.755	−0.847	−0.847
		(0.277)	(0.277)	(0.291)	(0.291)
β_2	Dispersion of export market	−0.674	−0.674	−0.740	−0.740
		(0.125)	(0.125)	(0.141)	(0.141)
β_3	Degree of automation	−0.109	−0.109	−0.101	−0.101
		(0.108)	(0.108)	(0.112)	(0.112)
β_4	Sales of plotted plants	0.231	0.231	0.219	0.219
		(0.124)	(0.124)	(0.131)	(0.131)
β_5	Sales to retailers	2.274	2.274	2.248	2.247
		(0.407)	(0.407)	(0.431)	(0.431)
β_6	Transport by specialized carriers	1.279	1.278	1.344	1.343
		(0.247)	(0.247)	(0.285)	(0.284)
β_7	Transport by customers	0.755	0.755	0.735	0.736
		(0.269)	(0.269)	(0.294)	(0.294)
Observations		126	126	126	126
Mean square error		40.087	40.084	40.812	40.803
Correlation coefficient[c]		0.945	0.945	0.945	0.945
		Mark-up model			
ρ_0	Average mark-up[d]	0.119	9.371	0.214	4.323
		(0.049)	(4.558)	(0.015)	(0.268)
ρ_1	Sales of potted plants	−1.745	1.543	0.953	1.032
		(0.404)	(2.151)	(0.138)	(0.152)
ρ_2	Sales to retailers	0.287	0.563	1.970	0.530
		(0.843)	(0.393)	(0.181)	(0.061)
ρ_{31}	Export to Belgium and Luxembourg	−2.951	10.107	0.928	1.014
		(1.752)	(33.752)	(0.157)	(0.165)
ρ_{32}	Export to France	−2.356	2.748	1.244	0.864
		(1.084)	(3.922)	(0.226)	(0.157)
ρ_{33}	Export to the United Kingdom	1.433	2.200	1.099	0.912
		(1.258)	(1.984)	(0.129)	(0.097)
ρ_{34}	Export to Italy	0.704	3.855	1.583	0.686
		(6.270)	(8.618)	(0.487)	(0.275)
ρ_{35}	Export to Austria and Switzerland	−0.297	0.064	1.410	0.632
		(1.163)	(0.598)	(0.245)	(0.133)
ρ_{36}	Export to other European countries	13.135	0.120	1.148	0.834
		(6.859)	(0.090)	(0.308)	(0.195)
ρ_{37}	Export to the rest of the world	−0.176	5.116	2.885	0.263
		(1.087)	(4.529)	(0.275)	(0.040)
ρ_4	Export growth	0.262	−0.244	0.044	−0.031
		(0.175)	(0.165)	(0.037)	(0.040)
ρ_5	Debt term	0.627	−0.359	0.104	−0.120
		(0.338)	(0.259)	(0.034)	(0.037)

Table III (Continued)

	A.1 $\mu = (1+\rho)\kappa$	A.2 $\mu = (1+\rho^{-1})\kappa$	A.3 $\mu = \rho\iota$	A.4 $\mu = \rho^{-1}\iota$
Observations	126	126	126	126
Mean square error (× 10^4)	7.029	7.078	44.505	49.292
Correlation coefficient[c]	0.965	0.961	0.606	0.548

[a] Asymptotic standard errors are given between parentheses.
[b] Average labour intensity is equal to the scale adjusted labour intensity if labour quality, dispersion, and degree of automation are equal to their sample average, and the other variables are equal to zero.
[c] Correlation coefficient between actual and estimated dependent variable.
[d] The average mark-up is equal to the actual mark-up if the variables determining the mark-up are equal to their sample average (in case of export growth and debt term) or equal to zero (in case of the other variables).

on profitability not only in relation to West-Germany but in an absolute sense. Therefore, the results of specification (A.1) are not considered plausible. The alternative mark-up on costs specification (A.2) does however give reasonable estimates, although some results do not conform with those obtained with the additive mark-up model. Thirdly, the two mark-up on purchasing

TABLE IV
Some numerical characteristics of the variables used

Variable	Mean	Standard deviation	Minimum value	Maximum value	Standard error of mean
L (in fte.)	19.479	18.447	1.000	91.000	1.643
q (in mln. kg)	1.213	0.998	0.015	4.857	0.089
Δq	0.000	0.656	−0.621	5.517	0.058
μ	0.230	0.078	0.044	0.459	0.007
C_{Lab}	0.083	0.024	0.020	0.144	0.002
C_{Res}	0.108	0.066	0.015	0.365	0.006
C_{Cap}	0.025	0.014	0.004	0.117	0.001
d/d_A	1.000	0.950	0.017	4.425	0.085
w/w_A	1.000	0.214	0.545	1.576	0.019
H/H_A	1.000	0.447	0.171	1.766	0.040
A/A_A	1.000	0.544	0.059	2.294	0.048
a_1	0.832	0.229	0.000	1.000	0.020
a_2	0.168	0.229	0.000	1.000	0.020
b_1	0.764	0.289	0.000	1.000	0.025
b_2	0.178	0.264	0.000	1.000	0.023
b_3	0.058	0.144	0.000	0.950	0.013
t_1	0.518	0.380	0.000	1.000	0.034
t_2	0.356	0.390	0.000	1.000	0.035
t_3	0.126	0.230	0.000	1.000	0.020
c_1	0.435	0.383	0.000	1.000	0.034
c_2	0.067	0.220	0.000	1.000	0.020
c_3	0.074	0.181	0.000	0.984	0.016
c_4	0.183	0.297	0.000	1.000	0.026
c_5	0.014	0.080	0.000	0.642	0.007
c_6	0.088	0.156	0.000	0.687	0.014
c_7	0.038	0.118	0.000	1.000	0.011
c_8	0.102	0.204	0.000	0.988	0.018

price models, (A.4) and (A.5), give mutually consistent estimates of the unknown effects. Only in case of exports to France the estimated effect differs from the estimate of the additive mark-up model. However, this difference is in favour of the former two specifications. A disadvantage of these models is that no distinction can be made with respect to costs and demand effects of the variables determining the mark-up. In other words, it is not clear whether exports to, e.g., Austria and Switzerland raise profitability because of higher transport costs or a lower demand elasticity. Obviously, more complex pricing models are needed to disentangle effects of different origins.

Appendix B: Some numerical characteristics of the data

The data used in the present study are obtained from the "Trade Group Wholesale in Agricultural Products" in Aalsmeer and the "Wholesale Management consultants" in Rijswijk, the Netherlands. The data refer to individual Dutch flower exporters. The data refer to individual Dutch flower exporters. The confidential nature of the data does not allow us to provide firm-level information. However, we are able to present an overview of the main numerical characteristics of the variables used in Table IV.

Notes

* This study is part of a research program on wholesaling, which is carried out at the "Center of Advanced Small Business Economics" (CASBEC) of the Erasmus University Rotterdam. The authors wish to thank the "Trade Group Wholesale in Floricultural Products" in Aalsmeer and "Wholesale Management Consultants" in Rijswijk for supplying us with data and information about the flower trade. We thank Bob Slik of the Erasmus University for carefully processing the data and two anonymous referees for helpful comments.

[1] We shall not mention individual papers here. Examples of studies on labour productivity can be found in Dogramaci's series on productivity (e.g., Dogramaci, 1983, 1986) and the recently started Journal of Productivity. For studies on profitability we refer to the extensive literature on industry performance as reviewed, for instance, by Cubbin (1988) and Schmalensee (1989).

[2] Reviews of productivity studies in retailing can be found in Gautschi (1983) and Nooteboom (1987). Retail profitability is dealt with by Nooteboom (1985), among others.

[3] The service capacity offered by flower traders can be summarized as follows. Flower exporters purchase flowers at the auction and sell them to foreign buyers: florists, local wholesalers, retail chains, and other buyers. Their activities consist of order acquisition, buying flowers at the auction, processing orders (washing, sorting, cutting, packing, etc.), and transporting flowers to customers. Details about the service capacity of flower exporters are given by Van Dalen and Thurik (1990).

[4] The model is developed by Nooteboom (1980, 1982) and generalized by Thurik (1984). A survey of empirical applications is given by Nooteboom (1987). Frenk *et al.* (1991) use modern queuing theory to derive the linear labour model.

[5] It is implicitly assumed that lags in the adjustment of actual to desired labour volume do not persist beyond a period of one year. Adjustments lags may occur during a particular year, but are supposed to be averaged out at an annual base. This assumption is important in view of procyclical effects in labour productivity as recorded, for instance, by Thurik and Kleijweg (1986).

[6] One referee questioned the use of the wage rate as indicator of labour quality in view of the occurrence of disturbing influences, like regional effects. Of course, wage costs per employee are only an approximation of labour quality. Nevertheless, we think it to be a reasonable one for the following reason. Flowers are bought at a central location: the auction, where information (of all kinds) travels fast. The transparency of this part of the labour market which is extremely important to flower traders, necessitates exporters to compensate high-quality labour with correspondingly high wage rates. If not, his personnel will sooner or later show an increased tendency to change jobs.

[7] The Herfindahl index, H, is calculated as follows. Let c_i be the share of exports to country i in total sales volume, then $H = \Sigma_i(1/c_i)^2$. In addition, the index is divided by its sample average, H_A. The Herfindahl is inversely related to dispersion of the export market. Therefore, the impact of the Herfindahl on labour productivity is expected to be positive.

[8] We wish to make three remarks regarding the choice of this particular specification. First, a multiplicative formulation of labour intensity is chosen to express the conditional nature of the variables considered. The impact of, e.g., assortment composition on labour intensity is likely to depend on the values of all other variables determining labour intensity. Second, the following strategy has been applied to represent different kinds of variables. Continuous variables taking positive values only are divided by their sample average and raised to a certain power. Variables assuming both negative and positive values are subtracted by their sample average and represented through the exponential function. Moreover, composed effects, such as assortment composition and types of buyers served, are incorporated by considering their compository shares in an additive manner. Third, threshold labour, α, might similarly be extended to take account of varying numbers of independently operating departments within a firm. However, the available data do not allow us to do so.

[9] Our estimation methods do not take account of this particular feature of the data. Therefore, the estimation results may be biased. The reason for using all available observations is that non-linear estimation techniques generally require a large number of data points in view of the asymptotic properties of the estimators.

[10] Nooteboom (1985) applies the mark-up model to explain retail margins at the shop type level. Bode *et al.* (1986) use his model to study differences in profitability among individual retail outlets. The model has also been applied to the hotel, restaurant and catering business by Van der Hoeven and Thurik (1987). We apply the mark-up model the flower trade, because of its intuitive appeal, the flexible way in which different cost categories can be considered, and its frequent use in retail research. Of course, other pricing strategies may prevail. In Appendix A four alternative specifications are examined.

[11] Discussions on the influence of sales growth on profitability are given, for example, by Esposito and Esposito (1971) and Pagoulatos and Sorenson (1976), who analyze pricing in manufacturing industries. Similarly, Bode *et al.* (1986) introduce sales development to explain differences in profitability among individual retailers.

[12] The credit function is one of many function which the wholesale trade is supposed to fill. Other wholesale tasks are, for example, inventory keeping, transportation and communication. The role of wholesaling is discussed by Van Dalen *et al.* (1990) and by references mentioned therein.

[13] Alternative mark-up rules are examined in Appendix A. Explicitly stated behavioural rules are considered by Van Dalen and Thurik (1990), who present an extended pricing model which assumes traders to apply a pricing strategy which is somewhere between sales and profit maximization.

[14] The issues raised in this subsection are largely based on Van der Wijst (1985).

[15] Such an observation is called influential. We refer to Krasker, Kuh and Welsh (1983) who extensively deal with the problem of influential data. They also list various statistics to detect influential observations and a method to reduce their influence (beyond deletion).

[16] The traditional method of diagnosing firm performance determines norm values for productivity by calculating the unconditional mean of the productivity values of individual firms, say $\gamma^{-1} = N^{-1}\Sigma_i(q_i/L_i)$. This implicitly amounts to assuming employment to be proportional to sales volume, or: $L = \gamma q$.

[17] The program called BAKEN has been developed in cooperation with a large software house. It is designed in such a way that it can be used on any IBM-compatible machine.

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