Abstract:

In this paper, we perform an empirical analysis on the variance of accounting profitability among manufacturing firms in the Belgian economy from 1992 to 2001. Our purpose is to understand the relative importance of industry, business unit and time on the profitability of Belgian companies described by 3 and 4-digit NACEBEL codes during this time period. Our results so far reveal very large business unit effects and relatively small but significant industry and industry-year interaction effects. These findings suggest that there is much higher within-industry than among-industry variance in Belgian manufacturing firm profitability.

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INTRODUCTION

Market imperfections impede allocation of resources that ultimately equalize returns across uses. The study of these imperfections or impediments can be broadly divided into two main streams of thinking. The industrial organization tradition views industry structure as a central determinant of firm performance. On the other hand, the resource-based view holds that the most important impediments arise not from collective actions of firms but from the unique resources and processes within firms or business units. Schmalensee (1985) pioneered empirical support to this debate by running statistical analyses on the US FTC Line of Business (LB) data. His work sparked interest in this stream of empirical study and a subsequent series of works ensued with results providing various perspectives of the debate, and at times '…yielding somewhat different conclusions' (McGahan and Porter 2002). Most if not all of these works have used data on US companies. No such similar extensive research has been done on European, and more specifically Belgian firms.

This study essentially seeks to develop better understanding of Belgian firm profitability by adopting methods from the US studies above. The method decomposes the variance of profitability of firms into factors consisting of industry, corporate parent, business unit and time. Put differently, it seeks to understand the relative importance of these factors on the total dispersion of reported rates of return without imputing causality (eg that industry shapes firm conduct, which in turn drives firm performance).

The profitability rate used is Return on Asset, which is defined as the ratio of profit before interest and taxes to total assets. We recognize that accounting rates of returns have been argued to have limitations in terms of being biased measures of true internal rates of return (Rumelt 1985, pp171) and that they do not account for the cost of capital nor for the accounting policies that may distort the true value of the underlying …assets (Hawawini, 2003, pp 1). We however also note Kay's (1976) findings, that 'the accountant's rate of profit, measured over a period of years, will be an acceptable indicator of the true rate of return: it is over a single year that it may prove seriously misleading.' For the purpose of comparison with antecedent studies, and in view of the limitations of data availability, eg plausible EVA estimates of Belgium firms, we proceed with our analysis using ROA data computed by Bureau Van Dijk Electronic Publishing using accounting data reported by Belgium firms to the Central Balance Sheet Office of Belgium. We will discuss our data in fuller detail in the subsequent data section.

ANTECEDENT STUDIES REVIEW

Schmalensee (1985) analyzed the FTC Line of Business data for a single year, namely 1975. He found that industry effects accounted for 19.59% of the variance in ROA, the business unit effect measured by market share represented 0.62% of the variance in ROA and that corporate effects did not exist.

Rumelt (1991) extended Schmanlansee's sample from one to four years, from 1974 to 1977, and denoted this as his sample A. Next he relaxed Schmalensee's constraint that only business units with a market share larger than one percent should be included in the sample. This enlarged database consisting of smaller firms was denoted as Rumelt's sample B.

Rumelt found comparable, but lower (than Schmalensee) industry effects of 16.12%. In addition, Rumelt's model specification allowed industry effects to be differentiated into stable and time-varying (year-to-year industry-specific fluctuations) components. This, he argued, would draw out the 'stable industry effects', which was the component that 'classical focus' on industry intended to study. His results showed that only 8.32% of profit variability was attributable to stable industry effects.

The major difference between Schmalensee and Rumet's findings however is in the business unit effect. While Schmalensee found a small but significant market share effect, Rumelt found the business unit effect accounts for 46.37% (while applying the COV or component of variance approach). This finding is interpreted by proponents of the resource-based view of the firm as a result which 'proves' that the primary relevant

dimension for strategic analysis is not the attractiveness of the industry as suggested by Porter, but the unique endowments, positions and strategies of individual businesses (Rumelt 1991, pp168).

Rumelt also reported a small (0.8%) but significant corporate effect. He found a very small but not always significant year effect.

In 1997, McGahan and Porter published their study based on Compustat business segment data for the period 1981 – 1994 and aggregated at the 4-digit SIC level. In contrast to the majority of the prior studies which analyzed only manufacturing data, McGahan and Porter's dataset consists of industries comprising the whole US economy except for the financial industry and government sectors. The data were analyzed using COV and nested Anova methods.

The COV method found industry effect accounted for 18.68% of profit variability. The nested Anova results revealed industry effects in the range of 6.8% to 9.4%.

The results for the business unit effects were as follows: 31.71% from COV estimation and between 34.9% to 35.1% from the nested Anova procedure.

McGahan and Porter also found considerable corporate effects. The COV methodology produced 4.33% whilst the nested Anova analysis resulted in corporate effects in the range of 9.1% to 11.9%.

The year effect appeared to be significant but small. The COV methodology produced an estimated year effect of 2.39%. For the nested Anova analysis, it was estimated as 0.3%.

McGahan & Porter also found a negative covariance between the industry and the corporate effect of –5.51% through the COV method.

In another study, Chang and Singh (2000) analyzed market share data for five years, 1981, 1983, 1985 and 1989. Their data were aggregated at the 3 and 4-digit SIC levels and consisted mainly of public manufacturing firms. As research methodology, they opted for COV analysis.

It should be noted that their analysis used market share as a dependent variable versus most others which used accounting profit. Chang and Singh however, considered the market share variable as a measure of the competitive position of a company within its industry. 'We believe these retrenchments [of incumbent firms by divestiture or plant closure] and expansions [by addition of new plants or acquisition] reflect changes in competitive performance' (Chang and Singh, pp744).

For the industry effect they found a range from 13.1% (3-digit SIC aggregation) to 15.9% (4-digit SIC aggregation). The business unit effect varied from as 31.9% (3 digit SIC aggregation) to 50.2% (4-digit SIC aggregation). The corporate effect estimates ranged between 2.4% (3 digit SIC aggregation) to 7.6% (4-digit SIC aggregation). They also found a significant year effect ranging from 0.5% (at 4-digit SIC aggregation) to 4.2% (3 digit SIC aggregation).

Hawawini (2003) et al introduced analysis on two ratios other than ROA, economic profit per dollar of capital employed and total market value per dollar of capital employed. Capital employed here refers to the sum of equity capital and debt capital. These two measures were used on grounds that they could better reflect a firm's past economic and future profitability. Analysis was also performed on ROA for comparison with previous studies. Data was provided by Stern Steward Consultancy and included 1000 US listed firms in a broad range of industries excluding finance. The COV method was used for estimation of the various effects excluding the corporate effect, as the latter could not be estimated due to the nature of the data set used. Analysis was run first on the full dataset and then on a reduced set that had the industry top two and bottom two value leaders (defined roughly as having outperformed and underperformed others within the industry for the maximum number of years within the period under study) removed. Their main finding was that the business effect had a larger impact on industry leaders and losers. For the vast majority of the other firms, ie firms that are neither industry leaders nor losers, industry factors dominated.

A summary of the above findings is presented in Table 1.

	Schmalensee 1985	Rumelt 1991[a]	McGahan & Porter 1997[b]	Chang & Singh 2000[c]	Hawawini et al 2003[d]
Study Parameters					
Statisical Technique	COV	COV Nested ANOVA	COV Nested ANOVA	COV	COV
Data Source	FTC	FTC	Compustat	Trinet	Stern Stewart Consultancy
Data Years	1975	1974-1977	1981-1994	1981+1983 +1985+1989	1987-1996
Industries included	Manufacturing	Manufacturing	Broad sector range, excl Finance	Mainly Manufacturing	Broad sector range, excl Finance
No of observations	1,775	6,931	58,132	8,132	5,620
Findings					
Corporate	No corporate effects	0.8%	4.33%	7.6%	Included in BU effect
Business Unit	0.62% (represented by Market Share effect)	46.37%	31.71% (represented by Segment-specific effect)	50.2% (represented by Market Share effect)	35.8%
Industry	19.59%	8.32%	18.68%	15.9%	8.1%
Year	Not estimated	Not estimated	2.39%	0.5%	1.0%
Industry x Year	Not estimated	7.84%	Not estimated	Not estimated	3.1%
Model	19.59%	63.33%	51.60%	74.20%	48.00%
Error	80.41%	36.87%	48.40%	48.40%	52.00%
Total	100.00	100.00	100.00	100.00	100.00

Table 1 Summary of Results of Antecedent Studies on Profit / Market Share Variability

NOTES
[a] Results from Rumelt (1991, Dataset A, COV estimates as reported in Table 3, pp178)
[b] Results from McGahan and Porter (1997, COV estimates as reported in Table 2, pp 23)
[c] Results from Chang et al (2000, Sample A at 4 digit SIC level , as reported in Table 3, pp 748
[d] Results from Hawawini et al (2003, COV estimates on ROA, as reported in Table 6, pp 12)

MODEL AND METHODOLOGY

Model

Our analysis of Belgian firm profit variation adopts Rumelt's 1991 model:

$$\mathbf{r_{i,k,t} = \mu + \alpha_i + \beta_k + \gamma_t + \delta_{it} + \Phi_{ik} + \varepsilon_{i,k,t}} \qquad \mathbf{(1)}$$

where

- $r_{i,k,t}$ is the accounting profit in year t of corporate-parent k's business in industry i. Profit is measured as the ratio of operating income to identifiable assets in percent (ROA).
- μ is the average profit over the entire period for all business units.
- α_i is the increment to profit associated with participation in industry i (industry effect). Differences in α reflect differing competitive behaviour, conditions of entry, rates of growth, demand-capacity conditions, differing levels of risk, different asset utilization rates, differing accounting practices, and any other industry specific impacts on the rate of return.
- β_k is the increment to profit conferred by membership in a diversified corporate-parent k (corporate effect - assume corporate-parent effect arises only if a business segment is a member of a diversified firm. Differences in β reflects differences in quality of monitoring and control, differences in resource sharing and other types of synergy, and differences in accounting policy.

- γ_t is the year-to-year fluctuations in macroeconomic conditions that influence all businesses equally (year effect).
- δ_{it} are industry-specific year-to-year fluctuations in return (interaction effects)
- $\Phi_{i,k}$ is the increment to profit associated with the specific situation of business unit i, k given the other effects (business unit effect). It arises from presences of business-specific skills, resources, reputations, learning, patents, and other intangible contributions to stable differences among business unit returns.
- $\varepsilon_{i,k,t}$ is the residual.

Estimation Methods

Following Rumelt, the total variance of returns is decomposed into the following variance components:

$$\sigma^2_r = \sigma^2_\alpha + \sigma^2_\beta + \sigma^2_\gamma + \sigma^2_\delta + \sigma^2_\Phi + \sigma^2_\varepsilon \qquad \textbf{(2)}$$

The parent-industry covariance term has been omitted from our analysis as it turned out to be insignificant in Rumelt's results. We then used the PROC VARCOMP procedure in SAS to perform the variance decomposition in equation 2. PROC GLM was then used to provide additional information on the model.

DATA AND SAMPLE

Our analysis covers 10 years data on Belgian manufacturing companies from 1992 to 2001 extracted from BELFIRST. BELFIRST is a product of Bureau Van Dijk Electronic Publishing, which obtains historical annual account information from the Central Balance Sheet Office to whom companies incorporated under Belgian law submit their yearly financial accounts. Companies can be classified and retrieved using various classifications – activity, liability of shareholders or partners etc. We have chosen to include Belgian manufacturing firms which are limited, are classified as large and have to fill up complete sets of accounts, and whose accounts have been audited by an independent, certified auditor. In addition, we have chosen manufacturing companies so as to compare our results directly with those of Rumelt.

We believe our 10-year data series includes information on a at least one full economic cycle in Belgium – from high interest rates and slow growth in the early 90's, to accelerated growth post 1996 due to increased demand and improved public finances, and to slowing of growth again from 2001 due to global economic slowdown.

EMPIRICAL RESULTS

Table 2 displays the results of a preliminary run of SAS Proc Varcomp on the initial manufacturing dataset. Rumelt's results are also displayed for reference and comparison.

	Line of business defined at 3-digit NACEBEL level	
	Estimate	%
Industry	0.59	0.12
Parent	22.85	4.62
BU	68.70	13.89
Year	0.21	0.04
Industry x Year	1.70	0.34
Error	400.43	80.98
Total	494.49	100.00

Table 2 COV analysis of ROA of Belgian Manufacturing Firms - Full model

These preliminary results appear to agree with Rumelt's findings that the business unit effects are the strongest among the five effects studied.

We are of the opinion that the high parent effect may be due to the fact there is an average of only 1.5 business units per parent. In other words, the parent information from our sample of manufacturing companies is not rich enough to reveal meaningful corporate effects. To investigate this, we omitted the parent data and performed a second PROC VARCOMP run on SAS. The results are shown in Table 3.

	Line of business defined at 3-digit NACEBEL level	
	Estimate	%
Industry	0.75	0.15
BU	91.38	18.48
Year	0.21	0.04
Industry x Year	1.71	0.34
Error	400.43	80.98
Total	494.48	100.00

Table 3 COV analysis of ROA of Belgian Firms
Restricted model excluding corporate variable

As the error from the restricted model differs by only 0.001% from the full model, we removed the corporate effect from subsequent analysis as it was not distinguishable from the other effects from our sample data set. We also expanded our analysis to include the same businesses but re-classified into the NACEBEL 4 digit codes.

The data was then screened for unusual observations. Using as reference, a general ROA value of below 20%[1], we detected several observations where ROA figures were extremely high or low due to wide swings in assets between years. This came mostly from firms which had reduced their assets to a minimal amount and appeared to be on an exit strategy.

We decided to produce 4 data sets for analysis by removing observations in stages and reviewing the results. The removal of observations would follow the following guide:

- exclude observations with ROA above 800% for dataset termed x800;
- exclude observations with ROA above 500% for dataset termed x500;
- exclude observations with ROA above 300% for dataset termed x300 and finally,

[1] See Walsh, Ciaran (1996) chapter 6

- exclude observations with ROA above 100% for dataset termed x100.

Our datasets were thus comprised as such :

- x800 : 40,455 valid observations, with 168 (385) levels of NACEBEL 3 (NACEBEL 4) digit industry factor, 4,590 levels of BU factor and 10 levels of year factor;
- x500 : 40,449 valid observations, with 168 (385) levels of NACEBEL 3 (NACEBEL 4) digit industry factor, 4,590 levels of BU factor and 10 levels of year factor;
- x300 : 40,428 valid observations, with 168 (385) levels of NACEBEL 3 (NACEBEL 4) digit industry factor, 4,590 levels of BU factor and 10 levels of year factor;
- x100 : 40,313 valid observations, with 168 (385) levels of NACEBEL 3 (NACEBEL 4) digit industry factor, 4,590 levels of BU factor and 10 levels of year factor;

Table 4a to 4d display the results of the Variance Component analysis of ROA for the 4 datasets, and for 3 and 4 digit NACEBEL activities accordingly.

	Belgian Companies defined at 3-digit NACEBEL level		Belgian Companies defined at 4-digit NACEBEL level	
	Estimate	%	Estimate	%
Industry	1.35	0.35	2.55	0.66
BU	102.12	26.28	100.91	25.97
Year	0.18	0.05	0.18	0.05
Industry x Year	0.69	0.18	0.95	0.24
Error	284.23	73.15	283.97	73.08
Total	388.57	100.00	388.56	100.00

Table 4a COV Analysis for x800 dataset

	Belgian Companies defined at 3-digit NACEBEL level		Belgian Companies defined at 4-digit NACEBEL level	
	Estimate	%	Estimate	%
Industry	1.45	0.45	2.31	0.71
BU	96.20	29.63	95.33	29.36
Year	0.23	0.07	0.23	0.07
Industry x Year	0.34	0.11	0.44	0.13
Error	226.45	69.75	226.35	69.72
Total	324.67	100.00	324.66	100.00

Table 4b COV Analysis for x500 dataset

	Belgian Companies defined at 3-digit NACEBEL level		Belgian Companies defined at 4-digit NACEBEL level	
	Estimate	%	Estimate	%
Industry	1.17	0.48	1.87	0.76
BU	81.52	33.31	80.81	33.02
Year	0.24	0.10	0.25	0.10
Industry x Year	0.58	0.24	0.90	0.37
Error	161.20	65.88	160.89	65.75
Total	244.71	100.00	244.70	100.00

Table 4c COV Analysis for x300 dataset

	Belgian Companies defined at 3-digit NACEBEL level		Belgian Companies defined at 4-digit NACEBEL level	
	Estimate	%	Estimate	%
Industry	1.42	0.86	2.08	1.26
BU	62.65	37.98	61.97	37.57
Year	0.18	0.11	0.18	0.11
Industry x Year	0.40	0.24	0.45	0.27
Error	100.30	60.81	100.25	60.78
Total	164.95	100.00	164.94	100.00

Table 4d COV Analysis for x100 dataset

The general results that can be reported from the above analyses are:

- moving between higher to lower aggregation of industry definitions, (ie moving from 3 to 4 digit NACEBEL codes produces minimal change in the industry effect on profitability of Belgian manufacturing companies.
- Results from the x300 and x100 datasets show the BU effect ranges from 33% to 38%, results that come quite close to those of McGahan and Porter's. However, as with Rumelt's findings, the BU component overshadows that of all the other effects. Refer to Table 5 for comparison.

Variance Component	This study x300 (NACEBEL 4 Digit)	This study x100 (NACEBEL 4 Digit)	Rumelt 1991 (Sample A)	McGahan & Porter 1997
Industry	0.76%	1.26%	8.32%	18.68%
BU	33.02%	37.57%	46.37%	31.71%
Year	0.10%	0.11%	Not estimated	2.39%
Industry x year	0.37%	0.27%	7.84%	Not estimated
Model	34.25%	39.22%	63.33%	51.60%
Error	65.75%	60.78%	36.87%	48.40%
Total	100.00%	100.00%	100.00%	100.00%

Table 5 Comparison of This Study's Results with Antecedent Findings

We have followed Rumelt in using the variance component estimation partly because our results can be compared directly with his (and the works of other authors on this subject), and also because it is a relatively straightforward method. We are aware however that

variance component technique is a method of moments estimator and has its limitations in producing parameters with good statistical properties[2].

In order to provide additional information on the adequacy of our model, we conducted significance tests for the individual effects. This was done using the PROC GLM procedure in SAS, setting the BU factor as fixed, and nested within the industry factor. The relevant SAS output are reproduced here :

The GLM Procedure

Dependent Variable: roa roa

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6046	6792068.70	1123.40	4.33	<.0001
Error	34408	8924561.01	259.37		
Corrected Total	40454	15716629.71			

R-Square	Coeff Var	Root MSE	roa Mean
0.432158	446.8361	16.10511	3.604255

Source	DF	Type III SS	Mean Square	F Value	Pr > F
nacebel3	167	330706.096	1980.276	7.63	<.0001
unit(nacebel3)	4421	5932351.522	1341.857	5.17	<.0001
year	9	4944.570	549.397	2.12	0.0247
nacebel3*year	1449	425934.373	293.951	1.13	0.0004

Table 6a Partial SAS Output of PROC GLM Procedure for x800 Dataset

[2] See Montgomery, Douglas (2001), chapter 12

The GLM Procedure

Dependent Variable: roa roa

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6046	6032950.29	997.84	4.84	<.0001
Error	34402	7096306.45	206.28		
Corrected Total	40448	13129256.74			

R-Square	Coeff Var	Root MSE	roa Mean
0.459504	391.5866	14.36231	3.667723

Source	DF	Type III SS	Mean Square	F Value	Pr > F
nacebel3	167	322619.600	1931.854	9.37	<.0001
unit(nacebel3)	4421	5218258.375	1180.334	5.72	<.0001
year	9	5250.942	583.438	2.83	0.0025
nacebel3*year	1449	392594.146	270.941	1.31	<.0001

Table 6b Partial SAS Output of PROC GLM Procedure for x500 Dataset

The GLM Procedure

Dependent Variable: roa roa

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6046	4910141.606	812.131	5.61	<.0001
Error	34381	4980152.925	144.852		
Corrected Total	40427	9890294.531			

R-Square	Coeff Var	Root MSE	roa Mean
0.496461	314.0022	12.03544	3.832917

Source	DF	Type III SS	Mean Square	F Value	Pr > F
nacebel3	167	280865.463	1681.829	11.61	<.0001
unit(nacebel3)	4421	4319869.598	977.125	6.75	<.0001
year	9	1651.874	183.542	1.27	0.2491
nacebel3*year	1449	246931.109	170.415	1.18	<.0001

Table 6c Partial SAS Output of PROC GLM Procedure for x300 Dataset

The GLM Procedure

Dependent Variable: roa roa

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6040	3487808.396	577.452	6.26	<.0001
Error	34272	3159328.852	92.184		
Corrected Total	40312	6647137.248			

R-Square	Coeff Var	Root MSE	roa Mean
0.524708	232.1015	9.601248	4.136659

Source	DF	Type III SS	Mean Square	F Value	Pr > F
nacebel3	166	171680.492	1034.220	11.22	<.0001
unit(nacebel3)	4417	3099289.562	701.673	7.61	<.0001
year	9	1321.257	146.806	1.59	0.1110
nacebel3*year	1448	171271.611	118.281	1.28	<.0001

Table 6d Partial SAS Output of PROC GLM Procedure for x100 Dataset

The GLM procedures on the x800 and x500 datasets show all the effects to be significant at the 0.05 significance level. The year effect is significant only in the more extreme x800 and x500 datasets. This could be due to extreme fluctuations happening in certain years[3] that were picked up by the year effect. In comparison, the industry-year effect is significant for all datasets, highlighting the importance of transient shocks that affect industries equally in magnitude and timing.

As expected, the fit of our model, as measured by the R-squared, improves progressively (as the extreme observations are removed) to 0.52 for the x100 dataset.

[3] Interestingly, more than half of the extreme observations appeared to happen in the years between 1998 and 2000. This result is worth further review and investigation.

DISCUSSION

Our results so far show Belgian manufacturing companies classified under NACEBEL 3 and 4 digit codes to be highly heterogeneous and there is much higher within-industry than among-industry variance in profitability during the period 1992 to 2001.

An immediate inference may be that it is the unique resources and actions of firms (business unit), rather than the collective conditions and behaviour of firms (industry) in the Belgian manufacturing sector that contributes to persistent unequal returns among Belgian companies. We wish to point out however, that the work completed to date is limited to time, resources and availability of data.

We acknowledge that further investigation could be conducted in view of the relatively high error of 61%. Also further research can be developed from here, such as performing a similar analysis on all sectors of the Belgian economy instead of just manufacturing and incorporation of the corporate effect, (where possible, depending on information within the data. It may also be interesting to performing the analysis with more advanced methodologies eg that of McGahan and Porter (1997) which incorporates a parameter that captures the intertemporal persistence of effects.

Nonetheless, our study points to the importance of the field of corporate strategy, with the firm as the main unit of analysis, as key to understanding differences in resource flows and persistent differences in returns within the manufacturing sector of the Belgian economy. We are confident that our results have initiated a sound basis for more informed work in this stream of study on European firms.

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