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Differences in profitability between European dairy processing firms of different size classes

BSc Thesis Agricultural Economics and Rural Policy (AEP)

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Abstract

The European dairy processing industry has changed considerably the last few decades. Countries differ in their industry structure, some having a small number of large enterprises and other countries a large number of small firms. This thesis investigates whether there are differences in the determinants of profitability between micro, small, medium and large firms in the European dairy processing industry. Profitability is measured as Return on Assets and profit per employee. An 11-years panel dataset is used that included dairy processing companies from six European countries. The Random Effects panel data estimation method is used. Results show that lagged profitability, total assets, leverage, age, and market share have a statistically significant effect on profitability. Differences between firm size and countries are tested. The most important conclusion for the European dairy processing industry is that there are significant differences in profitability between the four firm size classes. Also there are some differences between the six countries; especially Italy and the UK are different.

Key words

European dairy processing industry, panel data, profitability, firm size

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Chapter 1 Introduction

The European business life is changing its character. It has followed some stages to where it is now, a common market, with a common currency and in some areas there exists a common policy. Because of the introduction of an internal market within the European Union trade barriers are gone, whereby the potential market size has broadened. This caused options for firms to compete with firms in other EU countries, because of economies of scale. The processing industry has responded by a wave of mergers and acquisitions, which resulted in a number of large conglomerates dominating the market (Nilsson and Van Dijk, 1997). Firms are now able to participate in previously inaccessible foreign markets. However, according to Goddard et al. (2005), country-specific factors may still have a great influence on the performance of firms. Reasons are: trade still occurs more within national borders than cross-border; domestic savings are the main source of finance for domestic investment; and investors prefer national stocks.

Especially the European dairy industry structurally changed during the second half of the twentieth century. On the one hand economic protection and control in this sector has led to oversupply. On the other hand a decrease in demand together with changing consumer preferences also affected the industry. In the last three decades the sector has moved to a new structure which can be defined as “oligopolistic market with fringe” (Tozanli, 1997). A small number of very large enterprises emerged, with the share of dairy production by those large enterprises increasing enormously. At the same time there is still a large number of small dairy processing firms which operate in niche markets, but their share in production has decreased (Mahon, 2005).

These changes vary among European countries. In general one can say the dairy industry is more concentrated in the Northern European countries (except for Germany) than in the Southern and Eastern European countries. According to the study of Gardebroek et al. (2010), the four-firm concentration ratios in 2005 for five European countries, also used in this study, are as follows: for France and Germany it is 0.43, for Poland it is 0.27, for Italy it is only 0.12 and for the Netherlands it is 0.77 (using a three-firm concentration ratio). So there is a great difference in concentration of large enterprises between countries in Europe. Especially Italy has a lot of small dairy processing firms.

Porter (1980, 1985, 1990) has stated an interpretation of the structure-conduct performance (SCP) paradigm of classic industrial organization economics, which emphasises the importance of industry structure for firm profitability. It is based on two arguments; first, industry structure determines the

nature of competition, second the nature of competition is a major determinant of firm profitability. In some cases industry structure also influences the price competition and thus average profits. Porter also argued that profitability depends on firm strategy; this can shape industry structure and therefore the nature of competition, to its advantage. So a firm entrepreneur can influence his profitability by the choice of strategy (Hill and Deeds, 1996).

The objective of this thesis is to examine the differences in determinants of profitability between micro, small, medium and large European dairy processing firms. We use an 11-years firm-level panel dataset of France, Italy, the Netherlands, Poland, the UK and Germany, that was also used in a former study on this subject (Gardebroek et al, 2010). Some of the countries are characterised by many SMEs and others by large enterprises. Poland is included because it represents the industrial structure of the new EU member states. Moreover, there are included both Northern and Southern countries (Tacken et al., 2009). First, we will investigate what the effects are of different variables on profitability of European firms. Second, we will look at these effects separately per firm-size class and investigate if there are differences between the four size categories. Finally, we investigate whether there are differences between the six countries.

A lot of literature already exists on the determinants of profitability. There are studies on determinants of profitability in small firms in Scotland (Glancey, 1998). Also there has been done research on the effect of size on firm growth in the dairy processing industry (Gardebroek et al., 2010). But less common is research that considers differences in profitability between different firm size classes, in particular in the dairy processing industry. Previous studies focus frequently on manufacturing industries or the total industry, e.g. Goddard et al (2005). Although panel data has been used in many studies, particularly in studies on the primary agricultural sector or other sectors, this data is less used in analysing the dairy processing industry. We can use the theories in former studies to explain the determinants of profitability and then make a comparison between the results. This thesis contributes to the literature by providing a panel data analysis of the European dairy processing industry to investigate determinants of profitability in firms of different sizes.

The thesis is structured as follows. In chapter two we will give some background information on the subject and some theories which explain profitability of a firm. Chapter three describes the data and explains what kind of and how the data is used. In chapter four the profitability model and estimation method are presented. Chapter five describes the results of estimation and some hypothesis tests that are performed. Finally, chapter six gives the final conclusions of this research.

Chapter 2 Theoretical background

This chapter first gives some background information about the European dairy processing industry. Second, the differences in firm size classes are described. Finally, we have a look at what factors may have an effect on the profitability of a firm. Some existing theories and models are described and explained for the European dairy processing firms.

2.1 European dairy industry

According to Tozanli (1997), the European dairy sector has moved the last decades towards a market structure that is best described as “oligopolistic market witch fringe”, viz. a small number of large processing companies leading the market followed by a mass of smaller firms forming the fringe (operating in niche markets). The European dairy sector has changed towards a more concentrated market structure because of changes in the European Union. There is a decrease in the number of dairy firms, an increase in the number of cows per firm and an increase in the productivity of a cow. In the world market for dairy products the EU is a dominant player. The EU-25 exports an amount of €21 billion to other countries, while Oceania exports for €3.8 billion and NAFTA for €1.1 billion. However, the world market share of the EU is decreasing, since the demand on the world market currently grows faster than the EU can meet. Nowadays the EU specialises in cheese, mainly because of more competition of New Zealand in the milk powder market (Tacken et al., 2009).

The main products that are made of cow milk are: fresh milk, cheese, yoghurts, butter and milk powder. The EU dairy industry produces mostly for its home market, especially milk and cheese (because of the relative short shelf life). The market for consumption of milk is fairly stable; 73 kg per head in 2000 and 71 kg per head in 2006. The cheese consumption is increasing; 15.9 kg per head in 2000 and 16.6 kg per head in 2005. For milk most countries are self-sufficient, for cheese this is more diverse (Tacken et al., 2009).

According to Tacken et al. (2009), cheese and milk are assumed to be substitutes; in countries where the consumption of milk is high, the consumption of cheese is relatively low and vice versa. In addition, the newest entrants to the European Union have the highest annual growth of the real value added of the dairy industry in the European food industry. In the southern countries, there is a decrease in growth of the dairy industry share in the total food industry.

2.2 Difference in firm size

To test if there are differences in the profitability we look at different size classes of dairy processing firms. The EU distinguishes 4 size classes: micro, small, medium and large firms (Schiemann, 2006). We categorize them on the basis of the number of employees, defined by the European Commission. In inter-disciplinary literature it is argued that this is the most suitable size measure. Using for example assets or turnover non-financial motivations of an entrepreneur are not included, whereas these often are related to the number of employees in the firm (Glancey, 1998). Small and medium-sized enterprises (SMEs) are defined as firms having less than 250 persons employed. Within these SMEs we make a distinction in micro, small and medium firms. Micro-enterprises are defined as having less than 10 employees. They account for 90% of total number of non-financial enterprises in Europe, but generate only 20% to total value added. Small enterprises have between 10 and 49 employees and represent about 8% of total number of enterprises, with about 20% of total value added. Medium-sized enterprises have between 50 and 249 employees and represent about 1% of total number of enterprises in Europe. The last category, large enterprises are defined as having more than 250 employees, which only represent 0.2% of total number of enterprises in Europe, but they have by far the highest share in value added, namely 42.7% (Schiemann, 2006).

Firms are run by entrepreneurs that use their decision making abilities in order to gain profits. The distinctive role of the entrepreneur is to allocate scarce resources by making strategic decisions to achieve profit. In small enterprises there is one key decision maker who has ownership and control of capital and that greatly affects the way the firm strives for its objectives. In large corporate firms there are various management layers that influence one specific subject in decision making. Usually, there is a division in ownership and control (Glancey, 1998).

According to Glancey (1998), it is not always the only aim of entrepreneurs to maximise short-run profit. Some just like to be their own boss and are not motivated to expand their firm; they just gain profit to have an income. Others don't expand because if they would do, they have to delegate key functions, which lead to less control of decision making. This is conflicting with the economic theory of rational behaviour, which states that market demand determines the optimum size of a firm. It has been suggested (Lucas, 1978, cited in Glancey, 1998) that the less capable entrepreneurs manage small firms, and more capable entrepreneurs want to expand their firms. But keeping control over the decision making in a company can be very important for the utility of an entrepreneur. It is possible that the desire to retain control is larger than managing more employees. Professional managers could neglect profit maximisation in large enterprises operating in oligopolistic markets, to the prejudice of shareholders. However, entrepreneurs of small firms which operate in niche markets

could also have the same freedom to strive for non-profit maximising objectives (Glancey, 1998). It is also possible that firms have multiple strategies at the same time, so profit could be maximised, even if decision making is not delegated because of an expansion.

Now we know why there are different sizes in dairy firms in Europe, and how they can be categorized. According to Tozanli (1997) and Mahon (2005), there were many mergers and acquisitions the last decades. It is argued by economists that mergers can reduce industry competition, which results in higher prices for consumers. But mergers may also lead to efficiency gains, because of economies of scale, which reduce costs for producers. An accompanying assumption is that firms always have an incentive to merge, thus they can increase profits by raising price/reduce costs. This can be argued by the Cournot model, which states if the number of firms in industry is reduced, higher prices and profit per firm result (Perry and Porter, 1985).

However, it is also argued by e.g. George Stigler (1950) in the paper of Perry and Porter (1985) that firms which do not participate in a merger can also benefit. As the output in the merged firm will be lower than the combined former output of its participants, as a result industry price will rise. Because of this price increase non-participants will increase their output and therefore their profit. So participants in a merger do not necessarily gain more profit out of the merger than non-participants (Perry and Porter, 1985).

2.3 Different effects on profitability

There are several studies that identified determinants of firm profitability. As previously stated, Porter interpreted the structure-conduct performance (SCP) model by focussing on industry-level determinants of competition like concentration, economies of scale, and entry and exit barriers. There is also a more dynamic model, according to Mueller (1977, 1986) cited by Goddard et al. (2005), namely the persistence of profit (POP) approach, which examines the time-series behaviour of profitability at firm level. Because of the effects of rapid entry and exit of firms, there is always a short deviation of a firm's profit rate from the market average.

Discussed below are the variables that could have an effect on the profitability of the European dairy processing firms. These variables are tested by the above mentioned studies in other sectors and for different firm sizes, and most appeared to be significant.

Profitability and size

It is expected that there is a positive relationship between size and profitability, because of economies of scale. However, if firms grow faster than an entrepreneur can manage, diseconomies of scale could result, reducing profitability. Firms can become large because the entrepreneur uses the profits made to finance expansion and provide personal income. Also if the entrepreneur is motivated to more non-financial gains firms may remain small and may be expected to be less profitable (Glancey, 1998). According to Goddard et al. (2010), diversified firms (which can cause an increase in assets) tend to be less profitable. However it is also possible that diversification leads to an increase in profit, when the diversification is closely related to the firm's core product.

One could use the size of a firm measured by total assets. For manufacturing and services Goddard et al. (2005) found a significant negative effect of size (in total assets) on profit (net profit before tax plus interest divided by total assets). So expansion could have a negative effect on profitability, possibly because of increased rivalry and the finite capabilities of the management team.

Baumol, cited by Hall and Weiss (1967), stated that increased capital will not only increase total profit, but also the earnings per dollar of investment. Large firms have all of the options of small firms. Besides, the large investments they can make often require such a scale that small firms are excluded. So large enterprises should have higher rates of return than small enterprises.

A higher growth rate could also lead to higher profitability through efficiency enhancing learning effects. The growth rate is then measured as the change in total assets after a year. If a small firm entrepreneur uses retained profits to expand the firm, so disregarding external lenders, then it is expected that there is a positive relationship between profitability and growth. However, the effect could also be negative. Diseconomies of scale could arise, if a firm grows more than an entrepreneur can handle. Also if diversification in new markets is not the driver of growth, but lower prices in existing markets (Glancey, 1998).

Profitability and age

It is expected that there is a positive relationship between firm age and profitability, because of learning from experience. Older firms can benefit from reputation effects, but it is also possible that those firms have developed routines which are unsuitable for changes in market conditions, which causes a negative relationship (Glancey, 1998). Anastassopoulos (2004) also indicated that age has a positive effect on profitability in the Greek food industry. An explanation is that experience in the local market conditions is derived from a long presence. Because of this experience they may gain

organizational efficiency and flexibility, established brands, and knowledge of consumers' needs and tastes.

Profitability and location

A distinction can be made between enterprises in rural areas and in urban areas. Firms located in rural areas may have a higher profitability than firms in urban areas, because of lower costs in this region. Factor prices may be higher due to greater competition for land and labour in the urban areas and there may be space constraints. However, urban firms could also gain from their better position closer to the market (Glancey, 1998).

Profitability and market share

Market share is defined as sales of the firm as a proportion of sales in total industry. For the European dairy industry this would be the share in the national market in the country of that firm. It is tested by Goddard et al. (2005) (and also in other studies) that there is a significant positive relationship between market share and profit, thus having a higher portion in the market gives a higher profitability. This is associated with the positive relationship between productive efficiency and firm size; more efficient firms earn more profit, which means a large market share. Anastassopoulos (2004) states a firm's market share is usually a proxy for market power and for efficiencies relating to economies of size, therefore market share is positively affecting profit (in the food industry of Greece).

Profitability and financial factors

It is tested by Goddard et al. (2005) that there is a significant negative relationship between a firm's gearing (non-current liabilities plus loans divided by shareholder funds) and its profitability. In bad circumstances firms with relatively high debt are more likely to be liquidity constrained, which has a negative effect on initiatives for investment and this hurts profitability. In the 1990's the profit margins decreased, highly geared firms suffer from this because the share of profits devoted to servicing debt increases and the part for shareholders shrinks. Also a significantly negative relationship has been tested by Lin and Rowe (2005) for the liability-assets ratio to the ROA.

Another financial factor is the ratio of liquidity (current assets divided by current liabilities), which has a proven significant positive effect on profitability in the European manufacturing and service sector. The advantage for profitability of liquid firms is that they are able to adjust very fast to changing circumstances. However, too much liquidity could constraint long-term investments of a firm, which could affect profits negatively (Goddard et al., 2005).

Profitability and lagged values of profit

In some studies one or two period lagged values of profitability are included as an explanatory variable of recent profitability, which reflect how fast competitive forces induce profits above or below the average in a year. According to Nakano and Kim (2011) in a Japanese study, previous profits can allow for the short-run persistence of profits. It has been tested that there is a positive relationship between the lagged values of profit and the current value of profitability. This means there could be less competitive conditions so profits can persist. Market barriers could also play an important role in competition, so firms which have abnormal low profit do not exit, but remain in the market (Goddard at al., 2005).

Chapter 3 Data

This chapter describes the data used in this study. It is panel data from 1996-2006 of micro, small, medium and large dairy processing firms of six European countries. The first section describes how the data is selected; the second section describes the data in more detail and gives comparisons between means and some graphics.

3.1 Selection of the data

This thesis is a follow-up from a study by Gardebroek et al. (2010), which investigated the determinants of growth of dairy processing firms in six European countries, measured in number of employees and in total assets. The data used in that study was obtained from the Amadeus database, which contains pan-European data containing financial, legal, and basic economic information of over five million private and publicly owned firms across 34 Western and Eastern European countries. Due to time constraints to cover all countries, a selection was made of six countries for the period 1996-2006, so 11-years of panel data.

When making this selection there were some characteristics and criteria of the European dairy processing industry which had to be included. First, this industry is characterized by countries with a large proportion of SMEs, versus countries with a small number of large companies. Second, new and old member states of the EU had to be included, to have a good representation of Europe; therefore Poland is taken as a new member state. Third, also Northern and Southern European countries had to be taken into account both, northern countries are characterised by a high concentration of dairy firms (Tacken et al., 2009).

Based on these criteria in total 2,635 dairy processing firms are identified from France (579), Germany (92), Italy (1427), the Netherlands (50), the UK (299), and Poland (188). According to Tacken et al. (2009), the southern EU countries Italy and France have a lot of SMEs and strong competition. France and the Netherlands have a different dairy industry structure with both having 2 or 3 firms in the top 20 of world dairy firms. The market share in the total EU milk production is 21% for Germany, 11% for France, 11% for the UK, 8% for Italy, 8% for the Netherlands and 6% for Poland, in total accounting for about 65% of total milk production in the EU. The coverage of the data varies among countries, but per firm there is about seven years of data. Firms without financial reports, and firms which only have data for one or two irrelevant variables, or just for one year, were removed from the dataset.

3.2 Describing the data

In this study we use two different variables for profitability: first, the ratio of net profits before tax, interest, depreciation and amortization to total assets (Return on Assets (*ROA*)); second, the ratio of net profits before tax, interest, depreciation and amortization to the number of employees (profit per employee). The ROA variable for profitability is used in most studies in determination of profitability, because with this ratio one could make a good comparison between different companies in the same industry. It measures how efficiently a company uses its assets to generate returns (Lin and Rowe, 2005). The reason that interest is included in the profit is to remove variations in rates of return. And before-tax profitability is used to avoid the distortions caused by different tax treatments of firms. The second measure of profitability is used because the number of employees is easy to obtain and maybe more uniform and reliable than total assets. Moreover, it will not be affected by inflation or depreciation. Also the use of number of employees in the dependant variable fits well in this research, as we make a comparison between different firm size classes based on number of employees.

Table 3.1 shows the summary statistics of all model variables used in this study. As one can see, on average the profit (before interest, tax, depreciation and amortization) is about 1.4 million euro's and average total assets in the 10 years is about 12.7 million. In this industry the average Return on Assets is 0.08, by which companies can be compared. The other measure for profitability used is profit per employee, which is on average 17,510 euro. Because of missing values in the number of employees for some years, the variable *profavemp* is created, which is the average number of employees per firm over all years. So now it has values also for the years were number of employees is not available. The mean is then 15,840 euro of profit per employee, which includes more observations and thus is used from now on. The average age of all firms is about 28 years, with on average 107 employees (medium size class). The average liquidity in this industry is 1.86, which indicates that the current assets are on average higher than current liabilities. The average debt to asset ratio is 0.76. These two ratios cannot be negative.

The standard deviations for some of the variables are somewhat high. Especially for the profit and total assets variables the spread is very wide. For example *ROA* has an overall standard deviation of 1.58, which implies that *ROA* for some companies is negative; this is possible because some firms have losses instead of profits. Because panel data is used, the overall standard deviation can be divided into between variation and within variation. The between variation gives the spread over the mean values of all the firms included in the dataset. And the within variation gives the variation over time within firms, not taking into account variation between different firms. Generally the within

standard deviation is smaller than the between variation. In this dataset this is the case for almost all variables, except for liquidity and leverage, here the within variation is very large.

Table 3.1 Summary statistics for variables used in firm estimation

			standard deviation		
variable	**definition**	**mean**	**overall**	**between**	**within**
ebitda	profit before interest, tax, depreciation and amortization (x1000)	1,393.30	11,760.29	8,792.87	6,321.72
age	years	27.96	23.80	23.61	3.05
total assets	x1000	12,741.33	82,000.59	71,087.67	19,615.17
employees	number	107.22	530.18	407.02	179.41
liquidity	current ratio	1.86	5.23	2.87	4.42
leverage	debt/asset ratio	0.76	1.05	0.62	0.86
profitemp	profit/employees (x1000)	17.51	31.98	26.70	23.19
profavemp	profit/average employees (x1000)	15.84	27.48	22.46	18.77
ROA	Return on assets	0.08	0.17	0.11	0.14

In the dataset there is some difference in number of observations between the different variables. *ROA* and *ebitda* have about 13460 observations, total assets have 15283 observations. The variables based on number of employees have less observations (about 1000), because of many missing values for number of employees. This problem is solved by using the average number of employee over the 10 years of a firm. The financial variables (liquidity and leverage) have about 14500 observations. Age has by far the most, with 19744 observations. This means there is a difference in the number of observations which are included to estimate the value of a variable. Although, because of missing data the number of observations varies over firms and over the different variables, still the number of observations per variable is large enough to include them in the model.

In total there are 21910 observations in the dataset. For the 914 micro firms there are 10053 observations available; for the 492 small firms 5411 observations are available; for the 275 medium-sized firms 3024 observations are available; and for the 100 large firms there are 1100 observations available. So for 212 firms (which account for 2322 observations) data is not included in one of the firm classes, because no data exist about the number of employees of these firms.

In table 3.2 the average Return on Assets and profitability per employee are given, distinguished by size class, with their standard error and confidence interval. The averages of Return on Assets are all significantly different from the other firm size classes (at α=0.05), as the mean of ROA is not in the confidence interval of one of the other size classes. The average of medium-sized firms is significantly different from the other firm sizes for all profitability measures. The means of the others are just significantly different from one or two other firm sizes.

Table 3.2 Differences in profitability, per size class

	Mean	Std. Err.	[95% Conf.	Interval]
ROA				
Micro	0.060***	0.002	0.056	0.064
Small	0.078***	0.002	0.075	0.081
Medium	0.093***	0.004	0.084	0.102
Large	0.123***	0.004	0.115	0.131
profemp				
Micro	17.758*	0.556	16.668	18.849
Small	18.388*	0.480	17.448	19.328
Medium	15.221***	0.760	13.731	16.711
Large	16.948**	0.851	15.280	18.617
profavemp				
Micro	16.404**	0.483	15.457	17.352
Small	17.251*	0.375	16.515	17.986
Medium	13.781***	0.432	12.934	14.628
Large	16.988*	0.859	15.304	18.673

* Significantly different from one of the other size classes at α=0.05
** Significantly different from two of the other size classes at α=0.05
*** Significantly different from all of the other size classes at α=0.05

As we can see in figure 3.1 and 3.2, there are no big variations in the Return on Assets over the 10 years for all firm size classes. Only the large firms have some decrease in ROA. In the figure we also see that the larger the firm size, the higher profitability in ROA. Except for 2006 in every year a larger firm size class also has a higher profitability in ROA. If we look at the profitability per employee (figure 3.2) this is different. There is more variation over the years and also over the size classes, over the years. For example in the early years micro firms have on average the highest profit per employee, large firms the lowest, but over the years this is changing per year, and in the end micro is highest again. The biggest variation is within the large firms. For profit per employee it is not clear how profitability is ranked over the firm size classes over 10 years.

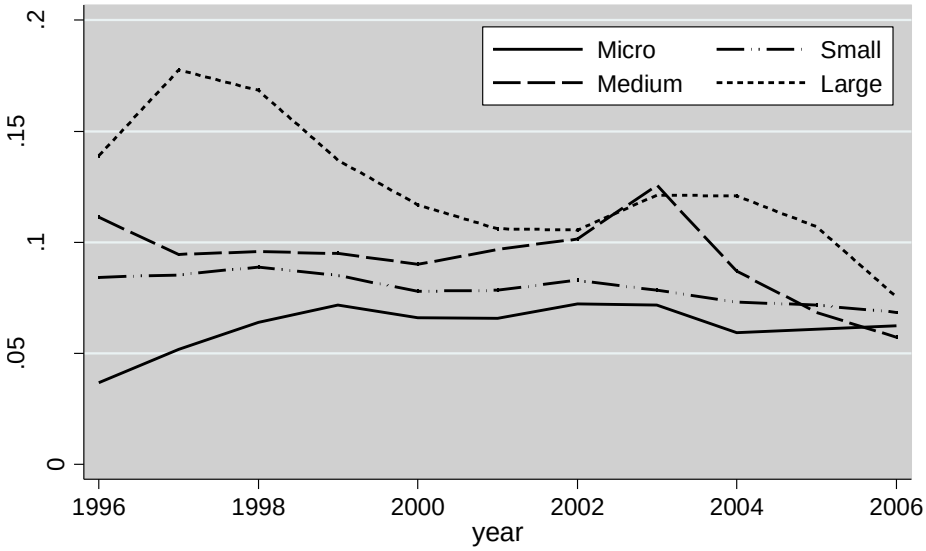

Figure 3.1 Average Return on Assets per firm size class from 1996-2006

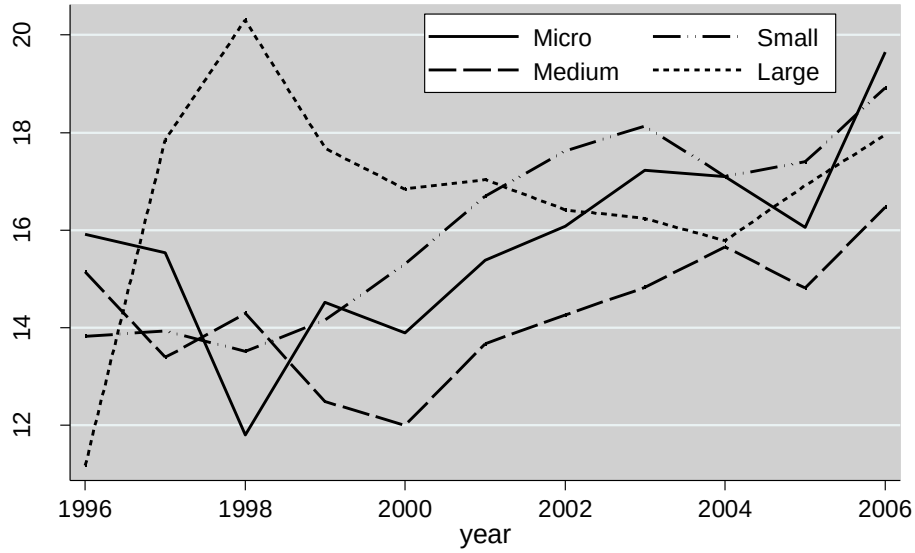

Figure 3.2 Average profit per employee, per firms size class from 1996-2006

In table 3.3 the means of all variables are given per firm size class. As mentioned before, the profit (before interest, tax, depreciation and amortization) of a dairy processor increases with the firm size class. Remarkable are the differences in the profit per employee. What we also saw in figure 3.2, profit is not necessarily lower for smaller firms. The smaller firms have on average even higher profitability per employee than the larger firms. This is in contrast with ROA, where the profitability is highest for the large firm size class. The liquidity and leverage ratios are a bit striking. On average they are smaller for larger firms. The number of employees on average in the micro class is a bit low, while the average number of employees in the large size class is very high. So this means that there are a lot of firms with very little employees (especially in Italy) and some which are extremely large (almost all in The Netherlands). The differences in number of employees in firms between the countries are also clearly shown in figure 3.3.

Table 3.3 Summary of variables included in the model, per firm size class

variable	definition	micro	small	medium	large
ebitda	profit before interest, tax, depreciation and amortization (x1000)	72.42	370.87	1,567.82	22,624.11
age	years	28.92	24.74	32.35	36.31
total assets	x1000	1,781.19	5,457.78	17,451.24	166,598.40
employees	number	4.80	22.96	121.90	967.12
liquidity	current ratio	1.96	1.93	1.36	1.49
leverage	debt/asset ratio	0.80	0.76	0.65	0.64
profitemp	profit/employees (x1000)	17.76	18.39	15.22	16.95
profavemp	profit/average employees (x1000)	15.90	16.28	14.23	16.93
ROA	Return on assets	0.06	0.08	0.09	0.12

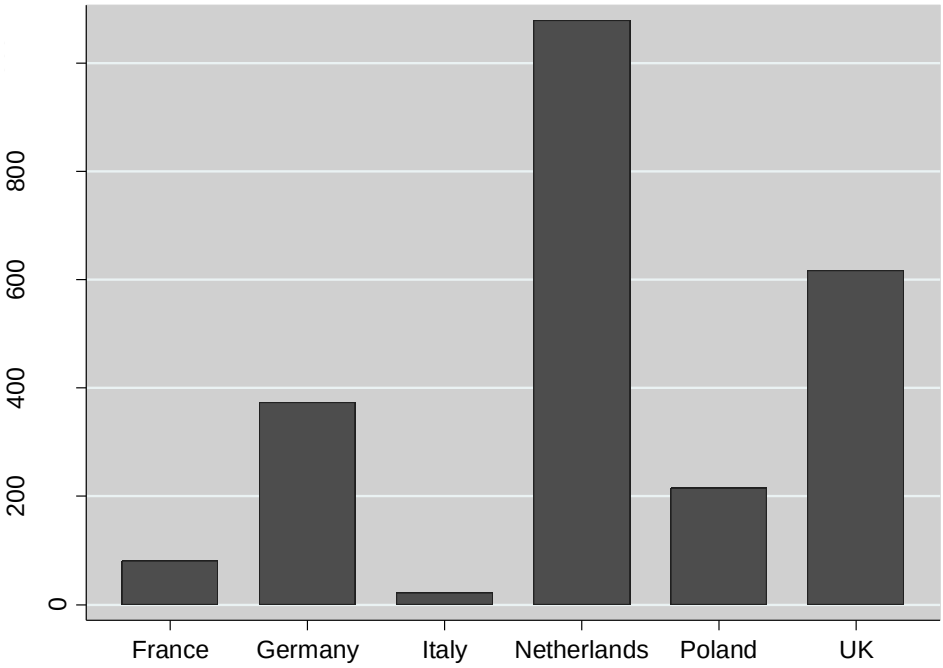

Figure 3.3 Average number of employees per country

Figures 3.4 and 3.5 describe the differences in profitability between the six countries. The Return on Assets is in all years lowest for Italy, while for profit per employee this country is in the middle. For the other countries it is not clear which one has highest profitability. Means of ROA are around 0.10 for all countries (except for Italy). For profit per employee there is more to say on differences between countries. On average this is lowest for Poland and highest for Germany and The Netherlands. So even though The Netherlands has the firms with the highest number of employees, it is also one of the countries with the highest overall profitability per employee. The other countries are somewhat in the middle. The variation in years is higher for the variable for profit per employee than the variable for ROA.

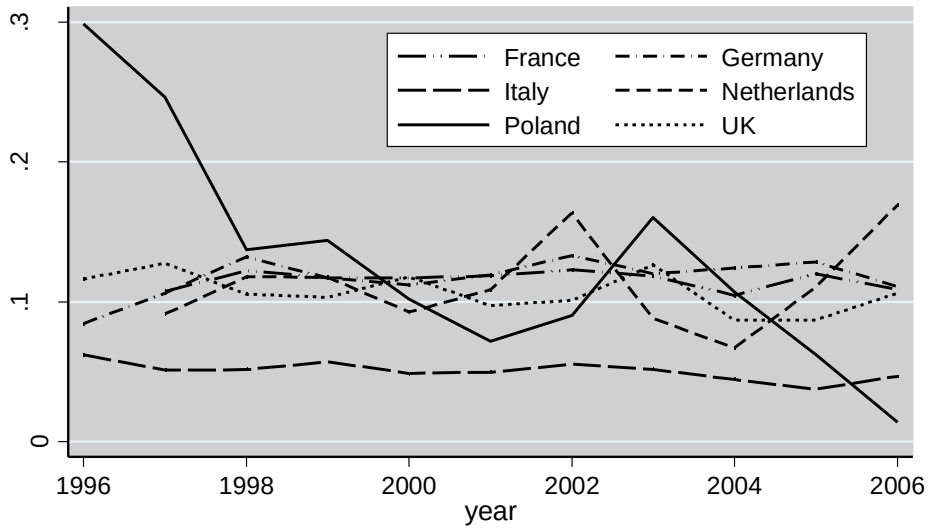

Figure 3.4 Average Return on Assets per country from 1996-2006

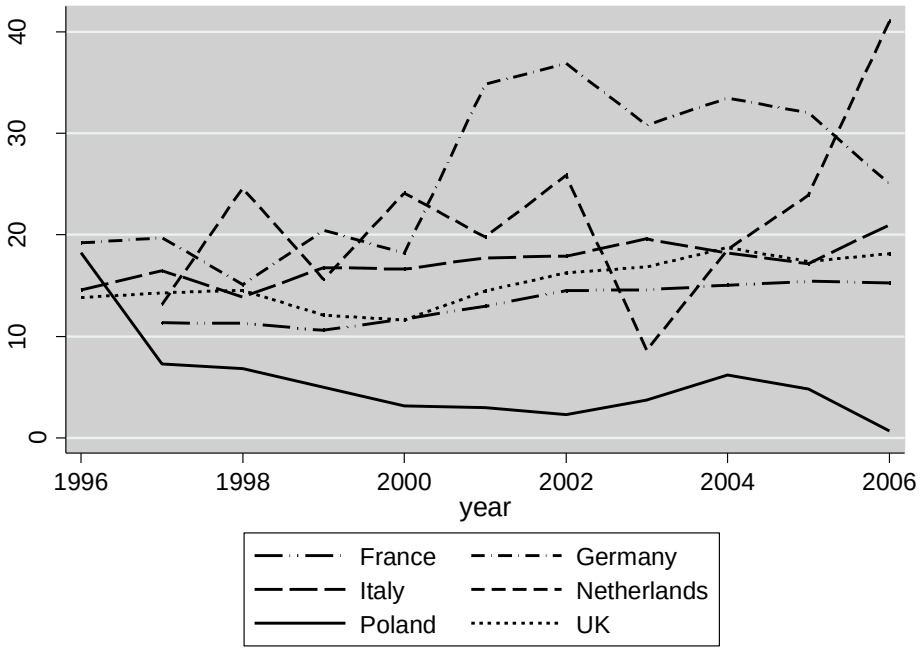

Figure 3.5 Average profit per employee per country from 1996-2006

Chapter 4 Methodology

This chapter outlines the methodology used to test the determinants of profitability for the four different firm size classes. Both the dependent and explanatory variables of firm profitability in different size classes are described.

The objective of this thesis is to investigate whether there are differences in the determinants of profitability for European dairy processing firms between four different firm size classes. To describe the specifications of the empirical panel model on profitability, we specify two equations following Goddard et al. (2005), for Return on Assets of firm *i* in year *t* ($ROA_{i,t}$) and profit per employee of firm *i* in year *t* ($profemp_{i,t}$):

(1) $ROA_{i,t} = \alpha_0 + \alpha_1 ROA_{i,t-1} + \alpha_2 ROA_{i,t-2} + \alpha_3 asset_{i,t} + \alpha_4 lev_{i,t} + \alpha_5 liq_{i,t} + \alpha_6 age_{i,t} + \alpha_7 share_i + \eta_{1\,i} + v_{1\,i,t}$

(2) $profemp_{i,t} = \beta_0 + \beta_1 profemp_{i,t-1} + \beta_2 profemp_{i,t-2} + \beta_3 asset_{i,t} + \beta_4 lev_{i,t} + \beta_5 liq_{i,t} + \beta_6 age_{i,t} + \beta_7 share_i + \eta_{2\,i} + v_{2\,i,t}$

As explanatory variables we only use firm-level variables. The following explanatory variables are expected to determine profitability:

- Lagged variables of *ROA* and *profemp*, these variables contain the lagged values of the dependent variable Return on Assets and profit per employee of one and two years before. This allows for the short-run persistence of profits. The parameter reflects the speed at which abnormal profits tend to converge on the long run average. If the coefficient is not significantly different from zero, then the market is so competitive that abnormal profits earned in previous periods do not persist in the next period; if it is positive, there could be less competitive conditions so profits persist; and when negative, past profits negatively affect current profits (Nakano and Kim, 2011).
- $asset_{i,t}$, this is defined as the natural logarithm of total assets of firm *i* in year *t*. Because of a very large spread in the data of total assets, we use values in natural logarithms (see figure 4.1 and 4.2). The coefficient of this variable represents the direction over the years of change in profitability of a firm, for a change in a firm's total assets. It is expected that there is a positive relationship between firm size in assets and profitability, because it can gain advantages from economies of scale when a firm expands. Though, diseconomies of scale are also possible, which means a negative effect of total assets on profitability.

- $lev_{i,t}$, leverage is defined as total liability (debt) divided by total assets, for firm *i* in year *t*. It is expected that there is a negative relationship between leverage and profitability, based on former literature already discussed in chapter 2.
- $liq_{i,t}$, liquidity is defined as current assets divided by current liabilities (debt), so the current ratio of firm *i* in year *t*. This variable is expected to be positively correlated to profitability, as firms with high liquidity ratios are considered to have short-term financial strength (Nakano and Kim, 2011).
- $age_{i,t}$, defined as the age of firm *i* at time *t*. A positive effect is expected of age on profitability since an older company has more experience in the market than a new entrant. They could have more knowledge and be more efficient, also because of more Research and Development done.
- $share_i$, proportion of average sales of firm *i* over all years in total average turnover in its own country, so average national market share of firm *i*. It is expected to positively affecting profitability, because a larger market share implies more market power, which increases profit. It has to be mentioned that market share is difficult to measure, because the dairy firms are more or less operating in different markets (cheese, milk, exclusive products), and maybe also in different countries.
- η_i and $v_{i,t}$ are the unobserved individual firm effects and random error term, respectively. The individual effects control for cross-sectional spread in profitability, so unobserved factors which are typical to the firm.

As previously mentioned in chapter 2 location and growth also have a possible effect on the profitability of a firm. But these variables are not included in this model, because no data was available for location. Growth is not used, because then the model becomes too complicated (including lagged values of explanatory variables), also because of missing data the amount of data available for this variable is very low.

Market share is used in this model to have a possible (positive) effect on profitability of a firm. The variable used is constructed as follows. First we took the average turnover per firm, over the 10 years of data. This because for each firm there are missing values, and in this way this problem is solved. Second, the total has been taken of all those average turnovers of all firms, but separately per country. Because the market is defined as a national market, this is characteristic for the dairy industry in Europe. To get the market share per firm in a certain national market, the average of firm *i* is divided by the average total turnover in the market, so the average total turnover of dairy processing firms in that country.

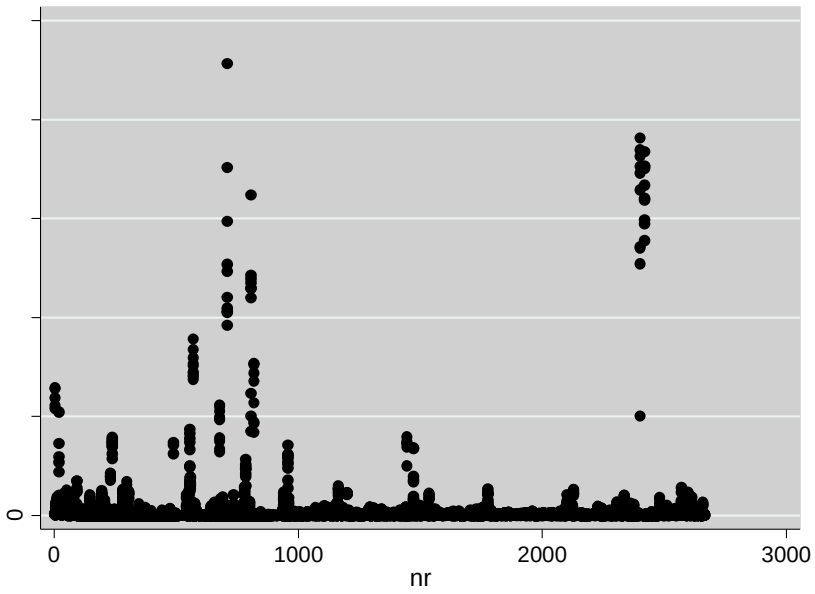

Figure 4.1 Spread in total assets

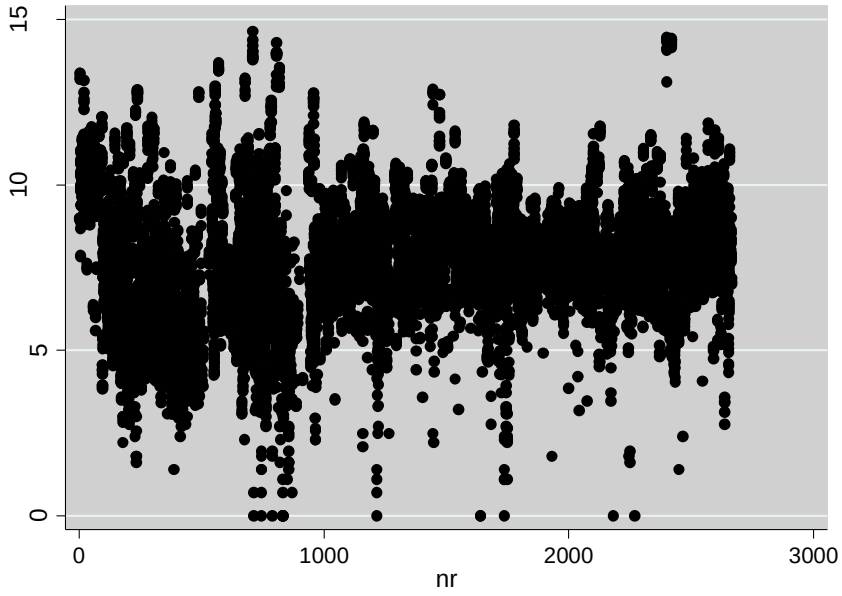

Figure 4.2 Spread in the logarithm of total assets

Equation 1 and 2 are panel data models, requiring panel data estimation techniques. The ordinary least squares (OLS) estimation is not suitable, because in the disturbance term the individual firm effects are included, which causes non-zero covariance between this disturbance term and the lagged dependent variable. This would cause biased estimation results of the coefficients of the lagged variables (Goddard et al., 2005). It is possible to estimate the equations with the Random Effects or the Fixed Effects model. If an unobserved individual effect is both correlated with profit as with one or more of the explanatory variables, the estimation will be biased using the Random Effects model. The Fixed Effect model takes account for the heterogeneity across different firms

and/or a time-specific effect (Wanga and Mathur, 2011). So the problem with estimation with the Random Effects model is that lagged values could correlate with the error term η_i, and then estimation is biased. With the Fixed Effects model this problem is not present, because of within transformation, but here the within transformed variables could correlate with the error term $v_{i,t}$, which also gives biased and inconsistent information. It will be tested by a Hausman specification test which of the two models has to be used for this dataset.

To test the determinants of profitability and the differences between different size classes we have to do a couple of regressions and tests. There are several options to test differences. First, we estimate the effects of all variables on profitability of the whole European dairy industry. Here we look at what effects are significant and if they are positive or negative. Second, we want to know whether there are significant differences between the determinants of profitability for the four different firm size classes, so we estimate equations 1 and 2 four times, separately for the four size classes. To find out if the parameters are jointly different for both equations F-tests are performed. These tests indicate whether the effects of determinants of profitability differ between the four groups. This F-test tests the hypothesis that all parameters, including the intercept, are significantly different for micro, small, medium and large firms. Finally, we want to test whether there are differences in firm profitability between European countries. Both equations are estimated again, but then with five dummy variables for Germany, Italy, the Netherlands, Poland and the UK. After estimation a Chi-square test has been done to look if there are significant differences between the six countries. So we only look at differences between the intercepts, not the slopes of the variables, because in the former study with this data of Gardebroek at al. (2010), only a few differences were found between countries.

Chapter 5 Results

In this chapter the estimation results are given for determination of profitability, measured by ROA and profit per employee. First, estimation results of equation 1 and 2 are given for the whole dataset. Second, results are given per firm size class and it is tested if there are statistically significant differences between the four size classes in parameters. Finally, also a regression has been done including dummies for the countries, so differences are tested between the six countries.

5.1 Overall estimation

First, we want to know which model to use for estimation of the equations. If we do a Hausman test to test whether the Fixed Effects model or the Random Effects model is better, the test is not significant. This means that the error terms are uncorrelated with the explanatory variables, and based on that both models could be used. In this study we use the Random Effects model, because this model has smaller standard errors and also a broad characterisation of the sources of errors (Pindyck and Rubinfeld, 1998: p. 250-256). This model uses both within and between variation[1] .

In the first model, model A, we look at the effects on the profitability of dairy processing firms for the whole dataset. Equations 1 and 2 are estimated by regression using the Random Effect approach for panel data. The estimated pooled dataset has 8245 observations for Return on Assets, and 8246 observations for profit per employee. Both have on average about 5 observations per firm, so 5 years of data per firm. In table 5.1 the estimation results for the profitability regression measured by Return on Assets and profit per employee are given (full estimation results can be found in table I.1 and I.2 in appendix I).

Almost all coefficients of the variables are significant, also the intercept. As we look at the measurement of profitability in Return on Assets both lagged variables (ROA_{t-1} and ROA_{t-2}) are significantly positive. This could mean that there are not very competitive conditions in the dairy industry in Europe and profit persists over years and that there are entry and exit barriers in the industry. There is a similar result for profit per employee; $profavemp_{t-1}$ and $profavemp_{t-2}$ are statistically significant and positive.

[1] After regression has been done with the Random Effects model, the coefficients of the lagged variables of profitability are significantly different from zero (see table 5.1). This means the model is dynamic and the Random Effects or Fixed effects model cannot be used actually, because lagged values could be dependent on the error term. Therefore it would be better to use the dynamic panel data estimator of Arellano and Bond. Here first-differences are taken in order to remove the unobserved η_i, and the lagged values are used as instrument. However, due to time constraints and various other reasons this is not done in this study.

Table 5.1 Estimation results for profitability in ROA and profit per employee

Variables	**Coefficients**	
	Return on Assets	*Profit per employee*
intercept	0.1209**	-4.6635**
1-year lagged profitability (*ROA$_{t-1}$, profavempt$_{-1}$*)	0.3591**	0.4922**
2-year lagged profitability (*ROA$_{t-2}$, profavempt$_{-2}$*)	0.0500**	0.1369**
log total assets	-0.0054**	1.7980**
leverage	-0.0208**	-1.5330**
liquidity	-0.0004	-0.0178
age of the firm	-0.0006**	-0.0524**
market share in national market	0.2543**	-33.6734*

** Significantly different at α=0.05

* Significantly different at α=0.10

The relationship between the logarithm of total assets and profitability is significantly negative for *ROA*, if the total assets increase by 1%, ROA decreases with 0.0054%. Though the coefficient is not very large, it is remarkable that the coefficient for profit per employee is significantly positive. The effect is also larger for profit per employee than for ROA, if total assets increase with 1%, profit increases 1.798%. In former studies (like Goddard et al., 2005) a significantly negative effect has been found (where ROA is used), where increased rivalry or finite capabilities were the explanation. A possible explanation for the difference could be that total assets are also included in the *ROA*, so if the size is bigger, than the profitability in ROA becomes smaller because of the size increase. With the estimation of profit per employee, assets are not used in the definition of the dependent variable, so this could not influence the outcome of the effect of total assets. A possible interpretation of the positive coefficient could be economies of scale.

The coefficient of leverage is significantly negative for both equations, as expected and in line with former studies. An interpretation is that high debts induce high interest payments, followed by lower profits and thus lower profitability. And as mentioned in chapter 2, firms with high leverage may suffer from an increase of competition and therefore their profitability decreases (Goddard et al., 2005). The liquidity ratio is unlike what was expected also negative, but not significant for both estimations. So it has no effect on the profitability of European dairy processing firms.

The effect of the age of a firm is significantly negative for both dependent variables, though the effect is not very large. A firm of one year older has on average 0.0006 less Return on Assets and 0.0524 less profit per employee. It was expected that there would be a positive relationship, because of learning from experience. But it could be that the routines which are developed by the older firms are not in line with the changes in the market conditions, so they are somewhat “old-fashioned” in

their market operations. New firms could come up with refreshing and more profitable strategies, which older firm cannot immediately implement. Though it is in contradiction with expectations because of former studies like Anastassopoulos (2004), also in the article of Glancey (1998) a negative relationship has been found.

For the effect of market share a positive coefficient has been estimated with ROA, significant at a 10% and 5% level. But for profit per employee a negative relationship has been estimated, only significant at a 10% level. If we look for an explanation for the estimation of market share for ROA, a larger market share leads to more market power, which causes higher profits. Following the theoretical background, a larger market share could be caused by efficiency, which causes higher profits and therefore a relatively large market share.

5.2 Differences between firm size classes

In the second model, model B, we want to test whether there are significant differences in determination of profitability of dairy processing firms between the four size classes. Therefore equation 1 and 2 are estimated using the Random Effect approach for the four firm sizes separately. The pooled data set has 4172 observations for micro, 2564 for small, 1100 for medium and 409 for large firms for estimation of both equations. All have on average about 5 observations per firm, only size class “small” has about 6 observations per firm. In table 5.2 and table 5.3 the estimation results for the profitability regression measured by Return on Assets and profit per employee are given, separated by size class (full estimation results can be found in table II.1 and II.2 in appendix II).

It is striking that there is a big difference in the significance of the effects on profitability between the four size classes. For the small firms almost all variables have a significant effect, except for age on the profit per employee. For the large category only the profit from the past has a significant influence on current profitability. The two lagged variables of *ROA* are significant for almost all firm size classes (except the 2-year lagged for micro). What is remarkable is that for all classes the coefficient is positive, except for the medium-sized firms. For the large firms the 1-year lagged variable of *ROA* has the largest effect on profitability, for the 2-year lagged variable the biggest influence is in the small firms. If we look at the profit per employee all significant effects of the lagged variables are positive and increase with the firm size.

Table 5.2 Estimation results for profitability in ROA separated by size class

Variables	**Coefficients**			
	Micro	Small	Medium	Large
number of firms	852	438	205	82
number of observations	4172	2564	1100	409
intercept	0.163**	0.135**	0.311**	0.043
1-year lagged profitability (*ROA$_{t-1}$*)	0.399**	0.374**	-0.081**	0.632**
2-year lagged profitability (*ROA$_{t-2}$*)	-0.005	0.288**	-0.140**	0.132**
log total assets	-0.011**	-0.024**	-0.004	-0.002
leverage	-0.025**	0.096**	-0.234**	-0.002
liquidity	-0.000	0.001*	0.005	0.000
age of the firm	-0.001**	-0.000	-0.000	0.000
market share in national market	-4.832	11.067**	0.308	-0.002

** Significantly different at α=0.05
* Significantly different at α=0.10

Table 5.3 Estimation results for profitability in profit per employee separated by size class

Variables	**Coefficients**			
	Micro	Small	Medium	Large
number of firms	852	438	205	82
number of observations	4173	2564	1100	409
intercept	-4.818	-9.302**	-13.313**	2.095
1-year lagged profitability (profavempt-1)	0.439**	0.540**	0.711**	0.965**
2-year lagged profitability (profavempt-2)	0.113**	0.181**	0.043	-0.020
log total assets	1.781**	2.433**	2.221**	-0.152
leverage	-1.471**	-6.652**	-4.989**	1.026
liquidity	-0.034	-0.126**	-0.279	-0.056
age of the firm	-0.080**	-0.051**	-0.003	0.003
market share in national market	16,503.860**	1,157.215**	34.587	-2.019

** Significantly different at α=0.05
* Significantly different at α=0.10

Market share has by far the largest effect, but is not significant for medium and large firms in both equations. The effect of liquidity is only significant for the small firms, but strangely is positive for *ROA* and negative, but also much bigger, for profit per employee. Leverage has no influence for large firms, and has only a positive effect on *ROA* in small firms, for the rest the effect is significantly negative. The effect is bigger for the larger firm sizes.

We want to test the null hypothesis that all parameters, including the intercept, are the same for micro, small, medium and large firms, against the alternative hypothesis that all parameters are significantly different. To test this we have to compare model A (restricted) of chapter 5.2 and model B (unrestricted) by doing an F-test. RSSA stands for Sum of Squares Residual from model A and RSSB for model B. The relevant test-statistic for the estimation of *ROA* is:

$$\text{T.S.} = \frac{(RSSA - RSSB)/K}{RSSB/(N-4K)} = \frac{(198.0832 - 72.1699 + 75.31298 + 27.70669 + 1.182129)/8}{(72.1699 + 75.31298 + 27.70669 + 1.182129)/(8245 - 4*8)} = 126.3784$$

Comparing this test-statistic with the critical value F_{crit} = F(8, (8245 - 4*8)) = 1.94, we find 126.3784 > 1.94. The F test-statistic does exceed the critical value, so the null hypothesis can be rejected. It is proven that for estimation of *ROA* the parameters for micro, small, medium and large firms are jointly significantly different.

If we do this test for profit per employee the relevant test-statistic is:

$$\text{T.S.} = \frac{(2277775 - 1528713 + 578113.5 + 129272 + 34186.77)/8}{(1528713 + 578113.5 + 129272 + 34186.77)/(8246 - 4*8)} = 3.387275$$

Comparing this test-statistic with the critical F-value of 1.94, we find 3.387275 > 1.94. Again the F test-statistic does exceed the critical value, so the null hypothesis can be rejected. It is proven that for estimation of profit per employee the parameters for micro, small, medium and large firms are jointly significantly different.

So it is proven that there are differences in all parameters, including the intercept, for the four different firm size classes, for both estimation of ROA and profit per employee. We could also test the differences between the intercepts of the four size classes. To know if there are significant differences in the intercepts only we have to estimate the model again, but including dummies for the four different size classes[2]. If we want to test only differences in slope vectors between the four sizes, we compare the model including dummies for firm size with model B by doing an F-test[3].

5.3 Differences between countries

In the third model, model D, we want to test if there are significant differences in profitability of dairy processing firms between the six European countries. Therefore, equations 1 and 2 are estimated including 5 dummy variables for Germany, Italy, the Netherlands, Poland and the UK. All have on average about 5 observations per firm. In table 5.5 the estimation results for the profitability

[2] All intercepts for both estimations are significantly different from each other, after doing the Chi-square test. If we look at the coefficients of the dummies we can conclude that for ROA large firms have the highest intercept, so are more profitable, and micro firms the lowest. For profit per employee it is the other way around (full estimation results can be found in table III.1 and III.2).

[3] Comparing the test-statistic with the critical value F_{crit} = F(7, (8245 - 4*8)) = 2.01, gives a significant outcome for ROA, but insignificant for profit per employee.

regression measured by Return on Assets and profit per employee are given, including the country dummy variables (full estimation results can be found in table IV.3 and IV.4 in appendix IV).

Table 5.5 Estimation results for profitability in ROA and profit per employee, including country dummies

Variables	**Coefficients**	
	Return on Assets	*Profit per employee*
intercept	0.1217**	-5.9824**
1-year lagged profitability (*ROA$_{t-1}$, profavempt$_{-1}$*)	0.3392**	0.4878**
2-year lagged profitability (*ROA$_{t-2}$, profavempt$_{-2}$*)	0.0369**	0.1330**
log total assets	-0.0029**	2.1318**
leverage	-0.0182**	-1.5941**
liquidity	-0.0002	-0.0203
age of the firm	-0.0005**	-0.0551**
market share in national market	0.2818*	-74.9837**
dummy Germany	0.0219	0.1547
dummy Italy	-0.0365**	-0.6196
dummy Netherlands	-0.1123	27.2747
dummy Poland	-0.0076	-7.3172**
dummy UK	-0.0184**	-4.4801**

** Significantly different at α=0.05
* Significantly different at α=0.10

In table 5.5 the different coefficients are given for the dummies for five countries, which are the intercepts of the profitability equations of the different countries, compared with France. First we look at the Return on Assets. The effect for a firm coming from the UK is significant, which means the intercept for this country is significantly lower than a firm coming from France. For Italy the intercept is also significantly lower than for France. If we test if Italy differs from the other countries too, by doing a Chi-square test (5% level), we can conclude that Italian firms have significantly lower profits than firms from Germany, Poland and the UK. The UK significantly differs from Germany also. Moreover, Germany has significant higher Return on Assets than Poland, at a 10% significance level.

If we look at the profit per employee the UK also has significantly lower profitability than France, the same for Poland. If we do the Chi-square test (5% level), Poland has also lower profits than Germany and Italy, and with a 10% level also significantly lower than the Netherlands. The UK has significantly lower profitability than Italy and the Netherlands, at a significance level of 10%.

Italy is characterised, as described in chapter 3, by a large number of micro firms. And for example the Netherlands has a lot of large firms. As can be concluded from above, Italy has on average significantly lower Return on Assets, because of the lower intercept. This could be related to the

outcome that micro firms have on average a lower Return on Assets than larger firms. Germany has the highest Return on Assets. Poland has the lowest significant profit per employee, because of its low intercept. And the Netherlands have by far highest profit per employee, but this difference is only significant compared with the UK and Poland. Since there are only a few dummy variables significantly different from zero, we did not estimate the models separately for each country to allow for different slope effects.

Chapter 6 Conclusions

The thesis investigates whether there are differences in the determinants of profitability (in Return on Assets and profit per employee) between micro, small, medium and large European dairy processing firms, using panel data estimation techniques. There is previous research on this topic, but mainly for other sectors. Former studies indicated that larger firms have higher profits because of economies of scale. However, other studies found the opposite and stated that larger firms can have lower profits because diseconomies of scale could arise. In this thesis we can conclude that there are certainly differences in determination of profitability between four firm size classes.

When describing the data we already saw significant differences in profitability when comparing the means. Especially with ROA, the means were significantly higher for the bigger firm size classes than for the smaller. With profit per employee this is less clearly ordered. If we look at the regression outcomes we also see a lot of significant differences in the effects of different variables on the profits. It is remarkable that the effects also differ between ROA and profit per employee. If we look at the effect of total assets, this is significantly positive for profit per employee, but significantly negative for ROA. A possible explanation for the difference could be that total assets are also included in the variable *ROA*, so more total assets decrease Return on Assets.

The variables which were most significant in almost all estimations are the lagged variables of profitability. The results suggest that despite the free trade, and creation of one European market, profits persists over the years, so the competitive conditions in Europe are not strong enough for new entrants to capture positive profits. Apparently it is hard to enter the market; there are entry and exit barriers in the market. The effect of lagged variables is pretty large for the large firms. If firms have a high leverage, those firms have lower profits on average. For example micro firms have on average the highest leverage, so you would expect lower profits, which is showed when comparing the means. But it has to be taken into account that the effect of leverage is not the same in all four classes, for micro firms this effect is not very large. Liquidity is not significant in this thesis and thus has no effect on profits in the dairy processing industry in Europe. Also age and market share don't have significant effects in all four size classes. Older firms in the smaller classes tend to decrease in profitability. A greater market share tends to have a very large positive effect on profitability of a firm, but only in the micro and small firms.

Over the six countries included in this study the concentration of the firms is very divers. For example the Netherlands and the UK have a small number of very large firms and very little of micro and small firms. In Italy there are many very small enterprises. The UK and Italy are evidently the countries which were most significantly different from the others. The UK and the Netherlands also have higher profitability than for example Italy.

Interesting is that liquidity has no significant effect in any of the cases. What induces that more liquidity in a firm will not make it more (or less) profitable, which was not expected. So a firm cannot increase its profitability by increasing its current assets or decreasing its current liabilities, which would be one of the instruments that is not very hard to use. But decreasing its total liability relative to total assets (leverage) positively affects profits, so decreasing debts or increasing total assets are viable strategies for raising profits. In the current downturn of the economy this effect could be hard because of the great increase in debts and as concluded here this could cause lower profitability for the European dairy processing industry. This will affect the larger firms more than the smaller firms.

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Appendices

Appendix I

Table I.1 Regression using Random Effects model on *ROA* (equation 1)

```
. xtreg ROA ROAl1 ROAl2  lsizeta lev currentratiox age mktsh if sizeclass < 5, re

Random-effects GLS regression                   Number of obs      =      8245
Group variable: BVDNo                           Number of groups   =      1577

R-sq:  within  = 0.0092                         Obs per group: min =         1
       between = 0.5787                                        avg =       5.2
       overall = 0.1372                                        max =         8

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   1309.93
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ROAl1	.3590619	.0137815	26.05	0.000	.3320507	.3860731
ROAl2	.0499699	.0118404	4.22	0.000	.0267632	.0731767
lsizeta	-.0053906	.0010733	-5.02	0.000	-.0074943	-.0032869
lev	-.020795	.0032599	-6.38	0.000	-.0271842	-.0144058
currentrat~x	-.0004032	.0003531	-1.14	0.254	-.0010952	.0002888
age	-.0005827	.0000807	-7.22	0.000	-.0007408	-.0004246
mktsh	.2543165	.0743106	3.42	0.001	.1086705	.3999626
_cons	.1209391	.0094836	12.75	0.000	.1023516	.1395267
sigma_u	0					
sigma_e	.14036295					
rho	0	(fraction of variance due to u_i)				

Table I.2 Regression using Random Effects model on *profavemp* (equation 2)

```
. xtreg  profavemp profavempl1 profavempl2  lsizeta lev currentratiox age mktsh if sizeclass < 5, re

Random-effects GLS regression                   Number of obs      =      8246
Group variable: BVDNo                           Number of groups   =      1577

R-sq:  within  = 0.0755                         Obs per group: min =         1
       between = 0.6741                                        avg =       5.2
       overall = 0.4898                                        max =         8

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   3346.19
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

profavemp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
profavempl1	.4922133	.0111942	43.97	0.000	.4702731	.5141536
profavempl2	.1369157	.0118082	11.60	0.000	.1137721	.1600593
lsizeta	1.797976	.2389415	7.52	0.000	1.329659	2.266293
lev	-1.532992	.4950385	-3.10	0.002	-2.50325	-.5627345
currentrat~x	-.0177761	.0465355	-0.38	0.702	-.1089839	.0734318
age	-.0524065	.0165775	-3.16	0.002	-.0848977	-.0199152
mktsh	-33.67341	17.83169	-1.89	0.059	-68.62287	1.276058
_cons	-4.663495	1.912506	-2.44	0.015	-8.411938	-.9150512
sigma_u	11.074531					
sigma_e	15.951224					
rho	.32524406	(fraction of variance due to u_i)				

Appendix II

Table II.1 Regression using Random Effects model on *ROA* (equation 1), by size class

-> sizeclass = 1

Random-effects GLS regression — Number of obs = 4172
Group variable: BVDNo — Number of groups = 852

R-sq: within = 0.0005 — Obs per group: min = 1
between = 0.6604 — avg = 4.9
overall = 0.2475 — max = 8

Random effects u_i ~ Gaussian — Wald chi2(7) = 1369.92
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ROAl1	.3994399	.016687	23.94	0.000	.366734	.4321458
ROAl2	-.0051943	.0122161	-0.43	0.671	-.0291375	.0187488
lsizeta	-.0110736	.001951	-5.68	0.000	-.0148975	-.0072498
lev	-.0246338	.0030073	-8.19	0.000	-.0305279	-.0187396
currentrat~x	-.0004479	.0003809	-1.18	0.240	-.0011944	.0002986
age	-.0007474	.0001009	-7.41	0.000	-.000945	-.0005497
mktsh	-4.831967	6.91396	-0.70	0.485	-18.38308	8.719147
_cons	.1629053	.0128729	12.65	0.000	.1376749	.1881358
sigma_u	0					
sigma_e	.1206267					
rho	0	(fraction of variance due to u_i)				

-> sizeclass = 2

Random-effects GLS regression — Number of obs = 2564
Group variable: BVDNo — Number of groups = 438

R-sq: within = 0.0210 — Obs per group: min = 1
between = 0.4197 — avg = 5.9
overall = 0.1269 — max = 8

Random effects u_i ~ Gaussian — Wald chi2(7) = 371.40
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ROAl1	.3741832	.0361123	10.36	0.000	.3034043	.4449621
ROAl2	.2877607	.0459221	6.27	0.000	.197755	.3777663
lsizeta	-.0236117	.0047905	-4.93	0.000	-.033001	-.0142225
lev	.0961172	.0130479	7.37	0.000	.0705438	.1216906
currentrat~x	.001174	.0006771	1.73	0.083	-.0001531	.002501
age	-.0000536	.0001982	-0.27	0.787	-.0004422	.0003349
mktsh	11.06652	4.350851	2.54	0.011	2.539012	19.59403
_cons	.134598	.0400079	3.36	0.001	.0561839	.2130121
sigma_u	0					
sigma_e	.16143988					
rho	0	(fraction of variance due to u_i)				

-> sizeclass = 3

Random-effects GLS regression — Number of obs = 1100
Group variable: BVDNo — Number of groups = 205

R-sq: within = 0.3244 — Obs per group: min = 1
between = 0.0010 — avg = 5.4
overall = 0.0138 — max = 8

Random effects u_i ~ Gaussian — Wald chi2(7) = 61.57
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ROAl1	-.0807144	.0334148	-2.42	0.016	-.1462062	-.0152225
ROAl2	-.1395716	.0327748	-4.26	0.000	-.2038091	-.0753341
lsizeta	-.0035444	.0094184	-0.38	0.707	-.0220043	.0149154
lev	-.2340398	.0410537	-5.70	0.000	-.3145036	-.1535761
currentrat~x	.005173	.0089471	0.58	0.563	-.012363	.0227091
age	-.0004458	.0003342	-1.33	0.182	-.0011008	.0002092
mktsh	.3080997	2.215206	0.14	0.889	-4.033624	4.649824
_cons	.3112673	.0843636	3.69	0.000	.1459177	.4766169
sigma_u	.05131748					
sigma_e	.10102447					
rho	.20510912	(fraction of variance due to u_i)				

```
-> sizeclass = 4

Random-effects GLS regression                   Number of obs      =       409
Group variable: BVDNo                           Number of groups   =        82

R-sq:  within  = 0.1599                         Obs per group: min =         1
       between = 0.9230                                        avg =       5.0
       overall = 0.6274                                        max =         8

Random effects u_i ~ Gaussian                   Wald chi2(7)       =    675.21
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         ROA |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        ROA1 |    .6321702   .0465072    13.59   0.000     .5410179    .7233226
        ROA2 |    .1322326   .0453788     2.91   0.004     .0432919    .2211734
     lsizeta |   -.0015863   .0026073    -0.61   0.543    -.0066966    .0035239
         lev |   -.0015965   .0147484    -0.11   0.914    -.0305028    .0273097
currentrat~x |    .0000224   .0008211     0.03   0.978     -.001587    .0016318
         age |    .0000108   .0001007     0.11   0.914    -.0001866    .0002082
       mktsh |   -.0015474   .0395438    -0.04   0.969    -.0790519     .075957
       _cons |     .042935   .0279194     1.54   0.124    -.0117859     .097656
-------------+----------------------------------------------------------------
     sigma_u |           0
     sigma_e |   .04530375
         rho |           0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Table II.2 Regression using Random Effects model on *profavemp* (equation 2), by size class

```
-> sizeclass = 1

Random-effects GLS regression                   Number of obs      =      4173
Group variable: BVDNo                           Number of groups   =       852

R-sq:  within  = 0.0559                         Obs per group: min =         1
       between = 0.5865                                        avg =       4.9
       overall = 0.4499                                        max =         8

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   1485.37
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
   profavemp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 profavempl1 |    .4389861   .0158329    27.73   0.000     .4079542     .470018
 profavempl2 |     .113179   .0166974     6.78   0.000     .0804527    .1459053
     lsizeta |    1.780932   .5741598     3.10   0.002     .6555999    2.906265
         lev |   -1.471314   .6534861    -2.25   0.024    -2.752124   -.1905052
currentrat~x |   -.0339461   .0702369    -0.48   0.629    -.1716079    .1037156
         age |   -.0804338   .0299776    -2.68   0.007    -.1391888   -.0216787
       mktsh |    16503.86   2107.149     7.83   0.000     12373.92    20633.79
       _cons |   -4.817811   3.646594    -1.32   0.186      -11.965    2.329381
-------------+----------------------------------------------------------------
     sigma_u |   15.059399
     sigma_e |   18.562182
         rho |   .39693609   (fraction of variance due to u_i)
------------------------------------------------------------------------------

-> sizeclass = 2

Random-effects GLS regression                   Number of obs      =      2564
Group variable: BVDNo                           Number of groups   =       438

R-sq:  within  = 0.1177                         Obs per group: min =         1
       between = 0.8572                                        avg =       5.9
       overall = 0.5502                                        max =         8

Random effects u_i ~ Gaussian                   Wald chi2(7)       =   3126.38
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
   profavemp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 profavempl1 |    .5399317   .0198752    27.17   0.000      .500977    .5788863
 profavempl2 |    .1813073   .0205985     8.80   0.000     .1409349    .2216797
     lsizeta |    2.432758   .4317144     5.64   0.000     1.586613    3.278903
         lev |   -6.651961   1.085477    -6.13   0.000    -8.779457   -4.524465
currentrat~x |   -.1259839    .059015    -2.13   0.033    -.2416512   -.0103166
         age |   -.0505175   .0172407    -2.93   0.003    -.0843085   -.0167264
       mktsh |    1157.215   385.6155     3.00   0.003     401.4227    1913.008
       _cons |   -9.302259   3.353862    -2.77   0.006    -15.87571   -2.72881
-------------+----------------------------------------------------------------
     sigma_u |           0
     sigma_e |   14.136537
         rho |           0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

-> sizeclass = 3

Random-effects GLS regression — Number of obs = 1100
Group variable: BVDNo — Number of groups = 205

R-sq: within = 0.1610 — Obs per group: min = 1
between = 0.8769 — avg = 5.4
overall = 0.6124 — max = 8

Random effects u_i ~ Gaussian — Wald chi2(7) = 1499.11
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

profavemp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
profavempl1	.7113949	.0328615	21.65	0.000	.6469875	.7758022
profavempl2	.0425555	.0346213	1.23	0.219	-.0253009	.110412
lsizeta	2.22107	.4928142	4.51	0.000	1.255172	3.186968
lev	-4.989303	2.139535	-2.33	0.020	-9.182715	-.7958916
currentrat~x	-.2787055	.5015171	-0.56	0.578	-1.261661	.7042499
age	-.0033212	.0151618	-0.22	0.827	-.0330378	.0263954
mktsh	34.58654	98.05497	0.35	0.724	-157.5977	226.7708
_cons	-13.31311	4.152232	-3.21	0.001	-21.45133	-5.174881
sigma_u	1.9039417					
sigma_e	10.123358					
rho	.03416345	(fraction of variance due to u_i)				

-> sizeclass = 4

Random-effects GLS regression — Number of obs = 409
Group variable: BVDNo — Number of groups = 82

R-sq: within = 0.3556 — Obs per group: min = 1
between = 0.9623 — avg = 5.0
overall = 0.8296 — max = 8

Random effects u_i ~ Gaussian — Wald chi2(7) = 1952.52
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

profavemp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
profavempl1	.9648431	.0424802	22.71	0.000	.8815835	1.048103
profavempl2	-.0197288	.0451244	-0.44	0.662	-.108171	.0687133
lsizeta	-.1515047	.5114888	-0.30	0.767	-1.154004	.8509949
lev	1.025982	2.571931	0.40	0.690	-4.01491	6.066873
currentrat~x	-.0564775	.13911	-0.41	0.685	-.3291281	.2161731
age	.0034989	.0171565	0.20	0.838	-.0301273	.0371251
mktsh	-2.018699	6.895147	-0.29	0.770	-15.53294	11.49554
_cons	2.094756	5.131276	0.41	0.683	-7.96236	12.15187
sigma_u	0					
sigma_e	8.1582528					
rho	0	(fraction of variance due to u_i)				

Appendix III

Table III.1 Regression using Random Effects model on *ROA*, including size class dummies (equation 1)

```
Random-effects GLS regression                   Number of obs      =      8245
Group variable: BVDNo                           Number of groups   =      1577

R-sq:  within  = 0.0076                         Obs per group: min =         1
       between = 0.5559                                        avg =       5.2
       overall = 0.1436                                        max =         8

Random effects u_i ~ Gaussian                   Wald chi2(10)      =   1380.97
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ROAl1	.3487556	.0137991	25.27	0.000	.3217099	.3758013
ROAl2	.0415812	.0118473	3.51	0.000	.018361	.0648014
lsizeta	-.0130936	.0014738	-8.88	0.000	-.0159822	-.010205
lev	-.0204789	.0032486	-6.30	0.000	-.0268461	-.0141117
currentrat~x	-.000356	.000352	-1.01	0.312	-.0010459	.0003339
age	-.0005098	.0000813	-6.27	0.000	-.0006691	-.0003506
mktsh	.1699594	.0796125	2.13	0.033	.0139217	.3259971
micro	-.0740998	.0106767	-6.94	0.000	-.0950257	-.053174
small	-.0539403	.0098311	-5.49	0.000	-.073209	-.0346716
medium	-.0329779	.0098736	-3.34	0.001	-.0523297	-.013626
_cons	.2394429	.018299	13.09	0.000	.2035776	.2753083
sigma_u	0					
sigma_e	.14036295					
rho	0	(fraction of variance due to u_i)				

Table III.2 Regression using Random Effects model on *profavemp*, including size class dummies (equation 2)

```
Random-effects GLS regression                   Number of obs      =      8246
Group variable: BVDNo                           Number of groups   =      1577

R-sq:  within  = 0.0792                         Obs per group: min =         1
       between = 0.6529                                        avg =       5.2
       overall = 0.4897                                        max =         8

Random effects u_i ~ Gaussian                   Wald chi2(10)      =   3428.80
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

profavemp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
profavempl1	.4801016	.0112585	42.64	0.000	.4580353	.5021679
profavempl2	.1267717	.0118365	10.71	0.000	.1035726	.1499708
lsizeta	3.436333	.3173493	10.83	0.000	2.81434	4.058326
lev	-1.677179	.4937343	-3.40	0.001	-2.64488	-.7094776
currentrat~x	-.0224308	.0463804	-0.48	0.629	-.1133347	.0684731
age	-.0708189	.0167651	-4.22	0.000	-.1036779	-.0379599
mktsh	-22.1737	19.0151	-1.17	0.244	-59.44262	15.09521
micro	13.49009	2.27212	5.94	0.000	9.036812	17.94336
small	8.357228	2.125697	3.93	0.000	4.190938	12.52352
medium	3.745445	2.16058	1.73	0.083	-.4892141	7.980104
_cons	-26.45618	3.718517	-7.11	0.000	-33.74434	-19.16802
sigma_u	11.083341					
sigma_e	15.951224					
rho	.32559318	(fraction of variance due to u_i)				

Appendix IV

Table IV.1 Regression using Random Effects model on *ROA*, including country dummies (equation 1)

```
Random-effects GLS regression                   Number of obs      =      8245
Group variable: BVDNo                           Number of groups   =      1577

R-sq:  within  = 0.0082                         Obs per group: min =         1
       between = 0.5538                                        avg =       5.2
       overall = 0.1473                                        max =         8

Random effects u_i ~ Gaussian                   Wald chi2(12)      =   1421.60
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

ROA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ROAl1	.3392163	.0138539	24.49	0.000	.3120633	.3663694
ROAl2	.0368676	.0118533	3.11	0.002	.0136355	.0600997
lsizeta	-.0028688	.0012601	-2.28	0.023	-.0053386	-.000399
lev	-.0181565	.0032671	-5.56	0.000	-.0245599	-.0117532
currentrat~x	-.0002257	.0003518	-0.64	0.521	-.0009153	.0004638
age	-.0005259	.0000813	-6.47	0.000	-.0006852	-.0003665
mktsh	.2818261	.1514916	1.86	0.063	-.0150919	.5787441
germany	.0219414	.0160941	1.36	0.173	-.0096025	.0534852
italy	-.0364998	.0042068	-8.68	0.000	-.0447449	-.0282546
nethrlnds	-.112313	.081951	-1.37	0.171	-.272934	.0483079
poland	-.0075612	.0095734	-0.79	0.430	-.0263247	.0112024
uk	-.0184095	.0093485	-1.97	0.049	-.0367323	-.0000868
_cons	.1216626	.0099861	12.18	0.000	.1020902	.141235
sigma_u	0					
sigma_e	.14036295					
rho	0	(fraction of variance due to u_i)				

Table IV.2 Regression using Random Effects model on *profavemp*, including country dummies (equation 2)

```
Random-effects GLS regression                   Number of obs      =      8246
Group variable: BVDNo                           Number of groups   =      1577

R-sq:  within  = 0.0763                         Obs per group: min =         1
       between = 0.6633                                        avg =       5.2
       overall = 0.4895                                        max =         8

Random effects u_i ~ Gaussian                   Wald chi2(12)      =   3369.52
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

profavemp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
profavempl1	.4877907	.0112162	43.49	0.000	.4658072	.5097741
profavempl2	.1330129	.011829	11.24	0.000	.1098286	.1561973
lsizeta	2.131798	.2732167	7.80	0.000	1.596303	2.667293
lev	-1.594069	.5004175	-3.19	0.001	-2.574869	-.6132686
currentrat~x	-.0202881	.0465351	-0.44	0.663	-.1114953	.0709191
age	-.0550856	.0168005	-3.28	0.001	-.088014	-.0221571
mktsh	-74.98371	34.32332	-2.18	0.029	-142.2562	-7.711232
germany	.1546851	3.186113	0.05	0.961	-6.089981	6.399351
italy	-.6195811	.9104464	-0.68	0.496	-2.404023	1.164861
nethrlnds	27.27465	19.19949	1.42	0.155	-10.35565	64.90495
poland	-7.317166	1.873497	-3.91	0.000	-10.98915	-3.64518
uk	-4.480147	2.162918	-2.07	0.038	-8.719388	-.2409056
_cons	-5.982435	2.005252	-2.98	0.003	-9.912656	-2.052214
sigma_u	11.094697					
sigma_e	15.951224					
rho	.32604309	(fraction of variance due to u_i)				