

Profitability of wood harvesting enterprises

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Working Papers of the Finnish Forest Research Institute publishes preliminary research results and conference proceedings.

The papers published in the series are not peer-reviewed.

The papers are published in pdf format on the Internet only.

<http://www.metla.fi/julkaisut/workingpapers/>
ISSN 1795-150X

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Title			
Profitability of wood harvesting enterprises			
Year	Pages	ISBN	ISSN
2009	39	978-951-40-2170-1 (PDF)	1795-150X
Unit / Research programme / Projects			
Vantaa Research Unit / Renewing wood product value chains and timber procurement solutions/3454 Profitability development of service businesses of wood procurement enterprises			
Accepted by			
Antti Asikainen, prof., 19.05.2009			
Abstract			
<p>The forest machine business is about 50 years old. The rapid technical development of machinery increased productivity up to the end of last century. In 2007, the total value of round and energy wood harvesting and silvicultural work operated by forest machine enterprises exceeded 570 mill. €. According to the materials of the Vehicle Administration Finland and Statistics Finland there are about 1 600 active harvesting enterprises in the personal and business taxation system. Beside this, there are according to the Ministry of Agriculture and Forestry about 1 300 farmers who do harvesting as side business.</p> <p>About 1 000 enterprises working in June 2007 were studied with their retrospective economic analyses from 2001. The data includes all enterprises that had supplied closing of the accounts data. One-machine entrepreneurs represent more than a third of the number of enterprises, but only 13 percent of the turnover. Enterprises with seven or more machines represent less than ten percent of the number, but over twenty percent of the turnover. Enterprises are largest in eastern and northern Finland, where the average number of machines per enterprise exceeds three. Small enterprises are mostly single-owner business enterprises with a median turnover of 125 000 euros per annum. Partnerships and limited enterprises have double the median turnover of single-owner businesses. Limited companies turn over a median of 450 000 €/y, representing 67 percent of total turnover.</p> <p>Median net profit varied between 6 and 10 percent of turnover in 2001–2007, but only between 2 and 4 percent where the wage adjustment is deducted from the profit. The wage adjustment is estimated as if the owners of single-owner businesses earn an operator’s salary. Profit was highest in 2002 and lowest 2006. In the smallest enterprise class with a turnover of less than 75 000 €/y, profit was lowest and negative in 2006 and 2007. The variation in profits between enterprises was also biggest in that period. The median net profit was best in limited companies and partnerships; about 6 percent. The annual reserve after debt amortization and investment was some 50 000 € among the biggest enterprises, about 30 000 € among the medium size groups and at most some 10 000 € in the smallest ones.</p> <p>Return on capital varied only a little, showing a slight decrease towards the end of study period. In 2007, return on assets (ROA) was around 12%, except in enterprises with turnover of less than 75 000 €, where ROA was two percent. Return on equity (ROE) varied between 15 and 25%, except for the smallest enterprises, with less than 10%.</p> <p>The harvesting business, with limited means of meeting the severe challenges of global recession, cease operations for several months. Finding a profitable growing formula and qualified operators is a challenge, even without these cuts.</p>			
Keywords			
Profitability, ratio analysis, management accounting, reserves for reorganising business, wood procurement			
Available at			
http://www.metla.fi/julkaisut/workingpapers/2009/mwp126.htm			
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Contact information			
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1 Introduction

1.1 Forest machine entrepreneurship

Forest machine entrepreneurship is a fairly recent industry. Horses dragged logs from forest stand to river- or roadside for hundreds of years. In the Nordic countries, farm tractors started to be utilized in forests at end of the 1950s. Up to then, logging was mostly winter work for farmers and rural men without their own farm. Growing logging volumes and competition from other employment opportunities were motives to develop more efficient terrain transport and then cutting. Logging had always been strenuous and even dangerous work (Salminen 1996).

The first chassis-steered tractors with hydraulic grapple loaders were constructed at the beginning of the 1960s. This development was based mostly on the ideas and technical solutions of entrepreneurs, i.e., farmers working in the forest in winter. Special machines could not be used for other tasks, which required the owner to work the whole year round in the forest. Machine felling, delimiting and cross-cutting started about ten years later (Drushka & Konttinen 1997).

The higher capital costs and risks needed to operate with special machines were often first borne by wood-buying companies. In Finland first and later in Sweden, these new forwarders, processors and harvesters were assigned to private entrepreneurs. In Finland, the Forest Machine Contractors Association was founded in 1969 with 600 members (Hakkila et al. 1989). Most enterprises started as one-man companies with only one machine, but the appearance of processors and harvesters caused growth in these enterprises (Mäkinen 1996). One entrepreneur had typically one or two machines and 3–4 operators working in two shifts. The forest industry, which bought entrepreneurs' services, supervised the work and directed the transfer of machines.

The entrepreneurs were mostly men with high mechanical skills who could keep the machines running. The Forest Industry and Forest Machine Contractors (later Entrepreneurs) association negotiated the compensation level based on work studies conducted by the industry's research organization (Rumpunen 1996). For almost 30 years, there was little need to excel in economics or business skills. Most of them had only one big customer and there were no other uses for machines than harvesting and terrain transport.

1.2 Structural changes

In the later process of joining European Union, Finland had to tighten its competition laws, resulting in the repeal of the general tariff agreements between the industry and entrepreneur associations 1991 (Rumpunen 1996). Since then every entrepreneur has negotiated volumes and compensation individually with customers who buy services from hundreds of entrepreneurs. The reduced negotiating power affected the possibility of increasing profits (Alajoutsijärvi et al. 2001).

The mechanisation increased the productivity of harvesting and terrain transportation of wood continuously for 30 years (Penttinen et al. 2006). Over the last ten years, the reduced growth in the efficiency of new machines has been shadowed by the need to work in poorer conditions than before, including smaller stands, more thinning, working on peat lands, etc. This increased productivity might have compensated for the increased operating cost, but during the last few years, the cost increase has overpowered the productivity increase.

The forest industry started reorganising and outsourcing wood procurement to save on the cost of its own organization, which enabled entrepreneurs to grow their businesses and offer new services (Jaakkola 2003). Small entrepreneurs may however have difficulty in getting an agreement with large customers (Ala-Fossi et al. 2004). It may also be difficult to get paid for all new services.

Russia has decided to increase tax on exported roundwood from 15 €/ m³ to 50 €/m³ (Government Russia 2009). The forest industry tries to compensate for this overly expensive supply by increasing domestic wood-buying and harvesting volumes. However, autumn 2008 brought the international recession, which has also severely affected the forest industries and limited their raw material needs. At the end of 2008, the Russian government surprisingly postponed these export taxes by 9–12 months.

The first generation of machine entrepreneurs is retiring and their enterprises need new owners or mergers. Machine operators need to have various skills from operations to hydraulics and to computers and even biology. The poor profitability of the business has kept salaries low, which has led to problems keeping operators and finding new ones (Penttinen et al. 2006).

All these changes in the forest machine business and its circumstances have led to structural changes which require entrepreneurs to have strong business, economic and management skills.

1.3 Earlier studies

The Finnish Forestry and Earth Moving Contractors Trade Association (The Trade... 2008) has conducted an annual questionnaire on their members' economic situation and expectations in the immediate future. Statistics on paid compensation is published in the Machine Entrepreneurs Calender (Koneyrittäjä Kalenteri 2008). The economic analysis of the business based on financial statements and the forecast for the next year is published in the magazine Koneyrittäjä (Jaakkola 2008).

The OP-Pohjola Group (previously OKO Bank) Central Cooperative (2008) conducts an economic analysis on their customers book-keeping numbers, divided into various industry sectors, every year. Forest machinery has been analysed since 1986. The number of enterprises analysed has increased from 40 then to 657 in 2001. Since then, the number of enterprises supplying the turnover figure has grown to 721 in 2006, but the detailed analysis is done only on a sample, 250 enterprises in 2006. OP-Pohjola's analysis is the longest continuous series on the forest machinery sector and is comparable with analysis of other sectors. The analysis is yearly published in Koneyrittäjä (Turkulainen 2008 and Saviaho 2009). The profitability of forest machine entrepreneurs varies, but lower quartile enterprises returned a negative result in 2002–2006.

Mäkinen (1988) interviewed 74 forest machine entrepreneurs in the period when the major change from chainsaw to harvester cutting took place in Finland. This extensive study showed that return on investment was weak or tolerable. The median was negative in the study period except for 1983. The financial results largely mirrored the corresponding OKO studies. Since the small sample produced a large dispersion of variable values, only a few conclusions on the factors affecting success in business could be drawn. The profitability of one-machine forwarder enterprises was little better than that of other enterprises.

Metsäteho Oy, a Finnish Forest Industries research company, has analysed the profitability of forest machinery; first with data supplied by three banks (Rajamäki & Heikka 1990) and second with data from Statistics Finland (Väkevä & Imponen 2001). Both these reports describe a large proportion of enterprises with poor general profitability and high leverage. A larger turnover seems to produce slightly better profitability or at least less variation in positive net results. In the older report, one man – one forwarder enterprises performed better than forwarder enterprises with more machines (Rajamäki & Heikka 1990), excessive work input by the entrepreneurs themselves making this possible.

In a later study, Metsäteho utilised data on enterprises working for the Metsätehos owner industry companies and state Forest Service (Väkevä & Imponen 2001). This provided access to data such as working volumes and general working conditions, which are not available in ordinary statistics or bank data. Enterprises with a turnover of less than 83 000 euros were excluded because of too much missing data. Larger volumes per harvester per year and a lesser ratio of thinning generated a slightly better result, which however was not confirmed by statistical analysis.

In Sweden, the SMF Swedish Forest Entrepreneur organisation (Skogsentreprenörerna 2009) has collected annual data on entrepreneur results since at least 1994. The net result has been below 5 per cent for more than ten years. One entrepreneur in three made losses in 2006 (Pekka 2008). The *Tidningen Skogsteknik* magazine publishes an article in every number on economics, advising entrepreneurs on good management (e.g. Löthberg & Löthberg 2008). Norin & Thorsen (1998) asked customers who are their best logging contractors. Good leadership and going along with customers wishes were valued most by the customers. Proactive contractors were entrepreneurial in all their actions as reactive ones were good in fulfilling customer's requests. Even these best contractors needed improving in personnel management, strategic planning and analysing of results.

Furness-Linden & Norin (2007) followed one forest industry company's change from negotiations to inviting tenders in hiring logging contractors. One of the targets of this change was to get less but larger and more innovative contractors. It was a useful process both for customer and contractors in defining the processes and business, but many details need to be redefined. Specifying compensation guarantees for rare tasks or special conditions might reduce the need for high risk insurance premium in compensation. Many guarantees were although dropped during the negotiations. Customer company got in average larger contractors with better qualified personnel. Effects of more development oriented contractors could not be attested. Writers propose a branch standard to define processes for general compensation system.

Dale (1993) surveyed the economic, technical and health situation of Norwegian forest machine contractors. Questionnaires were sent to 565 entrepreneurs, half of whom answered. Contracts with customers were generally unclear. Most contractors had some physiological problems resulting from work. Since contractors did not have enough data for their own financial calculations, the the price of work often did not reflect real costs. Business was poor because of decreasing volumes of work and low capital. Average yearly harvesting volume per entrepreneurs was only 10 000 m³.

In general, earlier studies have presented only a narrow cross-section of the current situation. Mäkinen (1988, 1993) has carefully analysed success and failure factors, but the structure of the business has changed since then. Väkevä and Imponen (2001) related material of harvesting en-

terprises' size and working connection to economical data, but they had to omit notable part of small and part time enterprises from the analysis. Generally, only brief summaries describe the business (Pekka 2008, Dale 1993). Both internal and external conditions of the harvesting business have changed, and so new research is needed.

1.4 The aim of the study

The aim of this study is to analyse the economic opportunities for the forest machine entrepreneur business. A key notion is to understand the situation and development of this industry and identifying its strengths and weaknesses. A special interest is to focus on whether economic success depends on the *scale of the enterprise*, the *form of the company* or the *area* in which it operates. The results of this study will be utilized later in developing the economic awareness of forest machine enterprises and developing economic and operational tools to support the decision-making of entrepreneurs.

2 Material and methods

2.1 Finnish Vehicle Administration

The Finnish Vehicle Administration AKE (AKE 2008) keeps a database of cars and working machines. The forest machine class includes forwarders and the multipurpose machine class includes harvesters. Registration of forest machines was not compulsory before 2008. Most machines are registered in any case, because this is required if the machine is funded by loans or is leased. Traffic insurance is also more readily available if the machine is registered. There is no annual payment or questionnaire by AKE, which causes situations in which old unutilised machines are still registered. There was thus a need to update the AKE data before utilising it.

The key to the AKE database is the registration plate markings. Variables include the identification data on the owner and authorized user of the machine as well as many technical characteristics. The original AKE data included 5 650 machines in June 2007, 490 of which were excluded because they were owned by schools, banks or manufacturers and their financing institutions. Of these, 270 were more than 15 years old when bought, and were excluded from data, not being considered to be in effective work any longer. Companies which were not engaged in the harvesting business owned 142 machines; some were well-sinkers, horse-farmers, log-house builders, and so on. Since not all enterprises could be checked, the database may still include some not working in forestry. The updated AKE data contained 4 748 machines. This data was sent to Statistics Finland.

2.2 Statistics Finland

The edited AKE-database was used as a basis for enquires in the Statistics Finland (2008) databases. Since not all enterprises were available in these databases, the number of basic Statistics Finland data was 2 271 enterprises and 4 698 machines. Statistics Finland data includes the number

of employees and a wide variety of financial statement data for each enterprise. The number of machines per enterprise, based on the AKE data, has been supplied with the enterprise identification code. Statistics Finland information comes from various state registers, such as the tax office, National Board of Patents and Registration of Finland, and pension insurance companies.

The problem is that much information is missing. Small enterprises do not need nor want to supply all the data. Limited companies have stricter rules and their information is more comprehensive. In the following analysis, the Statistics Finland data from 2007 included 1 670 enterprises which supplied turnover figures. In general, the data offered about 1 000 enterprises for analysis.

Another Statistics Finland data problem is that it also includes turnover which is derived from other sources than forest harvesting. There are examples of enterprises which include trucking, construction or some other business in the same enterprise unit as the forest machine business, the turnover and expenditures of which confuse the analysis of the harvesting business.

Although the data represents only enterprises which were operating in June 2007, data for these enterprises can be traced back to 2001. Observations on years before 2007 thus represent a smaller proportion of the total forest machine business, because data on enterprises which ended their operations before 2007 is missing. During 2001–2007, the meaning of some variables also changed. The problem is also that one cannot establish a connection or even follow data on the *same* enterprise through the whole period. Despite such problems, this is the broadest financial database available on harvesting enterprises.

2.3 Methods

Profitability

Profitability has been shown to be the best indicator of performance (Brozik 1984). However, even the best profitability does not help if there are financing difficulties. A liquidity crises can be fatal during rapid growth, despite profitability and opportunities being excellent. Profitability was studied by analysing the return on capital and structure of profit. The latter has traditionally been utilized, but the new International Financial Reporting Standard (IFRS) of the EU favours return on assets (ROA) or return on equity (ROE) (Laitinen & Laitinen 2004). The return on capi-

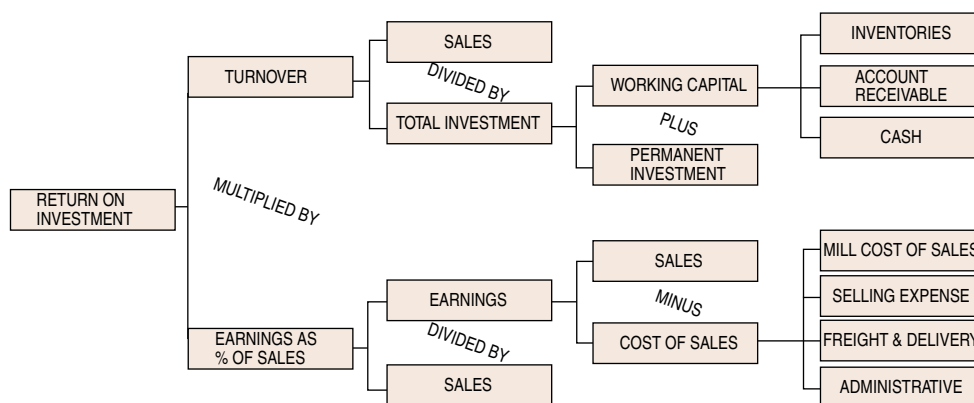


Figure 1. The Du Pont return on investment formula (Johnson & Kaplan 1987)

tal employed is based both on the contribution delivered by sales and the sales related to the total investment (Fig. 1).

On the financial ratios

Financial ratios follow a multiplicative rather than an additive law of probability, multiplicative behaviour of ratio components being a prerequisite for valid ratio usage. Moreover, multiplicative ratios are governed by proportionate or exponential growth. Multiplicative variables tend to be log-normally rather than normally distributed (McLey & Trigueiros 2002).

The *a priori* classification applied is that of Salmi et al. (1990), suggesting *profitability*, *liquidity*, and *capital adequacy* also called solvency, efficiency, operating leverage, riskiness and volume. Efficiency stands for inventory and account receivable turnover and is not relevant in this industry. The operating leverage includes ratios such as labour intensiveness and variable costs related to fixed costs. Riskiness may be proxied by the variability of earnings after interest and taxes. Volume stands for the long-term growth rate of deflated sales; however, it may be unrealistic to assume that ratio groupings, whatever they may be, will remain consistent and stable over time, according to Cowen and Hoffer (1982). Profitability is treated as the permanent key success factor here.

3 Volume and value of the industry

Forest machine entrepreneurs have traditionally felled trees, prepared wood assortments and/or transported bolts to roadside storage piles. Planning of the worksite, choosing the trees to be felled, measuring the wood handled and of course all organising of transferring machines and keeping them in working order are the tasks of entrepreneurs. The wood-harvesting tasks are executed by harvester and forwarder. The same machinery with additional attachments can also be used for such things as for energy wood harvesting, terrain transportation of bioenergy, harrowing, seeding and spreading root-rot prevention liquids. Many harvesting entrepreneurs also have an excavator, which can be used for mounding, stump extraction, ditching and road construction, beside harvesting trees with the harvester head.

This wide variety of tasks shows the difficulty in defining forest machine entrepreneurship. Measuring work volumes and values is also rather difficult. There are entrepreneurs doing only harvesting and that all the year round. Some do other tasks beside harvesting such as trucking or construction. Some do harvesting only as a part-time job. Enterprises with several machines and operators have to have work the whole year around to pay capital and salary costs. An entrepreneur with a farm background driving his older machine may not be hit so hard if there is no work for a while.

The volume of annual merchantable removals in Finland was during the study period of 2001–2006 around 50 mill. m³ (Fig. 2) (Finnish statistical... 2008). The compensation for harvesting is calculated separately for standing removals operated by harvesting enterprises for the wood-buying industry and for the forest owner's own delivery sales (Tab. 1). Metsäteho, a Finnish Forest Industries research company, records the cost of standing sales harvesting (Kariniemi 2008),

which represented 2007 about 87% of total harvesting volume. Metla monitors the costs of forest owners' harvesting work (Finnish statistical... 2008). According to Valkonen et al. (2007), about half of delivery sales are cut and 60% forwarded by harvesting enterprises and paid for by the forest owner. The cost of delivery sales executed by entrepreneurs was calculated with the thinning cost, because the bulk of the delivery sales is thinning. The proportion of delivery sales has decreased lately. Total roundwood removals were 64 mill. m³ in 2007 and 56 mill. m³ in 2006. The 2007 harvesting year was a record in Finland. The proportion of delivery sales has decreased slowly over the last five years, giving more scope for forest machine entrepreneurs.

The Statistics Finland-data included 1 670 forest machine enterprises with turnover data in 2007. Their total turnover was 741 million euros, which clearly exceeded the total costs of round- and energy-wood harvesting plus silviculture works (Tab. 1 and Fig. 2). Other experience indicates that forest machine enterprises do energy-wood processing, material transport on roads, road maintenance, machine repair and even sawmilling. In 2007, the turnover of Statistics Finland data enterprises exceeded the traditional roundwood harvesting cost (565 mill. euros in Fig. 2) by 30 per cent (Finnish Statistical... 2008). This includes industrial roundwood market removals harvesting. Ten per cent of the value of harvesting works is done by forest owners themselves and not by forest machine enterprises, however. Harvested volumes and total cost follow each other, but the Statistics Finland data on turnover does not do so because the turnover of harvesting enterprises which ended their activity before 2007 are missing.

Table 1. Volumes and values of forest machine entrepreneurs' work in 2007. (Finnish Statistical... 2008, Kariniemi 2008, Laitila et al. 2007, Valkonen et al. 2007. See also previous text).

Type of work	Unit	Unit	Total cost, €
Traditional round wood harvesting by forest machine entrepreneurs	Volume, solid mill. m³	Cost, €/m³	Compensation, mill. €
For forest industry	50.5	9.0	453
For forest owners, logging	3.6	8.3	30
For forest owners, forwarding	4.4	4.1	18
Fuel wood harvesting	0.6	19.0	12
Total traditional round wood harvesting	54.7		513
Silviculture, special equipment needed	Area, ha	Cost, €/ha	Compensation, mill. €
Soil preparation: scarification, harrowing, mounding, ploughing	127 436	vary	30
Mechanical seeding	23 800	40.0	1
Mechanical planting	1 803	700.0	1
Repelling root-rot disease	37 652	60.0	2
Total silviculture			34
Residual energy wood harvesting	Volume, solid mill. m³	Cost, €/m³	Compensation, mill. €
Small diameter stems	0.7	vary	12
Logging residues (only forwarding)	1.5	5.00	8
Stump extraction	0.3	5.90	2
Stump forwarding (volume as extracting)	0.3	7.50	2
Total residual energy harvesting	2.5		24
Total value of forest machine entrepreneur work in 2007			571
Total value of forest machine entrepreneur work in 2006			493

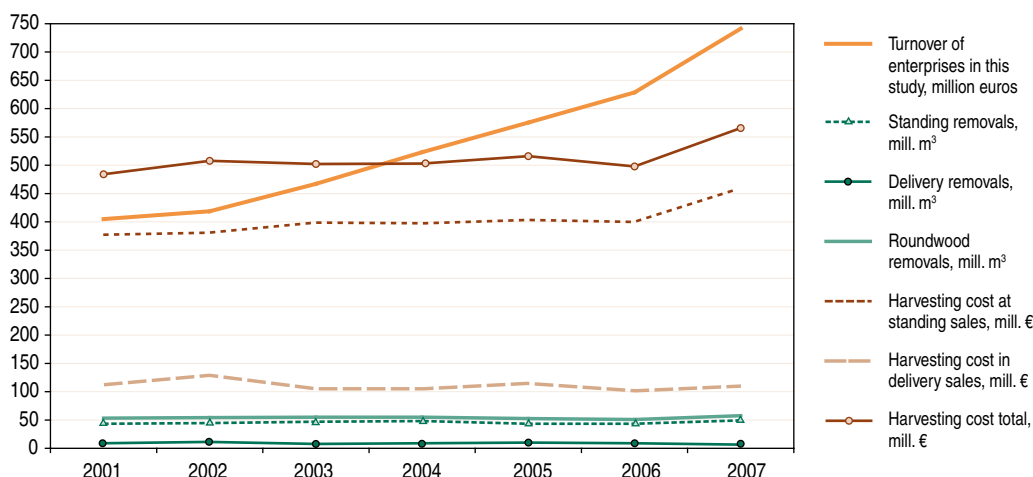


Figure 2. Volumes of industrial round wood removals divided into delivery and standing sales and estimates of their harvesting costs (Finnish Statistical... 2008) compared to total turnover of Statistics Finland data of harvesting enterprises. (Number of turnover observations in 2007 is 1 670 enterprises.)

The harvesting volumes varied during the study period between 51 and 58 mill. m³ (Fig. 2) (Finnish Statistical... 2008), which caused variation in total cost between 491 and 566 mill. €. The last year, 2007, had the highest values, but the previous year the lowest, so that there was a considerable jump at the end, which can also be seen in the total turnover in the Statistics Finland data.

Average compensation for harvesting calculated per cubic metre did not follow the harvesting volume (Fig. 3) (Finnish Statistical... 2008). The number of harvesters follows total roundwood harvesting loosely. During the study period, there has been a need for 30% capacity adjustments between extreme years and over 20% adjustment need between two adjacent years. With the harvester's life span of at least five years, this represents a significant cost for extra capacity (human and machine) during low production years. We already know that harvested volumes dropped dramatically in 2008 and 2009. There must be considerable strain on those enterprises which expanded for 2007 with new machines, but which could not find enough work the next year.

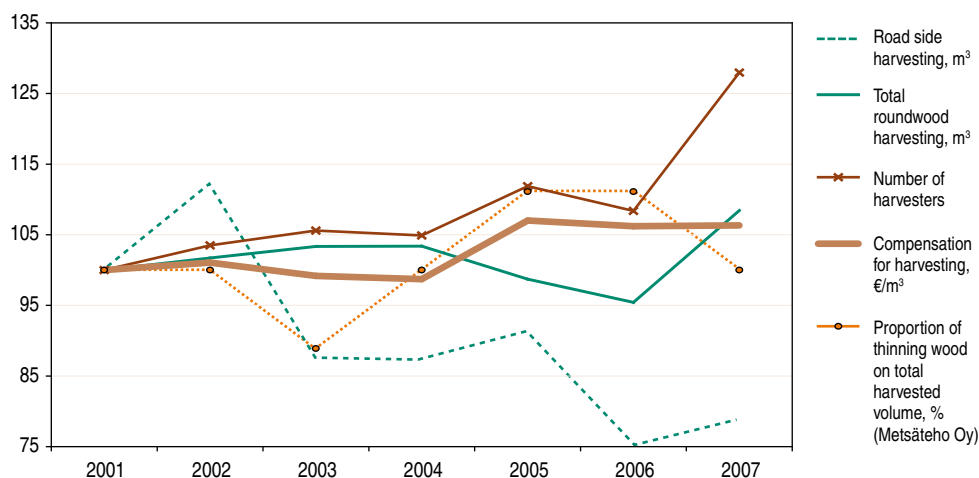


Figure 3. Index of harvesting volumes and types, number of machines, compensation and proportion of first thinning in 2001–2007 (Finnish Statistical... 2008, Metsäteho Oy by Kariniemi 2008). Year 2001 index is 100.

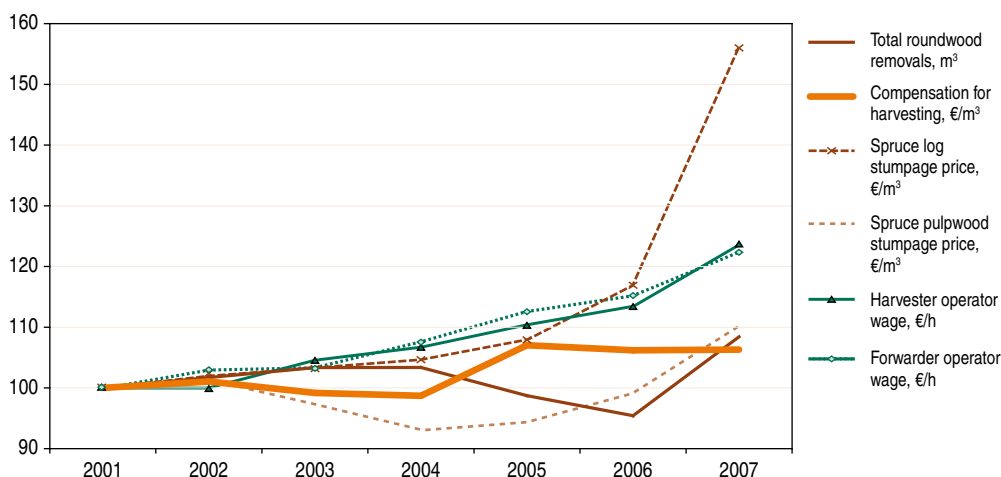


Figure 4. Index of compensation for harvesting, total removal volumes and wood and operators' wage indexes in 2001-2007 (Finnish Statistical... 2008). Year 2001 index is 100.

The proportion of roadside harvesting has dropped, which suggests that the lion's share of work is paid for by the industry and the state, with stronger negotiation power (Fig. 3). The average compensation rose 5 per cent between 2004 and 2005, remaining level at other times. Harvesting in the first thinning is much more expensive than in regeneration cuttings and the ratio of first thinning in the total harvested volume also rose in 2004–2005, but this cannot be the only reason, because the proportion in thinnings in other years showed no response in compensation. The rise in compensation has had other reasons than working volume or conditions.

High wood prices stimulated high removals in 2007 (Fig. 4) (Finnish Statistical... 2008), before which the wood price and removal volumes did not correlate. Operator wages have risen slowly across the whole period. The high harvested volumes have perhaps pushed the wages a little up in the last year. Average compensation for harvesting does not follow any of these variables (Fig. 4).

4 Turnover results

4.1 Enterprise scale

Enterprise scale typically underpins analysis of financial statements. Basic properties include total operating income in different areas by enterprise form, etc. related to machine and personnel numbers and other background variables. Total operating income contains the turnover and other operating income. Only the term *turnover* is used for simplicity hereafter to cover both. In fact, the scale of other operating income turned out to be negligible in this business.

The total turnover of the Statistics Finland data was 741 mill. € for 1 670 enterprises in 2007 (fig. 2 and 6). In 2001, the number of enterprises supplying turnover data was 1 358 (Fig. 5), their total turnover being 405 mill. €. The number of enterprises with comprehensive accounting data was 934 in 2001 and 1 061 in 2007; corresponding total turnovers were 315 and 498 mill. €. About

30 per cent of enterprises in the Statistics Finland database have delivered only turnover data to officials (Fig. 5).

Turnover is a typical indicator of enterprise scale. Machine and cost differences between harvesters and forwarders create differences also in turnover. Working conditions affect productivity and compensation per harvested cubic metre of wood, which is the general basis for payment in this business. Harvesting the first thinning may cost up to 20 €/m³, while in regeneration cuttings it may be less than 6 €/m³. Enterprises which have supplied comprehensive accounting data had about 30 per cent larger median turnover than the larger group where only the turnover was known (Fig. 6).

The median turnover of the Statistics Finland database enterprises with comprehensive closing of accounts data grew 19 per cent in the 2001–2007 study period; the turnover median of enterprises with only turnover data grew 22 per cent (Fig. 6). This corresponds to an annual growth of about

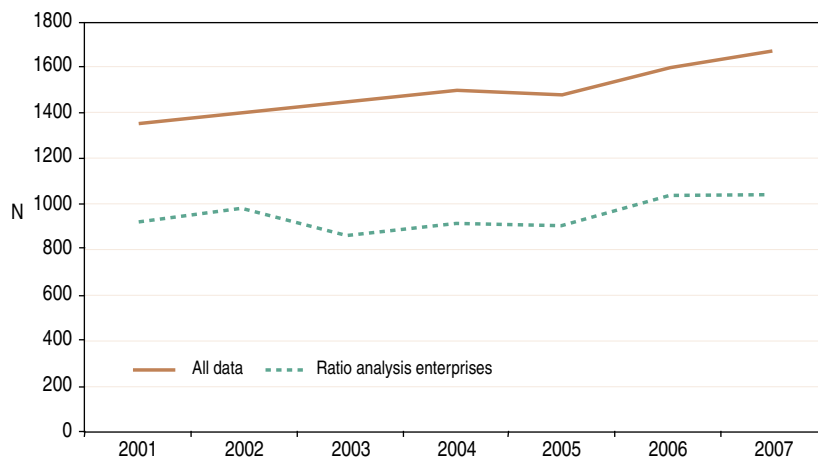


Figure 5. Number of enterprises in the Statistics Finland data base: continuous line shows number of enterprises with turnover data, dotted line shows number of enterprises which have comprehensive closing of accounts data.

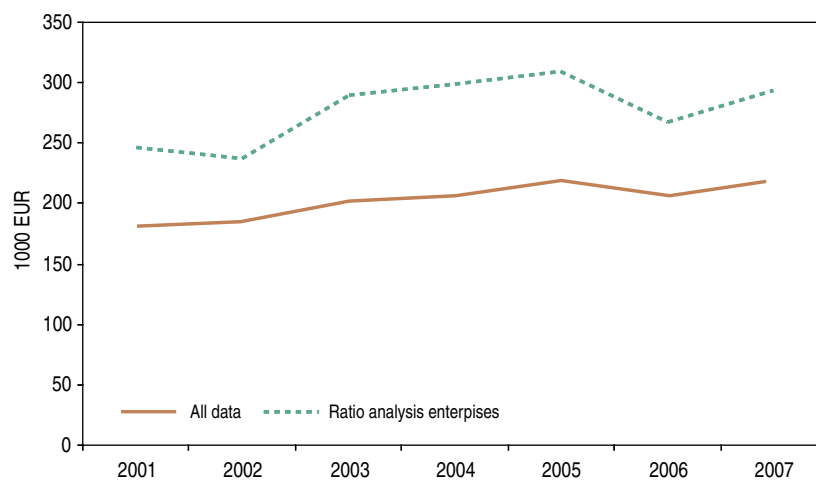


Figure 6. Median enterprise turnover in the Statistics Finland database: continuous line shows the median of enterprises with turnover data; dotted line shows the median of enterprises which have comprehensive closing of accounts data.

3 per cent, which in both overlapping groups clearly exceeds the inflation rate of 1.25% during the same period. One can assume that, of those enterprises existing in 2001, only the better ones have survived till 2007. Since 2001, new enterprises have also emerged, so that there is variation in success of enterprises in 2007.

The number of enterprises (with comprehensive accounting data in the Statistics Finland database) is dominated by small enterprises, nearly one third of enterprises accumulating less than 150 000 € turnover (Tab. 2), and accounting for less than six per cent of total turnover. On the other hand, the number of enterprises with a turnover above 600 000 € is one fifth of the total number, but they accumulate 60 per cent of the total turnover. The ratio of employees follows that of the turnover. In smaller enterprises, their share of machines is four times larger than that of turnover. Many small entrepreneurs drive alone their only machine, which may also be an older model with smaller capital cost. Bigger companies drive new machines in two shifts.

One machine per enterprise is most common. At least half the enterprises with a turnover between 75 and 150 000 € per year have only one machine (Tab. 3). Even in the 150–300 000 € class, at least a quarter have only one machine. To accumulate a turnover of over 600 000 €, enterprises seem to need to operate at least four machines. The biggest company in the AKE data has 29 machines.

The number of paid employees per enterprise follows the number of machines per enterprise, enterprises with a turnover of 75–150 000 € per year typically having at most one paid employee (Tab. 3). The entrepreneur himself operates the only machine. It may also be that an enterprise has two or more owners, so that no paid employees are needed even to operate more machines. Large

Table 2. Turnover and number of machines and personnel in turnover scale classes in 2007 (2001 figures in parentheses)

Turnover class 1 000 €	Enterprises		Turnover / year		Number of machines	Number of employees
	Number	%	Mill. €	%	%	%
Below 75	98 (137)	9.2 (14.7)	4.9	1.0 (2.0)	4.1 (6.7)	0.9 (1.9)
75–150	185 (159)	17.4 (17.0)	20.5	4.1 (5.7)	8.1 (8.4)	3.7 (4.7)
150–300	254 (265)	24.0 (28.4)	54.5	10.9 (18.7)	15.1 (20.9)	10.5 (16.5)
300–600	273 (244)	25.8 (26.1)	112.8	22.7 (32.4)	24.4 (32.0)	22.9 (32.8)
Over 600	250 (129)	23.6 (13.8)	305.0	61.3 (41.3)	48.3 (32.0)	62.0 (44.1)
Total, %		100		100	100	100
Total	1060 (934)		497.7 (314.9)		2975 (2713)	4059 (3058)

Table 3. Quartiles of machine and employee numbers in turnover scale classes in 2007(2001 figures in parentheses).

Turnover class 1 000 €	Machines / enterprise			Employees/ enterprise		
	Lower quartile	Median	Upper quartile	Lower quartile	Median	Upper quartile
Below 75	1 (1)	1 (1)	1 (1)	0.2 (0.2)	0.2 (0.3)	0.5 (0.5)
75–150	1 (1)	1 (1)	1 (2)	0.4 (0.6)	0.6 (0.9)	1.0 (1.0)
150–300	1 (1)	2 (2)	2 (3)	1.0 (1.3)	1.6 (1.8)	2.1 (2.4)
300–600	2 (2)	2 (3)	3 (5)	2.1 (2.7)	3.3 (4.0)	4.4 (5.2)
Over 600	4 (4)	5 (6)	7 (8)	5.8 (6.4)	8.4 (9.3)	12.4 (12.8)
Total	1 (1)	2 (2)	4 (4)	0.9 (0.9)	2.1 (2.0)	4.7 (4.2)

enterprises (turnover of more than 600 000 €) have more than one paid operator per machine. These enterprises operate usually with new machines in two shifts.

A typical turnover per machine is 100–150 000 € per year (Fig. 7). The largest turnover per machine is more than 400 000 € according to the Statistics Finland data. This is a very ambitious amount to earn in harvesting work. The explanation in some of these cases may be that these enterprises have other businesses beside harvesting or that they utilise unregistered as well as registered machines.

In the Statistics Finland database, the number of employees is calculated from total pension contributions paid by transferring them to full-time employees. The turnover per paid employee varies much more than that per machine (Fig. 8). The largest turnovers per employee may again contain other businesses than harvesting. It may also be that an enterprise has many owners, who are usually not calculated as employees, but only a few employees. In a single-owner business, the owner cannot pay himself a salary as it is possible in limited companies. The harvesting business has seasonal and economic variation. Operators who have another business during the low season (spring and summer) are of value to the enterprise in saving wage costs. Agriculture and forestry working seasons have traditionally complemented each other, which still often holds in some cases.

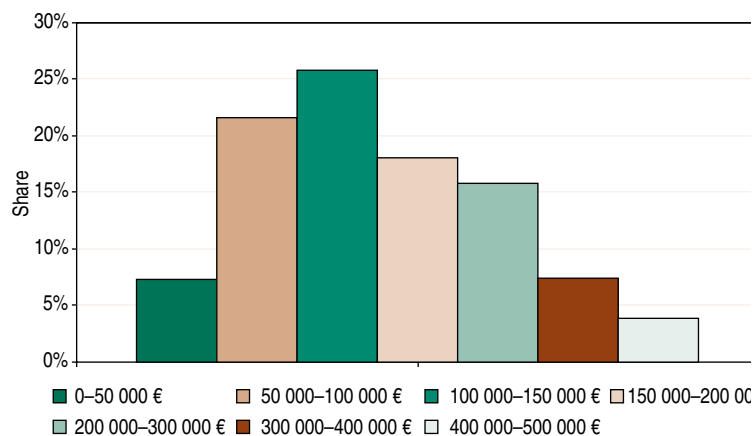


Figure 7. Distribution of turnover per machine in 2007.

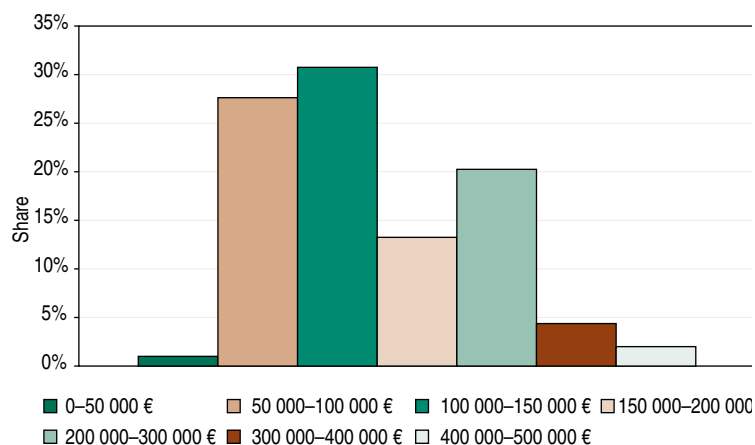


Figure 8. The distribution of turnover per one full-time employee in 2007.

4.2 Areal variation

Finland was roughly divided into six similar areas according to forest structure and industry (Fig. 9). The Coast area is clearly smaller than the other areas, but was kept as single unit, because the main customer there is the Forest Management Association rather than forest industry companies as in other areas. This is a long tradition in an area where Swedish-speaking Finns dominate. The forest machine enterprise size is smaller there than in other parts of Finland (Tab. 4). Lapland is a large area, but trees are smaller, so that it contributes a smaller proportion of turnover. On the other hand, enterprises are large there. Large customers and worksites and long distances there promote large enterprise size as also in Central and East Finland. South Finland and Ostrobothnia are known for their active small- and medium-size forest industry as well as active forest owners.



Figure 9. Location of the six test areas.

Table 4. Areal variation in enterprises, their turnover and size of enterprise in 2007 (2001 figures in parentheses)

Area	Number of enterprises	Turnover	Number of machines	Machines per enterprise	Number of personnel	Persons per enterprise
	%	%	%	Aver.	%	Average
Coast	5.7 (5.9)	3.9 (3.6)	3.9 (3.9)	1.9 (1.9)	3.8 (3.1)	2.6 (1.7)
South Finland	24.0 (23.4)	21.7 (20.5)	22.9 (21.2)	2.7 (2.6)	18.3 (18.8)	2.9 (2.6)
Central Finland	25.6 (25.5)	25.4 (25.4)	23.3 (23.3)	2.6 (2.7)	24.9 (26.2)	3.7 (3.4)
East Finland	20.4 (22.2)	26.3 (27.4)	26.4 (28.3)	3.6 (3.7)	28.9 (29.0)	5.4 (4.3)
Ostrobothnia	17.3 (16.1)	15.4 (15.4)	16.2 (15.7)	2.6 (2.8)	16.0 (15.2)	3.5 (3.1)
Lapland	7.0 (7.0)	7.3 (7.7)	7.3 (7.6)	2.9 (3.2)	8.1 (7.7)	4.5 (3.6)
Total, %	100	100	100		100	
Total or average	1 060 pc. (934)	497.7 mill. € (314.9)	2 975 pc. (2713)	2.8 (2.9)	4 059 pc. (3058)	3.8 (3.3)

It seems that the forest industry structure and forest owners and their forest management association's activity influences forest machine enterprise size. One sign of this is the policy of two of the three international forest industry companies promoting the region or key enterprises, which have a yearly agreement worth 500 000 € or more. The variations between areas are not that great after all. One and two machine enterprises still dominate over all, while the largest enterprises are located in Central, East and North Finland (Fig 10). The median turnover of enterprises grows from South to North. The turnover of the upper quartile is largest in East Finland. The highest median turnover is in East Finland and Lapland. Enterprises in the Coast area are smallest; the turnover of upper quartile enterprises being only some larger than that of median enterprises in the northern parts of Finland.

Present-day forest machine enterprise turnover has grown steadily through the study period in all areas (Fig. 11).

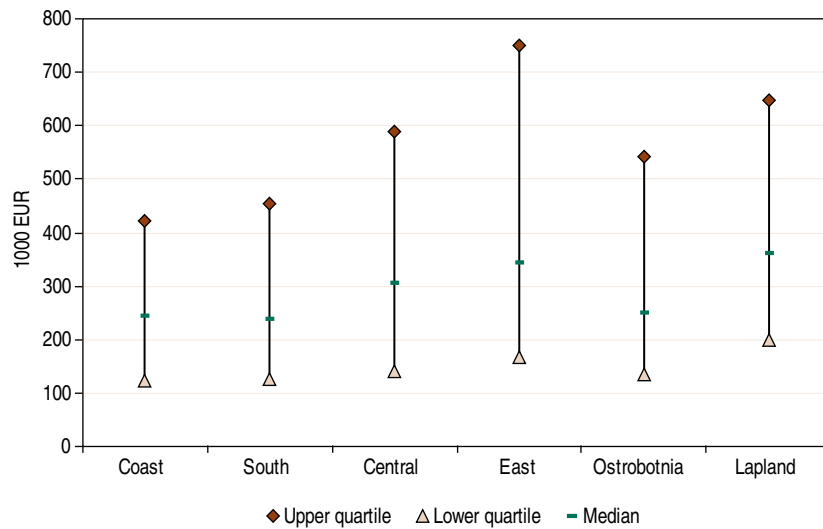


Figure 10. Lower and upper quartiles and medians on the turnover of enterprises divided into the six area classes in 2007.

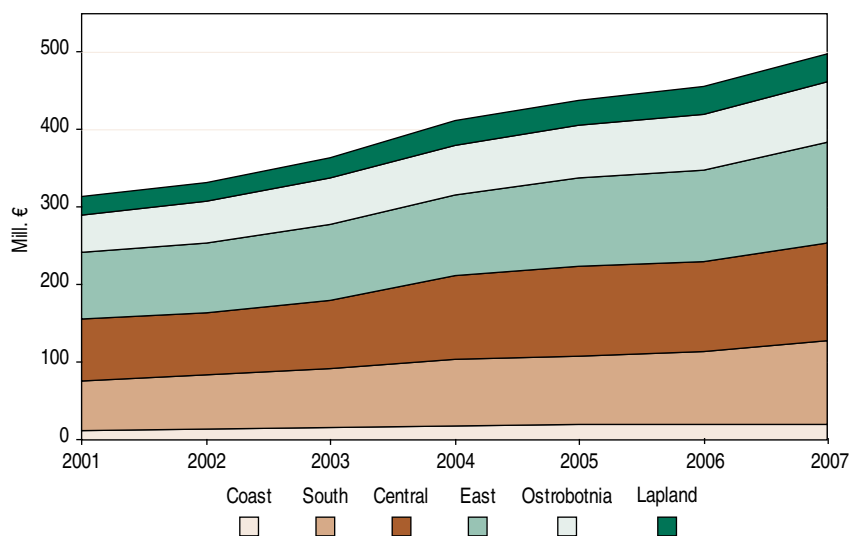


Figure 11. Total turnover in area classes during the study period 2001–2007.

The Coast and South areas demonstrate the smallest enterprise size, but the trend has been surprisingly stable. The average growth of turnover in 2001–2007 was 8%, that of Coast 9.4% and of South 8.9%. However, Lapland and East Finland remained lowest at the 7% and 7.2% levels. The total turnover growth cannot be seen in growing turnover among median enterprises in area classes (Fig. 12). The smallest turnover in the Coast area has grown slowly, like that in Central Finland. The turnover of median enterprises in other areas has varied very little during the study period. It is difficult to tell why the median enterprise has not grown while the total turnover has increased. One explanation may be that only the strongest enterprises have succeeded in surviving through the period and thus were at the same size at the outset. Only enterprises in the areas with the smallest enterprise size (Coast and Central Finland) have shown a slight increase in turnover. During the study period, many enterprises, perhaps small ones, have ceased their activities because the proportion of turnover of enterprises in our data over the total value of the harvesting business has grown during the period (Fig. 2).

4.3 Enterprise form

The form of the enterprise depends loosely on its size. Most forest machine enterprises have started as single-owner businesses, but growth and the entrepreneur's economic awareness have led to more sophisticated forms of business. Advances since the start of the forest machine business mean that almost half the enterprises were limited companies in 2007 (Tab. 5). Only a fifth is still single-owner businesses and their proportion of turnover is only 8 per cent. Partnerships account for about 9 per cent of turnover, but the proportion enterprises is clearly smaller than that of the single-owner business.

Entrepreneurs typically start a single-owner business with one machine. When several active entrepreneurs run an enterprise together, the partnership assists cooperation. Partnerships even offer some taxation benefits. A limited company also provides opportunities to return profits as capital

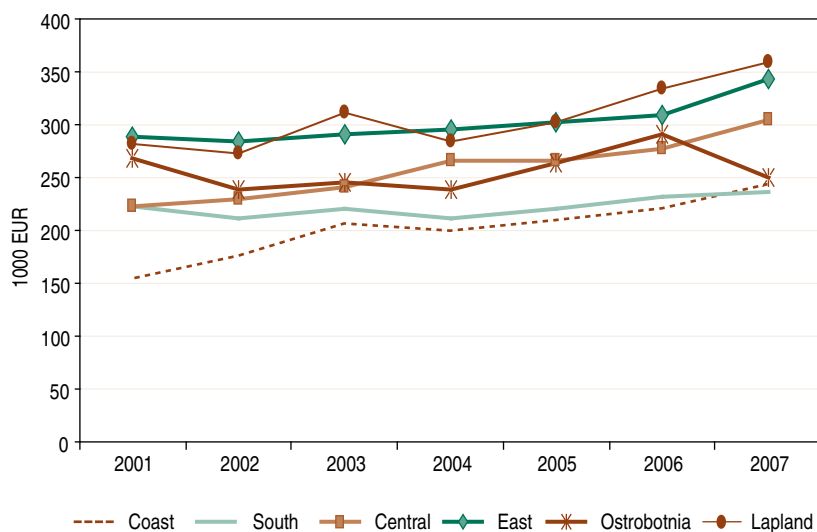


Figure 12. Turnover of median enterprises in area classes in 2001–2007.

Table 5. Number of enterprises, their turnover and number of machines and personnel by enterprise form class in 2007 (2001 figures in parentheses).

Enterprise form	Number of enterprises		Total turnover		Number of machines		Number of personnel	
	Total	%	Mill. €	%	Total	%	Total	%
Personal enterprise	209 (238)	19.7 (26)	38.9 (33)	7.8 (11)	325 (361)	10.9 (13)	262 (284)	6.5 (9)
Partnership	145 (142)	13.7 (15)	46.1 (35)	9.3 (11)	352 (371)	11.9 (14)	312 (277)	7.7 (9)
Limited partnership	209 (193)	19.7 (21)	79.4 (63)	15.9 (20)	509 (557)	17.1 (21)	610 (538)	15.0 (18)
Limited company	497 (361)	46.9 (38)	333.3 (184)	67.0 (58)	1789 (1424)	60.1 (52)	2875 (1960)	70.8 (64)
Total	1060 (934)	100	497.7 (315)	100	2975 (2713)	100	4059 (3059)	100

income. A key consideration in all enterprise forms is, however, that the entrepreneur should not offer his home and other personal property as collateral.

The limited company proportion of total turnover is 67 per cent, that of machines is a little less but the proportion of personnel somewhat larger (Tab. 5). Limited companies employ 1.5 persons per machine, which is clearly more than other forms of enterprise. Personal enterprises are often one-man businesses, which can also be seen in that they employed only 0.8 paid personnel per machine. Partnerships often represent cooperation between a few entrepreneurs, who all drive machines. Even when their turnover is larger than that of single-owner business, they do not employ much more personnel; 0.9 paid persons per machine. The more owners can operate the machines the more flexible an enterprise is in extreme situations. Owners can increase their work input with less cost than input with paid personnel, which means that owners accept a decreased-hourly “salary” for their own work. Extra work volumes in an enterprise working with paid salaries increases salary costs considerably, because extra hours must be paid better than ordinary hours. By contrast, less work volumes also bring problems with rising salary costs or personnel have to be laid off.

The median turnover of personal enterprises is smallest, while partnership forms have twice as much (Tab. 6). The median turnover of limited companies is twice as large as that of partnership enterprises. The same also applies to the number of machines. The proportion of persons per enterprise in limited companies is three times greater than in personal and partnership enterprises. The turnover variation in each enterprise form class is large, but the lower quartile of limited companies is larger than the upper quartile of personal enterprises.

Table 6. Turnover, the number of machines and personnel per enterprise by enterprise form in 2007 (2001 figures in parentheses).

Enterprise form	Turnover per enterprise			Machines per enterprise	Personnel per enterprise
	Lower quartile 1 000 €	Median 1 000 €	Upper quartile 1 000 €		
Personal enterprise	70.5 (59)	125.9 (102)	220.7 (172)	1.6 (1.5)	1.3 (1.2)
Partnership	148.4 (106)	242.7 (224)	392.3 (336)	2.4 (2.6)	2.2 (1.9)
Limited partnership	146.9 (153)	227.9 (254)	414.5 (379)	2.4 (2.9)	2.9 (2.8)
Limited company	244.3 (249)	442.3 (377)	836.8 (626)	3.6 (3.9)	5.8 (5.4)
All	140.9 (124)	291.9 (248)	566.8 (421)	2.8 (2.9)	3.8 (3.3)

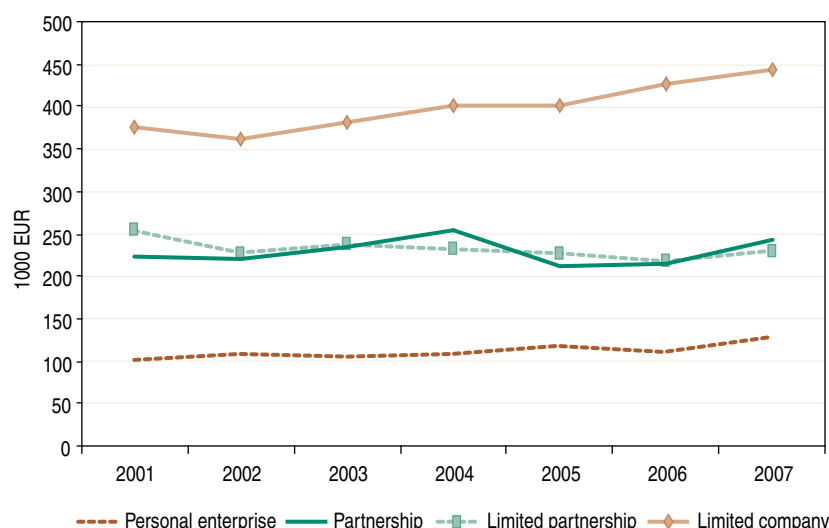


Figure 13. Turnover of median enterprises in enterprise form classes during 2001-2007.

The turnover of different enterprise forms shows little growth in limited companies (Fig. 13). Other enterprise forms have not achieved any growth during the period. There may be no intention to grow the business as a personal enterprise. If an enterprise grows, it often changes form to a partnership or limited company.

4.4 Number of machines

Classification of enterprises according to number of machines per enterprise shows results analogous to classification according to turnover (Tab. 7). This is rational because turnover depends so much on the number of machines. One and two machine enterprises produce a third of total turnover from two-thirds of enterprises. Average turnover per machine is roughly 125 000 euros in all machine number classes; slightly larger in the biggest enterprises. Number of personnel follows the same pattern, larger enterprises having slightly more paid personnel per machine than smaller ones.

Table 7. Number of enterprises and their turnover and number of machines and personnel by machine number class in 2007 (2001 figures in parentheses).

Number of machines	Number of enterprises %	Total turnover %	Number of machines %	Number of personnel %
1	38.2 (38.9)	14.4 (17.4)	14.3 (14.1)	12.5 (15.2)
2	26.4 (24.3)	17.9 (18.8)	19.7 (17.6)	16.4 (18.1)
3-4	22.2 (22.5)	28.0 (28.0)	28.4 (28.1)	28.3 (27.5)
5-6	6.3 (6.6)	11.5 (12.5)	11.8 (12.0)	12.4 (13.9)
7-10	4.9 (5.2)	16.1 (12.0)	14.6 (14.7)	16.9 (13.5)
Over 10	2.0 (2.5)	12.1 (11.3)	11.2 (13.5)	13.5 (11.8)
Total, %	100	100	100	100
Total, value	1017 pc. (892)	447.3 Mill. € (286.3)	2717 pc. (2461)	3649 pc. (2773)

5 Profitability

5.1 Structure of profit

Profitability, the starting point of all considerations, is related to other important items such as financial adequacy and capital structure. According to the present accounting decree, the distinction between variable (direct costs) and fixed costs (indirect costs) in the layout of the profit and loss account is not in conformity with the 4th EU directive (Teränne 1993). The traditional gross margin on sales, which can be obtained by subtracting variable costs from turnover, is thus not available. However, the empirical evidence gives an adjusted income statement based on expense categories and yields: (i) operating margin (EBITDA), (ii) operating result (EBIT), (iii) net result, (vi) total result, and (v) result for the fiscal period (CCA 2000). The abbreviations EBITDA and EBIT refer to “earnings before interest, taxes, depreciation and amortization” and “earnings before interest and taxes”. The total result and the result for the fiscal period hardly bring any additional value to the analysis of the business and are therefore ignored here.

By contrast, the (vi) financing result, which is obtained by adding depreciation and reductions back into net result, forms the basis the financing analysis. It is perhaps the most critical information in analysing the ability of an enterprise to cope with (i) the net decrease in long-term external financing, (ii) net investment, (iii) addition of working capital and (iv) the profit-sharing requirement (CCA 2005).

In this branch of the industry, the total operating income in general equals the turnover, which is used instead of the former. In order to eliminate the size of the enterprise operating margin, operating result, net result and financial result are divided by turnover in order to obtain the respective percentages (Tab. 8).

Since the wage adjustment of Statistics Finland was used here, the net results might be slightly optimistic. The return inquiry of the Finnish Forestry and Earth Moving Contractors Trade Association gave a median net result percentage of 2.5% for 2006 and 4.3% for 2007, claiming that a positive net result could be obtained by 65% of the enterprises (Jaakkola 2008). Moreover, enterprises with a ratio of thinning of less than 50% achieved 5.0% and enterprises with more than 50% share of thinning only a 3.3% median net result in 2007. More than 50% of the entrepreneurs considered the result satisfactory and more than 20% mildly so. However, the price level has remained steady according to 55% and increased according to 45%. The most important item to be corrected was the price level of 49% according to the replies. The median net profit percentage

Table 8. Key enterprise profitability figures and their variation in 2007. Values in 2000 according to Väkevä & Imponen (2001) in parenthesis.

Key figures	Lower quartile	Median	Upper quartile
Turnover, €	140 870	291 880	566 760
Operating margin, %	19.2 (25.8)	28.9 (35.2)	39.3 (43.4)
Operating result, %	4.1 (5.6)	10.9 (13.7)	20.2 (21.9)
Net result, %	0.3 (0.0)	6.3 (7.2)	13.7 (14.0)
Net result, €	160	18 700	47 600
Financing result, %	14.5	23.8	32.0
Financing results, €	29 840	69 210	131 280

was only 2.4% in 2006 with a sample of 300 enterprises (Turkulainen 2008). Saviaho (2009) recently investigated 700 timber harvesting enterprises, claiming that the median of their net profit was 3% in 2006 and 2% in 2007. However, even the median of the net profit percentage was previously negative in the case of a sample of 329 closing of the accounts in 1985-1989 (Rajamäki & Heikka 1990).

The net profit percentage, which depicts the profitability trend (CCA 2005, Kallunki & Kytönen 2007), is a key ratio. In 2001–2007, its median was roughly 5%, upper quartile some 12%, but lower quartile nil (Fig. 14). The net profit proportion started to decrease in 2003–2004. Moreover, the lower quartile dropped to negative in 2006, which may have been impacted by the decreasing felling amounts. In 2005, there was also a five-week paper workers’ strike, which caused a long delay in harvesting. Its trend by turnover class reveals differences between enterprise size groups, especially the weakness of the smallest enterprises.

The net result varied with compensation and cost. During the study period, all cost indices applying to mechanical harvesting increased clearly except the interest rate (Metsäalan konekustannus indeksi 2008). Fuel and oil prices increased most markedly. Their rise may have been the main reason for the rise in work compensation between 2004 and 2005. Since 2005, all factors have continued to raise, even the interest rate, but it has hardly affected compensation. According to these indices, there is strong pressure to raise compensation (Fig. 15).

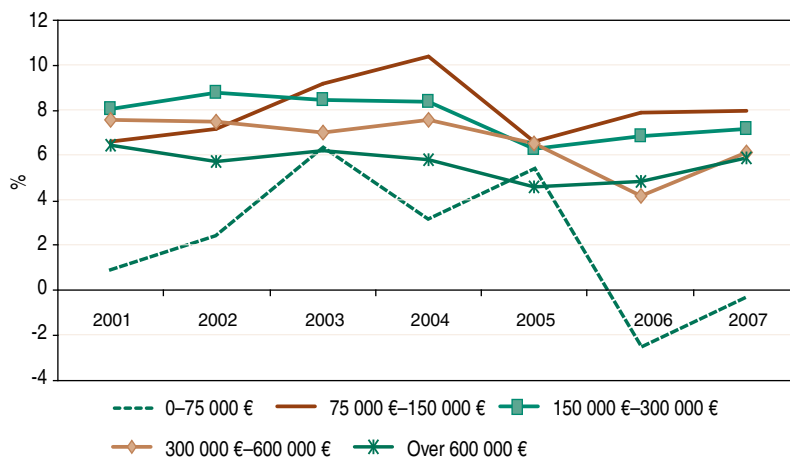


Figure 14. The medians of net profit in percentages by turnover class in 2001–2007.

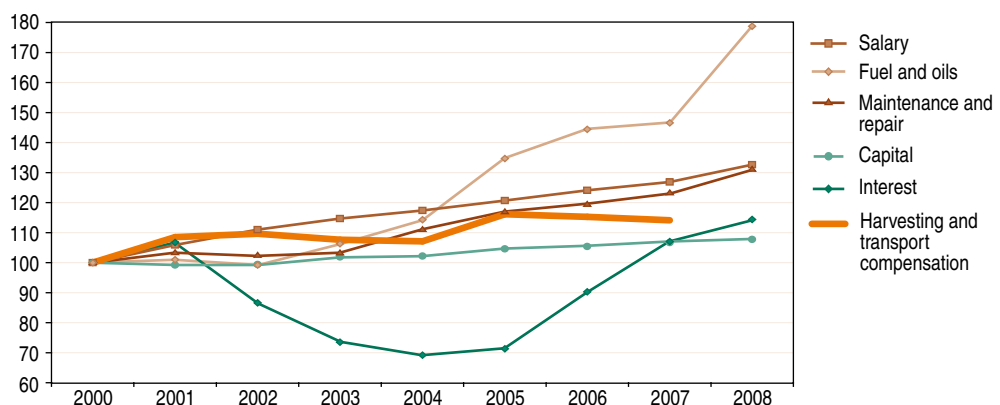


Fig 15. Trend of some cost factor indices in harvesting business compared to compensation in 2001–2008 (Metsäalan konekustannusindeksi 2008)

The net profit percentage after wage adjustment in the Statistics Finland data by turnover class demonstrates distinctions both in the level and distribution of the percentage (Fig. 16). Clearly the net profit median was smallest in the smallest enterprises, but the variation was also largest there. Enterprises with a turnover of less than 75 000 euros per year may operate only part of the year; and may operate with second-hand machines which could cause small turnover. However, the upper quartile of smaller enterprises produces a good profit. At the other end of enterprise size, even the lower quartile enterprises have positive net results. The larger enterprise size class shows the smaller variation in turnover. A large number of machines seem to dampen the effect of extreme positive income potential.

However, the net profit percentage by the six areas hardly demonstrates any real differences (Fig. 17). Enterprises in Lapland, where the variation was also smallest, had the smallest net profit median. Conditions there are harsh, distances long and the variation in forest structure is less than in the south. This could explain the smaller variation but not for low profit, because South and East had next smallest median profits, although these two areas have more favourable natural conditions than Lapland.

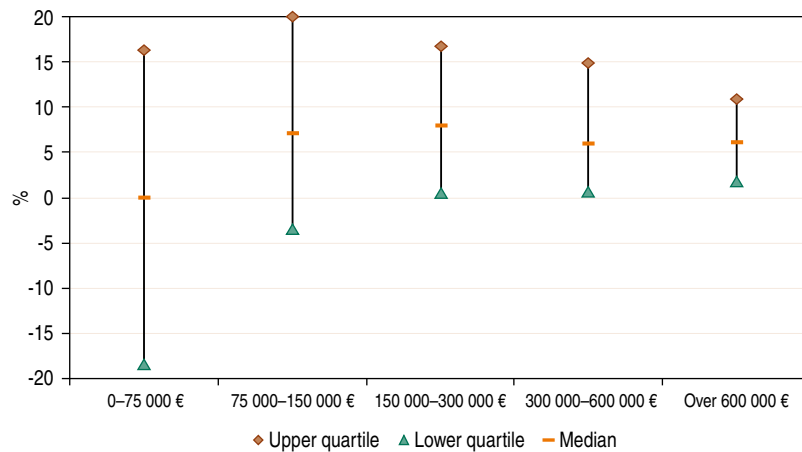


Figure 16. The median, lower and upper quartile of the net profit by turnover class in 2007

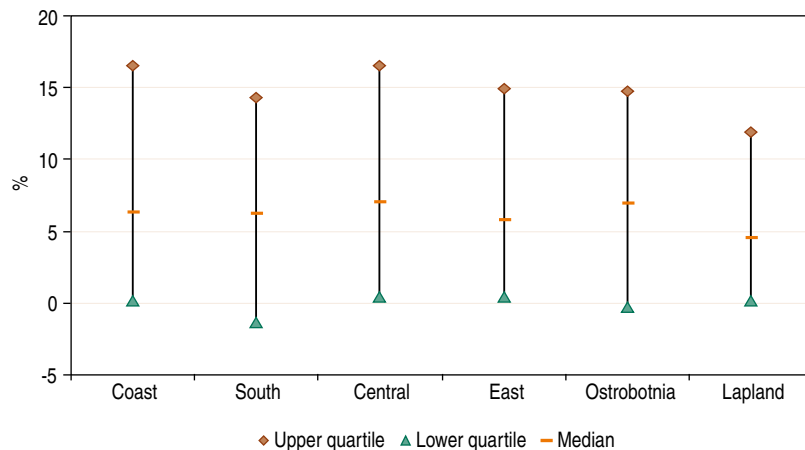


Figure 17. The net profit percentage in the six areas of Finland

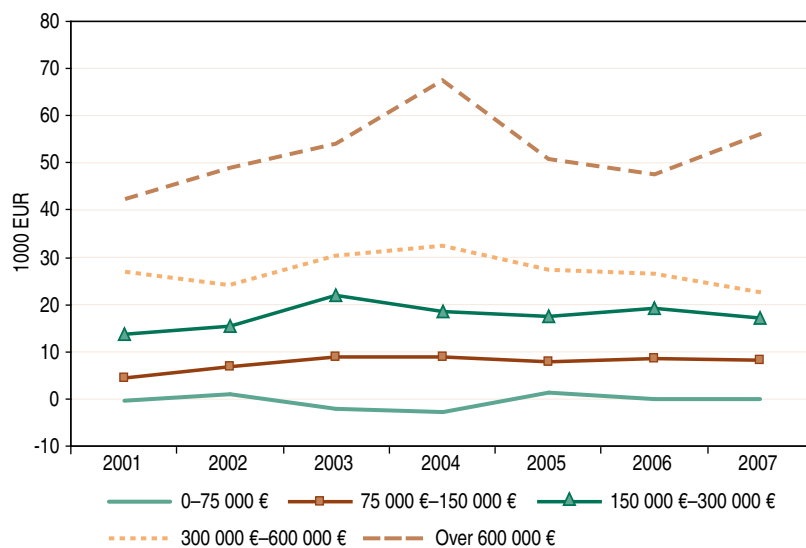


Figure 18. The median reserve of enterprises by turnover class in 2001–2007.

Finally, the growth opportunities are depicted based on the financing result and its use. The difference: ‘financing result - instalments of debts - capital financing part of investment’, which describes the opportunity to grow the business, is called the reserve.(Fig. 18). These opportunities are concentrated in larger firms, the reserve of which represent only advance payment of a harvester. If anything, the smallest firms tend to concentrate on the struggle to survive.

5.2 Wage adjustments

The entrepreneur of a single-owner business is not allowed to treat their own work contribution as a wage. The net profit of the firm will be added to his or her taxable income. The wage cost is thus included in the net profit, which may be considered misleading. In partnerships or limited partnerships, wages can be paid to the entrepreneurs, but they usually prefer the opportunity to make a private withdrawal from their company bank account. In limited companies, owners can pay themselves a wage and often do so. However, if a limited company makes a profit, it may be preferable for owners to take dividends instead of wages. If no wage cost is shown in the profit calculations of personal enterprises, partnerships and limited partnerships, it looks as if the owner has done the work without compensation his/her work contribution is then included in the profit figure.

The wage adjustment of the Statistics Finland material is based among other things on pension insurance payments by entrepreneurs and is not necessarily sufficient, especially in single-owner businesses and partnerships. There is a clear difference between enterprise forms in wage costs per machine in the Statistics Finland data, where their wage adjustment is included (Fig. 19). Personal enterprises have a markedly lower wage cost per machine than limited companies. Differences in wage cost depend on the number of shifts and the wage per shift. Loosely speaking, one could conclude that the limited companies tend to run with a relatively new fleet in two shifts but the single-owner business typically in one shift.

If owners of personal enterprises, partnerships and limited partnerships do not have another business, all their compensation is then typically included in the “profit” moment in closing of the

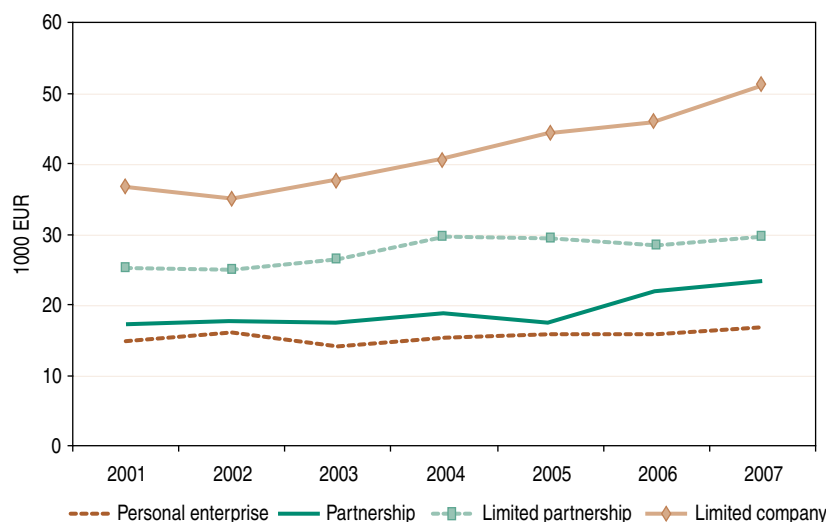


Figure 19. Wage costs per machine by enterprise form with Statistics Finland wage adjustment in 2001–2007.

accounts calculations. To be able to compare personal enterprise profits with those of limited companies implies profit independent compensation for owners of enterprises. To see the effects of this measure, an annual wage cost adjustment of 20 000 € for personal enterprise and limited partnerships and 30 000 € for partnerships has been used (later called the FFRI correction) on the profit figure subtracted instead of the Statistics Finland wage adjustment. The sum of 20 000 € stands for a typical 12 €/hour salary for a typical 1 670 hour / year working time. The owner of the enterprise would then get the same salary as his/her machine operators, without their social security contributions (typically 60% of salary). A partnership implies that there are at least two owners of the enterprise in the same legal position, which explains why the larger sum of 30 000 € is subtracted in partnership enterprises (roughly one and a half operators' wage for at least two owners). In limited partnership enterprises, since there are at least two owners, but owners except one may have only an economic risk in the business, only one operator's wage was subtracted.

By comparison, one sees that the FFRI wage adjustment brings the wage cost per turnover of all enterprise forms to the same level (Fig. 20). Subtracting theoretical wage costs from personal, partnership and limited partnership enterprise profits drops net profits markedly (Fig. 21). If the Statistics Finland wage adjustment is excluded, median net profit rises from 1 to 3 per cent to 6 to 10 per cent. Utilising the FFRI wage adjustment dropped median net profits to 3 to 4 per cent. This FFRI net profit varies less than the net profit with no wage adjustment. Comparing median net profits of different areas showed only a minor difference if wages have been adjusted or not. Various wage adjustments have been made in addition to Statistics Finland by Mäkinen (1988) and Väkevä and Imponen (2001).

Moreover, the impact of the FFRI wage adjustment hardly reduces the net profit percentage by the machine number class except for the one and two machine classes, which drop by some 5%. However, the results by turnover class demonstrate clear differences, especially in the smallest classes (Fig. 22). The median of net profit percentage of the smallest enterprises is almost 25% negative. Even the upper quartile of those enterprises is negative, which raises the question of whether the entrepreneur charges all these working hours in any form from the enterprise. The net profit median of enterprises with less than 150 000 € turnover is also only slightly positive.

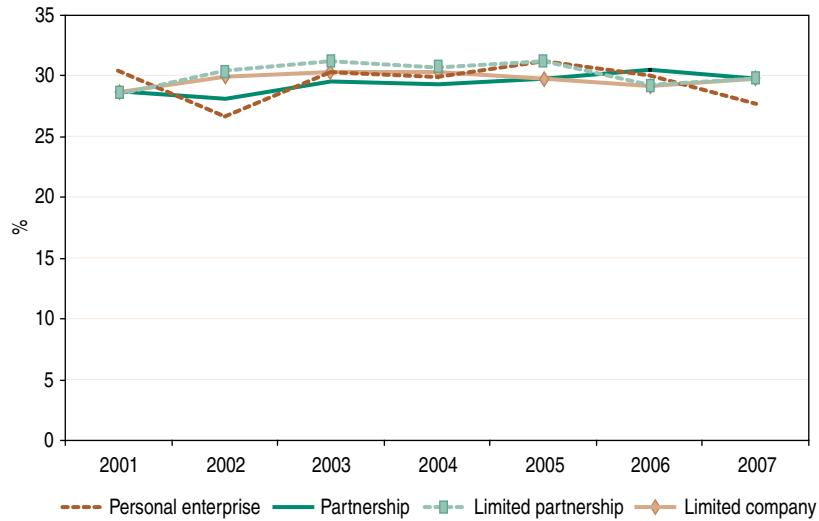


Figure 20. Median wage cost per turnover after the FFRI wage adjustment by enterprise form in 2001–2007.

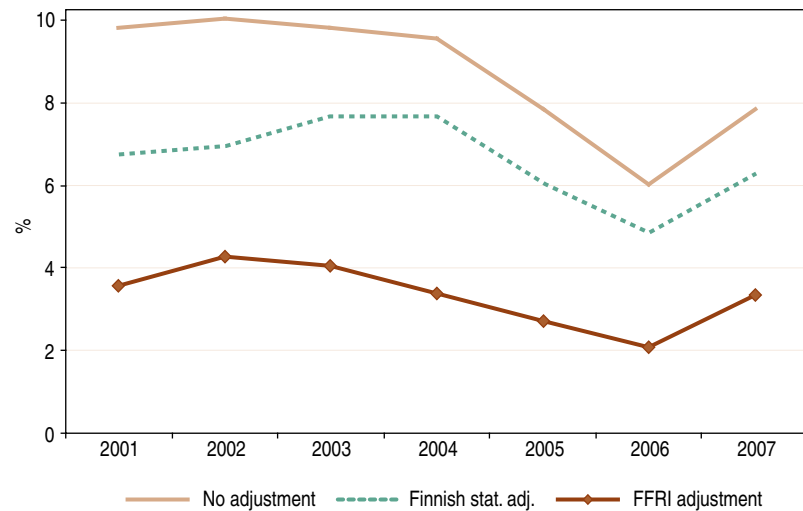


Figure 21. The median net profit percentage with no adjustment Statistics Finland and FFRI wage adjustment in 2001–2007.

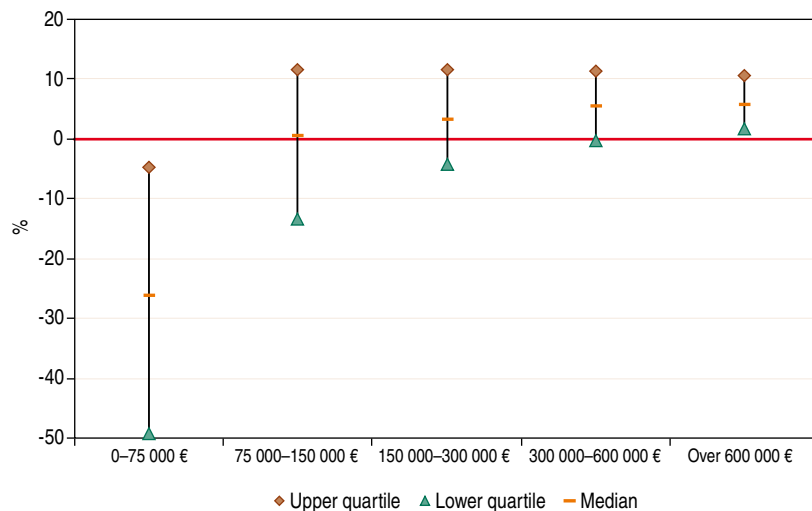


Figure 22. The net profit percentage after the FFRI wage adjustment by turnover class 2007.

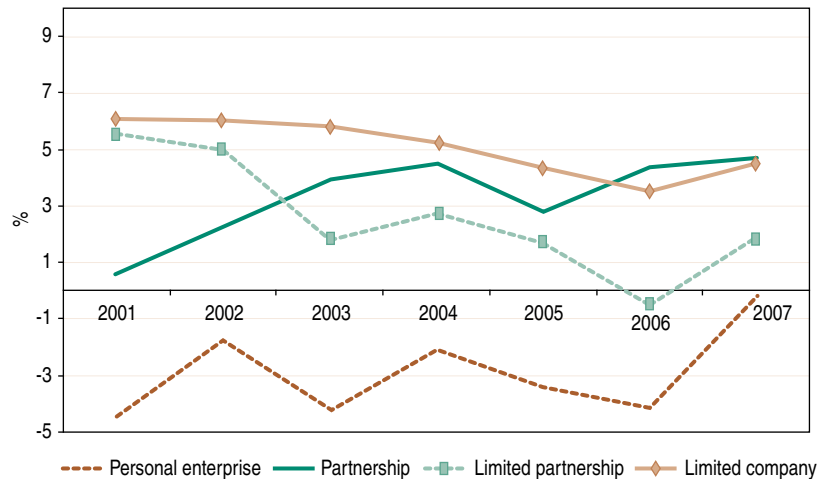


Figure 23. Median net profit percentage by enterprise form after the FFRI wage adjustment.

In larger enterprises, the FFRI wage adjustment has less or no effect. Since these are most often limited companies, no corrections were made.

Naturally, the FFRI-wage adjustment reduces most net profit of the single-owner business (Fig. 23). The median net profit in percentage terms in personal enterprises has been negative during the whole period researched. The net profit percentage of limited companies decreased during the study period till last year's rise. Its result varied less and was clearly positive throughout.

5.3 Return on capital

Although the Finnish accounting tradition emphasises profit and loss as its key measures, both the American and the present European accounting concentrates on estimating property values, the so-called 'fair values' of the IFRS of the EU (Penttinen and Rantala 2008). The profit for the period can be interpreted as the difference in property values at the beginning and the end of the fiscal period. The return on capital is also a central measure in the forest sector. An industrial customer Stora Enso, for example, has a target of achieving a 13% ROCE (Return on Capital Employed) (Stora Enso 2007).

Return can be calculated on invested capital (ROI), total capital (ROA) and shareholder equity (ROE). The various returns on assets showed a moderate median contribution (Tab. 9), but enterprises below the lower quartile could hardly cope with the price of external financing. Moreover, the balance sheet and invested assets are of the size of one to two harvesters, but the equity remains modest.

For a 300 harvesting enterprise sample, the mean ROA was only 6.7% in 2006 (Turkulainen 2008). Return on total capital can be considered good if it is over 10%, satisfactory at 5–10% and poor below 5% (CCA 2005). The statistics on the wood-harvesting business supplied by OP bank classify ROI as good if it exceeds 15%, satisfactory at 9–15% and poor below 9% (Väkevä & Imponen 2001).

The ROA measures the return on the total capital – external and internal – and has been clearly decreasing in all years, which can be explained by both the increase in the amount of capital and the decrease in the return itself (Fig. 24). The ROA has decreased in 2001–2007, its median falling to 12%, the upper quartile to 20% and the lower one to 3%. The ROA by turnover class shows the differences, especially the difficult situation of the smallest enterprises.

However, when an enterprise is seen only as an investment of shareholder equity, the return on equity (ROE) is the measure which shows the return on owner invested capital. Its median was nearly 20%, the upper quartile exceeded 40%, but the lower quartile persisted at the zero level (Tab. 9). The negative lower quartile of the ROE suggests that capital will be consumed and many enterprises will have to close down. The ROE by turnover class also emphasises the distinction between the smallest enterprises and the rest (Fig. 25).

In all, ROE can be misleading because of the difference between interest rate of loans and ROA, exaggerates it both in good and bad times. Moreover, shareholder equity is a slippery concept in many small and medium size enterprises. However, ROE does show whether enterprises have development opportunities.

Table 9. Key return figures in 2007, values in 2000 according to Väkevä & Imponen (2001) in parenthesis.

	Lower quartile	Median	Upper quartile
The sum of balance sheet, €	131 930	274 230	515 370
Return on total capital (ROA), %	3.6	10.4	21.4
Invested assets, €	105 130	215 070	410 110
Return on invested assets (ROI), %	4.6 (7.0)	13.1 (18.0)	27.0 (35.0)
Equity, €	- 0.43	45 240	136 960
Return on equity (ROE), %	1.5	20.0	50.2



Figure 24. The medians of the return on assets (ROA) by turnover class in 2001–2007.

All turnover ratios represent the DuPont approach (Fig. 1), which multiplies earning as % of sales and asset turnover. The median asset turnover was at the level of 1.1, the upper quartile exceeded 1.5 and the lower quartile decreased below 0.8, all of these being surprisingly stable (Fig. 26). The asset return by turnover class revealed some differences, however.

The asset turnover is so stable that it hardly reveals success or failure drivers.

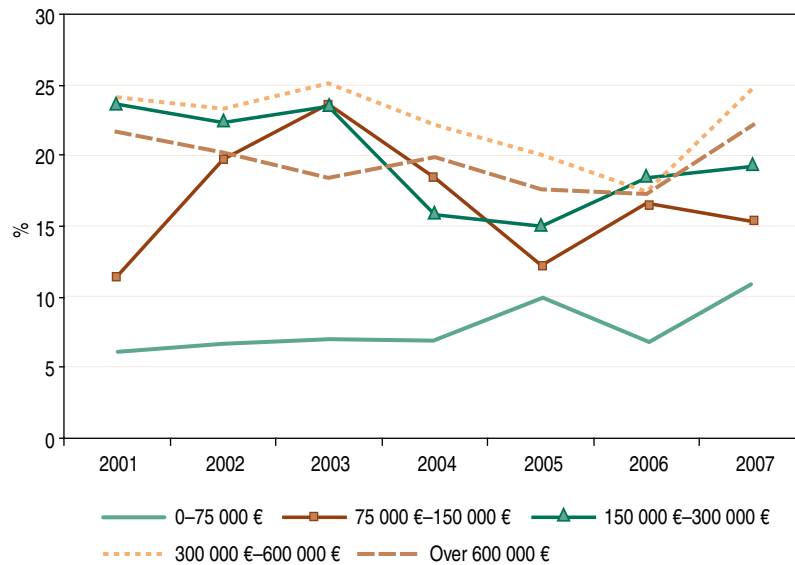


Figure 25. The medians of return on equity (ROE) by turnover class in 2001–2007.

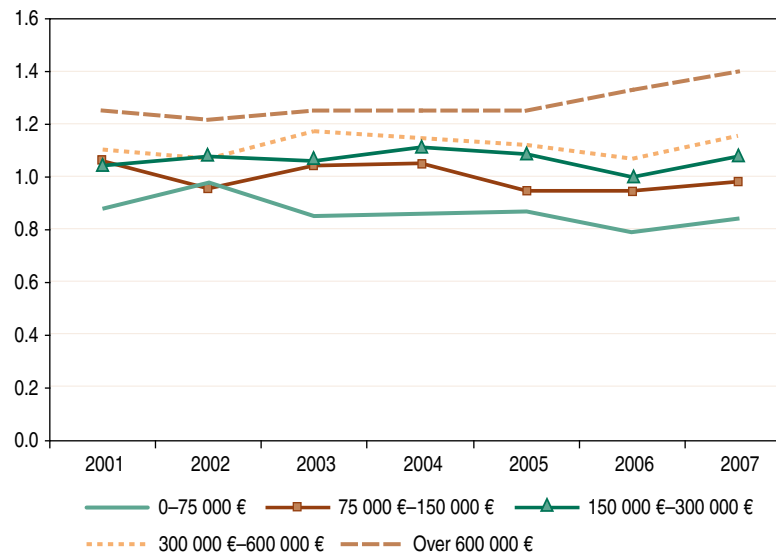


Figure 26. Medians of turnover divided by total assets by turnover class in 2001-2007.

6 Discussion

6.1 Restrictions on the material

The AKE data misses all unregistered forest machines and machines which are built on other base machines than forest machines; e.g., excavators or agricultural tractors. Since 2008, forest machine based harvesters and forwarders have had to be registered. According to a conservative estimate, a maximum of five per cent of harvesters could be unregistered. The forwarder question is more difficult because farm tractors can transport wood in easy conditions almost without any special equipment. Semi-professionals utilise a farm tractor with a hydraulic loader and self-propelled trailer for terrain transport of wood in easy conditions.

The Statistics Finland database shows only those enterprises which were actively operating in June 2007. Thus the key numbers for 2001 of those enterprises which have ended their operations before 2007 are missing. The data may give somewhat biased results for interpreting the situation of the entire forest machine business. In 2001–2007, the average turnover of those enterprises which have supplied closing of the accounts figures was 6–13% greater than that of all enterprises which had supplied closing of the accounts or turnover only. Thus the economic numbers given in this study represent little more than 63 per cent of all enterprises in the Statistics Finland data, which represents the lion's share of the harvesting business. It may be that the entrepreneurs of smaller enterprises intend to work for their livelihood without intending to grow the business. Some of them work only part-time in harvesting. After all, the numbers in this study may well represent those enterprises which bear the main volume of work and have the potential and interest to grow.

The Statistics Finland database does not recognise success and failure factors, which depend on the working conditions and customers. Earlier studies (e.g., Mäkinen 1988, Väkevä & Imponen 2001, Väättäin et al. 2008) have shown that proportion of thinning, distance between work sites, biological area of the country, and number of customers, among other things, affects the profitability of the harvesting business.

6.2 Enterprise background and its changes

The weak economy of the wood-harvesting business has already continued practically the life cycle of the business (see Mäkinen 1988, Väkevä & Imponen 2001). More precisely, about a third of enterprises have made continuous losses or achieved a zero result. If the same enterprises make continuous losses, they have to close down or go bankrupt. External factors such as the entrepreneurs' own organising and business ability tend to remain the same, which suggests that a negative result is difficult to turn around. Similarly, the best enterprises would theoretically achieve the best result in any year.

The life span of wood-harvesting enterprises has not been studied systematically, not to mention how their life-span has varied depending on general economic or forest industry conditions. According to this study, the number of still-operating forest machine enterprises which have delivered turnover data to Statistics Finland has grown 23% in six years.

The median turnover of an enterprise grew almost 10 per cent per year during the same period. Successful enterprises show clear growth. At the beginning of the study period (2001), the turno-

ver of Statistics Finland enterprises was 83 per cent of traditional round wood harvesting costs, while at the end (2007) turnover was 31 per cent greater than costs (Fig. 2). The difference is 49 per cent, which could indicate that enterprises worth more than a third of harvesting work capacity have ceased operations during the seven-year period.

The majority of wood-harvesting enterprises are small one machine single owner enterprises, but most turnover in the business is produced by larger companies. This situation has hardly changed since 2000, when Väkevä & Imponen (2001) studied harvesting enterprises working for the forest industry and the state Forest Service. The smallest enterprises are missing in Väkevä and Imponen's study (2001) as well as in this study. If the pattern of "small enterprises small net profit" is valid in this largely unknown group, an even greater number of enterprises make losses than shown in this study. One man one machine entrepreneurs may not have the time or skills to develop the economics of their enterprise. There is some growth in size in enterprises since 2000 (Väkevä & Imponen 2001); the ratio of both number of enterprises and their turnover in the smallest class having dropped by half (Tab. 2). In Väkevä and Imponen's study (2001) the upper turnover limit of the smallest class was slightly larger than in this study 83 000 € versus 75 000 €.

The weakness of the economic situation and perhaps of the compensation negotiations of harvesting enterprises can be seen in Saviaho's result (2009), which shows that the growing turnovers in good years (2007) have not improved the operating margin in the same proportion. Enterprises in East and North Finland are on average slightly larger than elsewhere, which may correlate with the large share of large customers and with forest-owners' little interest in making delivery sales. Enterprises in South and West Finland were smaller than in other parts of the country (not the same regional division as in this study in Fig. 9) in Väkevä & Imponen's 2001 study.

The smallest companies are single-owner personal enterprises, because of the history of starting this business, and the larger are organized more formally (Figs 5 and 13). The limited company is the most common enterprise form (Tab. 5), offering greater potential to operate with financing. In Väkevä & Imponen's material (2001), a personal enterprise's average turnover was less than half that of a limited company's. In their study, the personal enterprises proportion was 66 per cent and that of limited companies 34 per cent of the total enterprises. The limited company proportion of total turnover was 53 per cent. Thus, in seven years the share of limited companies has increased both in number of enterprises and in total turnover (compares Tab. 2 and 5). Number of machines offers an almost equivalent explanation of the enterprise budget as the turnover, though one machine can accumulate a varying turnover depending on the machine type and age, number of shifts and working site characteristics.

Entrepreneurs operating with new machines have a high capital cost structure, which requires two shifts operating the whole year round (10–11 months). Operating with older machines with lower capital cost enables a shorter daily shift and/or shorter working period per year. Part-time operators would also decrease cost stress where work is not available year around. Forwarders and especially harvesters have difficulty in finding other work. General machines like excavators or farm tractors could perhaps offer a lower capital cost where the problem is to tackle variation in work volume. A well-established enterprise could stop working when compensation is too low for profitable activity.

6.3 Profitability considerations

The key research questions to be tackled were: (i) What are the chances of survival of the forest machine enterprises? (ii) What are the opportunities to expand and grow the business? The expansion and growth requirement was determined by the forest industries some years ago. They prefer to negotiate with key / area / wide responsibility enterprises, which in turn have subcontractors (Ala-Fossi et. al. 2004). Forest service enterprises have been studied in Finland using the growth-profitability-financing approach, the so-called KASKARA model (Kärhä 2000).

The three background variables considered were the scale of the enterprise, its form and the area where it operates. The differences in net profit by area were small, Lapland being clearly weakest, however. The average turnover per enterprise growth of 8% was exceeded in Coast (9.4%) and South (8.9%), but remained lowest in Lapland (7%) and in the East (7.2%). Growth percentages were thus largest in those areas where the enterprise size was smallest (Tab. 4). The deterioration in the net profit percentage in 2001–2007 was a very clear finding, which could be explained by the increase in fuel, wage and other costs. The difference in profitability between the smallest enterprises (turnover $\leq 75\,000\text{€}$) and the others was dramatic, especially in 2006 and 2007. After the Statistics Finland wage adjustment, even the median net result of these smallest enterprises remained negative in 2006 and 2007, but that of the other groups exceeded 5%.

Even after the Statistics Finland wage adjustment, the annual wage costs per machine differed clearly by enterprise form, being some 40 000 € in limited companies and 20 000 € in single-owner businesses and partnerships (cf. Mäkinen 1988 and Väkevä and Imponen 2001). A wage adjustment of 20 000 € for personal enterprises and limited partnerships, and 30 000 € for partnerships was deducted to get profit figures comparable with those of limited companies. This also explained large differences in wage costs per machine between limited companies and other enterprise types (Fig. 19). The median of the net result percentage dropped from 8% with no wage adjustment to some 6% with the Statistics Finland adjustment, and to 4% with the above adjustment, the last of which is weak (Fig. 21, cf. CCA 2005).

After the FFRI wage adjustment, the net profit percentage of small enterprises (turnover $\leq 75\,000\text{€}$) and personal enterprises remained negative. However, even the lower quartile was on the positive side only in the group of the biggest enterprises (turnover $< 600\,000\text{€}$) (Fig. 22). Opportunities to grow can be found among limited companies and partnerships, but more so among firms in bigger turnover classes (Fig. 20). However, the annual reserve is hardly sufficient to buy a forwarder.

The attitudes of entrepreneurs to focussing on profitability were a more important success factor than the size of the business in Mäkinen's study (1993). Soirinsuo & Mäkinen (2009) later studied 32 growing forest machine enterprises, whose net median profit decreased from 7 to 4 percent from 2001 to 2006. At the same time they grew about 12 percent per year. Their own capital percentage decreased at the same time from 50 to 40%, which stresses the need to concentrate on profitability instead of growth.

The median of the return on total capital ROA (10.4%) could be considered good (CCA 2005). Both the ROA and the return on equity ROE were tolerable, some 12–16% and 18–25% median in other groups, but really weak in the smallest enterprises (turnover $\leq 75\,000\text{€}$). The asset turnover was 0.8–1.4, but the differences were surprisingly modest and the trend over time very stable. However, the smallest enterprises were always the weakest. The various returns on investment (ROI) figures were surprisingly good compared with the net result percentage. The smallest en-

terprises especially can survive only by increasing the labour contribution of the entrepreneur and not necessarily taking a corresponding wage in one form or other, but how long this will be possible is unclear. The return on equity (ROE) clearly exceeds the return on assets (ROA), which indicates that the business yields more than the interest level of debts. Unfortunately, the heavy debt burden is a risk in a recession, because the foreign capital leverage which produced profits in good times eats into the owners' capital in bad times. How enterprises face financing difficulties in today's recession and what the financing structure of this business is, will be analysed in a separate study.

As a comparison, earth construction enterprises demonstrated a roughly 10% ROA and 5% net profit in the median over more than ten years (Turkulainen 2009). The most recent year of compiled statistics, 2007, showed little increase in both figures compared to previous year.

6.4 New research topics

A minor part of the harvesting is done by part-time entrepreneurs (Penttinen et al. 2009), most of whom have agriculture as their main source of income. If the total cutting volume increases and present seasonal variation remains, an interesting possibility may be to increase the ratio of this kind of entrepreneur. They operate with older machines, but they can economically withstand longer breaks in harvesting operations.

They are still beyond the scope of this study. They drive agriculture and do harvesting as a part time job with more or less professional machines. According to Tike statistics (2009), about 1 300 farmers do harvesting work as a side business (Penttinen et al. 2009). Approximately 200 of them are in the AKE database and thus in the Statistics Finland database. The value of their side business varied from 5 000 euros to over 200 000 euros per year. The latter operate with the same intensity as entrepreneurs. Metla is conducting an ongoing study of these farmer-harvesters (Mäntynen 2009).

The Statistics Finland database offers material for general analysis, but the connection to customer company structure and working conditions data is missing. Sample enterprises with longer-run book-keeping data and perhaps follow-up in the future would offer an interesting opportunity to research real-life success and failure factors. Connecting business success to machine fleet, work-site conditions, customers and local competition may offer real insight into the profitability drivers.

The current material does not also offer grounds for studying the change of machines. The capital cost of machines is a significant proportion of total company turnover. The life-span of a machine depends on work volumes. Normally the maximum is about 10 000 effective work hours, which will be reached in four to six years. In small enterprises with one or two machines especially, the profitability of operation and ability to continue depend very much on the right time to exchange machines. Another point of view on this question is selection of the right type of machine; size class, new or second-hand, forest or general machine. etc.

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Appendix I

Equations used in the calculations of the financial ratios (CCA 2000, 2005)

$$\text{Operating margin, \%} = 100 * (\text{Operating margin} / \text{Total operating income})$$

$$\text{Operating result, \%} = 100 * (\text{Operating result} / \text{Total operating income})$$

$$\text{Net result, \%} = 100 * (\text{Net result} / \text{Total operating income})$$

$$\text{Financing result, \%} = 100 * (\text{Financing result} / \text{Total operating income})$$

$$\text{Return on assets (ROA), \%} = 100 * [(\text{Net result} + \text{financing expenses} + \text{taxes}) / \text{Average total capital}]$$

$$\text{Return on investment (ROI), \%} = 100 * [(\text{Net result} + \text{financing expenses} + \text{taxes}) / \text{Average invested capital}]$$

$$\text{Return on equity (ROE), \%} = 100 * (\text{Net result} / \text{Average shareholders' equity})$$

$$\text{Asset turnover} = \text{Total operating income} / \text{Average total capital}$$

Note: Total operating income nearly always equals turnover in this material

Appendix II

The closing of the account variables used in the study

PROFIT AND LOSS STATEMENT

- Turnover
- Total operating income
- Operating margin (EDITDA)
- Operating result (EBIT)
- Net result
- Financing result

BALANCE SHEET

- Tangible assets
- Financial assets
- Equity
- Long-term liabilities
- Short-term liabilities

OTHERS

- Additions of the value of machines and equipments
- Machines and equipments at the end of the financial year
- Personnel
- Invested capital
- Added value
- Return on invested capital
- Net wealth
- Number of machines
- Forest centre

