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internationalization patterns of firms***

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An Empirical Investigation of the Role of Industry Factors in the Internationalization Patterns of Firms

Abstract: *Research on companies' internationalization has mainly focused on firm-level and country-level factors in order to explain firms' cross-border activities. With the exception of a limited number of studies emphasizing rivalistic behavior in oligopolistic industries, industry factors have been neglected as potential determinants of companies' internationalization. We argue that differences across industries with regard to concentration, research intensity, tangibility of the products, and the existence of clusters should influence the impetus and opportunities to internationalize. This study examines the role of such factors using panel data covering the internationalization patterns of the 100 largest non-financial Norwegian companies over the period 1990 to 2000. We find that even for firms in a small population advanced economy where the limited market size in itself motivates firms to internationalize, industry factors still contribute significantly to explaining the internationalization of these companies. Furthermore, the effects of industry factors remain strong when firm-level characteristics are taken into account.*

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It is generally recognized that both internal and external factors influence firms' internationalization patterns. However, most of the literature has hitherto focused on firm-specific (internal) issues and on country-level (external) issues.

Internationalization has traditionally been seen as reflections of home country conditions (Kogut 1991) – e.g., limited domestic market sizes compel many firms in small, open and advanced economies to internationalize (Benito et al. 2002) – and of decision-makers' (entrepreneurs) willingness to act upon market opportunities abroad (Andersson 2000; Cavusgil 1980; Johanson and Vahlne 1977). In contrast, industry factors are often overlooked, too generalized, or inadequately measured (Makhija, Kim, and Williamson 1997). After decades of research on the internationalization of business activities, we still have limited knowledge about the influence of industry-specific factors on firms' internationalization patterns.

External factors such as political and macro-economic issues, tariffs, socio-cultural differences, and competitive and industry structures generate opportunities as well as costs and uncertainties (Davidson 1980; Hirsch 1976). External factors are typically analyzed from the perspective of firms and, in particular, decision-makers' perceptions of potential costs or disadvantages of organizing and performing activities in various locations. Economics based approaches such as transaction cost theory (Buckley and Casson 1976; Hennart 1982; 1991), internalization theory (Buckley and Casson 1976) and the eclectic framework (Dunning 2001) treat decisions to internationalize as being dependent on firms' identification of relevant alternatives, awareness of uncertainties, and willingness to take risk. Studies focusing on managerial behavior and internal organizational processes also accentuate a perceptual view on external factors. The internationalization process perspective, for instance, filters the influence of external factors through the notion of psychic

distance (Johanson and Vahlne 1977). Firms within the same industry may thus be expected to follow fairly different internationalization paths since external factors become marginalized over time and their influence is contingent on the perceptions of decision makers (Gripsrud and Benito 2005).

Some scholars argue that industry characteristics strongly shape firm strategies and that they constrain the strategic options open to firms, both large well-established ones (Ghoshal 1987; Porter 1986) and smaller more entrepreneurial ones (Fernhaber, McDougall and Oviatt 2007). According to oligopolistic reaction theories firms are strongly influenced by the strategic moves of their competitors. Hence, if one competitor internationalizes, others are prone to follow (Knickerbocker 1973), a pattern that has been demonstrated for example in the global tire industry (Ito and Rose 2002). The international strategy literature also addresses industry-related characteristics in the global integration/local responsiveness framework in terms of various pressures in the firms' competitive environment (Bartlett and Ghoshal 1989; Prahalad and Doz 1987).

A few studies propose that global industries can be identified by looking at structural characteristics such as research intensity (Kobrin 1991) or by outcome-oriented variables such as international linkages and the integration of value chain activities (Makhija, et al. 1997). The main argument is that in some industries, firms are pushed to pursue global strategies in order to capitalize on dispersed resource endowments and scale economies (Morrison and Roth 1993; Porter 1986). One might then expect to find many similarities in internationalization patterns among firms within the same industry. Pursuing strategies that do not fit the industry characteristics would create disadvantages in the long run, with divestments and market withdrawals as possible outcomes (Benito 2005).

In all, scarce attention has been given to the influence of underlying industry factors on the internationalization patterns of firms. The present study addresses this gap by analyzing the association between industry characteristics and firms' internationalization strategies. We identify four key industry characteristics, which we use to analyze central dimensions of internationalization in a sample of the 100 largest non-financial Norwegian firms. Norway is a small, open and advanced economy that constitutes an interesting context for examining the role of industry factors in firms' internationalization. Previous analyses of Norwegian firms' internationalization have typically emphasized the role of macro-level factors (Benito and Narula 2007).

Moving from an inward-looking and highly protective posture in the years immediately following WWII, Norwegian policy-makers gradually increased the openness of its economy. The EFTA agreement in 1960 was particularly conducive in perpetuating an increasingly liberal policy towards foreign trade and investment throughout the 1970s and 1980s. Even though Norwegian authorities have appreciated a certain preference for national champions, especially in sectors such as oil and gas, metals, and telecommunications, the internationalization of Norwegian firms seems to have been a relatively widespread trend. Starting from an already fairly high level in 1990, the Norwegian economy experienced a noticeable increase in its overall degree of internationalization during the 1990s and into the new millennium; to illustrate, the stock of Norwegian FDI as percentage of GDP was 34 percent in 2005, up from 10 percent in 1990 (Statistics Norway 2007). In this study, we find that even in a small, open and advanced economy like Norway where the influence of macro level factors is considerable, the internationalization of firms is evidently also related to industry characteristics.

Industry factors and the internationalization of firms

On an aggregate level, firms' internationalization may be seen as a reflection of home country factors such as resource endowments and size (Krugman 1991). For example, one may generalize that firms from small domestic markets typically internationalize quicker as scale economies are difficult to achieve domestically (Benito et al. 2002). However, this would apply to all firms in our study since they all originate from the same country. Heterogeneity is partly firm-specific and reflects firms' strategic decision-making, their resource base, and their international competitiveness, where high performers in the domestic market have a higher propensity to internationalize (Grant, Jammine, and Thomas 1988). Smaller firms and those with a somewhat weaker position in their industry may also have an incentive to internationalize as a way to avoid head-on competition with market leaders (Fernhaber et al. 2007; Ito 1997; Mascarenhas 1986). If most of the variation can be explained through firm-specific factors, one should not expect to find any major differences across industries. If firms' internationalization is related to industry factors one should observe similar internationalization patterns among firms within the same industry (Graham 1978). Given that patterns vary across industries, it is pertinent to ask what drives such differences, i.e., which industry characteristics might explain them? Previous studies, albeit scarce, suggest that the following industry characteristics in particular are likely to have an impact on firms' propensity to internationalize and the consequent development of their foreign activities (Andersson, Gabrielsson, and Wictor 2004; Benito, et al. 2002; Contractor, Kundu, and Hsu 2003; Porter 1990; Yu and Ito 1988): (1) industry concentration, (2) research intensity, (3) tangibility of the products, and (4) existence of clusters in the domestic market. Each industry characteristic is described in more detail below.

Industry concentration

A competitive domestic arena generally helps in strengthening the ways in which firms perform value activities (Besanko, Dranove and Shanley 2000; Grant, et al. 1988), and intense rivalry is particularly effective in sharpening firms' commercial skills (Porter 1990). Too many competitors, however, can lead to a fragmented domestic market where firms lack the resources and drive to internationalize (Fernhaber et al. 2007). Rivalry intensifies as a few large players dominate the industry, and firms become more motivated to initiate or respond to competitive behavior. Often times, the competition comes from foreign firms entering the domestic market (Graham 1978), but internationalization can also result from a direct countermove to competitors internationalizing, creating a chain of interdependent moves and countermoves (Knickerbocker 1973). While firms in oligopolistic industries tend to react vigorously to competitor's moves, firms operating in industries with large numbers of incumbents are less motivated to follow their competitors (Yu and Ito 1988).

The motive behind internationalization is not always directly related to domestic competition (e.g. foreign direct investment motivated by efficiency-seeking), but empirical studies indicate that competitive home country environments increase the probability of successful internationalization of firms (see e.g., Wan and Hoskisson 2003). In all, we expect the degree of rivalry in an industry, as expressed in its concentration ratio of the four largest competitors, to be positively associated with incumbent firms' propensity to internationalize.

H1: The degree of firms' internationalization is positively associated with the concentration ratio in an industry.

Research intensity

A firm's ability to achieve competitive advantage is rooted in its ability to innovate. By operating in a dynamic and innovation intensive environment, firms develop organizational capabilities that serve as the foundation for successful long-term strategies (Grant 1996). Firms with the highest technological competencies would thus have the resources and capabilities needed to manage international activities (Cantwell and Janne 1999). Some studies also report that innovation-oriented firms are more likely to expand abroad (Basile, Giunta, and Nugent 2003; Wakelin 1998). This does not necessarily suggest that R&D activities are often moved to foreign locations. There has, in fact, traditionally been a low degree of internationalization of R&D (Zander 1999).

The key point is that research intensity is an important driver of the level of global integration in industries (Kobrin 1991; see also Fernhaber et al. 2007). Firms competing in research intensive industries are generally pushed at some point to internationalize in order to support their R&D expenditures and access sufficient qualified personnel to further develop their complex technologies (Kobrin 1991). Barring some national differences, a positive relationship has been identified between industry average R&D and export sales due to technology spillovers (Ito and Rose 1999). Recent studies also show an increasing tendency of research intensive firms to engage in international activities in order to monitor and gain access to technological developments outside their home market (Criscuolo and Narula 2007; Patel and Vega 1999). In all, this suggests that firms with high research intensities may also have higher propensities to seek international markets.

H2: The degree of firms' internationalization is positively associated with the research intensity in an industry.

Tangibility of resources and product offer

Service firms have traditionally remained local and thus been less internationalized than manufacturing firms (Contractor, et al. 2003). One reason is that internationalization drivers and motives differ between goods and services. While the relocation of production facilities to foreign sites is largely driven by the search for lower costs and access to resources or distribution channels (Dunning 2001; Vernon 1966; Yip 1989), service firms rarely compete across borders primarily on price or costs, and they depend more on simultaneous customer interaction (Løwendahl 2000; Lovelock and Yip 1996).

Another reason is that non-tariff barriers often create considerable difficulties – both real and perceived – for service firms when venturing outside their original local markets (Grönroos 1999). While manufacturing firms primarily battle with issues of balancing standardization against local customization, service firms deliver a package of intangibles that requires extensive customer involvement in the delivery (Lovelock and Yip 1996). Such customer involvement often calls for local presence and spending much time and effort in order to learn the market, which considerably adds to the costs of servicing a market. Whereas manufacturing firms can try new markets on a marginal cost basis, service firms are likely to face high market entry costs when expanding abroad, which, in turn, may result in lower degree and pace of internationalization.

H3: The degree of firms' internationalization is likely to be higher in manufacturing industries than in service industries.

Clusters

Studies reveal that certain dynamic areas – so-called clusters – that foster innovation, technology development and fierce competitiveness co-exist with many other areas that perform less illustriously. Porter (1998, 197) defines clusters as geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also cooperate. So far the focus has been on identifying clusters and few studies have analyzed how clusters may influence the internationalization of firms (Brown and Bell 2001).

The potential impact of clusters is essentially twofold. On the one hand, a dynamic local environment might attract new firms interested in learning through a strong local network (Håkanson 2005). Clusters may then act as a centripetal force for attracting foreign firms (Benito, et al. 2002; Porter and Sölvell 1998). MNEs that are seeking-out information, technology, and/or advanced marketplaces are likely to be attracted to clusters when they locate activities to particular geographic areas (Enright 2000). On the other hand, clusters may also act as driving forces for internationalization as firms strengthen their competitiveness and know-how by belonging to them (Brown and Bell 2001; Mariotti and Piscitello 2001; Porter 1998). Competitiveness results from strong domestic rivals, aggressive home-based suppliers and demanding local customers (Porter 1990), all of which are typically found in

strong local clusters. We hence expect a higher internationalization propensity among firms located within strong clusters.

H4: Firms that are part of clusters are more likely to have a high degree of internationalization than firms outside clusters.

Methods

Data

The study has been designed as a longitudinal study where a database containing detailed information about the 100 largest non-financial Norwegian companies was compiled for the years 1990, 1995 and 2000. The bulk of the database is made up of information taken from companies' annual reports. Additional data were found on company web sites, company directories, and in some cases direct contact with firms.

The companies were selected from *Kapital*'s listing of the largest firms in Norway in 2000, but excluded financial firms that have traditionally been bound by strict regulations, foreign-owned firms, and government-owned organizations with narrowly defined scope of activities and restricted strategic autonomy. Because the firms were selected from the 2000-ranking and data were collected retrospectively, the potential for survival bias needs to be addressed. Only large firms that have succeeded over time are included in the sample, which may underplay some of the dynamics that occurred in the particular period. However, it turns out that only six percent of the companies did not have ties back to the 1990-ranking, which suggests that the survival bias in the sample is small and of little consequence.

Measures

The study seeks to identify the associations between industry characteristics and the internationalization of firms. Although there are several ways of measuring internationalization, commonly accepted measures are lacking. Previous efforts have been criticized for not being sufficiently reliable or definitive (Sullivan 1994). By using three measures we circumvent some of the limitations and misrepresentations of one-sided measures, while at the same time generating a multidimensional understanding of internationality. Moreover, since the three measures are independent we avoid the reliability and validity limitations and interpretability problems of existing multi-item scale measures (Ramaswamy, Kroeck, and Renforth 1996). The first measure of internationalization is the percentage ratio of foreign sales to total sales, which primarily identifies the amount of international activities (*FSALE*). Although this ratio has been criticized as a stand-alone measure (Sullivan 1994), it provides a straightforward statistic of whether the bulk of the firm's activities are aimed at the domestic or foreign markets. Because the foreign sales ratio indicator does not distinguish well between exports and deeper commitments in foreign markets, two other measures were also included.

The second measure is the ratio of foreign employees to total employees, which captures the extent of internationalization in terms of physical presence in foreign markets (*FEMPL*). Foreign employment not only confirms actual presence in foreign markets but also gives an indication of the balance between management challenges in the domestic and foreign markets. This indicator is commonly used as a structural internationalization indicator (Dörrenbacher 2000). Finally, we use the number of foreign subsidiaries (*FSUBS*) to map in more detail companies' commitments abroad, in particular the complexity of foreign activities.

All firms were categorized according to ISIC (Rev. 3) codes. We use four independent variables to measure key characteristics of industries. The companies in the sample were distributed across 30 different main industries (two-digit level ISIC). The variable *MANUFACTURING* identifies whether the company is in service or manufacturing industries. Specifically, we use a dummy variable with one indicating manufacturing firms and zero indicating service firms.

The concentration of competitors in an industry, *CONCENTRATION*, is measured as the market share of the four largest firms in a given industry. The definition of an industry was taken down to four-digit level ISIC codes to ensure that the variable measured the actual degree of concentration confronting firms in their immediate competitive arena. Sales figures were collected from the annual volume of *Norges Største Bedrifter* (Norway's Largest Firms) for 1995 and 2000.

Research and development intensity, *TECHINT*, is measured as the average R&D intensity in an industry at the two-digit ISIC level. Industry level data for Norway for the years 1990 and 1997 were taken from OECD's 2002 *Science, Technology and Industry Outlook*. Our choice of measure was guided by availability of data, across many industries and years. We acknowledge that using industry level measures of R&D intensity is only an approximation to the innovation processes – and their outcomes – that actually take place in companies and in the various research institutions which together constitute a system of innovation (Smith 2005).

The *CLUSTER* variable identifies whether a firm operates in an industry with cluster characteristics. Our classification is based on two large-scale studies of clusters in Norway (Reve and Jakobsen 2001; Reve, Lensberg, and Grønhaug 1992). These studies identified a group of strong clusters and a few additional industries that had some – but not all – of the characteristics commonly attributed to clusters. The

latter group was labeled 'weak clusters'. This leaves us with a classification of strong, weak and no clusters. The strong clusters are characterized by strong interconnectedness, commonalities and complementarities, as discussed by Porter (1990; 1998). In our sample, these include oil and gas activities and the maritime sector (Benito et al. 2003), whereas an example of a 'weak cluster', is furniture manufacturing on the northwest coast of Norway.

Firm-specific variables were added as controls. The variable *DIVER* identifies diversified companies, i.e., firms operating in multiple industries with ISIC codes that are not directly related. The variable is binary, with the value of one given to diversified companies. Firm size is measured by *TSALE*; total sales for each of the years 1990, 1995, and 2000.

Results and analysis

We have complete data sets for almost all of the 100 firms in the original sample, which means that for most analyses there are only a few missing cases. From our previous discussion, we expected to find significant differences in internationalization patterns across the industry groups. A Kruskal-Wallis test was conducted to check for differences across industries (at the 1-digit level) in relation to the three dependent variables. It turned out that there are statistically significant (at the 0.001 level) industry differences on all three dimensions of internationalization. This prompted further investigation into whether certain industry characteristics are related to firms' internationalization patterns in different ways across industries. Specifically, we run regressions with the selected independent variables to investigate why internationalization patterns differ across industries. The basic regression model is:

$$(1) \quad Y_i = \alpha + \sum_{m=1}^4 \beta_m \text{Industry} + \sum_{z=1}^2 \gamma_z \text{Firm} + \varepsilon$$

where Y_i represents the three different dependent variables *FSALE*, *FEMP* and *FSUB*; *Industry* refers to the set {*MANUFACTURING*, *CONCENTRATION*, *TECHINT*, *CLUSTER*} of industry characteristics, while *Firm* represents the set {*TSALES*, *DIVER*} of firm characteristics; ε denotes the error term and α , β and γ are the parameters to be estimated. Based on our theoretical arguments, we generally expect a positive relationship between the industry factors and internationalization patterns, i.e. $\beta_m > 0$, for $m = 1, \dots, 4$, but make no predictions about the γ coefficients.

Descriptive statistics

Table 1 shows aggregate internationalization indicators for the firms in the study. On average, the firms experienced an increase over the period 1990 to 2000 on all three measured dimensions indicating an increased level of international activity (sales) as well as an increase in firms moving value activities to foreign locations (employees and subsidiaries). Although the average figures show a steady growth in international activities, such figures mask considerable variation across firms. The median figures reveal that at least half of the firms did not actually have any employees in foreign countries until the end of the period studied.

***** Insert Table 1 about here *****

A correlation matrix was generated to check whether the dependent variables in the study really reflect separate dimensions of internationalization. Some degree of correlation between the dependent variables ought to be expected, but very high values suggest that the various measures were merely replicating each other. As reported in Table 2, the three dependent variables are indeed correlated, but the coefficients are in the region of 0.44-0.68, which should not cause any alarm. The

three dependent variables seem to capture different aspects of firms' internationalization and it makes sense to examine each of them separately.

***** Insert Table 2 about here *****

Descriptive statistics and correlations among the independent variables are reported in tables 3 and 4. Correlations are generally low, with the exceptions of some correlation between the year dummies and between the dummy for year 2000 and industry concentration ($r=0.44$), and that industry concentration correlates with firm size ($r=0.40$). The table also reveals that the indicator for industry sector is moderately correlated with concentration ratio ($r=0.29$) and research intensity ($r=0.25$), and that companies' diversification is correlated with their size ($r=0.25$). T-tests confirmed that manufacturing industries are indeed more R&D intensive than service industries ($t= 4.44, p<0.001$), and also more concentrated ($t= 5.14, p<0.001$), and that diversified companies are larger than focused companies ($t= 4.30, p<0.001$). We made additional tests to check for multicollinearity. The variance inflation factors were all below 2.0, and the highest condition index value was 6.58, which are all well within common threshold values. All variables were therefore kept in the analyses.

***** Insert Table 3 about here *****

***** Insert Table 4 about here *****

Estimation

We performed pooled and random effect (RE) estimations of the models using the STATA package. Under the pooled specification, equations 2 and 3 are estimated by OLS with heteroskedasticity corrected standard errors (White 1980). The basic pooled regression models are as follows:

$$(2) \quad FSALE_j = \alpha + \sum_{m=1}^4 \beta_m Industry + \sum_{z=1}^2 \gamma_z Firm + \sum_{t=1}^2 \varphi_t Year_dummies + \varepsilon$$

$$(3) \quad FEMP_j = \alpha + \sum_{m=1}^4 \beta_m Industry + \sum_{z=1}^2 \gamma_z Firm + \sum_{t=1}^2 \varphi_t Year_dummies + \varepsilon$$

where $FSALE_j$ and $FEMP_j$ represent foreign sales and foreign employment for firm j , $Industry$ includes four industry level variables, $Firm$ includes two firm level variables (as outlined in the preceding section). Dummies for the years 1995 and 2000 are also included.

The third dependent variable $FSUB$ is expressed as a count variable. We can consider the number of foreign subsidiaries i , as the number of occurrences of an event y_i . A Poisson regression is usually thought to be suitable for the estimation:

$$(4) \quad P(Y_i = y_i) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!}, \quad y_i = 0, 1, 2, 3, \dots$$

where λ_i denotes the expected number of events per period and is equal to $\exp(\beta'X)$, X is a vector of industry and firm-specific variables ($Industry$ and $Firm$), and β represents the parameters to be estimated. However, using a Poisson distribution would imply the assumption that $E[y_i / x_i] = \text{Var}[y_i / x_i]$, but the frequency chart (Figure 1) shows that the data are highly skewed to the right: the variance is more than 30 times the mean, which is a sign of over-dispersion (mean=10.4, variance=375.8). Running the Poisson model on the data, a goodness of fit- χ^2 test where $\chi^2 = 4060$, and $p > 0.001$ indicated that using the Poisson model was not appropriate. As an alternative, Greene (2003) suggests using the negative binomial model, which is estimated by maximum likelihood. Since the negative binomial model formulation arises from 'natural formulation of cross sectional heterogeneity', the mass function can be written as:

$$(5) \quad f(y_i | x_j, \mu_i) = \frac{e^{-\lambda_i \mu_i} (\lambda_i \mu_i)^{y_i}}{Y_i!},$$

Where μ_j is the individual unobserved effect for firm j ($j=1,2,\dots,n$).

***** Insert Figure 1 about here *****

Random effects specification

If we assume that there are some unobserved random effects specific to each firm that are time invariant, then as suggested in Maddala (1987) and Greene (2003), the above model should be estimated by the inclusion of random effects. Hence, adding a random term v to the equations, the random effect (RE) model is estimated by the Generalized Least Squares procedure (GLS). It is assumed that the unit specific component v is uncorrelated with each of the explanatory variables in the model. Fixed effect (FE) estimation could be used as an alternative method to RE, as it would allow correlation between the explanatory variables and v . However, since time invariant coefficients are dropped from the estimation in the FE, this would leave out some important variables from our model. We tested the RE specification against the FE using standard Hausman tests. Testing H_0 : Random Effects model [$\text{Cor}(\alpha_i, x_{it}) = 0$] vs. H_1 : Fixed Effects model [$\text{Cor}(\alpha_i, x_{it}) \neq 0$] gave $\chi^2 = 5.40$ ($\text{Prob} > \chi^2 = 0.37$) for *FSALE* models and $\chi^2 = 3.45$ ($\text{Prob} > \chi^2 = 0.63$) for *FEMP* models. Hence, the RE models cannot be rejected in favor of the FE models. Generally, RE models preserve more information in the data set and GLS is very efficient given that the conditions for using a random effects model are satisfied. Maddala (1987) suggests that RE models are superior for making inference about the population from which the data originates.

Results for pooled regressions

Models 1, 3, and 5 in table 5 refer to the pooled estimations. First, we observe that foreign sales ratios and the number of foreign subsidiaries are positively related to the

type of industry, whereas the foreign employment ratios are not. Service firms internationalize less than manufacturing firms in terms of foreign sales and FDI, but their foreign employment ratios are comparable to those of manufacturing firms.

***** Insert Table 5 about here *****

Second, the *CONCENTRATION* coefficients show insignificant effects on any of our measures of internationalization. Third, industries' research intensity appears, as expected, to be significantly related to the internationalization of the firms in the sample. Fourth, there is a positive association between the existence of industrial clusters and all measures of firms' internationalization. Finally, the estimations produced significant coefficients for the firm level variables that were introduced as controls, suggesting that the size of firms and their degree of diversification have positive effects on internationalization.

Results for random effects estimation

As a whole the regression runs for the base models indicate that for our sample of firms, their internationalization is indeed associated with industry factors. However, the previous results are based on pooled data using either OLS regressions with robust standard errors or a negative binomial model (for the dependent variable *FSUB*, which is a count of events). We now turn to RE estimations, i.e. the models numbered 2, 4, and 6 in table 5.

RE estimation shows that results remain unchanged for models with *FSALE* as dependent variable (model 2 vs. model 1). RE estimation of the model for *FEMP* (model 4) also largely reproduces the results for the pooled regression (model 3), but with some exceptions: the coefficient of the industry concentration variable (*CONCENTRATION*) becomes significant, albeit only at the 10 percent level, and

similarly, the coefficient for type of industry is weakly significant thereby reinforcing the overall finding that companies in the service industries are less prone to internationalize than those in the manufacturing sector. Model 6 was estimated as a negative binomial model with RE. Again, the results only differ slightly from those for the pooled regression (model 5): the coefficient for *MANUFACTURING* loses some weight and is significant only at the 10 percent level; conversely, the coefficient for *CLUSTER* gains weight being significant at the 5 percent level.

We apply a Breush-Pagan Lagrange multiplier test for random effects. Our test is significant for all models, and hence we cannot reject that the random effect model is a correct specification (H_0 Pooled Model: $\sigma_\alpha = 0$ vs. Random Effect model H_1 : $\sigma_\alpha > 0$ gave $\chi^2 = 158.5$ ($P > \chi^2 = 0.000$) for *FSALE* and $\chi^2 = 124.6$ ($P > \chi^2 = 0.000$) for *FEMP*). For the negative binomial model (*FSUB*) we use a likelihood ratio test, which tests the RE versus the pooled specification. The test is in favor of the RE specification ($\chi^2 = 53.6$, $P > \chi^2 = 0.000$). However, the conclusion remains that the results are robust and differ little between the different types of estimation.

Summary and Discussion

Using panel data on a sample of large Norwegian firms, this study has examined the relation between industry factors and firms' propensity to internationalize. Firms differ a lot in their degree of internationalization and such differences can, *inter alia*, be related to characteristics of the industries in which they operate. In this study, we uncover the effects of four industry characteristics: competition, research intensity, product tangibility, and the existence of clusters. Previous studies have largely neglected industry level characteristics, the focus being instead on firm and country level factors. Our analysis shows that industry characteristics also drive or hinder

internationalization, and that leaving out such factors restricts the understanding of firms' internationalization patterns.

Because single measures do not capture firms' internationalization adequately (Dörrenbacher 2000), we use three distinct measures to describe the scale and scope of their international activities. Taken together these three measures not only identify the level of international activities, but also allow distinguishing between foreign sales and other types of commitment.

The results show both that industry factors indeed are significantly associated with the propensity to internationalize, and that the investigated industry characteristics are related to different aspects of internationalization (thus supporting the use of multiple measures of internationalization). First, we find that service firms generally exhibit lower foreign sales levels and have fewer foreign subsidiaries than manufacturing firms, but their foreign employment ratios are similar to those of manufacturing firms. While this generally indicates a lower internationalization propensity among service firms, whenever they do move abroad service firms do so with personnel intensity that is equivalent to that of manufacturing firms. Second, in agreement with the literature dating back to the seminal studies by Vernon (1966) and Caves (1971), the higher the research intensity the more likely it is that industry incumbents develop competitive advantages and that they enhance their capacity to innovate and launch new products that find customers at home and abroad. The propensity to internationalize in turn increases. However, the difficulties of ensuring that innovation is adequately measured in service firms (Smith 2005) means that one must be cautious when interpreting this finding. Half of the firms in the sample are categorized as belonging to service industries, which are less R&D intensive, but service firms are also generally less prone to internationalize. Third, we find that

firms within clusters have substantially higher foreign sale and foreign employment intensities than those outside such clusters, and that clustering is positively associated, but somewhat less strongly, with the establishment of foreign subsidiaries. It is interesting that the *CLUSTER* variable had a less robust effect in the *FSUB* models. Belonging to a cluster may boost the international competitiveness of its incumbents firms (Brown and Bell 2001; Mariotti and Piscitello 2001; Porter 1998), but does not seem to be strongly associated with to what extent firms establish a network of units abroad. Overall though, the findings concur with studies indicating that clusters are successful both in attracting business to certain locations and in retaining those firms that are already established there (Enright 2000; Reve and Jakobsen 2001). Fourth, and against our expectation, we find that concentrated home markets do not generally push firms to internationalize. This finding does not rule out rivalry behavior as an impetus to internationalization as suggested by oligopolistic reaction models (e.g., Knickerbocker 1973). In oligopolistic industries, firms tend to carefully monitor the moves of their closest competitors. If firms regard the domestic market as their single most important market, their attention would also primarily be on the competitive developments in that market. It could simply be that a substantial number of typically home-market oriented industries (for example in the consumer goods and retailing sectors) tend to be oligopolies in Norway, thereby obscuring the potential effect of competition on internationalization. It is beyond the scope of this study to offer specific reasons for the insignificant finding, but future studies with more detailed data on which geographical markets are deemed most important could hopefully provide further insight into the issue. Finally, firm-level control variables indicate that the results are robust.

Our findings concur with Caves (1996) and Porter (1986) that industry factors are essential in order to understand the propensity of firms to internationalize. They indicate that for small advanced economies, market size alone is not sufficient to understand external factors influencing firms' propensity to internationalize. However, our understanding of how industrial dynamics influence internationalization remains sketchy. Only four industry characteristics were examined and future studies should look at other factors. An interesting avenue for further investigation is also to look at differences across industries and over time regarding firms' internationalization strategies and subsidiary roles. If internationalization strategies and subsequent subsidiary roles are related to industry factors, they may be expected to vary across industries: some industries require local adaptation and others more global integration (Bartlett and Ghoshal 1989). These issues have yet to be examined in detail.

This study demonstrates the importance of including industry factors in models of firms' internationalization, but its limitations should be noted. Collecting the data retrospectively eases the task and reduces much "noise" stemming from industry dynamics (e.g., company restructuring and bankruptcies). This is in part positive since such dynamics *per se* lie outside the scope of the study, but the approach also introduces a degree of success and/or survival bias in the sample. Also, because the data were collected for three points in time with 5-year intervals, potentially important information gaps exist in the in the data set. Annually collected data would have been better both in order to capture small gradual changes in firms' internationalization, and to uncover significant disruptions in-between data collection points.

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Table 1
Indicators of internationalization for the 100 largest non-financial Norwegian firms in 1990, 1995, and 2000

	1990	1995	2000
Avg. foreign sales (%)	32.1%	39.6%	43.4%
Median foreign sales (%)	6.0%	30.0%	38.0%
Avg. foreign employees (%)	11.8%	17.9%	29.4%
Median foreign employees (%)	0.0%	0.0%	16.0%
Avg. number of foreign subsidiaries	6.9	9.8	14.7
Median number of foreign subsidiaries	0.0	2.0	5.0

Table 2
Dependent variables: Descriptive statistics and correlations

Variables	Mean	Std.dev.	Min.	Max.	1.	2.	3.
1. FSALE	0.39	0.39	0.00	0.99	1.00		
2. FEMP	0.21	0.28	0.00	0.99	0.68*	1.00	
3. FSUB	10.35	19.39	0.00	95.00	0.44*	0.63*	1.00

Note: * Correlation is significant at the 0.05 level (2-tailed).

Table 3
Descriptive statistics for the independent variables

Variables	Mean	Std.dev	Min.	Max.
1. MANUFACTURING	0.49	0.50	0.00	1.00
2. CONCENTRATION	0.44	0.25	0.05	1.00
3. TECHINT	3.68	9.43	0.00	71.90
4. CLUSTER	0.71	0.90	0.00	2.00
5. DIVER	0.07	0.26	0.00	1.00
6. YEAR1995	.033	0.47	0.00	1.00
7. YEAR2000	0.33	0.47	0.00	1.00
8. Ln (TSALES)	7.61	1.29	3.74	12.25

Table 4
Correlations among independent variables

Variables	1.	2.	3.	4.	5.	6.	7.	8.
1. MANUFACTURING	1.00							
2. CONCENTRATION	0.29*	1.00						
3. TECHINT	0.25*	0.23*	1.00					
4. CLUSTER	0.07	0.04	0.03	1.00				
5. DIVER	0.20*	0.14*	0.12*	0.13*	1.00			
6. YEAR1995	0.00	-0.22*	0.01	0.00	0.00	1.00		
7. YEAR2000	0.00	0.44*	0.01	0.00	0.00	-0.50*	1.00	
8. Ln (TSALES)	0.13*	0.40*	-0.01	0.12*	0.26*	-0.02	0.28*	1.00

Note: * Correlation is significant at the 0.05 level (2-tailed).

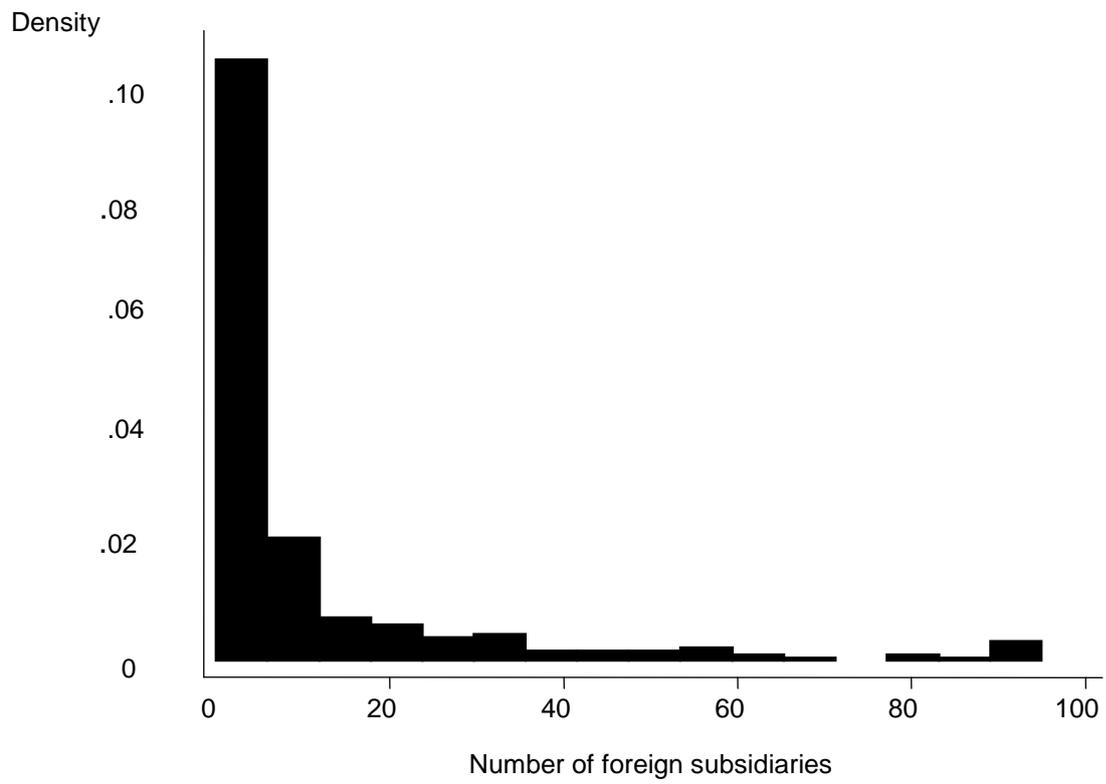


Figure 1. Histogram of dependent variable: Number of foreign subsidiaries

Table 5
Regression results: t-values in parentheses

Independent variables:	Model 1 Pooled FSALE	Model 2 RE FSALE	Model 3 Pooled FEMP	Model 4 RE FEMP	Model 5 Pooled FSUB	Model 6 RE FSUB
<i>MANUFACTURING</i>	0.284 (4.96)***	0.292 (5.42)***	0.069 (1.340)	0.081 (1.650)*	0.971 (2.96)***	0.415 (1.640)*
CONCENTRATION	-0.049 (0.390)	-0.074 (1.130)	-0.041 (0.340)	-0.116 (1.830)*	0.345 (0.530)	0.375 (0.940)
TECHINT	0.008 (4.80)***	0.006 (2.83)***	0.005 (2.04)**	0.004 (1.95)*	0.018 (2.66)***	0.031 (3.06)***
CLUSTER	0.230 (7.16)***	0.231 (7.97)***	0.086 (2.80)***	0.094 (3.51)***	0.287 (1.870)*	0.278 (2.02)**
Ln(TSALES)	0.045 (2.06)**	0.066 (4.63)***	0.057 (3.26)***	0.052 (3.82)***	0.863 (6.81)***	0.446 (5.44)***
<i>DIVER</i>	-0.277 (4.22)***	-0.299 (2.89)***	-0.151 (2.49)**	-0.143 (1.540)	-1.192 (3.73)***	-0.908 (2.17)**
Year 1995	0.025 (1.290)	0.014 (0.660)	0.025 (1.530)	0.026 (1.290)	0.371 (2.07)**	0.445 (2.52)**
Year 2000	0.059 (1.560)	0.044 (1.560)	0.119 (3.08)***	0.137 (4.99)**	0.435 (2.09)**	0.623 (2.97)***
Constant	-0.263 (1.820)*	-0.398 (3.76)***	-0.360 (3.28)***	-0.298 (2.97)***	-5.990 (6.48)***	-4.407 (6.64)***
Observations	284	284	276	276	278	278
<i>F</i> -value	46.11***		11.66***			
χ^2 value		164.9***		115.7***	116.6***	150.1***
Adjusted <i>R</i> ²	0.526	0.520	0.246	0.254		

Note: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$