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## 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 competition level, 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 data covering the internationalization patterns of the 100 largest non-financial Norwegian companies over the period 1990 to 2000. We find that industry factors contribute significantly to explaining the internationalization of these companies, and that the effects of industry factors remain strong when firm-level characteristics are taken into account.



**Key words**: Internationalization, multinational companies, industry factors, Norway

**JEL classification**: F21, F23, L10

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## I. Introduction

It is generally recognized that both internal and external factors influence firms' internationalization patterns. However, most of the research 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 advantages (Porter, 1990; Kogut, 1991) and of decision-makers' (entrepreneurs) willingness to act upon market opportunities abroad (Andersson, 2000; Cavusgil, 1980; Johanson and Vahlne, 1977). Industry factors are often overlooked, too generalized, or inadequately measured (Caves, 1996; 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; Globerman and Shapiro, 2003; Hirsch, 1976). They can act as both centrifugal and centripetal forces for the internationalization of firms from small economies (Benito et al., 2002). For example, oligopolistic market structures supposedly have an especially strong impact on firms with small domestic markets since the influence on the competitive situation is likely to be more immediate. 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 (Hennart, 1982; Hennart, 2000), 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). Starting from a point of strong perceived uncertainty a firm gradually increases its "comfort zone" of foreign markets; its level of uncertainty is reduced through accumulation of experience and learning. 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.

Some scholars argue that industry characteristics strongly shape firm strategies and that they constrain the strategic options open to firms (Porter, 1986; Ghoshal, 1987). Theories of oligopolistic reaction argue that firms are strongly influenced by the strategic moves of their competitors. Hence, if one competitor internationalizes, others are prone to follow (Flowers, 1976; Graham, 1978, 2000; Knickerbocker, 1973). 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 ways of identifying the globality of industries by looking at structural characteristics such as research intensity (Kobrin, 1991) or 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 the 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). The success of firms' internationalization strategies could be highly dependent on industry characteristics: for example, Porter argues that "in a multi-domestic industry, company internationalization is discretionary…. in a global industry, a firm must in some way integrate its activities on a worldwide basis to capture the linkages among countries" (Porter, 1986: 12).

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 influence of industry characteristics on firms' internationalization strategies. We identify key industry characteristics, which we use to analyze central dimensions of internationalization in a sample of the 100 largest non-financial Norwegian firms. We find that even in a small economy such as Norway where the influence of macro level factors is considerable, the internationalization of firms is evidently also influenced by industry characteristics.

## II. 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; e.g. high performers in the domestic market have a higher propensity to internationalize (Grant, Jammine, and Thomas, 1988). If most of the variation can be explained through firm-specific factors, one should not expect to find any major differences across industries. However, if industry factors do influence firms' internationalization, one should observe similar internationalization patterns among firms within the same industry (Graham, 1978). If 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 four industry characteristics in particular have an impact on firms' propensity to internationalize and the consequent development of their foreign activities (see e.g. Andersson, Gabrielsson, and Wictor, 2004; Benito et al., 2002; Contractor, Kundu, and Hsu, 2003; Porter, 1990; Yu and Ito, 1988): (i) the level of competition, (ii) research intensity, (iii) tangibility of the products, and (iv) existence of clusters in the domestic market. Each industry characteristic is described in more detail below.

1. LEVEL OF COMPETITION IN THE DOMESTIC MARKET

A competitive domestic arena generally helps strengthening the ways in which firms perform value activities (Grant, Jammine, and Thomas, 1988). Intense rivalry is particularly effective in sharpening firms' commercial skills (Porter, 1990). Often times, however, the rivalry comes from foreign firms entering the domestic market. (e.g. Graham, 1978; Ito and Rose, 2002). Internationalization can also result from a direct countermove to competitors internationalizing, creating a chain of interdependent moves and countermoves (Flowers, 1976; 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 competition in an industry, as expressed in its concentration ratio, to positively influence incumbent firms' propensity to internationalize.

2. RESEARCH INTENSITY

A firm's ability to achieve competitive advantage is rooted in its ability to innovate. The innovative skills can be either technological or market oriented (Porter, 1990). 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) and some studies report that innovation-oriented firms are more likely to expand abroad (Basile, Giunta and Nugent, 2003; Wakelin, 1998)[1].

Research intensive firms may internationalize for a number of reasons such as seeking new markets or moving production to lower cost locations (Vernon, 1966). A reason for internationalizing activities can also be the need to adapt goods or

[1] This does not necessarily imply that firms with high research intensities are more inclined to internationalize, nor does this suggest that R&D are activities that are often moved to foreign locations. Even though Guellec and de la Potterie (2001) have recently argued that there is an increasing trend of technology transfer across borders, there has, in fact, traditionally been a low degree of internationalization of R&D (Zander, 1999).

processes to local markets and provide local technology support (Patel and Vega, 1999). These reasons for internationalizing are not necessarily driven by high industry levels of research intensity *per se*, and do not sufficiently explain why research intensity would push firms to internationalize. Nonetheless, operating in a research-intensive environment may generally strengthen the firm's competitiveness in general, which in turn could induce firms to compete outside their domestic markets (Porter, 1990). Indeed, most firms tend to internationalize technologies that made them particularly strong in their home markets (Patel and Vega, 1999).

Research intensity has been identified as a key structural determinant for global integration in industries (Kobrin, 1991). 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 (Patel and Vega, 1999). In all, this suggests that firms with high research intensities may also have higher propensities to seek international markets.

### 3. TANGIBILITY OF RESOURCES AND PRODUCT OFFER

Service firms have traditionally remained local and thus been less internationalized than manufacturing firms (Contractor et al., 2003). This can be explained by a number of reasons. First, 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 (Lovelock and Yip, 1996; Løwendahl, 2000).

Second, significant non-tariff barriers often create real and perceived difficulties for service firms in marketing outside their original local markets (Grönroos, 1999). While manufacturing firms battle with issues of balancing standardization against local customization, service firms deliver a "performance" that requires customer involvement in the delivery (Lovelock and Yip, 1996). We recognize that industry specific characteristics will influence both service and manufacturing firms (Porter, 1986), but the influence of industry factors is likely to differ between these two types of firms (Løwendahl, 2000). Increased recognition of the diversity among service firms has led some researchers to divide them further into sub-groups (Contractor et al., 2003; Lovelock and Yip, 1996). Our purpose here, however, is simply to examine whether potential differences between firms in their propensity to internationalize depend on the tangibility of their product offer.

## 4. CLUSTERS

With the increasing focus on cross-border activities, one could expect a diminishing focus on geographical location. Yet, many studies reveal that the proliferation of certain dynamic geographical areas – so-called clusters – fostering technology development and fierce competitiveness co-exist with many other areas that perform less illustriously. Although several studies focus on identifying clusters, limited research has so far analyzed their impact on the internationalization of firms (Brown and Bell, 2001). The potential impact of clusters is essentially twofold. On one hand, a dynamic local environment might attract new firms interested in learning through a strong local network. 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. Subsidiary research has identified that subsidiaries in leading edge clusters are in fact more internationally oriented that subsidiaries in other industry sectors (Birkinshaw and Hood, 2000). Hence, we could expect a higher internationalization propensity among firms located within strong clusters. Some even argue that firms without this sharpened competitiveness derived from cluster environments will have greater difficulties competing internationally (Mariotti and Piscitello, 2001).

## III. Methods

### 1. 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 was found on company web sites, company directories such as *Kapital*, and in some cases collected through direct contact with the firms.

The companies were selected from *Kapital*'s listing of the 500 largest firms in Norway, in 2000. The list was modified to exclude (a) financial firms that have traditionally been bound by strict regulations, (b) foreign-owned firms, and (c)

government-owned organizations with narrowly defined scope of activities and restricted strategic autonomy. Since the firms were selected from the 2000-ranking and data was collected retrospectively, the potential for survival bias needs to be addressed. Indeed, the selected sample only includes large firms that have succeeded over time and thus fails to capture some of the dynamics that occurred in the particular period. This could be problematic if a large portion of the firms over time actually had ceased to exist due to bankruptcies and the like. It turns out that only 6 percent would have disappeared by the end of the observation period (i.e. in 2000) due to poor economic performance if we had used the 1990-ranking. 36 percent of the companies appear on both lists under the same name, and 38 percent reappear under different names (mainly due to mergers and acquisitions)[2]. For the remaining 20 percent of firms, majority ownership had been sold off to foreign owners. The potential survival bias[3] was hence judged to be small and of little consequence, especially in comparison to the problems posed by building a dataset (based on the 1990-ranking) containing substantial amounts of industrial dynamics that lie outside the scope of this study.

## 2. MEASURES

The study seeks to identify the influence of industry characteristics on the internationalization of firms. In order to examine such developments and whether and to what extent industry influences firms' internationalization, we focus on three distinct measures that fit the objectives of this particular study[4]. By using three

[2] It is important to note that the 38 percent that underwent mergers or acquisitions were largely merged into a few companies that were already on the list of the largest firms in 1990.
[3] In the 2000-sample, only 6 percent have no ties back to 1990.
[4] 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). A number of multi-item aggregate indices have thus been developed to avoid the limitations of single-item measures and create a multidimensional understanding (Basile et al., 2003; Ietto-Gillies, 1998; Sullivan, 1994). It is questionable, however, whether an existing index can be theoretically

measures we circumvent some of the limitations and misrepresentations of one-sided measures[5], while at the same time generating a multidimensional understanding of internationality. The first measure of internationalization is the percentage ratio of foreign sales to total sales, which primarily identifies the amount of international activities (*FSALES*). Foreign sales ratio is commonly used to measure the degree of internationalization. Although it 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 included to better describe the extent of international activities.

The second dependent variable 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*) as a measure of internationalization, to map in more detail companies' commitments abroad and identify to some extent the geographical spread of their activities[6]. Although this does not in itself detail the geographical or cultural diversity, it indicates the degree of

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justified or methodologically appropriate for subsequent studies (Ramaswamy, Kroeck, and Renforth, 1996).

[5] For example a reduction in foreign employees may indicate increased efficiency rather than reduced international activity. Similarly, a reduction in foreign subsidiaries may merely reflect a concentration of activities with increased emphasis on fewer geographical areas rather than a reduction of international activities *per se*.

[6] For a given company *j* at time *t* we have; $FSALE_{jt}$ = (*foreign sales*$_t$ / *total sales*$_t$); $FEMP_{jt}$ = (*foreign employment*$_t$ / *total employment*$_t$); and $FSUB_{jt}$ = # foreign subsidiaries.

complexity related to whether the foreign activities are centered in one or many locations.

All firms were categorized according to ISIC (Rev. 3) codes. We use four independent variables to measure key characteristics of industries. The variable *TYPE* identifies whether the company is in service or manufacturing industries. Specifically, we use a dummy variable with 1 indicating manufacturing firms and 0 indicating service firms. The concentration of competitors in an industry, *COMP*, is measured as the market concentration 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 *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 provided by OECD. 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, Lensberg, and Grønhaug, 1992; Reve and Jakobsen, 2001). These studies identified a group of strong clusters and a few additional industries that had some of the characteristics commonly attributed to clusters. The latter group was labeled "weak clusters". This leaves us with a trichotomy of strong, weak and no clusters, coded 2, 1, and 0 respectively.

Firm-specific variables were added as controls. The variable *CONGL* identifies conglomerate companies, i.e. firms operating in multiple industries with ISIC codes that are not directly related. This means that firms may have multiple industry codes without being classified as a conglomerate. For example firms with

industry codes 05 (fisheries), 15 (food manufacturing) and 51 (food retailing) were not classified as conglomerates since these activities represent different aspects of the same value chain. Firm size is measured by *TSALE*; the total sales for each of the companies for the years 1990, 1995, and 2000.

## IV. 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 in fact statistically significant (at the 0.001 level) industry differences on all three dimensions of internationalization. This prompted further investigation into whether particular dimensions of industry characteristics influence firms' internationalization patterns differently across industries. Specifically, we run regressions with the selected independent variables to investigate why internationalization patterns differ across industries. The basic regression model is as follows:

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

where the dependent variable $Y_i$ is measured with three different variables *FSALE*, *FEMP* and *FSUB*; *Industry* refers to the set {*TYPE, COMP$_t$, TECHINT, CLUSTER*} of industry characteristics, while *Firm* represents the set {*TSALES$_t$, CONGL*} of firm characteristics; $\varepsilon$ denotes the error term and $\alpha$, $\beta$ and $\gamma$ 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 $m = 1,..,4$, but make no predictions about the $\gamma$ coefficients.

1. 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 markets (employees and subsidiaries). Although the average figures show a steady growth in international activities, such figures mask considerable variation across the 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. Similarly, half of the firms had a maximum of five foreign subsidiaries throughout the time period.

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 would suggest that the various measures were merely replicating each other. The correlations given in Table 2 indicate that while the three dependent variables indeed are correlated, the coefficients are in the region of 0.44-0.68, which does not indicate alarmingly strong correlations. The three dependent variables hence seem to capture different aspects of firms' internationalization and it makes sense to examine each of them separately.

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

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

Correlations among the independent variables are reported in table 3. These were generally low, with the exception of research intensity that is moderately correlated

with the indicator for type of firm. One would expect these two variables to be somewhat interrelated since R&D tends to be more important for manufacturing firms. A correlation of 0.58 does not *per se* suggest any harmful collinearity. However, additional tests were conducted to ensure that multicollinearity was not a problem. Neither the variance inflation factors (VIF) nor the condition index indicated problems, both being within common threshold values (Hair et al., 1998)[7]. Both variables were therefore kept in the analyses.

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

## 2. 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:

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

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

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.

Our 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 $y_i$, and use a Poisson regression for the estimation:

[7] VIF values were in the range of 1.065 to 1.698 (2.142) and the condition index values range from 2.026 to 5.565.

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

where $\lambda_i$ denotes the expected number of events per period and is equal to exp($\boldsymbol{\beta}$'**X**), **X** is a vector of industry and firm-specific variables (*Industry* and *Firm*), and $\boldsymbol{\beta}$ represents the parameters to be estimated. However, using a Poisson distribution would imply an assumption that E[ $y_i$ | $x_i$ ] = Var[ $y_i$ | $x_i$ ], but the frequency chart (Figure 1) shows that the data is highly skewed to the right: the variance is more than 30 times the mean, which is a sign of overdispersion (mean=10.4, variance=375.8). Running the Poisson model on the data revealed that the goodness of fit-$\chi^2$ test indicated that using the Poisson model was not appropriate: $\chi^2 = 4060$, $p>0.001$. As an alternative, Greene (2003) suggests using the negative binomial model, which is estimated by maximum likelihood[8]. We again assume that **X** is a vector of industry and firm-specific variables (*Industry, Firm*), $\boldsymbol{\beta}$ are the estimated parameters, $\varepsilon_i$ is an error term and $\mu_j$ is the individual unobserved effect for firm $j$ ($j$=1,2…$n$). Since the negative binomial model formulation arises from "natural formulation of cross sectional heterogeneity", the mass function can be written as:

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

Because $\mu_j$ is unobserved, the unconditional distribution of $y_i$ represents the integral evaluated over the density of $\mu_j$, which is assumed to have a gamma distribution (see Greene (2003) for a fuller elaboration), with conditional mean equal to $\lambda_i$ and conditional variance of equal to $\lambda_i$ +(1+(1/$\theta$) $\lambda_i$ ) with $\theta > 0$ indicating overdispersion[9].

[8] A negative binomial distribution with the overdispersion parameter equal to zero reduces to a Poisson distribution. The Poisson model can be considered as nested in the negative binomial, and one may therefore apply a LR test for the parameter of overdispersion.
[9] LR test for $\theta$ under the null hypothesis.

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

## 3. 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 the $v$. 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. The tests showed that the RE models could not be rejected in favor of the FE models[10]. 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[11].

The results from the pooled and RE estimations are shown in table 4. First we comment on the pooled regression and then on the RE models.

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

[10] $H_0$: Random Effects model [$Cor(\alpha_i , x_{it}) = 0$] vs. $H_1$: Fixed Effects model [$Cor(\alpha_i , x_{it}) \neq 0$] gave $\chi^2 = 5.40$ (Prob> $\chi^2 = 0.3694$) for *FSALE* models and $\chi^2 = 3.45$ (Prob> $\chi^2 = 0.6317$) for *FEMP* models.

[11] Maddala (1987) also remarks that "as the $v$ measures the firm-specific effect that one is ignorant about in the same way $\varepsilon$ measures effects of cross section unit in the specific period $t$ that we are ignorant about". Then if we treat $\varepsilon$ as random there should be no reason why $v$ should not be treated as random.

## 4. RESULTS FOR POOLED REGRESSIONS

Models 1, 3, and 5 in table 4 refer to the pooled estimations. First, we observe that type of industry influences foreign sales ratios and the number of foreign subsidiaries positively, but not the foreign employment ratio. 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. Thus, while this generally indicates lower internationalization propensities among service firms, whenever they do move abroad service firms do so with a personnel intensity that is equivalent to that of manufacturing firms.

Second, the coefficients of *COMP* do not show significant effects on any of our measures of internationalization. This suggests that high concentration ratios in the home market do not generally provide an impetus to internationalization. This finding is in agreement with the idea of rivalistic behavior in oligopolistic industries, which suggests that in such industries firms tend to carefully monitor the moves of their closest competitors. The domestic market is usually the single most important market to the firms, and their attention is hence above all on the competitive developments in that market. However, to the extent that key competitors venture abroad and consequently potentially increase their scale of operations and resource base, diversify risks etc., other firms may be tempted to follow abroad in order to mitigate possible adverse effects on their domestic competitive position.

Third, industries' research intensity appears, as expected, to have significant effects on the internationalization of the firms in the sample. 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 specific advantages and that they enhance their capacity to innovate and launch new

products which can be exploited abroad. In turn, the propensity to internationalize increases.

Fourth, there is a positive association between the existence of industrial clusters and firms' foreign sales as well as their foreign employment ratios, and at the 10% level also on the number of foreign subsidiaries. It is interesting that the *CLUSTER* variable had a less robust effect in the *FSUB* models. Belonging to an industrial cluster may boost the international competitiveness of its incumbents firms (Brown and Bell, 2001; Mariotti and Piscitello, 2001; Porter, 1998), but does not have a strong impact on whether firms establish an extensive network of units abroad. Overall though, the findings concur with previous studies indicating that industrial clusters are successful both in attracting business to certain locations and in retaining those firms that are already established there (Enright, 2000).

Finally, the estimations produced significant effects 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.

## 5. RESULTS FOR RANDOM EFFECTS ESTIMATION

As a whole, the regression runs for the base models indicate that industry factors indeed have an impact on the internationalization of the firms in the sample. 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 expressed as a count of events (*FSUB*). We now turn to RE estimations, i.e. the models numbered 2, 4, and 6 in table 4.

RE estimation shows that results remain unchanged for models with *FSALE* as dependent variable (model 2 *viz* 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 sales concentration variable (*COMP*) is negative and becomes significant, albeit only at the 10% level, and similarly, the coefficient for type of industry is positive and 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 *TYPE* loses some influence and is significant only at the 10% level; conversely, the coefficient for *CLUSTER* gains influence being significant at the 5% level.

We apply a Breush-Pagan Lagrange multiplier test for random effects. The test is based on the null hypothesis that the variance of the error component is zero versus the alternative hypothesis that is not[12]. Our test is significant for all models, and hence we cannot reject the random effect model as being a correct specification. 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 ($\chi^2 = 53.6$ (Prob> $\chi^2 = 0.0000$). However, our conclusion remains that the results are robust and differ little between the different types of estimation.

## V. Summary and discussion

Using panel data on a sample of large Norwegian firms, this study has examined the influence of industry factors on the propensity of firms to internationalize. Firms differ considerably regarding their degree of internationalization and such differences are significantly related to characteristics of the industries in which they operate; in particular their research intensities, the tangibility of products, and the existence of clusters. Previous studies have neglected industry level characteristics and focused

[12] Pooled model $H_0$: $\sigma_\alpha = 0$ vs. Random Effect model $H_1$: $\sigma_\alpha > 0$ gave $\chi^2 = 158.5$ (Prob> $\chi^2 = 0.0000$) for *FSALE* and $\chi^2 = 124.6$ (Prob> $\chi^2 = 0.0000$) for *FEMP*.

instead on firm and country level factors. Our analysis shows that internationalization patterns are also influenced by industry characteristics that drive or hinder internationalization. Leaving out such factors restricts the understanding of firms' internationalization patterns.

Because single measures may be too constraining to capture firms' internationalization adequately (Dörrenbacher, 2000), we use three distinct measures to capture the scale and scope of international activities. The selected variables identify the relative level of foreign activities (foreign sales to total sales), the extent to which the foreign activities involve presence in foreign locations (foreign employees to total employees), and finally an indication of the level of commitment and spread of firms' international activities (number of foreign subsidiaries). Taken together these three measures not only identify the level of international activities, but also allow distinguishing between exports and other types of commitment.

The results show both that the investigated industry factors indeed have significant effect on the propensity to internationalize, and that the various industry characteristics influence different aspects of internationalization (thus supporting the use of multiple measures of internationalization). First, in line with oligopolistic behavior frameworks (see e.g. Flowers, 1976; Graham, 1978; Knickerbocker, 1973) we find some evidence that concentrated home markets push firms to establishing subsidiaries abroad. Second, in agreement with previous studies (Contractor et al., 2003) we find that service firms generally exhibit lower foreign sales levels and have fewer foreign subsidiaries than manufacturing firms. However, their foreign employment ratios are similar to those of manufacturing firms. Third, we find that firms within industrial clusters have substantially higher foreign sale and foreign employee intensities than those outside such clusters, and that industrial clustering has

a positive, but somewhat weaker, effect on the establishment of foreign subsidiaries. Fourth, industries' research intensity positively influenced all the studied dimensions of firms' internationalization. Finally, the firm-level control variables indicate in general that the results are robust.

While our findings concur with Caves (1996) and Porter (1986) that industry factors are essential in order to understand the propensity of firms to internationalize, our understanding of how industrial dynamics influence internationalization remains sketchy. Industry factors may push or hold back firms from crossing some internationalization threshold, but we have not yet explored their impact over time once the critical initial barriers have been overcome. One suggested avenue to explore further in order to assess the influence of industry factors over time is to examine differences across industries in internationalization strategies and subsidiary roles. If internationalization strategies and subsequent subsidiary roles are highly 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, 1999). These issues have yet to be examined in detail.

Although the study demonstrates the fruitfulness of including industry factors in models of firms' internationalization, its limitations should be noted. Collecting the data retrospectively has advantages as well as drawbacks. The approach makes data collection somewhat easier 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 some degree of success and/or survival bias in the sample. An additional issue is that the data were collected for three points in time with 5-year intervals, which may introduce potentially important information gaps 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 (in percent ) | 32.1% | 39.6% | 43.4% |
| Median foreign sales (in percent) | 6.0% | 30.0% | 38.0% |
| Avg. foreign employees (in percent) | 11.8% | 17.9% | 29.4% |
| Median foreign employees (in percent) | 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**
Correlations (Pearson) among dependent variables.

| Variables | 1. | 2. | 3. |
|---|---|---|---|
| 1. FSALE | 1.00 | | |
| 2. FEMP | 0.683* | 1.00 | |
| 3. FSUB | 0.436* | 0.627* | 1.00 |

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

**Table 3**
**Correlations (Spearman's Rho) among independent variables.**

| Variables | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|
| 1. TYPE | 1.00 | | | | | | |
| 2. COMP | 0.283* | 1.00 | | | | | |
| 3. TECHINT | 0.576* | 0.320* | 1.00 | | | | |
| 4. CLUSTER | 0.074 | 0.037 | 0.239* | 1.00 | | | |
| 5. CONGL | 0.202* | 0.095 | 0.303* | 0.123* | 1.00 | | |
| 6. YEAR | 0.221* | 0.220* | 0.154* | -0.205* | 0.110 | 1.00 | |
| 7. TSALE | 0.092 | 0.368* | 0.168* | 0.062 | 0.214* | 0.371* | 1.00 |

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

**Figure 1**

Histogram of dependent variable: Number of foreign subsidiaries.

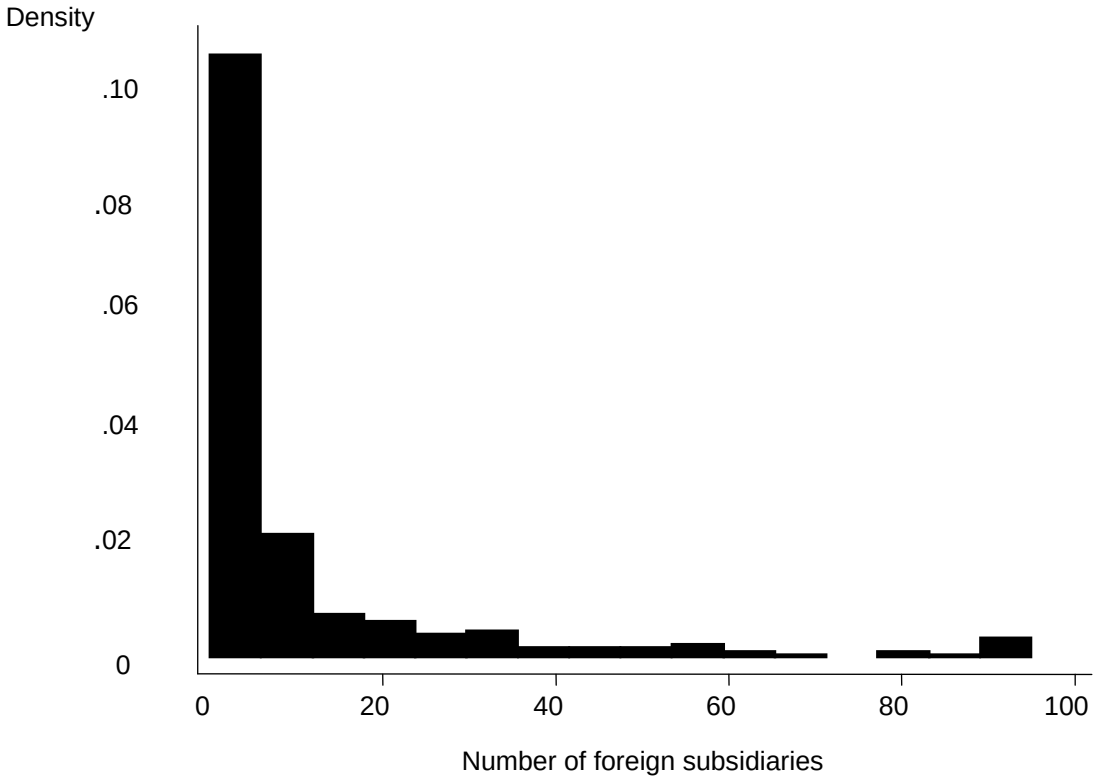

**Table 4**

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

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

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