Evolution of Subsidiary Competences: Extending the Diamond Network Model

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SMG WP 11/2006

August 2006

SMG Working Paper No. 11/2006
August 2006
ISBN: 87-91815-29-0

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August 2006

Acknowledgments: The authors would like to thank Professors Bent Petersen, Alan M. Rugman, Nicolai J. Foss and Dan Li. They are also grateful to Copenhagen Business School for sponsoring the empirical part of this study, and to the Indiana University Center for International Business Education and Research (IU CIBER).

Keywords: MNC environment, subsidiary competence configuration, industrial clusters, differentiated network, subsidiary embeddedness.

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Abstract

We extend the 'centers of excellence' concept in the multinational corporation (MNC) literature to address the diversity and the multidimensionality of subsidiary competence and link such diversity to the host country environment. Using Rugman and Verbeke's (1993) diamond network model of competitive advantage of nations, we hypothesize the contingencies under which heterogeneity in host environments influences subsidiary competence configuration. We test our model with data from more than 2,000 subsidiaries in seven Western European countries. Our results provide new insights on the evolution of subsidiary competence and how MNCs can overcome 'unbalanced' national diamonds by acquiring complementary capabilities across borders.

Keywords: MNC environment, subsidiary competence configuration, industrial clusters, differentiated networks, subsidiary embeddedness.

EVOLUTION OF SUBSIDIARY COMPETENCES: EXTENDING THE DIAMOND NETWORK MODEL

The roles played by national subsidiaries have become pivotal to the discussion of the strategy and structure of multinational corporations (MNCs). In the global firm, the subsidiaries are more or less passive recipients of resources and strategic imperatives from the parent firm, whereas in the multinational firm they are self-sufficient entities with considerable autonomy. However, in recent decades, a growing body of research has been building on the idea of the MNC as a network of specialized, interdependent units (Hedlund, 1986; Bartlett and Ghoshal, 1989; Westney, 1990; Ghoshal and Nohria, 1997). In the networked MNC, the role of subsidiaries is much more complex than in the global or multinational firm, as each subsidiary can be simultaneously a recipient and a contributor of knowledge, products, and services (Gupta and Govindarajan, 1991). By building dispersed and specialized competences in its subsidiaries, the MNC can ideally arbitrage national differences in comparative and competitive advantage and generate superior returns compared to its domestic and non-specialized international competitors.

A powerful and well-known model of environmentally determined competitive advantage is Porter's (1990) "diamond model", which states that firms derive competitive advantage from the presence of local industrial clusters. However, surprisingly few studies have applied this framework to the study of *subsidiary* competence evolution. Some researchers have touched upon aspects of the diamond framework by relating the characteristics of the subsidiary's environment to its competences (e.g. Almeida and Phene, 2004; Mariotti and Piscitello, 1995; Cantwell and Mudambi, 2005). Other studies have tested Porter's framework more explicitly, although indirectly, by using industrial cluster membership rather than host country diamond components to predict subsidiary strength. For example, Birkinshaw and Hood (2000) found that membership of local cluster industries led to higher subsidiary embeddedness, autonomy, and international sales. However, Benito (2000) examined whether subsidiary centers of excellence emerge in Norway's cluster industries and found mixed support for this proposition. As pointed out by Birkinshaw and Hood (2000), "it is not just cluster membership but the specific characteristics of the cluster in question that impacts the likely subsidiary role." Presently, we have very little knowledge about the mechanisms and dimensions along which these cluster characteristics work.

This paper attempts to fill this research gap by moving away from the concepts of environment and subsidiary *strength,* and toward the concept of *configuration,* which captures both the strength and the diversity of the combinations of strength across value chain activities. We build on the logic that a heterogeneous diamond configuration on the host country level should lead to a heterogeneous and diverse competence configuration at the subsidiary level, by drawing on insights from the "diamond network" model propounded by Rugman and Verbeke (1993). By empirically testing our ideas on a large sample of subsidiaries in Western Europe, we make two important contributions: We incorporate a value chain distinction into the diamond framework and we extend the scope of the diamond network model by explicitly relating it to the geographical competence distribution of the MNC.

The remainder of this paper is structured as follows. The next section develops the conceptual framework by revisiting Porter's (1990) diamond framework and the Rugman and Verbeke's (1993) diamond network model. Then we develop a set of four hypotheses which together present a multidimensional perspective of subsidiary competence and their antecedents. Subsequently we present the research design and our results. Finally, we discuss the implications of our research to MNC theory and practice.

Host Country Environment and Subsidiary Competence

How do local environments influence the competitive advantage of local firms? Consistent with observations made by Marshall (1920), Porter proposed the simple and powerful notion that firms based in 'industrial clusters'[1] could appropriate a location-specific competitive advantage. A cluster's strength is determined by a system of reinforcing environmental elements – the national 'diamond' – consisting of factor conditions, demand conditions, local competitive rivalry, and related and supporting industries. Porter (1990) hypothesized that MNCs based in industrial clusters in their home countries would be highly competitive in the global marketplace, resulting for instance in an increased export propensity from those clusters. In that way, Porter's contribution was positioned firmly in the traditional foreign direct investment literature, in which the MNC is seen to exploit its firm-specific advantages – developed at home – to overcome the inherent disadvantage of foreign operations (Hymer, 1976; Vernon, 1966; Hennart, 1982).

The need for a strong home country diamond seems to be consistent with the broadly accepted premise that transfer of tacit knowledge between firms occurs more effectively in cases of geographical proximity and cultural similarity (Almeida and Kogut, 1999; Porter, 1990). However, once knowledge is absorbed into a subsidiary, it can be filtered, codified, and transferred *internally* to other subsidiaries through the knowledge sharing routines and infrastructure that constitute the internal network of the MNC (Kogut and Zander, 1993). Thus, MNCs can potentially use FDI to access and combine dispersed and complementary sources of competitive advantage by selectively sourcing components of diamonds abroad, leading some scholars to suggest that MNCs approach something of a 'multi home-base' structure (Dunning, 1996; Sölvell and Zander, 1995), involving several distinct bases for competence building often referred to as centers of excellence. This line of thinking is also prevalent in the model of the metanational MNC proposed by Doz *et al* (2001) where the process of searching for pockets of knowledge wherever they can be found and mobilizing the knowledge in the global MNC network is the key to competitiveness.

Rugman and Verbeke (1993) suggest that industrial clusters at the national level as well as components of the regional or even global environment may provide an enlarged system of diamond

[1] An industrial cluster consists of a proximate group of "interconnected companies and associated institutions linked by commonalities and complementarities" (Martin and Sunley, 2003: 10).

elements – a ‘double diamond’ or a ‘diamond network’ – that these MNCs combine for competitive advantage. For example, Sölvell *et al* (1991) describe how Swedish MNCs benefited from combining the advanced technical and supply resources in their home country – the factor conditions of the diamond – with their exposure to demanding customers in other countries. In a survey based on the diamond model, Dunning (1996) estimates that between 40 percent and 50 percent of MNCs’ competitive advantage are derived from FDI and international alliances, and in particular from tapping into natural resources and inter-firm rivalry in other countries. So, in the words of Dunning (1993:12), “The *principle* of the diamond may still hold good – but its geographical constituency has to be established on very different criteria.” If MNCs can co-specialize and create complementarities across borders – using foreign subsidiaries to interact *locally* with complementary firms in other countries – individual specialized diamond elements may develop in different locations, and reinforcing cluster dynamics may take place across borders.

The diamond network suggested by Rugman and Verbeke (1993) in fact is a natural extension of the network-based MNC structure (Hedlund, 1986; Bartlett and Ghoshal, 1989; Westney, 1990; Ghoshal and Nohria, 1997). It presents the MNC as an organization that combines diamond components from different countries through a high degree of external embeddedness in each local environment and a high degree of integration between these dispersed units. The role of the individual subsidiary in the diamond network is to *specialize* in the type of knowledge or resource that the MNC wishes to source in the host country. Although specialization is often asserted as a stylized fact or described as a key property of the network-based MNC, we have very little knowledge of the antecedents of subsidiary specialization. We deal with this subject in the next section.

A Multidimensional View of Subsidiary Competence

Although MNC literature acknowledges that subsidiaries can specialize in a limited range of activities in the value chain, most studies have taken a one-dimensional view of subsidiary competence by looking at individual activities in isolation, or by averaging the competence of the subsidiary in different parts of the value chain (e.g. Frost *et al*, 2002). Such an approach effectively conceals the degree of specialization. Just as the firm can be seen as a collection of activities (Porter, 1985), a subsidiary contains a *subset* of those activities and the capabilities that reside within them. Note that the term ‘subsidiary competence’ captures both the existence of the activity in the value chain and the proficiency in that activity – the former being a prerequisite for the latter. A subsidiary’s competence within a part of the value chain ranges from the case where the relevant activities are not performed at all in the host country over a minimal activity volume, to the case where the subsidiary conducts the activities with high skill and expertise. Some of the subsidiary’s activities may cluster into natural groups based on co-location advantages, similar skill requirements, and shared links with the environment. IB scholars have suggested several such groupings. In a factor analysis of subsidiary capabilities, for example, Forsgren *et al* (1999) found one factor consisting of product development expertise, technological expertise, and knowledge among professional staff; and another factor containing supplier relationships, advanced user contact, and insight into competitors. The former was called the ‘internal’ factor and the latter the ‘business network’ factor. However, in a similar distinction, Andersson *et al* (2002) measure the embeddedness of subsidiaries along both a ‘business’ and ‘technical’ dimension, reflecting that both types of competences may actually be linked to the environment.

Building on these two studies, we propose a three-way segmentation of subsidiary competences into supply, market, and technical competences. *Supply* competences describe the firm’s skill and expertise in handling its production inputs, and include such activities as procurement and distribution of intermediary products. *Market* competences, on the other hand, are concerned with production outputs, and include sales, marketing, and service activities. Finally, *technical* competences are needed to transform inputs to outputs and reside in the research, development, and production departments. The combination of supply and market competences corresponds to the business or business network factors described in the above studies; however we separate the two because they deal with different parts (upstream and downstream) of the subsidiary’s external network. Together, the supply, technical, and market aspects constitute the 'competence configuration' of the subsidiary – a multidimensional construct capturing both the depth and breadth of the firm's capabilities.

If we look at the diamond elements described by Porter (1990), a similar distinction can be made on the environment side. Broadly speaking, the supply environment consists of upstream business partners and raw material suppliers. The technical environment consists of labor with industry-specific skills, local research institutions, and related industries using similar technologies, thereby providing synergies and technology spillovers. The market environment consists of demanding customers and competitive rivalry, providing market inputs to the firm and pressuring it to position its product offering. The combination of supply, technical, and market environments can be called the 'diamond configuration' of a given country. By recognizing distinct groupings of competences and environmental resources, we implicitly open up the possibility of 'unbalanced diamonds' and specialized subsidiaries. The diamond can be said to be unbalanced if one element is much weaker or stronger than the others. Indeed, we suggest that MNCs can respond to unbalanced diamonds by linking specialized subsidiaries together in a diamond network. This scenario is illustrated in Figure 1.

*** Figure 1 About Here ***

Hypotheses Development

In the diamond network, the MNC generates its competitive advantage by using dispersed competences to access complementary diamond elements in different countries. The means of achieving this is subsidiary specialization: One subsidiary has local supply competences that enable it to tap into the local supply environment, another has the technical competences to assimilate local technical resources, and the third subsidiary has market competences to enhance learning from the market environment. Such a competence distribution is crucial in the diamond network, because host country knowledge absorption requires both localized *and* specialized competences.

Localized competences are required, as positive knowledge externalities are geographically bounded, and proximity is conducive to knowledge sourcing and technological spillovers between firms

(Porter, 1990; 1998; Almeida and Kogut, 1999; Almeida and Phene, 2004; Jaffe *et al*, 1993). Hence, the local external network of the firm and the embeddedness in this network is a facilitator of knowledge acquisition. This has been shown to be true for both the business (supply and market) network and the technical network of MNC subsidiaries (Andersson *et al*, 2002).

Specialized competences, on the other hand, are necessary because absorptive capacity – the ability to assimilate knowledge from the environment – is a function of existing knowledge within a particular field (Cohen and Levinthal, 1990). Hence, we extend the embeddedness concept by suggesting that the subsidiary's network links are specific to value chain activities. This means that the competences of a local MNC unit should be embedded in the local environment along the three proposed dimensions. For example, local market competence is clearly necessary to access the market components of the national diamond: In order to benefit from demanding consumers in a certain area, the firm would need competent salespeople who can interact closely with these customers and convey market information and pressures up the value chain. Similarly, technical competence is necessary to access the technical diamond components: If the firm wants to tap into research synergies with universities, it would need engineers with the skills required to assimilate this research. Finally, to take full advantage of world-class suppliers in a certain location, skilled procurement specialists must work with these suppliers to enable tight integration and knowledge sharing in the supply chain.

Host Country Diamond Configuration

It is instructive to compare the diamond network model to the industrial cluster view, as each scenario paints a very different picture as to how the environment affects subsidiary competences. The subsidiaries of Porter's (1990) globally competitive firm have competence profiles inherited from their parent – if they have any significant competences at all – as they are merely implementers of the corporate competitive advantage generated in the home base. As this type of MNC can access all diamond components in the home country industrial cluster, it has little incentive to facilitate learning abroad by locating specialized competences in its subsidiaries. Hence, the relationship between the diamond configuration of the host country and the competence configuration of the subsidiary is conceptually weak.

In contrast, the MNC diamond network locates specialized competences where needed in order to access idiosyncratic environmental resources. This implies that the supply competences of a given subsidiary should be highly correlated with the strength of the supply environment in the host country, its technical competences with the technical environment, and market competences with the market environment. These relationships are the 'direct paths' in the causal model presented in Figure 2. Due to the necessity of localized and specialized competences, these direct paths should be significant, as opposed to the 'cross-paths' . This leads us to the following hypotheses:

> *H1: The strength of a given part of the environment (supply, technical, or market) positively affects the* directly corresponding *subsidiary competence type.*
>
> *H2: The strength of a given part of the environment has no effect on the subsidiary's competences* other than *the directly corresponding competence type.*

*** Figure 2 About Here ***

Geographical Proximity

It is necessary to draw certain contingencies which can significantly influence the relationships hypothesized above. In particular, two contingencies determine whether a given subsidiary is likely to be a node in a diamond network: the proximity of the host country to the location of the MNC headquarters, and the degree to which the host country environment can contribute with complementary resources to other MNC units.

The value of gaining access to specialized resources is contingent upon the ability to combine these with complementary resources through the MNC's international network (Malnight, 1996). It is generally believed that the cross-fertilization obtained by combining different types of knowledge is conducive to innovation (Zander and Sölvell, 2000). This is consistent with the view that a firm needs to access *all* elements of the diamond in order to innovate and create competitive advantage, a key insight of Porter's (1990) model. For instance, accessing a pool of technical skills is not enough if there is no strong market environment to create the pressures and the market knowledge necessary to put these skills to their best use, or no supply environment to provide the component technology on which to apply the skills. So a firm tapping into the supply environment in one country, the technical environment in another, and the market environment in a third country (as does the firm in Figure 1) must somehow bring these crucial inputs together by transferring knowledge across borders. This need for international knowledge transfer may create both direct and indirect costs for the network-based firm. The direct costs are related to travel, communication, and meeting expenses, administrative wages, investments in technology, codification of knowledge, the opportunity cost of employee time, etc. The indirect costs reflect the knowledge that is lost or distorted in the process, or that which is not conveyed because it would be too costly. High geographical distance between the different units in the network is likely to aggravate these costs, making the specialized resources in an individual host country environment less valuable to the MNC.

In other words, geographical proximity is an important contingency affecting the feasibility of sourcing diamond components abroad. In markets close to the rest of the organization, and in particularly to the MNC headquarters, such sourcing could be feasible and the MNC would have a strong incentive to locate the necessary competences there in order to facilitate learning. These markets effectively constitute the MNC's enlarged diamond from which to derive competitive advantage, and here we should observe a strong relationship between particular environmental strengths and the competences needed to access them. In more distant markets, conversely, selective sourcing may be prohibitively costly, and the incentives for investing in specialized local competence consequently weaker. These effects are expressed in hypothesis 3:

H3: Geographical proximity to headquarters positively moderates the relationship between the environment and the subsidiary competences.

Resource Contribution

Geographical distance is but one reason a given subsidiary may not be tightly integrated with the rest of the organization, even in cases where it has access to valuable resources. For example, the MNC may already be tapping similar resources in other locations, or it may be based in an industrial cluster in its home country, making an otherwise valuable host country environment redundant. In both cases, the host country environment is likely to be used only as output market, and hence we should expect the subsidiary's perceived resource contribution – the degree to which the rest of the organization depends on the subsidiary's competences – to be low. A subsidiary with low resource contribution is essentially a market-seeking unit – it contributes to the rest of the MNC with revenue rather than with competences. In this type of subsidiary, there is little incentive to invest in specialized competence acquisition, and the link between environment and competence configuration should therefore be weak. In contrast, subsidiaries with high resource contribution could be described as resource-seeking units. In fact, the variable of subsidiary contribution has been used to identify centers of excellence in previous empirical studies (e.g. Frost *et al*, 2002), and Andersson and Forsgren (2000) show that such centers of excellence have higher degrees of external embeddedness than do other subsidiaries. In the diamond network this should be valid for each of the three competence dimensions, as we can see from Figure 1; and a strong relationship between environment and competence configuration is therefore to be expected. In short, the integration of the subsidiary with the rest of the MNC correlates with its learning from the local environment, as reflected by hypothesis 4.

> *H4: The contribution of the subsidiary to the rest of the MNC positively moderates the relationship between the environment and the subsidiary competences..*

Research Design

Data

The data was collected as part of the Centers-of-Excellence project that engaged researchers in the Nordic countries, the United Kingdom, Germany, Austria, Italy, Portugal and Canada (see Holm and Pedersen 2000). The project was launched in May 1996 with the purpose of investigating headquarter-subsidiary relationships and the internal flow of knowledge in MNCs. In order to collect comparable quantitative data on acquisition of subsidiary knowledge, it was decided to construct a questionnaire that could be applied in all the involved countries. This was accomplished after several project meetings and extensive reliability tests of the questionnaire on both academics and business managers.

For practical reasons, each project member was responsible for gathering data on foreign-owned subsidiaries within their own country, thus, all subsidiaries in the database belong to MNCs. One advantage of choosing subsidiary respondents rather than headquarters is that they are directly engaged in the local environment and are therefore more acquainted with its characteristics. Although we may expect any subsidiary to have a reliable awareness and understanding of its own knowledge elements, it would be an advantage to gather information on intra-MNC knowledge flows from other corporate units as well. However, it would be an unmanageable task first to identify the subsidiaries in each country and then to identify the relevant management units in the foreign MNCs.

This paper is based on data from seven countries: Austria, Denmark, Finland, Germany, Norway, Sweden and the UK. All countries are located in the northern part of Europe. The four Nordic countries and Austria are relatively small, while Germany and the UK are among the largest in Europe. Approximately 80 percent of the questionnaires were answered by subsidiary executive officers, while financial managers, marketing managers or controllers in the subsidiary answered the rest. The response rate varied between 20 percent (UK) and 55 percent (Sweden), depending on the country of investigation. The quality of the data is quite high; a general level of missing values was not greater than five percent. The total sample covers information on 2,107 subsidiaries. It comprises all kinds of subsidiaries in all fields of business. The size of the sample is rather similar for the seven countries as it ranges from 202 subsidiaries in UK to 530 subsidiaries in Sweden. The average number of employees in the subsidiaries is 742 and the median is 102.

Measures

The configuration of the environment was measured with several items reflecting the subsidiary manager's perception of the strength of the host country diamond. The competence configuration of the subsidiary consists of perceptual measures of the subsidiary's competence in different value chain activities. Both sets of items were collected using 7-point Likert scales[2], and each item was then assigned to one of the six theoretical constructs discussed above (the proposed three dimensions of both environment and competence). Table 1 lists the two sets of items and inter-item correlations.

*** Tables 1 About Here ***

Geographical proximity is a dichotomous variable taking the value of 1 if the MNC was headquartered in Europe and 0 if it was headquartered outside Europe. Since we cannot observe the overall location pattern of each MNC, we take the location of headquarters as a proxy for the geographical 'center of gravity' of the firm. Of the subsidiaries in the sample, 27 percent had headquarters outside Europe. Finally, resource contribution is operationalized as the degree to which the subsidiary manager perceives the rest of the MNC to be dependent on the competences of the subsidiary. Resource contribution was originally measured on a 7-point Likert scale and subsequently collapsed into a dichotomous variable, where 'low contribution' reflects values of 1-3[3] and 'high contribution' 4-7.

Structural Equation Models

The hypotheses are tested in LISREL models that allow for simultaneous formation of underlying constructs (the measurement model) and also test structural relationships among these constructs (the structural model). First, we perform four different analyses with the same measurement model but with different structural models. These four models are *nested*, allowing an increasing number of relationships among the latent constructs, the validity of which can then be evaluated by comparative χ^2 tests.

Model 1 is the measurement model, where no relationships between the latent constructs are allowed. Model 2 is a highly restricted model with only the three direct paths linking the three diamond components with their respective competence types. A comparison of these two models tells us something about the hypothesized embeddedness of the subsidiaries. In model 3, we allow correlations among the

[2] The competence scales were coded to include 0, which means that a given activity is not performed at all in the host country.

[3] Other cut-off points were tried, but this segmentation had the highest discriminating power when used as a grouping variable in the structural equation models. Incidentally, previous studies have used the same cut-off point as a way of operationalizing the 'center of excellence' construct (e.g. Frost *et al*, 2002). Although the use of cut-off points is always quite arbitrary, it was necessary to create a categorical variable since LISREL models cannot accept interval-scaled variables as moderators.

environment factors as well as among the competence factors. There are specific theoretical reasons for this: Different diamond components are likely to be correlated because of their reinforcing nature (Porter, 1990), and different competences are likely to be correlated because co-location economizes on international transfer costs. Comparing models 2 and 3 enables us to evaluate the validity of these theoretical expectations. Finally, model 4 adds the cross-paths as well to show whether these are significant individually and as a group. In combination, these models and the estimated relationships will enable us to evaluate hypotheses 1 and 2. As we hypothesize a weak impact of the cross-paths, model 3 is the causal model that corresponds most closely to our theoretical framework.

Subsequently, we test the moderating effects of geographical proximity and resource contribution by two group analyses. First, the sample is split into 'low-proximity' and 'high-proximity' subsidiaries and the model is estimated for both sub-samples. Comparing the strength of the direct paths across the two groups allows us to test hypothesis 3. Then the same procedure is applied to compare 'low-contribution' and 'high-contribution' subsidiaries, allowing us to test hypothesis 4.

Validity and Reliability of Measures

The validity of LISREL models is estimated by the validity of the measurement and structural model combined, i.e. by the nomological validity. But before estimating the nomological validity of the model with the causal relations specified, it is important to judge the hypothesized relationships between constructs and items, as well as the convergent validity (homogeneity) and the discriminant validity (distinctness) of the constructs. In Table 3, the constructs are judged by the factor loading for each indicator, measuring the strength of the linear relationships, and the *t*-values, a significance test of each relationship in the model (Jöreskog and Sörbom, 1993). For each construct, one item is set to have an unstandardized loading of 1. Therefore, *t*-values are not reported for that item, and the loadings of the other items are measured *relative* to that item.

*** Table 3 About Here ***

As can be seen in Table 3, the strength of the linearity in the relationship between constructs and items is in most cases relatively strong with standardized factor loadings all above 0.53. We can also conclude that the *t*-values are highly significant, as they are all above 13 (compared to the critical *t*-value of 3.29 at p=0.001).

To see whether the constructs were internally coherent we report several tests of convergent validity in Table 4. First, the reliability of each construct is calculated and we can see that some of the constructs fall slightly below the recommended threshold of 0.70 (Gerbing and Anderson, 1988). This could indicate that these constructs are too heterogeneous in the sense that they contain sub-dimensions not recognized by our theoretical model. However, we could not decompose the constructs further due to our relatively small number of measured items and we therefore have to leave this challenge for future research. Also, when we look at the variance extracted the picture is somewhat better: All constructs are very close to or above the recommended threshold of 0.50. Since the overall fit of the model is acceptable and the sample size is large, we can accept a marginal lack of convergent validity.

From a theoretical point of view it is particularly important to assess discriminant validity, since the multidimensionality of the constructs is a central proposition in this paper. Our theoretical model breaks the national diamond and the subsidiary competence into dimensions that are hypothesized to be conceptually distinct, and discriminant validity is the empirical means of assessing this distinctness. Several measures of discriminant validity were obtained from the data. First, we compared model 3 to a one-dimensional model in which only one broadly defined environment factor was set to influence one competence factor. Model 3 was better (based on a χ^2-difference of 1,202 with 12 degrees of freedom, significant at $p<0.001$), leading us to reject the one-dimensional model. To see if this was a result of the sample size, we also checked the normalized residuals. The one-dimensional model had 36 percent of its normalized residuals above 2.58, indicating a very bad fit to the data, while model 3 was at 13 percent, which is closer to statistical threshold of 5 percent.

Another test of discriminant validity is to test whether the correlations and causal paths between the latent constructs are significantly different from 1 (e.g. Burnkrant and Page, 1982). Constructing 99.9

percent confidence intervals around the correlations and causal paths in model 2, we can confirm that none of them are close to including 1. Finally, Fornell and Larcker (1981) suggest comparing the variance extracted for each construct with the squared correlations or paths between the constructs. Both are given in Table 4, and the variance extracted is clearly the higher of the two values for all constructs. In combination, these tests indicate that the discriminant validity of the six constructs is good.

Model Fit

We assessed the entire model by different goodness-of-fit measures including the χ^2-value, the Goodness of Fit Index (GFI), and the Normed Fit Index (NFI), which are measures of the distance between data and model, i.e. nomological validity (Jöreskog and Sörbom, 1993). Since the nested models have different degrees of freedom, we also looked at the Parsimonious Normed Fit Index (PNFI) which takes this into account. Table 4 presents goodness-of-fit statistics for all eight estimated structural equation models.

*** Table 4 About Here ***

Of the first four models, model 3 fits the data best and is highly significant with a GFI of 0.97 and a NFI of 0.92. The χ^2-value is still both high and significant, which may indicate a problem but is more likely in this case to be a result of the large sample size (Rigdon 1998: 269). Instead, we can use RMSEA, which controls for sample size. At 0.0635 this statistic is within the 'acceptable range' (between 0.05 and 0.08) with 90 percent confidence. Parsimonious NFI is also higher for model 3 than for the other models, indicating good explanatory power per estimated relationship. As mentioned above, an inspection of the normalized residuals in model 3 showed that 13 percent of these were above 2.58, compared to the 5 percent that is statistically justifiable. The item 'Production of Goods and Services' was involved with approximately half of the high residuals. This could indicate that production may not, as hypothesized in our model, always be co-located with research and development – a proposition supported by anecdotal evidence of current off-shoring trends. Future studies should look more closely into this factor and its potential subdimensions.

Because model 3 is superior to the other models, and because it is theoretically grounded, it forms the basis of the two group analyses. The goodness-of-fit statistics for these analyses correspond approximately to that of the main model.

Results

We can test individual relationships between the constructs in the model with *t*-values, and groups of relationships with χ^2-comparisons of the nested models. Figure 4 shows model 3 with standardized factor loadings, causal paths, and correlations.

*** Figure 4 About Here ***

A comparison between the χ^2-values of the nested models (cf. Table 4) indicates that the direct paths added in model 2 are highly significant as a group (χ^2=2,951, p<0.001). From Figures 4 and 5 we can see that they are so individually as well. We therefore confirm hypothesis 1.

The correlations added in model 3 are also collectively significant (χ^2=597, p<0.001). Hence, the fit of the model to the data improves significantly by allowing these correlations, indicating that both the environment and the competence components are internally reinforcing, as expected[4]. This is confirmed by the fact that most of the correlations estimated in models 3 and 4 are significant individually. However, the correlations among the competence factors are clearly weaker than those among the environment factors, indicating that co-location advantages may be less important *within* the individual MNC than it is *between* co-specialized firms.

Finally, the χ^2-values show that the system of cross-paths added in model 4 is insignificant (χ^2=6). This means that restricting the cross-paths to 0 is valid at p=0.05 and lower. The GFI and RMSEA statistics also suggested that model 4 is inferior to model 3, and the PNFI drop rapidly as well when we add the cross-paths. If we look at the cross-paths individually we get a similar result, as only one of them

[4] To see this more clearly, model 4 can be compared to a similar model without correlations (not presented here). This reveals that allowing correlations weakens all the cross-paths, and thus that the indirect causality indicated in such a restricted model is largely spurious. For example, if the market environment reinforces the supply environment, and the supply environment determines the subsidiary's supply competences, the model without correlations would capture this indirect effect and falsely indicate that the market environment actually affects the supply competences.

--the path from technical environment to supply competence--is significant and only at p=0.05. On the one hand, this could suggest that supply competences are more broadly embedded than are technical or market competences. On the other hand, the cross-path from the technical environment is weaker than the direct path from the supply environment. All in all, we can therefore confirm hypothesis 2: The data generally support the idea that subsidiary learning occurs primarily along the three proposed dimensions and not across them.

Table 5 lists the standardized path coefficients for the two group analyses. A comparison of the low-proximity and high-proximity sub-samples shows a clear pattern: All direct path coefficients are stronger and much more significant for the high-proximity subsidiaries. Therefore, we confirm hypothesis 3: Proximity does matter as determinant of local resource acquisition. In fact, for low-proximity subsidiaries, the relationship between environment and competence is very weak, apparently being valid only on the supply dimension. Similarly, the degree of resource contribution reinforces the direct paths in model 6, leading us to confirm hypothesis 4. Still, even for low-contribution subsidiaries the technical and supply paths are quite strong. This could indicate that also some market-seeking units embed those two types of competences, for example to provide locally engineered products based on local components for increased adaptation and fit. However, these types of subsidiaries are likely to be more interested in market *attractiveness* (revenue growth and income) than in market environment *strength* (demanding customers and competition).

*** Table 5 About Here ***

Discussion

In particular, three significant implications can be drawn from this study. First, our results indicate that the strength of the host country environment should be conceptualized and operationalized in a multidimensional way. Environment strength seems to vary along (at least) three distinct dimensions, which are the supply, technical, and market environment, and perhaps even further decomposition is warranted. The industrial cluster view may overestimate the reinforcing nature of the different diamond elements: the data show a correlation, but nowhere near equifinality, between the three environmental dimensions, and the discriminant validity of the three environment factors are high. This tells us clearly that 'unbalanced diamonds' exist and that MNCs need to respond to them in their FDI decisions.

The second important implication of this paper is that subsidiary competences, like the environment, should be seen as multidimensional. This is not a new idea in the literature and the center-of-excellence line of research has brought significant advances in that direction. However, our typology suggests that the dichotomous center-of-excellence distinction may be too coarse, in part because it can be difficult to draw the line between what is a center of excellence and what is not – significant competences may also exist in subsidiaries which are not denoted centers of excellence – but most importantly because it does not capture the actual variety of subsidiary competence configurations. The idea of subsidiary competence configuration captures both the overall competence and the diversity of this competence along three dimensions that are empirically distinct, giving us a more complete picture of subsidiary specialization.

Finally, and tying together the two previous points, the results suggest a link between the configuration of the environment and that of the subsidiary's competences. We have shown empirically that a strong supply environment leads to strong supply competences, technical environments to technical competences, and market environments to market competences – with very weak if any interaction between the three dimensions. This result challenges the industrial cluster view of the evolution of subsidiary competences. We would acknowledge that the presence of an industrial cluster (with a strong supply, technical *and* market environment) may be a sufficient condition for subsidiary competences to arise. We know such clusters exist and we have some tentative evidence of their impact on subsidiary competence. However, industrial clusters need not be a *necessary* condition for subsidiary competence; environments with specialized resources may also be valuable to MNCs, presumably because they can be matched with complementary resources derived from other nodes in the internal network.

Whether or not this is feasible depends in turn on the proximity and the integration of the subsidiary. For example, if the subsidiary's technical environment is advanced *and* located close to the rest of the MNC, it will be attractive to have technical competences there in order to tap into this knowledge and transmit it to other parts of the organization. On the other hand, if these technical resources are located in a distant market, it may not be worthwhile to source them, as the costs of combining this knowledge with that of the rest of the firm would be too high. In a similar argument, if the subsidiary is not integrated with the rest of the MNC, knowledge transfer is difficult and the value of specialized resources is accordingly lower. There could also be some degree of reverse causality: The MNC has a strong incentive to integrate specialized subsidiaries in order to exploit their resources. In any case, the explanation of competences provided here differs from a direct knowledge spill-over explanation in the sense that it emphasizes the role of MNC and subsidiary *incentive* in the subsidiary competence acquisition process. Learning from the environment requires an effort, and such an effort is less likely to take place if this knowledge plays a limited role in the differentiated network of the MNC.

Including proximity and resource contribution as a contingency makes our model sufficiently general to include both Porter (1990) and Ghoshal and Nohria (1997) as special cases. In distant host countries, and in units that are loosely linked to the MNC network structure, specialization is not attractive. This means that the firm is likely to leave such local units to pursue their revenue markets and generate MNC-wide competitive advantage elsewhere, for instance in the home base. In contrast, tightly integrated subsidiaries sufficiently close to one another can effectively constitute an enlarged diamond network from which it is feasible to source selective environmental resources. Hence, this paper mediates in the highly polarized debate between the two 'extreme views' – the industrial cluster school of thought arguing that competitive advantage should be developed in one location, and the differentiated network view arguing for competitive advantage generated by combining resources from a geographically dispersed network. These views rely on different assumptions, and hence each may be valid in its own right *given* the appropriate context. Geographic proximity and resource contribution are two contextual variables that, apparently, have a strong influence on the relative predictive power of the two theories.

While the complex relationship between host country environments and subsidiary competences is still an area of uncharted territories, this study highlights some directions for further investigation. Most importantly, our findings point to the need for further efforts to explore the multidimensional nature of Porter's (1990) diamond model. The relatively weak convergent validity of our constructs indicates that future studies should theorize toward an even more fine-grained and multidimensional model of environment strength and subsidiary competence, and that more comprehensive set of measurement items should be obtained. Also, whereas Porter's industrial clusters are defined by their export propensity, this study has used perceptual measures of individual diamond elements to predict subsidiary competences. A more direct approach that combines the benefits of these two approaches would be to derive objective measures of the individual diamond components, for instance using well-established measures of competitive intensity, local research activity, etc.

As a contribution to the literature on subsidiary-specific advantages, the prime focus of this paper has been on the evolution of subsidiary competences. An equally important question, however, is how these competences in turn influence the role played by the subsidiary in the larger context of the MNC. In particular, the model presented here strongly implies that the configuration of subsidiary competence is related to the knowledge flows within the MNC network, and that specialized subsidiaries should be both recipients and senders of such knowledge. We touch upon this aspect with our group analysis on resource contribution. However, further testing of the diamond network model with an emphasis on the flows rather than the stocks of resources could be useful in this respect.

'Modern' MNCs are often asserted to be transforming themselves into networks of specialized, interdependent units operating across borders. Yet we still have few means of measuring this specialization, and little knowledge about what drives it. This paper has attempted, based on the diamond network model of Rugman and Verbeke (1993), to fill this research gap. In particular, we posit that host country diamond heterogeneity – the presence of unbalanced diamonds – may lead MNCs to locate specialized competences in host countries in order to access complementary knowledge. A multidimensional specification of both environment strength and subsidiary competences may enable us to capture the richness of these links in a better way than a one-dimensional specification can.

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Figure 1 – The MNC as a Diamond Network

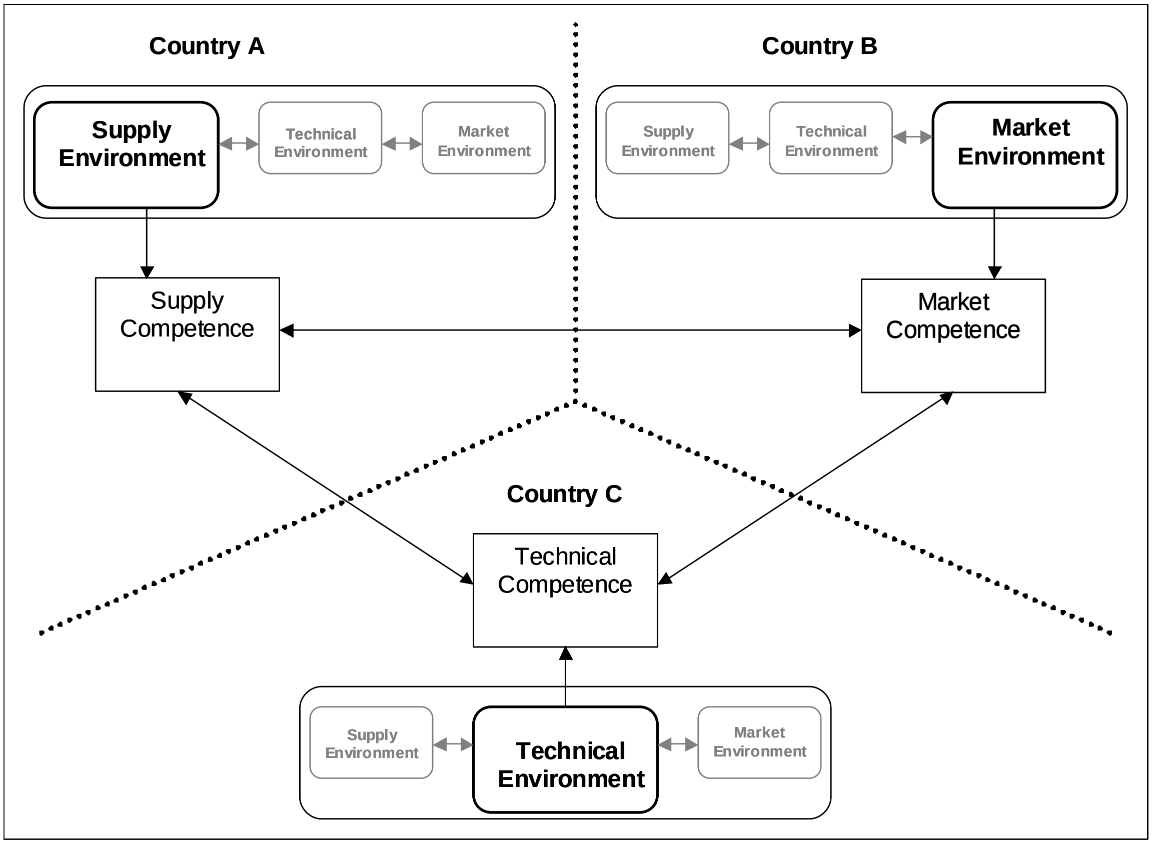


Figure 2 – Causal Model and Hypotheses

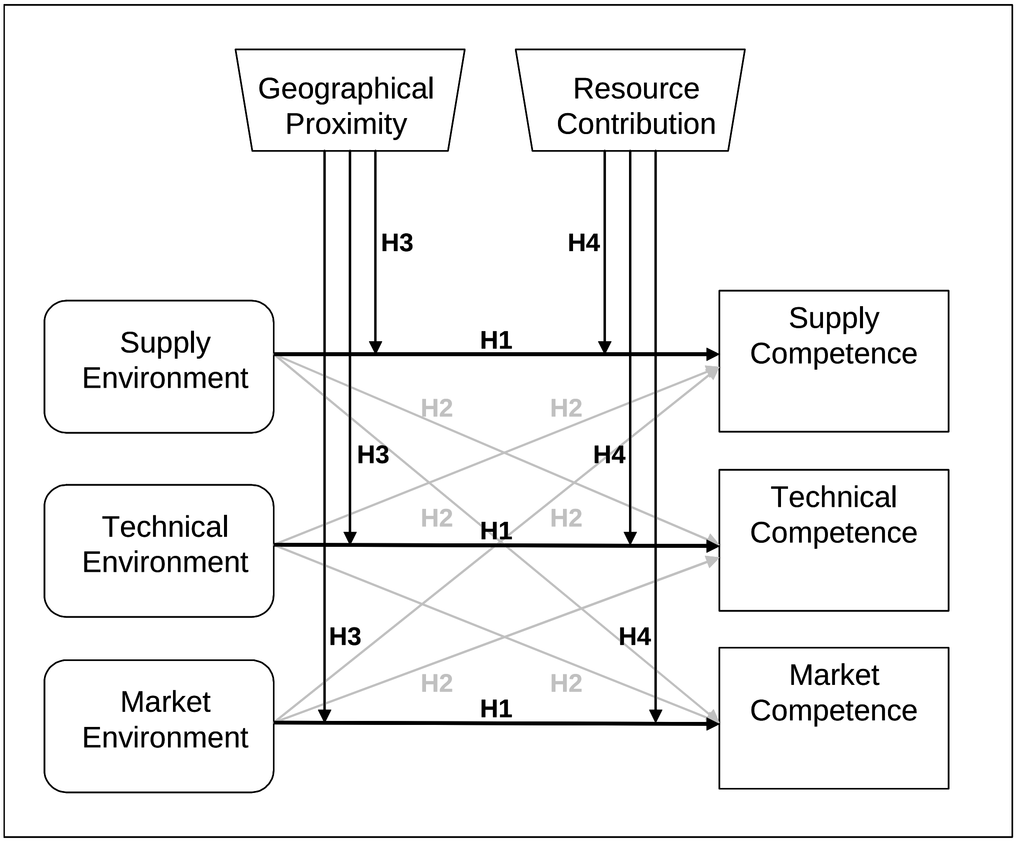
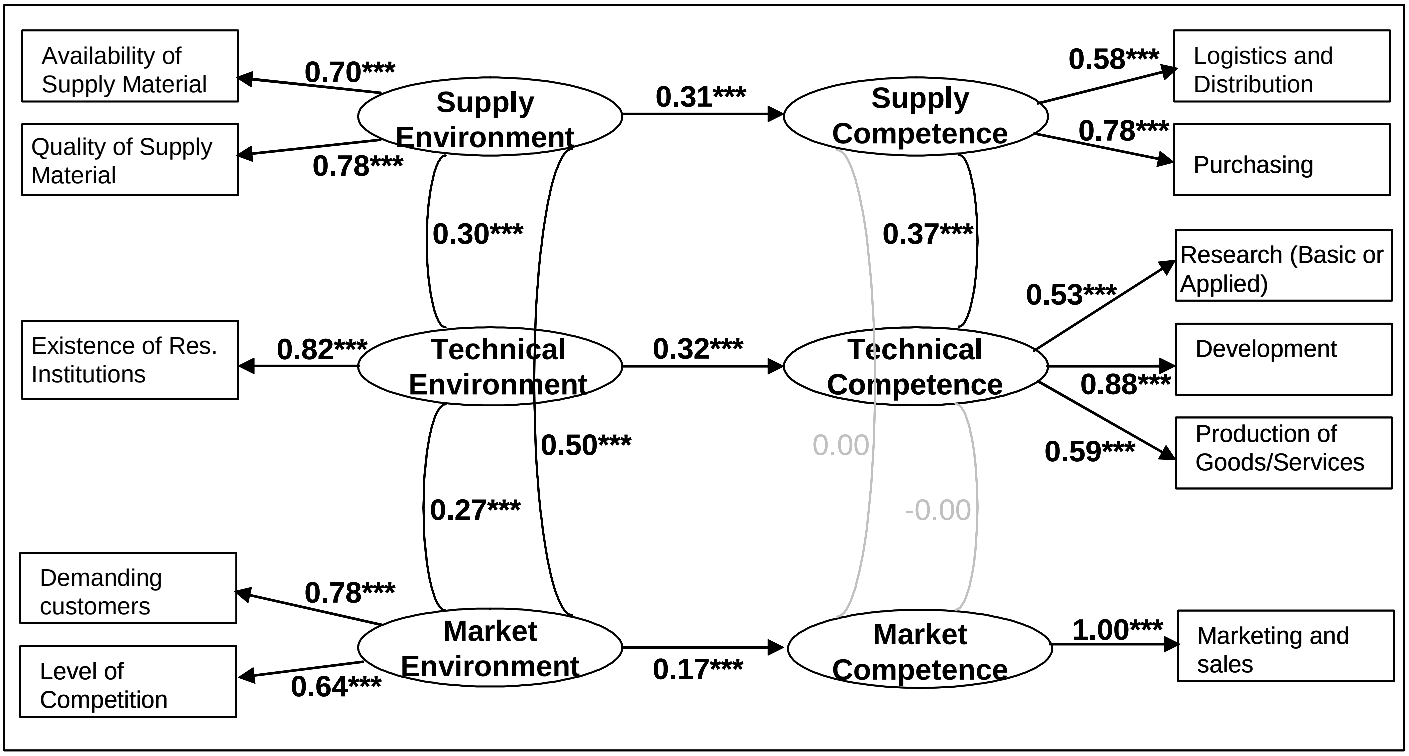


Figure 3 – Structural Equation Model (Model 3)



* Significant at p<0.05.
** Significant at p<0.01.
*** Significant at p<0.001.

Table 1 – Measured Items and Correlations

Variable	1	2	3	4	5	6	7	8	9	10
Supply Environment										
1. Availability of Supply Material	-									
2. Quality of Suppliers	0.56**	-								
Technical Environment										
3. Existence of Research Institutions	0.22**	0.15**	-							
Market Environment										
4. Demanding Customers	0.23**	0.34**	0.16**	-						
5. Level of Competition	0.21**	0.23**	0.16**	0.52**	-					
Supply Competence										
6. Logistics and Distribution	0.12**	0.13**	0.08**	0.10**	0.10**	-				
7. Purchasing	0.18**	0.16**	0.10**	0.10**	0.06**	0.21**	-			
Technical Competence										
8. Research (Basic or Applied)	0.03	0.02	0.25**	0.03	0.02	0.06**	0.14**	-		
9. Development	0.07*	0.04	0.22**	0.09**	-0.01	0.12**	0.27**	0.48**	-	
10. Production of Goods or Services	0.15**	0.07**	0.15**	0.09**	0.03	0.12**	0.31**	0.22**	0.51**	-
Market Competence										
11. Marketing and Sales	0.04	0.04	0.01	0.08**	0.11**	0.30**	0.48**	0.01	0.03	-0.05*

* Significant at p<0.05.
** Significant at p<0.01.

Table 3 – Factor Loadings in Measurement Model

Constructs and items	Loading*	*t***	Construct Reliability	Variance Extracted	(Highest C/P)^2
Supply Environment			0.71	0.55	0.25
Availability of Supply Material	0.70	16.7			
Quality of Supply Material	0.78	-			
Technical Environment			0.67	0.67	0.10
Existence of Research Institutions	0.82	-			
Market Environment			0.67	0.51	0.25
Demanding Customers	0.78	-			
Level of Competition	0.64	13.7			
Supply Competence			0.64	0.47	0.14
Logistics and Distribution	0.58	13.3			
Purchasing	0.78	-			
Technical Competence			0.71	0.47	0.14
Research (Basic or Applied)	0.53	17.3			
Development	0.88	-			
Production of Goods or Services	0.59	18.3			
Market Competence			1.00	1.00	0.03
Marketing and sales	1.00	-			

* Standardized factor loadings
** All *t*-values are highly significant at $p < 0.001$ (requires *t*-values above 3.29).

Table 4 – Goodness-of-Fit Statistics

Model	Description	N	χ^2	df	GFI	NFI	RMSEA	PNFI
1	Measurement Model	1936	3848*	50	0.70	-	0.2009	-
2	With Direct Paths	1936	897*	41	0.92	0.77	0.1054	0.57
3	With Direct Paths, Correlations	1936	300*	35	0.97	0.92	0.0635	0.59
4	With Direct Paths, Correlations, Cross-paths	1936	293*	29	0.97	0.92	0.0696	0.49
5a**	Low-Proximity Subsidiaries	514	98*	35	0.97	0.91	0.0603	0.58
5b**	High-Proximity Subsidiaries	1421	261*	35	0.97	0.91	0.0684	0.58
6a**	Low-Contribution Subsidiaries	820	155*	35	0.97	0.90	0.0653	0.57
6b**	High-Contribution Subsidiaries	1106	171*	35	0.97	0.92	0.0605	0.59

* All χ^2 values are significant at $p<0.001$.
** Models 5 and 6 resemble model 3, i.e. they include direct paths and correlations.

Table 5 – Moderating Effects of Proximity and Contribution

Model	Description	Direct Supply Path		Direct Technical Path		Direct Market Path	
		B	***t***	***β***	***t***	***β***	***t***
5a	Low-Proximity Subsidiaries	0.26	4.39***	0.25	2.02*	0.05	1.13
5b	High-Proximity Subsidiaries	0.33	8.03***	0.36	3.15***	0.15	4.78***
6a	Low-Contribution Subsidiaries	0.27	5.14***	0.13	1.30***	0.09	2.19*
6b	High-Contribution Subsidiaries	0.35	7.56***	0.34	3.23***	0.15	4.30***

All Betas are standardized path coefficients.
* Significant at $p<0.05$.
** Significant at $p<0.01$.
*** Significant at $p<0.001$.

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