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Abstract

The IB literature informs us of several ways to measure firms' degree of internationalization. In this paper we make the argument that in fact none of the existing indices really measure firms' degree of "global specialization", that is, to what extent their allocation of resources is multidomestic or global. As argued, all the existing measures may gauge a purely multidomestic firm as having a high degree of internationalization, whereas a truly global firm may be ranked low. In order to remedy this we introduce a complementary index measuring how firms are configuring their value chains – whether they are replicating value chain activities from country to country or locating them in globally specialized units in order to exploit an international division of labor. In addition to mathematical modeling and numerical examples, we examine the relevance of the new index of global specialization on data of Danish MNCs by looking at the correlation between the new global specialization index and existing indices of firms' degree of internationalization. We find that the index is able to identify a distinct group of firms with significantly higher degrees of global value chain configuration.

Key words*:* Internationalization, value chain, global configuration.

JEL Codes: F02, F23, L22, L23

HOW DO WE CAPTURE "GLOBAL SPECIALIZATION" WHEN MEASURING FIRMS' DEGREE OF INTERNATIONALIZATION?

1. Introduction

What is meant by the internationalization or globalization of firms and how do we measure the phenomenon? The questions have roused the curiosity of most IB scholars and the many different answers found in the literature indicate that there are no simple answers. Measuring the internationalization of multinational corporations (MNCs) may have a phenomenalistic justification of its own (see e.g. Benito and Welch, 1997), but usually, measurements are made in order to establish the interrelationship between the degree of internationalization and financial performance (see e.g. Stopford and Dunning, 1983; Daniels and Bracker, 1989; Geringer *et al*, 1989). For that purpose, firms' foreign sales as percentage of their total sales have been widely used (Sullivan, 1994), and – to a lesser extent – the proportion of foreign to total assets and of foreign to total employees (Geringer *et al*, 1989). Since these dichotomous (home vs. abroad) internationalization indices do not capture the spatial spread of the foreign activities, IB scholars (e.g. Ietto-Gillies, 1998; Fisch and Oesterle, 2003) have developed various spread/diversity indices to supplement dichotomous indices. In combination, the dichotomous and spread/diversity internationalization indices are good indicators of how expansive firms are in terms of generating revenue outside their home market, and also in terms of measuring physical presence and magnitude of value added activity outside the firm's home country. Moreover, the data requirements of these types of measures are moderate:

most often, researchers can compile the needed data from secondary sources, such as industry directories and annual reports.[1]

However, the dichotomous and spread/diversity measures are of little help if one wants to establish to which degrees firms are following multidomestic or global strategies (Porter, 1986; Prahalad and Doz, 1987; Bartlett and Ghoshal, 1989). This is regrettable inasmuch as the integration/responsiveness discussion is pivotal in the current international management literature. The renewed interest in global sourcing has further exposed the inadequacies of the dichotomous and spread/diversity measures separately or combined, since in reality they are completely insensitive to how firms configure their global value chains and hence fail to capture one important aspect of globalization. This dimension, which could be called "global specialization", is the degree to which MNCs exploit different location-specific advantages through international division of labor, by letting geographical units specialize and become global suppliers of different activities within the internal network of the MNC. The ability to do this has long been recognized as one of the inherent advantages of internationalization (Dunning, 1980; Hedlund, 1986; Prahalad and Doz, 1987). A high degree of international division of labor creates a need for coordination of cross-border flows of products, services and knowledge; hence it is likely to be an important (but until now largely unmeasured) characteristic of global companies.

So what does it take to capture firms' degree of global specialization? First of all, one has to shift the level of analysis. In order to establish to what extent an international division of labor prevails within an MNC, it is necessary to take the individual value added activity as the basic unit of analysis – instead of firms'

[1] As will be accounted for later, the international orientation of managers makes up a third type of internationalization measures with somewhat tighten data requirements.

activities as a whole, as in the case with the dichotomous and spread/diversity measures. To clarify, it might be useful to make parallels to concepts in international economics. The macro-analogy to division of labor within a corporation are the measures of degrees of international division of labor among countries. In the absence of international trade, all the products and services in local demand have to be produced in the individual country, which thereby constitutes an autarchic economy. As export and import evolves, countries tend to specialize in certain industries; in other words, absolute and comparative advantages of international trade are achieved (Smith, 1776; Torrens, 1815; Ricardo, 1817). If we for a moment make the preposterous assumption that the world economy was comprised by one gigantic MNC, the subsidiaries of this corporation would resemble countries, and value added activities of the subsidiaries would correspond to industries or business sectors. Like an autarchic national economy with a full range of (presumably very inefficient) industries, a self-sufficient subsidiary would replicate all activities of the value chain of the MNC. Expressed in a parent-subsidiary terminology, the subsidiary would constitute a (mini-) replica of the parent, and the MNC as a whole would follow a multidomestic strategy[2].

From the above it should be clear that we cannot expect to capture the extent to which firms engage in global specialization – or, in Porter's (1986) terms, configure their value chains globally – *unless* we introduce the individual value added activity as the basic unit of analysis. Since the ambition of this paper is to capture the global specialization dimension, we will demonstrate by the use of mathematical modeling,

[2] Whether or not such a multidomestic strategy is optimal for an MNC is contingent on many factors, including transportation costs between countries, factor endowment/cost differences, as well as scale and scope economies. However, this is not the subject of our discussion (instead, see Porter, 1986; Prahalad and Doz, 1987; Bartlett and Ghoshal, 1989).

numerical examples, and preliminary empirical evidence how this can be done in practice.

The balance of the paper is organized in the following way: In the next (second) section we review the existing indices of firms' degree of internationalization offered by the IB literature and point out the strengths and weaknesses of the various indices. In section three we develop a new global specialization index that supplements existing ones in terms of capturing the degree to which an MNC is pursuing global specialization and integration among its affiliates. Section four accommodates preliminary empirical evidence (derived from data of Danish MNCs) of the correlation between our new global specialization index and existing indices of firms' degree of internationalization. Section five concludes and suggests further avenues of research.

2. A review of existing internationalization indices

The IB literature informs us of several ways to index firms' degree of internationalization. Although existing indices vary considerably in terms of sophistication, data requirements, internationalization aspect emphasized, etc. the indices are composed of one or several of the following three dimensions: (1) Firms' distribution of assets, employees, etc. between the home country and foreign countries as a whole, usually referred to as dichotomous measures; (2) Spread measures, i.e. firms' spread of assets, employees and/or activities across countries and cultures; (3) psychological or mental measures, i.e. international orientation of employees, in particular management. Some indices, such as the UN's (UNCTAD's) index of transnationality, are based on a unidimensional measure (namely a dichotomous measure), whereas others are multidimensional (or composite) indices including

several of the above-mentioned measures. In this review we first outline existing uni-dimensional (although not necessarily single-item) internationalization indices as offered by extant IB literature. In the second part of the review we outline multidimensional, or composite, internationalization indices, i.e. indices comprising two or three of the abovementioned dimensions. Thirdly, we account for a theoretical construct that is essential when developing our new index, namely Porter's (1986) global value chain configuration framework.

Unidimensional indices

The most simple – and widespread – internationalization indices are the dichotomy measures. Dunning and Pearce (1981) developed a widely-used unidimensional index based on companies' sales. Sullivan (1994) in his overview of internationationalization indices presented a list of 16 studies relying solely on the ratio of foreign sales to total sales. Reeb *et al* (1998) use the same sales ratio. Chen *et al* (1997) use the ratio of foreign pre-tax income to total pre-tax income. Other possible dichotomy measures are the shares of foreign employees, profits, value added, or shareholders. In their literature overview study Nguyen and Cosset (1995) investigate the properties and interrelatedness of single internationalization measures. Since 1995 UNCTAD has published (in its annual World Investment Reports, see e.g. UNCTAD, 2004) internationalization measures of foreign assets, sales and employees of the 100 largest companies in the world. UNCTAD's "transnationality index" weights the percentage of these three measures.

There are two obvious limitations of such dichotomous home-versus-foreign measures: First, the measure is less suitable for cross-country comparisons, i.e. comparisons of firms domiciled in different countries of varying size. All else being

equal, dichotomous measures will assign multinationals of larger countries (like US multinationals) with a lower degree of internationalization because the domestic market – e.g. USA – makes up an important part of the world economy. In contrast, many Swedish multinationals will experience Sweden to be of minor importance in terms of sales, assets, and even employees. Second, dichotomous measures do not capture the spatial spread of the foreign activities. In other words, e.g. a US firm with 50 percent sales in Canada will be gauged as being just as international as a US firm with 50 percent sales scattered over a broad range of countries in different continents.

As a consequence of these deficiences, IB scholars have developed various spread/diversity measures to supplement, and remedy the shortcomings of, dichotomy measures. These range from the very simple – e.g. the number of countries in which the MNC has subsidiaries (Tallman and Li, 1996) – to the more advanced entropy-based measures (Hirsch and Lev, 1971; Miller and Pras, 1980; Hitt *et al*, 1997). The latter type of index increases in both the number of countries spanned *and* the spread of the distribution across those countries, and is therefore better at capturing international diversification. Still, it could be argued that a truly globalized firm would disperse its sales not evenly among its countries but rather in proportion to World GNP. Building on that idea, Fisch and Oesterle (2003) compare the global spread of large German companies to that of the world economy itself, on a scale from 0 to 1. They find that there is still plenty of room for further internationalization – even for these, in relative terms, highly internationalized companies.

The obvious advantage of these two categories of unidimensional indices - i.e. the dichotomy and spread/diversity measures – is the relative ease by which the required data can be accessed. The indices operate with information from databases with open access and are therefore directly applicable to researchers and company

managers as well. This property allows for large sample sizes and comparisons over the course of time, and between companies, can be done with ease. All in all, unidimensional indices cause few obstacles in empirical research (Fisch and Oesterle, 2003).

A third category of unidimensional measures, the international orientation of company employees, in particular managers, does not have the advantage of easy data availability. Only to a limited extent are secondary data available, such as information about the personal records (including international experience) of managers and board members. Usually, primary data have to be retrieved through surveys and/or personal interviews. In his classical study of international orientation of US managers Perlmutter (1969) distinguished between managers of etnocentric, polycentric, and geocentric orientation. Later on Perlmutter, together with Chakravarthy (Chakravarthy and Perlmutter, 1985) added a fourth, regiocentric orientation. Although widely used in many IB-contexts, the EPRG-paradigm is less suitable for unidimensional internationalization indices inasmuch as the four management orientations do not lend themselves easily to scaling: in other words, it is difficult to establish to what degree a geocentric oriented manager is more international than a polycentric. As a consequence, more mundane – but scaleable – measures, such as years of international experience, are used.

Multidimensional indices

In his well-known multidimensional internationalization index Sullivan (1994) chose five variables to measure internationalization. These are (i) the foreign sales as a percentage of total sales, (ii) the overseas subsidiaries as a percentage of total subsidiaries, (iii) the foreign assets as a percentage of total assets, (iv) the psychic

(cultural) dispersion of international operations, and (v) top managers' international experience. All indicators are calibrated from zero to one, receive equal weights, are summed up, and result in a degree of internationalization that happens to be a number in the interval of [0, 5]. Hence, Sullivan's index comprises elements of all three dimensions: dichotomous, spread/diversity, and management orientation.

The multidimensional index by Ietto-Gillies (1998) attempts a combination of the dichotomous measure (as used by UNCTAD) and a spread measure. More specifically, Ietto-Gillies multiplies the foreign assets, sales, and employees ratios with the percentage of the world's 178 countries in which the respective MNC owns subsidiaries. As such, Ietto-Gillies does not take into account cultural diversity in her index. The two dimensions are weigthed equally. Germann *et al* (1999) and Hassel *et al* (2000) do not aggregate their three indicators of internationalization. They keep the percentage of foreign revenues and employees and a categorization of the international spread separately in so-called 'bundles' of internationalization indicators.

Even though there may be few obstacles to measure more than one dimension of internationalization, the challenge is to derive compact conclusions from multiple sets of numbers. As an example, Ramaswamy *et al* (1996) express severe criticism about Sullivan's (1994) approach arguing that the dubious step is adding up completely different aspects of internationalization to a common index score. The same can be argued in relation to Ietto-Gillies' index.

Porter's global value chain configuration construct

Most of the indices reviewed above are somewhat detached from theoretical constructs of firm globalization. An important such construct is Porter's (1986)

activity configuration dimension, which ranges from "dispersed" – the mini-replica case – to "concentrated", as in the case of the global firm. In the process of testing this framework, a few empirical studies have introduced measures of international division of labor (Roth *et al*, 1991; Roth, 1992). However, we still lack a sufficiently fine-grained index of globalization at the corporate level, for two reasons. First, the existing studies use binary measures of activity-level concentration (i.e. is the activity performed in only one or in multiple countries), thus pooling all intermediate levels of dispersion and concentration. Second, we run into problems if we want to aggregate these activity-level measures to obtain a corporate-level measure of firm globalization as originally conceptualized by Porter. For one, how do we weight the different acitivities? Another question is how to distinguish empirically between a firm centralizing many activities in the same country, and a firm that centralizes each activity in a different country. We cannot make this distinction without asking *where* each activity is located and looking at the entire configuration of the firm as a whole. The index proposed in this paper is arguably a more direct measure of Porter's configuration dimension, since it is defined at the corporate level, it is activity-weighted by design, and it measures international division of labor rather than just the concentration of individual activities.

3. Developing a global specialization index

As the literature review has shown, the terms "internationalization," "globalization", "international diversification" and "multinationality" are often used interchangeably. However, the way we define these theoretical constructs have dramatic consequences for how we measure them, and for what purpose. Globalization seems to be a stronger word than internationalization and should therefore be defined as a higher-order

construct. Specifically, we posit that globalization can be broken down into two dimensions: internationalization and global specialization. *Internationalization* pertains only to the geographical scope of the firm' activities, ranging for example from national over regional to global, while *global* s*pecialization* captures the international division of labor *given* that scope. A truly globalized firm – i.e. a firm with a global supply chain – would have to be both global in scope *and* globally specialized. Whereas these two dimensions are often not separated in any explicit way in extant definitions of "global strategies", our model allows us to distinguish between them theoretically and empirically. Since the internationalization dimension can be measured by existing indices, we will focus on how to measure the global specialization dimension here.

Let G denote the global specialization of a single firm, defined as the international division of labor – independently of the geographical spread of that firm – on an interval [0,1]. A firm with index 0 has no division of labor, which means that each geographical unit is a mini-replica of the firm itself, duplicating all activities in the exact same proportion. An index value of 1, on the other hand, is the extreme of *complete* division of labor, where duplication is eliminated and each activity performed in only one geographical area, divided evenly across the firm's geographical scope.

Assume that we are given a measure of the firm's activity volume segmented by value chain activity (e.g. R&D, manufacturing, sales, etc.) and geographical area (for instance split by country or region). This information is written in a *volume matrix*, $\mathbf{V} = \left[v_{ij}\right]$, where v_{ij} is the volume of activity i in area j. This could be measured as the number of employees, the value of assets, or some other proxy for the size of activity i in area j. Assume that the firm reports a total of I value chain activities and J

geographical areas. For now, we take these for given; later we will explore what happens if we change the segmentation of activities and/or expand the number of geographical areas reported by the firm.

The global specialization index (G) is a measure of the international division of labor implied by the configuration of the firm's volume matrix. The following terms must be calculated to transform **V** to G:

$$\mathbf{a} = [a_i], \text{ where } a_i = \sum_{j=1}^{J} v_{ij} \Big/ \sum_{i=1}^{I}\sum_{j=1}^{J} v_{ij} \qquad \textit{Activity Weights} \quad [1]$$

$$\mathbf{S} = [s_{ij}], \text{ where } s_{ij} = \frac{v_{ij}}{\sum_{j=1}^{J} v_{ij}} \qquad \textit{Activity Shares} \quad [2]$$

$$\underset{1\times J}{\mathbf{w}} = \underset{1\times I}{\mathbf{a}} \times \underset{I\times J}{\mathbf{S}} \qquad \textit{Weighted Average Shares} \quad [3]$$

$$\mathbf{Q} = [q_{ij}], \text{ where } q_{ij} = (s_{ij} - w_j)^2 \qquad \textit{Squared Differences} \quad [4]$$

$$\underset{1\times J}{\mathbf{r}} = \underset{1\times I}{\mathbf{a}} \times \underset{I\times J}{\mathbf{Q}} \qquad \textit{Area-Level Weighted Variances} \quad [5]$$

$$T = \left(\underset{1\times J}{\mathbf{r}} \times \underset{J\times 1}{\mathbf{1}'}\right) \qquad \textit{Total Weighted Variance} \quad [6]$$

$$G = \left(\frac{J}{J-1}\right)T \qquad \textit{Global Specialization index} \quad [7]$$

Deriving the *activity share* matrix **S** in Equations [1] and [2] is the most important step towards calculating the global specialization index and deserves some elaboration. **S** shows, for each geographical area, how large a share of each activity is located in that area (e.g. how large a percentage of the firm's total manufacturing workers are located in Ireland). The heterogeneity of this matrix gives an important indication of the degree of international division of labor. Consider the two extremes

analyzed in Equations [8]. The matrix values are hypothetical examples of measured activity volume; for instance, it could be the number of employees performing the three value chain activities in three different countries.

$$\mathbf{V}=\begin{bmatrix}12 & 6 & 9\\ 8 & 4 & 6\\ 12 & 6 & 9\end{bmatrix} \Rightarrow \mathbf{S}=\begin{bmatrix}0.44 & 0.22 & 0.33\\ 0.44 & 0.22 & 0.33\\ 0.44 & 0.22 & 0.33\end{bmatrix}$$
$$\Rightarrow \quad \mathbf{r}=\begin{bmatrix}0 & 0 & 0\end{bmatrix} \Rightarrow \quad G=0$$

[8]

$$\mathbf{V}=\begin{bmatrix}12 & 0 & 0\\ 0 & 12 & 0\\ 0 & 0 & 12\end{bmatrix} \Rightarrow \mathbf{S}=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}$$
$$\Rightarrow \quad \mathbf{r}=\begin{bmatrix}0.22 & 0.22 & 0.22\end{bmatrix} \Rightarrow \quad G=1$$

In the first example, each geographical unit is a mini-replica having a fixed share of *all* the activities of the firm (equal to 44%, 22%, and 33%, respectively, for the three areas here). This means that each area vector of **S**, i.e. the column vector of activity shares for a certain geographical area, is completely homogenous with the same value for all activities. In the second example, conversely, each activity is performed in a different location. In that case an area vector of **S** is highly heterogeneous, since it contains a 1 for the locally performed activity and 0's for all off-shored activities.

The point of these examples is to show that the heterogeneity, or variance, of the area vectors in **S** captures the international division of labor: highly heterogeneous area vectors imply a high degree of global specialization. If one location hosts a very high share of some activities and a very low share of others, it is likely to be because of this geographical unit "importing" some activities (those with low shares) and "exporting" others (those with high shares). This implies a high degree of international division of labor and will result in a high variance. Hence, the operations

performed on the matrix **S** in Equations [3] through [7] correspond to taking the weighted variance of each area vector (these variances go into the vector **r**), and adding them to obtain a total weighted variance measure *T*. Finally, the sum of area-level variances, *T*, is multiplied by *J/(J-1*) to arrive at the global specialization index *G*.

The global specialization index thus computed has several important properties that will be discussed in the following.

Robust to Arbitrary Activity Splits

The identification of value chain activities in an industry is to some extent subjective and is likely to differ from firm to firm. Some firms may report R&D as one activity, for instance, whereas others distinguish between research and product development. This type of sub-segmentation does not in itself affect the global specialization index, however, as long as the new sub-activities and the original activity have the same country distribution. This is because the index measures *weighted* variance, so that the two new activities together carry the same weight as the original activity did. See Appendix I for a formal proof of this property. Of course, if we split an activity and it turns out that the two new activities have *different* area distributions, the index will change. In that case, however, the original activity segmentation was clearly too aggregated to give an accurate indication of the degree of globalization, and *G* should and will respond to the new information made available.

Range [0,1]

The global specialization index can never be negative or larger than one. The two hypothetical examples in Equations [8] are in fact the value-minimizing and -

maximizing configurations, respectively, for J=3. A firm that duplicates all activities from country to country in the exact same proportion gets G=0; a firm which concentrates and distributes activities evenly across its geographical scope gets G=1; and most firms will lie somewhere between 0 and 1 depending on which of these two extremes it comes closest to[3]. For a more general proof of this property, see Appendix II.

Relative to Geographical Spread.

The global specialization index describes the extent to which labor is divided *within a given scope of geographical areas.* Hence, to put this number into perspective it should always be reported along with the number of geographical areas measured. To have complete division of labor between 2 countries is of course not as daunting an achievement as having complete division of labor between 50 countries; although both cases would give a index value of G=1 if we allow J to vary with the global "spread" (geographical extension) of the firm's activities. This is because G controls for the number of areas J to give a measure that captures exclusively the degree of spatial division of labor, independently of the geographical scope of the firm. This scope is already captured by existing measures (e.g. Fisch and Oesterle, 2003) and G is designed to be complementary to, not overlapping with, those measures.

To put this more formally, a firm with complete international division of labor across its z countries of operation will get a value of G_z=1, if and only if measured in

[3] The requirement of even area distribution is a point of commonality between our measure, G, and the entropy measure of internationalization, here denoted E. For a given number of areas n, the configuration that maximizes G (at 1) will also maximize E (at log n), since both measures share this requirement. However, while an even area distribution is the *only* requirement for E to be maximized for a given number of areas, we must also have concentration of individual value chain activities for G to be maximized. Hence, a configuration that maximizes E may or may not maximize G; in fact it can have a value of G anywhere between 0 and 1. Referring to the distinction between global specialization and internationalization, we may be able to say that a firm with high entropy is highly internationalized, but we cannot say whether it is so in a global or a multidomestic way.

these z countries. The same firm, measured across $J=z+y$ countries (where y of these countries are hence empty), will only get a value of $G_{z+y}=1-y/(z(y+z+1))$. It can be shown that $0<G_{z+y}<1$ (see Appendix III) and $dG_{z+y}/dy=(1-z)/(z(z+y-1)^2)<0$ for all $z>1$. In words, as we add empty countries to the measured volume matrix, the potential degree of globalization (i.e. the maximum value of G) decreases from 1.

This property means that the index is well suited to combine with existing indices in an overall evaluation of the globalization of the firm. However, if we do want one single measure capturing simultaneously geographical spread and division of labor, we can fix the number of measured geographical areas *independently* of the firms' actual global spread when we calculate G. If we want to compare firms in a given sample, this may be a good solution. For instance, we could include all countries in a certain region to measure the respondent firms' degree of globalization within that region. Those firms present in only a few of the pre-specified countries would then get low scores even if they had a high degree of division of labor, and only firms combining high spread with high division of labor could get a value close to 1. In fact, this is the approach used in the empirical section of this paper.

In combination, these theoretical properties tell us something about the robustness of the global specialization index – about its expected behavior under different sampling and measurement contexts. However, the usefulness of the index is ultimately an empirical question. In the next section we provide the results of the first attempt to measure it with real data.

4. Global specialization of Danish MNCs – some preliminary results

The main purpose of this section is to explore how the global specialization index correlates with existing measures of firm's internationalization. If the observed

variance in *G* could be largely explained by more simple indices – such as the ratio of foreign to total employees – the index would add little new to our existing ability to measure internationalization. On the other hand, if the correlation is small, the index truly captures something omitted by traditional indices. After a brief description of the data set used here, we will therefore test the extent of such a correlation, and whether it is stable over time. Finally, to give some qualitative meaning to these results, we will use cluster analysis to see if the global specialization index can be combined with traditional indices in a multidimensional taxonomy of firm globalization.

Data

The data set is based on two surveys conducted in 1998 and 2003 to track Danish firms' international expansion activities. Using Denmark as a sample has certain advantages, in that the small size of the country forces Danish companies to go international at rather early stages in their lifecycle. Therefore, a large proportion of Danish companies has international operations and is exposed to the problems of international expansion.

In order to increase the response rate, the data were collected in collaboration with the Federation of Danish Industries. A questionnaire was formulated in autumn 1997 (and again in autumn 2002) and after carrying out two test interviews the initial mailing occurred in February 1998 (February 2003). The base sample was comprised of members of the Federation of Danish Industries operating foreign subsidiaries. These 420 firms (362 firms) operated foreign subsidiary activities including sales, service, and production. We estimate that these firms account for approximately three fourths of the international value added activities of all Danish firms.

Questionnaires were mailed personally to each company's CEO. These

CEOs or other top executives completed most questionnaires. A reminder was mailed two months after the initial mailing. Upon this follow-up procedure the number of replies usable for data processing reached 176 (77), corresponding to a 42 (22) per cent response rate.

Measures

The items used to calculate the global specialization index were derived from several questions: (1) The total number of employees in the firm, (2) the number of employees in each of five pre-specified value chain activities[4], and (3) for each value chain activity, the percentage of employees located outside Denmark. Based on these numbers, a (I=5, J=2) volume matrix can be calculated, specifying the number of employees performing each activity in Denmark and abroad. Using the employee distribution as a proxy for activity volume has the advantage that it is more unambiguously measured than, for instance, assets or turnover. Also, location of employees is likely to be highly correlated with location of assets and with local activity volume.

The global specialization index was calculated by applying Equation [1] to the derived volume matrix, and the resulting G-values compared with the total ratio of foreign to total employees for each firm. Using our previous distinction, the latter value will henceforth be called "internationalization" and denoted I.

Results

Table 1 reports the correlation statistics between G and I for the two data sets (1998 and 2003) as well as for the consolidated data set with both surveys.

[4] The five value added activities were: (1) Production of goods and services, (2) R&D and design, (3) Sales and marketing, (4) Purchasing and logistics, and (5) Management, administration, HR, and IT.

Table 1 About Here

The results indicate that the two measures are correlated. However, the small sample size of the two surveys limit the power of the tests, and in the 1998 sample the correlation is not statistically significant. Only in the consolidated data set is the correlation highly significant. Of course, consolidating the two surveys may invalidate the results if the degree of globlization or the relationship between internationalization and globalization changed between 1998 and 2003. Therefore, to test for the stability of the relationship, several regressions were run on the consolidated samples, with *G* as the dependent variable and *I*, *Y* (a dummy variable distinguishing between the 1998 and 2003 surveys), and $I \times Y$ as independent variables in different combinations. In all cases, the coefficients involving *Y* turned out to be insignificant. From this we conclude that the apparent change between the 1998 and 2003 correlations was insignificant and that we can therefore consolidate the two samples for further analysis.

Although the consolidated correlation is highly significant, the value is quite small: having a correlation coefficient of 0.19 means that the degree of internationalization can only explain 3.6% of the variance in the global specialization index. In other words, the disaggregation of the value chain performed by our measure apparently reveals information that is hidden by aggregate (corporate-wide) dispersion measures. This means that the global specialization index clearly captures something new compared to the traditional notion of geographical spread.

To explore this idea in more detail, we conducted a cluster analysis on the consolidated data. This should enable us to see if the observations converge around

certain archetypes of firms that lend themselves to a qualitative interpretation. Cluster analysis has been used frequently in the IB literature, primarily to create or test typologies of firms based on different strategic or structural variables (e.g. Roth, 1992; Nohria and Garcia-Pont, 1991), and our aim is similar here.

To identify clusters based on *I* and *G*, we used a hierarchical cluster method (Ward's Minimum Variance Cluster Analysis). The criteria used to find the optimal number of clusters usually consist of finding a local minimum for the *CCC*- and Pseudo t^2-values and a local maximum for the Pseudo *F* statistic (Hair *et al*, 1995). We found that a three-cluster solution met these criteria best. This is also reaffirmed by a graphical inspection of the data. We then used analysis of variance (ANOVA) to test cluster mean differences for our two measures. The three clusters are shown in Figure 1, and Table 2 reports the number of firms in each cluster and the cluster means.

Figure 1 About Here

Table 2 About Here

We can see both graphically and from the cluster means that clusters 1 and 3 do not differ significantly on the global specialization index, which is close to 0 for both clusters. Of these, cluster 1 has the lowest degree of internationalization, with only 12% of their employees located outside Denmark, on average. This "home-market bias" will in itself lead to a low value of *G*, since all elements of $[s_{i1}]$ will be close to 1

and all elements of [s_{i2}] close to 0, and the area-level variances will therefore be low[5]. As such, the firms in cluster 1 could be called "Ethnocentric" (Perlmutter, 1969) or "International" (Bartlett and Ghoshal, 1989) – archetypes characterized by a strong home-market orientation, using exports as a primary internationalization device.

Cluster 3, on the other hand, have the highest degree of internationalization of the three groups with an average of 57% of employees located outside Denmark. However, *G* is still very close to 0, implying that the large foreign operations of these firms merely replicate the activity distribution of the Danish operations. These firms could be called "Polycentric" (Perlmutter, 1969), "Multidomestic" (Porter, 1986), or "Multinational" (Bartlett and Ghoshal, 1989) – archetypes where foreign subsidiaries are run primarily like self-contained and autonomous units.

If all firms belonged to these two groups, we could use a simple measure like *I* to distinguish between them. Hence, cluster 2 is the most interesting group with regard to our measure, since it consists of firms with significantly – and dramatically – higher degree of global specialization than the two other clusters. The firms in cluster 2 are by no means completely globally specialized, but they are in fact concentrating some of their activities abroad, and with some reservations we could therefore call them "Geocentric" (Perlmutter, 1969) or "Global" (Porter, 1986).

It is worth noting that these global firms are actually significantly *less* internationalized than the multidomestic cluster. There can be several potential explanations for this. First, with only 34% international division of labor, global specialization apparently is (or was in 1998 and 2003) in its infant stages among Danish firms. Hence, firms driven by sourcing advantages would still tend to be limited in their international orientation. In contrast, the multidomestic firms'

[5] In the limit, a firm with no employees outside Denmark would get a global specialization index of 0 (a special case of the third property, with z=1 and y=1).

international expansion may be primarily demand-driven, and since Denmark is a small market we should expect them to seek a significant presence in other countries. Also, global specialization may be inherently more difficult and costly than internationalization in terms of coordination requirements and strain on managerial attention in HQ and may therefore proceed at a slower pace.

To conclude, the cluster analysis suggests that the global specialization index measures a different dimension of international strategy than previous indices do. If we were restrained to a unidimensional measure of international spread, we could have concluded only that the firms in cluster 2 were more globalized than the "international" firms and less so than the "multidomestic" firms, but we would otherwise not be able to distinguish them from those two groups. Hence, the most important contribution of the index seems to be its ability to identify the *global* firm as being both conceptually and now also empirically distinct from other MNCs.

5. Conclusions and managerial implications

In this paper we have argued that existing indices of firms' degree of internationalization fail to capture to what extent MNCs are truly globalized. An MNC scoring high on internationalization indices of foreign assets and spread of activities across countries may in fact follow a multidomestic strategy with a minimal degree of value chain globalization and cross-border coordination. In its pure form, a multidomestic strategy implies that the local affiliations are sub-ordinated a clearly identifiable parent, but operate quite independently as mini-replica. In other words, the international division of labor within the multidomestic corporation is limited, if not non-existing, and one can hardly characterize such an MNC as being "global". In order to capture firms' degree of global integration or specialization we developed an

index that has the individual value added activity of the firm as its unit of analysis. Firms that across countries have the same distribution of employees (or assets) on value added activities are arguably less globalized than those firms having very different foreign affiliates in terms of value added activity composition.

The application of the global specialization index on a preliminary data set on Danish MNCs indicated a relatively low correlation (0.19) with the traditional index of distribution of employees between home country and foreign countries. A cluster analysis identified a group of "international" firms with low degrees of internationalization and globalization, a group of "multidomestic" firms that scored high on the internationalization index, but low on our global specialization index, and a third group of "global" firms with significant higher global specialization values than the two other groups.

Unlike existing indices, our index is closely aligned with the global integration-responsiveness strategy literature. Still, some reservations should be made as to what the index actually measures and what it does not. First, the index is a reliable measure of the extent to which firms are involved in global value chain *configuration*, i.e. location of value chain activities in specific countries. The index cannot establish to what extent the international location is cost efficient, i.e. if value added activities are located where the factor endowment is the most favorable. Second, the index can tell even less about the extent to which firms exercise global *coordination*, that is, if the various value chain activities are carried out in accordance with a common, corporate strategy. In other words, we cannot just assume that global configuration or specialization entails global coordination or integration. One way to measure a firm's degree of global coordination/integration is to observe the exchange of knowledge, goods and services, and capital between its affiliates.

Third, compared to existing internationalization indices our index is much more demanding in terms of the data requirements. Taking the individual value added activity as the unit of analysis excludes in reality the use of secondary data. Hence, the provision of data on the distribution of value added activities in various countries is contingent on the willingness of the business community to collaborate. Even with firms' positive collaboration secured, the operationalization of the index is quite challenging: in practice, the number and character of value added activities may differ substantially across industries or business sectors (Stabell and Fjeldstad, 1998). In principle, only the individual firm itself can establish the number and character of its value added activities, but for practical reasons some standard templates for specific industries or business sectors may be used to assist the company informants and to ensure internal validity. Because of this, the first property of the index – robustness to arbitrary activity splits – is extremely important from an empirical measurement point of view.

Another challenge is the difficulty of actually measuring the number of people or assets comprised by a firm's value chain. For instance, which criteria and to what extent should employees (or assets) of an OEM supplier or IT insourcing vendor be included in the value chain? The easy solution would be to count only value added activities performed as in-house activities of the respondent firm. However, this "solution" does not qualify for a global value chain measurement and dismisses observations of potentially important global outsourcing phenomena.

Managerial Implications

Despite these practical intricacies our global specialization index has promising managerial perspectives. Managers may use the global specialization index to

benchmark their companies against competitors: Does my company take advantage of factor endowment differences of countries to the same (or less) extent as competitors? Companies that score low on the global specialization index in comparison with other companies in the industry may see this as an opportunity to reconsider their value chain configuration. Companies that find themselves in the high end of the index, but with performance below industry average, may consider a re-localization of their value added activities, or a better cross-border coordination of these activities.

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Appendix I

Assume that we take activity 1 of the firm (with weight a_1) and split it arbitrarily into two smaller activities, so that one of these has weight a_1x and the other $a_1(1\text{-}x)$, while both activities still have the same country distribution [s_{11} s_{12} … s_{1J}]. Such a split is purely "nominal" in the sense that it does not reveal any new information, and therefore it should not affect *G*, which is a "real" measure of global specialization. To prove this, note that the weighted average and variance before the split is given by:

$$\begin{aligned} w_j &= a_1 s_{1j} + a_2 s_{2j} + \ldots + a_I s_{Ij} \\ r_j &= a_1 \left(s_{1j} - w_j\right)^2 + a_2 \left(s_{2j} - w_j\right)^2 + \ldots + a_I \left(s_{Ij} - w_j\right)^2 \end{aligned} \qquad \text{[A1]}$$

And after the split:

$$\begin{aligned} w_j^* &= a_1 x s_{1j} + a_1 (1-x) s_{1j} + a_2 s_{2j} + \ldots + a_I s_{Ij} \equiv w_j \\ r_j^* &= a_1 x \left(s_{1j} - w_j\right)^2 + a_1 (1-x) \left(s_{1j} - w_j\right)^2 + a_2 \left(s_{2j} - w_j\right)^2 + \ldots + a_I \left(s_{Ij} - w_j\right)^2 \equiv r_j \end{aligned} \qquad \text{[A2]}$$

Since the activity split does not affect **r** or *J*, the values of *T* and hence *G* are left unaffected as well. The corollary to this result is the fact that we can always merge two or more activities with the same country distribution, without affecting the degree of measured global specialization.

Appendix II

It is easy to prove that *G* can never be lower than zero. By the definition in Equation [4], The **Q** matrix contains squared expressions, which will always be non-negative.

The elements of **r** are a (weighted) sum of these squares and must therefore also be non-negative, and hence so are *T* and *G* as well.

Proving that *G* has an upper limit of 1 is slightly more difficult. We propose the following volume matrix as the *G*-maximizing configuration:

$$\mathbf{V} = \begin{bmatrix} \alpha & & & & & & & \\ \dots & & & & & & & \\ \alpha & & & & & & & \\ & \alpha & & & & & & \\ & \dots & & & & & & \\ & \alpha & & & & & & \\ & & \dots & & & & & \\ & & & \dots & & & & \\ & & & & \dots & & & \\ & & & & & \alpha & & \\ & & & & & \dots & & \\ & & & & & \alpha & & \\ & & & & & & \alpha & \\ & & & & & & \dots & \\ & & & & & & \alpha & \end{bmatrix} \qquad [A3]$$

where all empty cells contains 0, and we have segmented the firm's value chain into *n* (a very large number of) "microactivities" of equal size α. It is assumed that α is the smallest possible unit of change for the firm. This assumption is without loss of generality, as we can always (by the result in Appendix I) subsegment the activities further without affecting *G* until we have reached a sufficiently small unit. By letting $n \to \infty$, the size of each activity $\alpha \to 0$, and in that case a unit change in the matrix (moving α from one country to another) can be interpreted as a *marginal change* in the firm's configuration.

To prove that *G* cannot exceed 1, we need to prove 1) that the configuration in Equation [A3] has *G*=1, and (2) that no marginal change to that configuration can lead

to a higher value of *G*. To show the first property, we first consolidate all activities with identical country distributions. We know from the result in Appendix I that we can do this without affecting the value of *G*. The resulting matrix is:

$$\mathbf{V} = \alpha \begin{bmatrix} 1 & & & & \\ & 1 & & & \\ & & \ldots & & \\ & & & 1 & \\ & & & & 1 \end{bmatrix} = \alpha \mathbf{1} \qquad \text{[A4]}$$

From this it follows that **S**=**1**, $\mathbf{a} = \begin{bmatrix} \frac{1}{J} & \ldots & \frac{1}{J} \end{bmatrix}$, and $\mathbf{w} = \begin{bmatrix} \frac{1}{J} & \ldots & \frac{1}{J} \end{bmatrix}$. Hence, the **Q**-matrix contains $(1-\frac{1}{J})^2$ in the diagonals and $\frac{1}{J^2}$ in all other cells. This gives us $\mathbf{r} = \begin{bmatrix} \frac{J-1}{J^2} & \ldots & \frac{J-1}{J^2} \end{bmatrix}$ and finally $T = \frac{J-1}{J}$ and *G*=1.

To show the second property, assume that we take the volume matrix in [A3] and move a unit from area 1 to area 2. This changes only the area-level variances r_1 and r_2. After the change we have $w_1 = \frac{1}{J} - \frac{1}{n}$ and $w_2 = \frac{1}{J} + \frac{1}{n}$. That means that in the first column (area vector) of **Q**, a fraction $\frac{1}{J} - \frac{1}{n}$ of the cells contains $(1-\frac{1}{J}+\frac{1}{n})^2$ and $1-\frac{1}{J}+\frac{1}{n}$ contains $(\frac{1}{J}-\frac{1}{n})^2$; while in the second column, $\frac{1}{J}+\frac{1}{n}$ contains $(1-\frac{1}{J}-\frac{1}{n})^2$ and $1-\frac{1}{J}-\frac{1}{n}$ contains $(\frac{1}{J}+\frac{1}{n})^2$. Taking the two weighted variances of these area vectors and adding them gives us $r_1+r_2= 2(\frac{J-1}{J^2}-\frac{1}{n^2})$, which is smaller (by the magnitude $\frac{2}{n^2}$) than the r_1+r_2 before the change. Hence, a marginal change in the volume matrix [A3] decreases the value of *T* and *G*, as we intended to show.

Appendix III

This Appendix examines the consequences of expanding the geographical scope of measurement (*J*), while keeping the actual geographic spread of the measured firm constant. Assume that we have a firm with activities in *J* areas, and measured within

these J areas it has the globalization indices T_J and G_J. Now we append an empty area and recalculate these variables, denoting the new values T_{J+1} and G_{J+1}.

By the definitions in [1] and [2], the activity weights **a** and the original area vectors $[s_{i1}\ s_{i2}\ \ldots\ s_{iJ}]$ remain unchanged by the addition of an empty area. Therefore, $[w_{i1}\ w_{i2}\ \ldots\ w_{iJ}]$ remains the same, as does the first J columns of **Q**, and hence also $[r_1\ r_2\ \ldots\ r_J]$. As for the final area-level variance value, r_{J+1}, the following must be true:

$$v_{iJ+1} = 0 \quad \Leftrightarrow \quad s_{iJ+1} = 0 \quad \Leftrightarrow \quad w_{J+1} = 0 \qquad \text{[A5]}$$

This implies that column J+1 of **Q** contains only zeros, and so r_{J+1}=0. Since $[r_1\ r_2\ \ldots\ r_J]$ remain unchanged and r_{J+1}=0, the total variance remains the same, i.e. T_{J+1}=T_J.

This result can be generalized by continuing to add more empty areas to the volume matrix. Hence, if the volume matrix contains z geographical areas with activities and y empty geographical areas, T_{z+y}=T_z. However, G_{z+y} will in general be smaller than G_z. We know from Appendix II that T_z and thereby T_{z+y} has an upper range of $(z\text{-}1)/z$. This means that G_{z+y} has an upper range of $((z\text{-}1)/z)\times(z+y)/(z+y\text{-}1)=1\text{-}y/(z(y+z+1))$, which is smaller than 1 for any non-negative y and z, and goes towards $1-\frac{1}{z}$ $(=\frac{z-1}{z}$, which is the upper range of T) as $y\rightarrow\infty$.

Table 1 – Correlations between G and I

Sample	***N****	**Pearson Correlation between G and I**	***p***
1998	164	0.15	0.06
2003	67	0.27	0.03
Consolidated	231	0.19	0.00

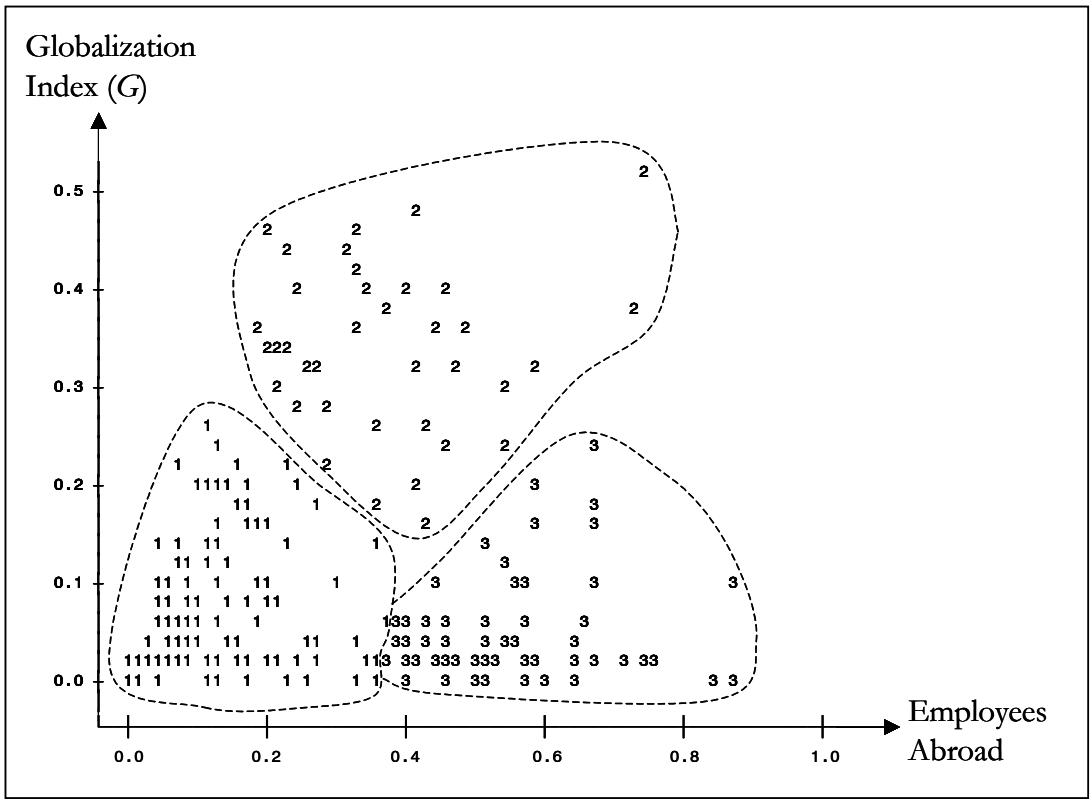
* Missing values on some variables reduced the usable number of observations

Table 2 – Cluster Means

Cluster	***n***	***I***	***G***
1 – "International"	130	0.12 (a)	0.06 (a)
2 – "Global"	41	0.38 (b)	0.34 (b)
3 – "Multidomestic"	60	0.57 (c)	0.04 (a)

A Duncan grouping was conducted and cluster means sharing some of the same letters (a, b or c) are not significantly different; cluster means with no shared letters are.

Figure 1 – Clusters



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