Discussion Paper No. 06-009

Global Sensing and Sensibility

A Multi-Stage Matching Assessment of Competitive Advantage from Foreign Sources of Innovation

Wolfgang Sofka and Thorsten Teichert

ZEW

Zentrum für Europäische
Wirtschaftsforschung GmbH

Centre for European
Economic Research

Discussion Paper No. 06-009

Global Sensing and Sensibility

A Multi-Stage Matching Assessment of Competitive Advantage from Foreign Sources of Innovation

Wolfgang Sofka and Thorsten Teichert

Non-technical summary

The driving forces behind globalization (information technology and open market ideology) enable firms to source localized expertise in technology and demand. On the one hand, this makes the accessible pool of global innovation sources large and deep. On the other hand, it requires special expertise to pick the most promising fishing grounds and land the largest catch amid intensified global competition. Companies need an “early warning radar system” that enables them to keep track of recent technological and market trends worldwide as well as to distinguish between crucial signals and secondary noise. We investigate this global sensing capability and extend existing research on the theoretical and methodological side.

From a theoretical perspective we draw arguments from the capability based view of the firm and test whether global sensing is actually a competitive advantage generating capability of a firm. This is not clear from the outset. Global sensing implies identifying, synthesizing and combining knowledge across national, cultural and social borders. It is easier today to transfer information across borders, yet putting it into the right context to get the most out of it remains challenging. On the methodological side we introduce the novel technique of matching estimators to management studies which address a major shortcoming of the resource/capability based view of the firm: the lack of an empirical basis. In essence, matching estimators rely on a straightforward idea. If each global sensing firm can be matched with an almost perfect twin firm (e.g. same size, industry, region) from a control group, the remaining performance differences can be attributed to global sensing. On this basis, we develop a multistage evaluation framework that preserves the heterogeneity among firms and disentangles the effects of global sensing while controlling for context specific factors. Subsequently, we achieve an undisguised view of the strategic effects of global sensing. We test our evaluation framework empirically for a broad sample of more than 1,600 German companies from both manufacturing and services.

We find the strongest and most consistent support for global sensing as a strategic enabler for technological leadership. Companies that plan to build their competitive advantage around their technologically unique processes and competencies are more likely to search and find creative sparring partners outside of their home countries. We suggest that these reconnaissance activities are also more targeted and hence cost efficient for them. Pockets of elite technological expertise are less likely to be randomly scattered across the globe. Instead they need substantial physical investments (e.g. specialized labs) and, more importantly, a proven knowledge stock to arise. Hence they can be tracked and traced much more easily. What is more, our results also highlight the fact that foreign external sources of innovation are generally not superior to domestic sources for competitive advantage. Hence, neglecting this domestic innovation environment would be ill-advised.

Global Sensing and Sensibility

A Multi-Stage Matching Assessment of Competitive Advantage from Foreign Sources of Innovation

Wolfgang Sofka[1] and Thorsten Teichert[2]

Abstract

We focus on one of the core competitive capabilities of modern firms: the ability to deliver successful innovations in a globalized environment. Companies literally find themselves confronted with a world of ideas. The challenge remains to decide which impulses should be on top of the list and which at the bottom. Given limited resources and substantial investments, betting on the wrong horse can be risky and costly. Theoretically integrated in capability based view of the firm we investigate firms' capabilities to assimilate, identify and prioritize valuable knowledge across national, cultural and social borders - a competence we call global sensing. We establish an analytical framework to examine whether global sensing activities generate competitive advantage. Consequently, we develop an empirical, multistage evaluation strategy. This strategy rests on a matching approach for a recent, broad sample of almost 1,700 German companies from both services and manufacturing. We find the strongest and most consistent support for global sensing as a strategic enabler for technological leadership. Apart from this strategic advantage we observe that foreign external sources of innovation are generally not superior to domestic ones.

Keywords: Global innovation, global sensing, capability based view, matching estimation

JEL-Classification: F23, O31, O32

[1] Centre for European Economic Research (ZEW), Department of Industrial Economics and International Management, P.O. Box 10 34 43, D-68034 Mannheim, Germany

[2] Professor at Hamburg University, Institute of Retailing and Marketing, Chair for Marketing and Innovation, Von-Melle-Park 5, D-20146 Hamburg, Germany

Corresponding author: Wolfgang Sofka, sofka@zew.de, Tel.:+49-621-1235-181, Fax: +49-621-1235-170

The authors thank Dr. Georg Licht, Dr. Christian Rammer and Tobias Schmidt for invaluable comments and discussions.

1 Introduction

Globalization has not led to a borderless world (as suggested by Ohmae (1990)) with universally homogeneous customers (as suggested by Levitt (1983)). Market demands and technological opportunities remain globally heterogeneous and country specific. There is thus a need for efficient knowledge management since the basic sources of global competitive advantage remain local, sticky, diverse and dispersed (Doz et al., 2001).

The intensified exchange of products, services, capital and – most important to our analysis – know-how has created strong economic ties between geographically dispersed countries (Archibugi and Iammarino, 2002; Govindarajan and Gupta, 2001). Doz et al. (2001) identify three levels of competition in this global knowledge economy: Sensing (identifying and accessing new competencies, innovative technologies, and lead-market knowledge), mobilizing (integrating scattered capabilities and emerging market opportunities to pioneer new products and services) and operations (optimizing the size and configuration of operations for efficiency, flexibility, and financial discipline).

The mobilizing and operations aspects of this framework have received relatively more attention in the literature so far.[1] We focus on the sensing aspect: the ability of a firm to sense leading technological and market trends globally. The driving forces behind globalization (information technology and open market ideology) enable firms to source localized expertise in technology and demand (Govindarajan and Gupta, 2001; Gupta and Westney, 2003). On the one hand, this makes the accessible pool of global innovation sources large and deep. On the other hand, it requires special expertise to pick the most promising fishing grounds and land the largest catch amid intensified global competition. Companies need an "early warning radar system" that enables them to keep track of recent technological and market trends worldwide as well as to distinguish between crucial signals and secondary noise. We investigate this global sensing capability and extend existing research on the theoretical and methodological side.

From a theoretical perspective we draw arguments from the capability based view of the firm and test whether global sensing is actually a competitive advantage generating capability of a firm. This is not clear from the outset. Global sensing implies identifying, synthesizing and combining knowledge across national, cultural and social borders. It is easier today to transfer information across borders, yet putting it into the right context to get the most out of it remains challenging. Hence, these capabilities have the potential to generate competitive

[1] Major topics include the sources of advantage for multinational enterprises (MNEs) (Dunning, 1981), their organizational structure (Bartlett and Goshal, 1989), balanced configurations between headquarters and subsidiaries (Doz and Prahalad, 1984; Prahalad and Doz, 1987), knowledge flows between them (Birkinshaw and Fry, 1998) and the management of globally dispersed teams (Boutellier et al., 1998; Maznevski and Chudoba, 2000).

advantage. This question is at the very heart of this paper: does global sensing produce measurable competitive advantage?

On the methodological side we introduce the novel technique of matching estimators to management studies which address a major shortcoming of the resource/capability based view of the firm: the lack of an empirical basis (Priem and Butler, 2001). In essence, matching estimators rely on a straightforward idea. If each global sensing firm can be matched with an almost perfect twin firm (e.g. same size, industry, region) from a control group, the remaining performance differences can be attributed to global sensing. On this basis, we develop a multistage evaluation framework that preserves the heterogeneity among firms and disentangles the effects of global sensing while controlling for context specific factors. Subsequently, we achieve an undisguised view of the strategic effects of global sensing. We test our evaluation framework empirically for a broad sample of more than 1,600 German companies from both manufacturing and services.

This paper follows an integrated design. The section subsequent to this introduction conceptually embeds global sensing in the capability based view of the firm. Section 3 condenses this argumentation into an analytical framework that can be tested. In section 4 we introduce the empirical tools to actually conduct these tests. Accordingly, section 5 discusses our results and is followed by our conclusions in section 6.

2 Conceptual Framework

2.1 The nature of global sensing

Literature identifies a number of reasons why companies have to think beyond their own boundaries and search for external sources for innovation: Competitive pressure, shorter product lifecycles, high investments, available external expertise (see for example Chesbrough (2003)). Firms need a knowledge management system that picks the right sources, synthesizes the inputs and combines them with existing expertise (Gottfredson et al., 2005; Stock and Tatikonda, 2004). In a globalized world modern information and communications technology as well as changing ideology increase the potentials from these external innovation inputs, most notably in China and India (Govindarajan and Gupta, 2001; Gupta and Westney, 2003). At the same time, the pockets of valuable expertise are becoming more globally diverse and dispersed (Doz et al., 2001). The immense scope of potential knowledge increases the peril from strategic blind spots (Rugman and Verbeke, 2004) or betting on the wrong horse. Competitive advantage can be achieved if companies have the competencies and capabilities to identify, combine and develop market and technology opportunities that are unarticulated, overlooked or underestimated (Von Zedtwitz and Gassmann, 2002a). We call this capability “global sensing.” It includes sifting through the enormous amounts of prospective innovation signals from worldwide customers, competitors and suppliers, absorbing and prioritizing them and triggering an adequate organizational response.

2.2 Global sensing as a strategic capability

We suggested in the previous section that global sensing capabilities are a source of competitive advantage. We substantiate this claim by integrating it in the literature on the resource and capability based view of the firm (Barney, 1991; Conner, 1991; Penrose, 1959; Peteraf, 1993; Wernerfelt, 1984). Competitive advantage stems from internal resources and capabilities and subsequent proactive strategic choices to create and grasp market opportunities (Lado et al., 1992). We argue that global sensing fits the criteria for a strategic capability because of the special kind of knowledge that has to be transferred and the capacities needed to synthesize and integrate them (i.e. component and architectural competence (Henderson and Cockburn, 1994)). Firstly, impulses from foreign customers, suppliers and competitors are valuable, specific and difficult to imitate or substitute. These resources are valuable because they generate three types of performance potentials (Bartlett and Goshal, 1987; Dunning, 1981, 1992). These are responsiveness to foreign market conditions (e.g., tastes, regulations), learning from localized, country-specific expertise (Rugman and Verbeke, 2003) and efficiency through comparative cost advantages abroad (e.g., large supply of scientific personnel, 24/7 lab activities) (Von Zedtwitz, 2004). They are specific because the particular configuration of foreign customers, suppliers and competitors is unique for a firms' value chain and difficult to imitate because the information that has to be transferred is often subtle, complex and sticky (Doz et al., 2001).

Secondly, we argue that competitive advantage through global sensing stems not only from the knowledge transferred but also from firms' capabilities to establish "pipelines to knowledge sources around the globe" (Malmberg and Maskell, 2005). These potentials have to be identified, activated and managed to generate competitive advantage. Competitive capabilities imply the targeted deployment and combination of resources through organizational processes (Amit and Schoemaker, 1993). Eisenhardt and Martin (2000) similarly use the concept of dynamic capabilities to describe the organizational and strategic routines through which companies trigger or adapt to market changes. Capabilities are cultivated in practice over time which makes them causally ambiguous and socially complex (Dierickx and Cool, 1989). This embeddedness makes them hard to acquire or imitate and therefore generates competitive advantage (Brush and Artz, 1999). Identifying, sharing and exploiting valuable knowledge assets has been identified as such a source of competitive advantage (Zander and Kogut, 1995). We extend this argument to global sensing by stressing the particularities of cross-border relationships. Synthesizing and applying existing and sensed knowledge (i.e. combinative capabilities, Kogut and Zander, 1992) across national, cultural and social borders requires intelligent processes and competencies that are built up over time. This includes identifying impulses from abroad and putting them in a fitting context to trigger an adequate response. Knowledge transfers across national borders have been found to be difficult and subject to losses (Branstetter, 2001; Jaffe and Trajtenberg, 1999). In particular, tacit knowledge often associated with face-to-face contact and shared experiences is of crucial importance but difficult to transfer across cultural barriers (Al-Laham and Amburgey, 2005; Liesch and Knight, 1999). Frictional losses stem from increased transaction costs and principal-agent problems (Rugman and Verbeke, 2003; Von Zedtwitz and Gassmann, 2002b). These frequent mistakes and delays in cross-border situations have been summarized as liabilities of foreignness (Hymer, 1976; Zaheer, 1995). Their prime drivers are costs related to spatial distance (travel, transportation, time zones), higher learning costs in the new environment due to a lack of roots, higher reputation costs due to a lack of perceived legitimacy in the host country and legal restrictions in the home country (Zaheer, 1995). These liabilities of foreignness can be overcome through superior firm specific advantages and learning from foreign affiliates (Caves, 1971; Mezias, 2002).

In conclusion, we argue that impulses from foreign customers, suppliers and competitors are a strategic resource. Moreover, firms which can identify and transfer these inputs across national and cultural borders and combine them with existing knowledge can achieve competitive advantage. Hence we hypothesize that global sensing is a strategic capability.

3 Analytical framework

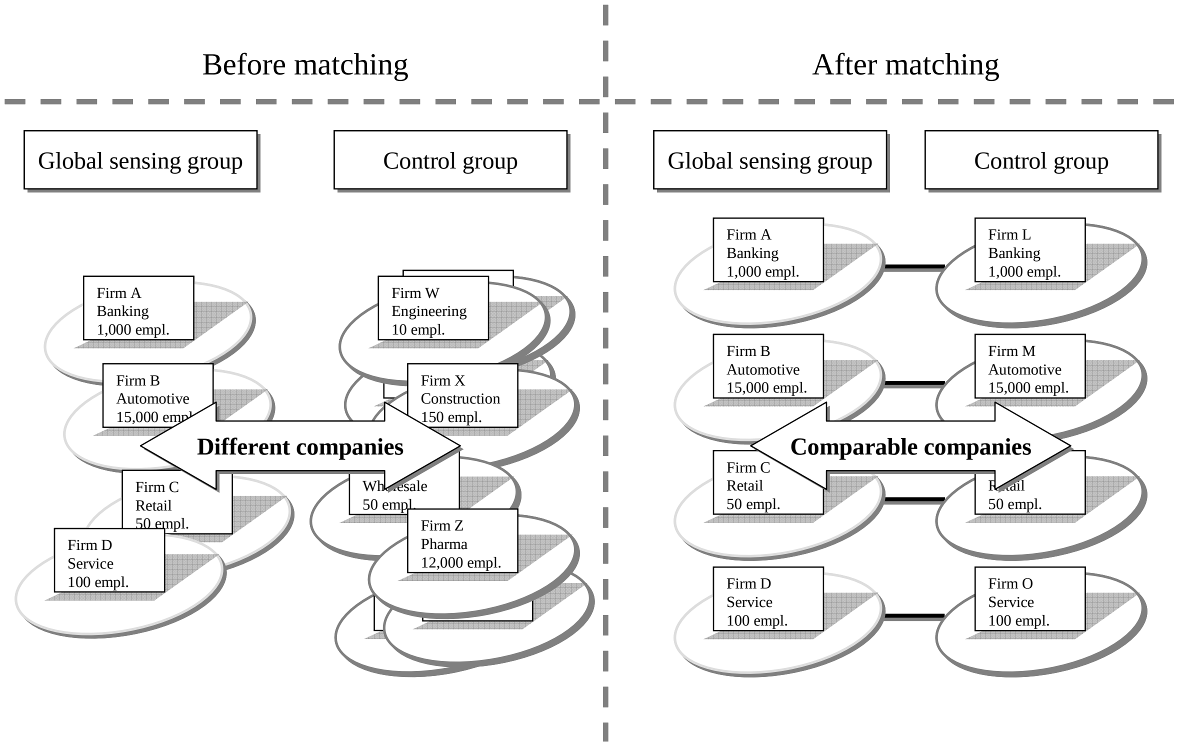
3.1 Capturing capabilities through matching estimators

The resource based view of the firm has come under criticism for lacking specificity, and neglecting dynamics in the firm environment and empirical validation (Hoops et al., 2003; Priem and Butler, 2001). Priem and Butler (2001) suspect that "virtually anything" can be a resource. Hence, a methodology is required that empirically validates the effects from strategic resources and capabilities. This implies separating their contributions from other factors in the environment (e.g. industry). Conventional methods achieve this goal by comparing average firms. These comparisons of "averages" run counter to the central resource based concepts of uniqueness, heterogeneity and equifinality (Rouse and Daellenbach, 1999, 2002). We suggest an approach that allows both context sensitivity and empirical verification: matching estimation.

In essence, the matching procedure follows the benchmarking rationale on a larger scale. Put simply, the matching procedure extends the simple idea of comparing mean differences between global sensing firms and the rest (control group). Instead of comparing apples and oranges it aims at identifying almost perfect twin companies from both groups. These twin companies are assigned based on propensity scores estimated from predefined context variables (e.g., same size, industry). The differences in firm performance between these twins can subsequently be attributed to global sensing. If these effects are positive and significant global sensing can be considered a strategic capability.

Matching approaches have been predominantly developed and discussed in labour market research (Heckman et al., 1998b; Heckman et al., 1999; Lechner, 2000). The technique has also made inroads in industrial economics, most prominently through studies on the effects of public R&D subsidies (Almus and Czarnitzki, 2001; Czarnitzki et al., 2004). We consider this approach especially fitting for empirical tests of the resource and capability based view of the firm for two reasons. Firstly, it compares firms with similar contexts and dynamics in their environment. Secondly, it preserves the heterogeneity among firms, which is a central pillar of the resource based view; i.e. firms are not compared to an average firm but to a firm that is relatively similar. Figure 1 summarizes the matching rationale.

Figure 1: Rationale behind matching estimation



A suitable analytical scheme requires the definition of relevant context factors and constructs to measure competitive advantage.

3.2 Relevant context and performance measures

The context of global sensing

Amit and Schoemaker (1993) suggest that the resource based view of the firm complements traditional industry analysis and that internal and external factors have to be considered to understand the sources of competitive advantage. Along these lines several studies have argued that capabilities cannot be separated from their relevant context (Atuahene-Gima and Haiyang, 2004; Brush and Artz, 1999). In line with Priem and Butler (2001) we define the relevant context as the "when, where and how" resources and capabilities translate into competitive advantage. We suggest that these context factors can be captured at three levels: the company's degree of internationalization (access and opportunity), the relevance of knowledge from abroad (need) and the competencies and processes the company has to leverage impulses from abroad (absorptive capacity). We shall now elaborate this categorization briefly.

Global sensing systems are naturally linked to the absorptive capacities of organizations: (Cohen and Levinthal, 1989, 1990): The ability to identify, assimilate and exploit knowledge from the environment, which is developed while performing R&D activities. Therefore R&D not only generates innovations by itself, it also supports the building-up process of knowledge within a company and its personnel (Engelbrecht, 1996). We suggest that organizations develop certain skills and competencies when interacting with foreign customers, suppliers and competitors that enable them to establish channels across borders which subsequently serve as pipelines for valuable knowledge from abroad. Through this embeddedness they find it easier to transform these foreign impulses into inputs that can be injected in the company's innovation system. Therefore, we argue that global sensing activities are more efficiently conducted if the company and its employees possess previous experience in internationalization since the existence and richness of transmission channels propel knowledge flows (Gupta and Govindarajan, 2000). Hence a company's degree of internationalization should propel global sensing activities. Besides, cultural barriers to knowledge flows have proven to be rather entrenched and persistent in society (Ghemawat, 2001, 2003). There is a need to address them organizationally, e.g., by recruiting managers from abroad or with foreign experience (O'Grady and Lane, 1996).

Moreover, we suggest that global sensing activities are targeted. They focus on compensating an - at least perceived - shortage in the quality or quantity of suitable domestic sources. These relative shortcomings can originate at the country, industry or firm level. Push factors might propel domestic companies to exploit their firm-specific advantages abroad but they might also experience pull factors from superior foreign inputs (Le Bas and Sierra, 2002). These drivers could be structural (e.g., barriers to competition) or cognitive (e.g., high information costs) in nature (Dunning, 1981). This process is dynamic. It can be stimulated through intensified international competition or offshoring activities from important customers or suppliers (Doz et al., 2001). Additionally, the development stage within the innovation process is important. As Pearce (1989) and Dunning (1992) suggest, applied R&D activities should more likely be decentralized, while fundamental basic research is better conducted domestically.

In conclusion, firms need access to relevant knowledge that fits their needs and adequate absorptive capacities to leverage these inputs. Hence in line with Sofka (2005) we conceptualize the mechanisms behind global sensing as a combination of three factors: access, need and absorptive capacity.

Performance effects of global sensing

Global sensing can only be considered a strategic capability if it generates competitive advantage through superior firm performance. Hence there is an obvious need to define the latter. The performance potentials from global sensing have been outlined before: responsiveness, learning and efficiency (Bartlett and Goshal, 1987). We break these concepts down in line with the literature on innovation controlling (Hauschildt, 2004; Klomp and van Leeuwen, 2001). Additionally, we distinguish between strategic outcomes (i.e. a firm's cost and quality position from global sensing) and strategic potentials (i.e. whether global sensing enables firms to choose a cost or quality leadership strategy for the future).

Following this line we suggest measurement constructs which will guide our subsequent empirical study. As operative effects of global sensing (strategic outcomes) we suggest the share of turnover a company can achieve through market novelties, the sales increase it can achieve through quality improvements and the cost reductions it can generate through innovative processes. Obviously, strategic potentials are a less tangible construct. Hence, we suggest surveyed management ratings for certain strategies. These strategies are industry leadership with new products, technological leadership and cost leadership. Table 1 summarizes the operationalization and emphasizes its integration in the conceptual framework.

Table 1: Dimensions of global sensing

Benefits from global sensing	***Key drivers for global sensing***	***Strategic outcomes: Operative effects from global sensing***	***Strategic potentials generated by global sensing***
Efficiency	Competition and society driven	Cost reduction	Cost leadership
Responsiveness	Market requirements	Turnover with market novelties	New product leadership
Learning	Technological opportunities	Quality improvement	Technological leadership

4 Estimation strategy

4.1 Data and variables

For the empirical part of this paper we use cross section data from a survey on the innovation behavior of German enterprises called the "Mannheim Innovation Panel" (MIP) The survey is conducted annually by the Centre for European Economic Research (ZEW) on behalf of the German Federal Ministry for Education and Research. The methodology and questionnaire of the survey, which is targeted at enterprises with at least five employees, are the same as those used in the Community Innovation Survey (CIS), conducted every four years by Eurostat. For our analysis we use the 2003 survey, in which data was collected on the innovation behavior of enterprises during the three-year period 2000-2002. About 4,500 firms in manufacturing and services responded to the survey and provided information on their innovation activities.[2] We utilized this data to operationalize the concepts presented above. Additionally, we complemented this dataset with international trade data provided by the OECD (ITCS – International Trade by Commodity Statistics 2003 and TIS – Trade in Services 2004) and data on business R&D expenditures (ANBERD - R&D Expenditure in Industry 2003).

Our dataset of observations without any missing values consists of 1,664 companies. 324 of those indicated that they had used at least one foreign customer, supplier or competitor as a source of innovation (global sensing). Non-innovating firms are excluded. This is the full sample which we will use at the first and second stage of our evaluation scheme. For step three (net potential from global sensing) we restrict our dataset to firms which used external business sources (foreign or domestic). To achieve a more homogeneous sample we exclude companies from Eastern Germany. This leaves us with 405 observations. 209 of those had used a foreign business source for innovation. This relatively high portion has methodological implications. We will return to this issue at stage three of our evaluation scheme.

Naturally, global sensing activities cannot be readily observed. Some employee might read a foreign newspaper or receive an e-mail from a foreign friend that would serve as an impulse for in-house innovation activities. Still, we do not consider it helpful to draw too broad a spectrum of potential global sensing activities. We therefore focus on major activities that let domestic companies feed relevant technological or market information into their innovation processes. These sensing activities may result from active screening or could be the by-product of other activities. We want to judge the utilization of these particular sources on its

[2] The sample was drawn using the stratified random sample technique. A non-response analysis showed no distortions. For a more detailed description of the dataset and the survey see Janz et al. (2001) and Rammer et al. (2005).

merits. Therefore, we conclude that a company is conducting global sensing activities once it has indicated that it has used innovation impulses from foreign[3] customers, suppliers or competitors.[4] A detailed description of all variables can be found in section 7.3 of the annex. The industry classification is based on grouped NACE 2 and is detailed in section 7.4 of the annex.

4.2 Evaluation scheme

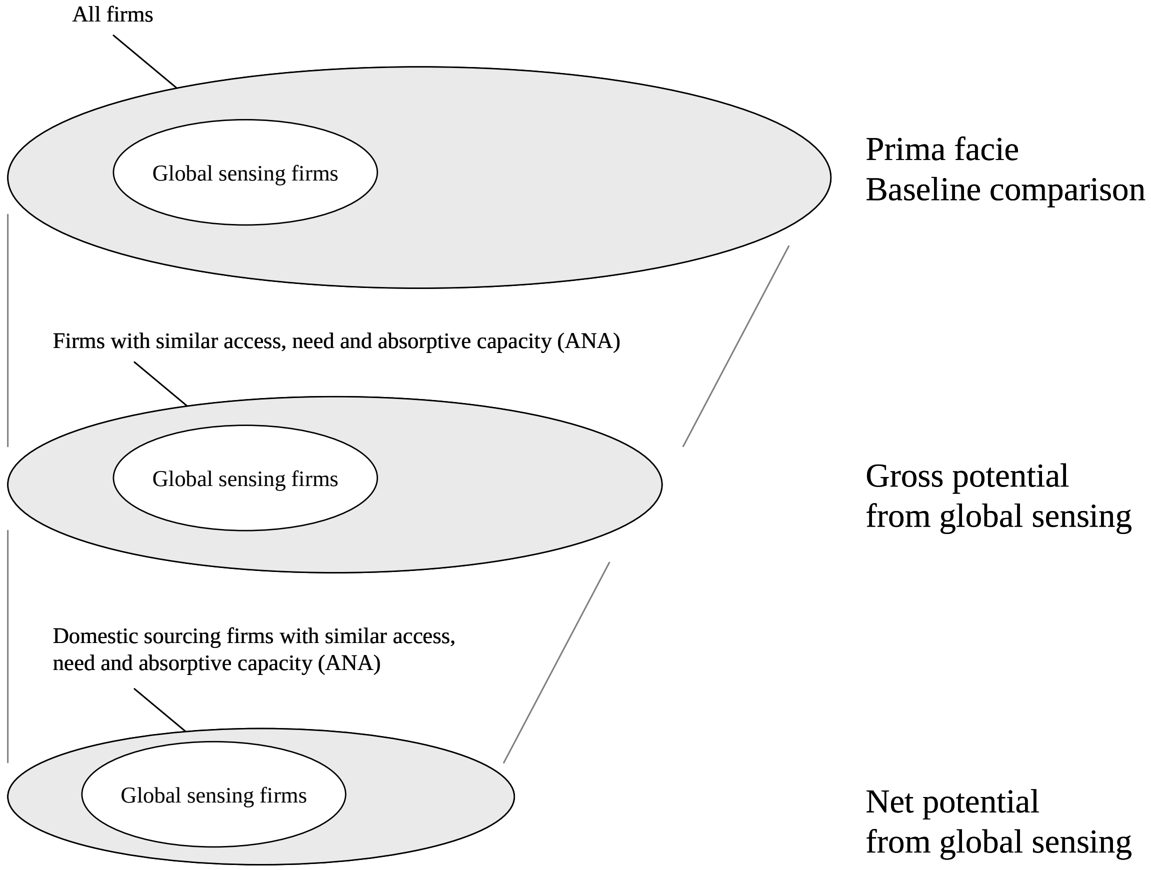
Based on the foundations presented so far we suggest a three layer evaluation design. At all levels of the evaluation we will judge the strategic effects of global sensing based on the comparison of actual strategic outcomes. For this we initially divide our sample into two sub samples: those enterprises that have conducted global sensing and a comparison group that has not. We will refine this comparison group step by step. The three evaluation layers are briefly outlined.

As a baseline case we conduct a prima facie comparison between the global sensing firms and all other companies. That is, we ignore the firm context to generate a benchmark case for all subsequent steps of the analysis. Secondly, we restrict the comparison group to companies that closely resemble our global sensing firms based on the contextual factors presented above. The differences in strategic outcomes can now be attributed to the global sensing activities since we have controlled for other sources of heterogeneity. We call the resulting differences in strategic outcomes between the two groups "gross potential of global sensing." Third, we restrict our comparison group to companies that have sensed for external innovation sources domestically and again construct a homogeneous sample based on context factors. We will interpret the remaining differences in strategic outcomes as the "net potential from global sensing." This implies that we investigate the extra effect a firm can achieve from extending its search for external sources across national borders. Figure 2 summarizes our approach.

3 To be precise, respondents were asked to name the country of origin of their innovation impulse. Thus, the term foreign implies that they named a country other than Germany.

4 Our survey framework tracks only those sensing activities that led to successful innovations. One the one hand, this enables us to capture the sensing process within the company comprehensively (from impulse reconnaissance through the final innovation). On the other hand, it has to be acknowledged that we underestimate the scope of global sensing activities since we cover successful innovations only.

Figure 2: Evaluation scheme for the strategic effects of global sensing



4.3 Matching procedure

Our analytical setting is typical for evaluation analyses. Since we can easily distinguish between our two groups of companies and their choice to sense globally or not, this is clearly not random, we operate in a non-experimental setting. This allows us to utilize the estimation strategies offered by the literature on the econometrics of evaluation. We opt for the matching procedure (additional methodological considerations can be found in section 7.1 of the annex). It controls for observed heterogeneity and necessitates no assumptions on the functional form of the outcome equations or the distribution of the error terms of the selection or outcome equations (Czarnitzki et al., 2004).

The procedure works as follows (Czarnitzki et al., 2004; Gerfin and Lechner, 2002). All companies are divided in two groups: global sensing companies and the remaining control group. Matching is based on the idea that the counterfactual situation of the controls can be estimated from the global sensing firms. The matching estimator generates a sample of global sensing firms which are comparable to the control firms. This comparability is based on a set of a priori defined characteristics (context factors). These characteristics would typically translate into same size or same industry. This produces matched control firms. As comparability with respect to this predefined criteria is achieved between global sensing companies and matched control firms the differences between them in the outcome variables can be explained exclusively through global sensing activities[5].

There is an obvious necessity to identify a suitable vector of context variables that defines these criteria of comparability. One would be tempted to develop a vector as large as possible to achieve a high degree of comparability. This endeavour has a downside. One runs into the curse of dimensionality (Czarnitzki et al., 2004): as the number of matching criteria increases it becomes harder to identify control observations. Rosenbaum and Rubin (1983, 1985) solve this problem by reasoning that it is sufficient to balance the samples based on an equal propensity score (or probability) for global sensing. We use the previously introduced framework of access, need and absorptive capacity (ANA) to identify comparable context factors. The operationalization of these ANA-components follows Sofka (2005). More details can be found in section 7.2 of the annex. A probit estimation based on these components will provide the propensity scores for all subsequent analytical steps.

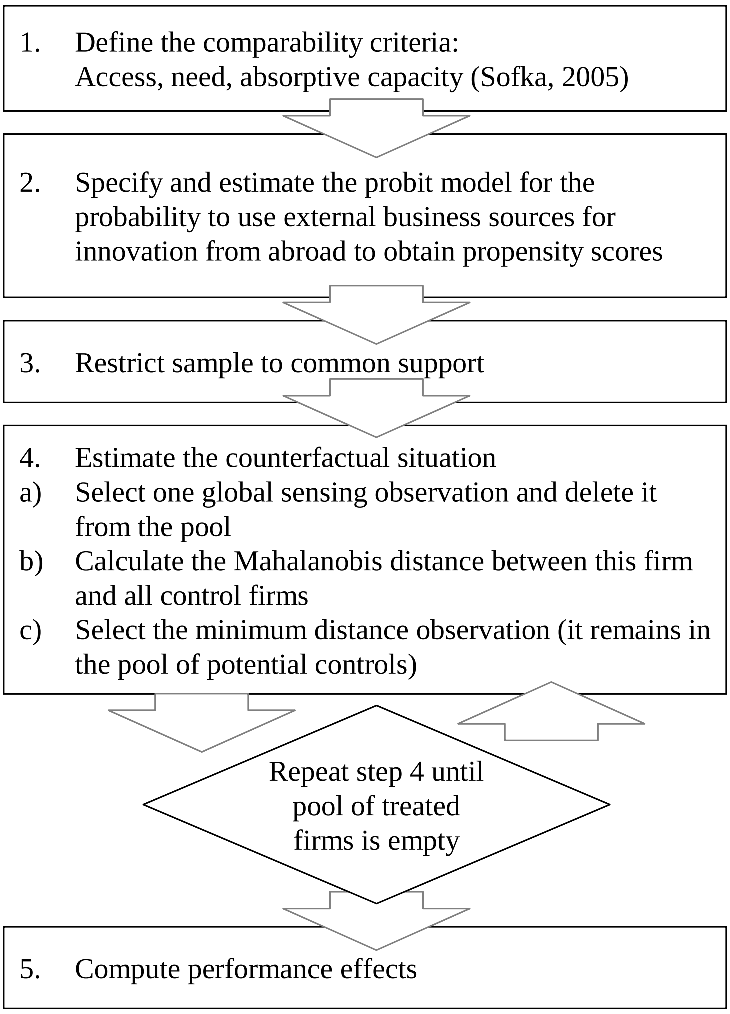
We introduce two additional modifications to our estimation strategy to enhance the quality of the results. First, we complement the propensity score matching with additional conditions to guarantee a proper threshold of comparability. Lechner (1998) suggests this so-called "hybrid matching". In our study this implies that propensity score matching will only be applied to companies which are roughly equal in terms of size (number of employees), industry and regional location (West or East Germany).[6] Secondly, concentrating on properly matched pairs of companies improves the quality of our analysis. Hence, we focus on matched pairs with "common support", i.e. observations with propensity scores above the smallest maximum and below the highest minimum of all sub-samples are eliminated (Czarnitzki et al., 2004).

[5] These differences are usually termed "average treatment effect on the treated (ATT)." The terminology follows matching labor market studies which evaluate the effects of training programs on the unemployed. Those programs are considered a "treatment" and the program participants are the "treated." In our context global sensing is the treatment and global sensing firms are the treated. We consider these terms confusing for our research question and will henceforth avoid them.

[6] We use Mahalanobis distance measures for the conditioning of these variables.

In conclusion, the matching protocol in Figure 3 summarizes our matching approach.[7]

Figure 3: Matching protocol



Source: Own illustration based on Czarnitzki et al. (2004).

[7] This approach was implemented through psmatch2 by Leuven and Sianesi (2003).

5 Content analysis

5.1 Baseline case: Prima facie comparison

In essence, our estimation strategy attempts to provide an answer to the core question of this paper: How does the strategic performance of a company change if it uses global sensing? The hypothetical nature of this question already points towards the challenges in tackling it empirically. The counterfactual situation cannot be observed. One might intuitively suggest comparing the average outcomes between companies that did use these particular sources of innovation with those who did not (prima facie comparison). This procedure would most likely be subject to a selection bias, i.e. the companies in the two groups differ in important characteristics. Thus differences in the outcome variables could not only be attributed to different patterns for using external sources but they could also be explained by differences in size, location or industry effects, to name a few. With this in mind we conduct a prima facie comparison to generate a baseline benchmark for the subsequent stages of analysis. Table 2

Table 2: Results of prima facie comparison

Definition	***Variable***	***Mean***		***t-test***
		Global sensing	*Control*	*t*
Strategic outcomes				
Share of turnover with market novelties	novel	11.350	3.436	9.54***
Sales increase due to quality improvement in per cent	qual	2.637	1.051	4.65***
Cost reduction due to process innovation in per cent	costred	3.776	0.826	9.82***
Strategic potentials				
Innovation strategy industry leader with new products	stratfirstprod	2.179	0.659	23.31***
Innovation strategy technological leadership	strattechleader	2.352	0.655	25.17***
Innovation strategy cost leadership	stratcostleader	1.855	0.613	20.36***

* significant at 10%; ** significant at 5%; *** significant at 1%

With this very basic tool one would be tempted to conclude that global sensing firms are better off on all accounts and companies should rush to establish international sensing capabilities because these will guarantee them competitive advantage. This conclusion would be dangerously myopic. Global sensing firms and the control group differ on a variety of items and each of these mitigating factors could explain large portions of the differences in competitive performance. Section 7.5 gives a full descriptive comparison, so we shall restrict ourselves here to briefly outlining the major differences.

Global sensing companies have roughly six times more employees than the average control firm. Global sensing firms are much more internationalized. Almost every third Euro of their turnover stems from exports while this is only one out of ten for the control group. They are also much more frequently part of a multinational group. While global sensing companies operate in industries in which Germany has a relatively strong international competitiveness (RCAs), the German shares of business expenditures on R&D are roughly equal for both groups. Global sensing firms are both more self-reliant in their innovation activities and more R&D intensive than the control group. They are also much more sensitive to obstacles to innovations than the control firms across the board. Finally, global sensing firms have higher absorptive capacities on average, indicated by the share of college educated employees, relative R&D expenditures and management programs for stimulating innovativeness. In conclusion, a technique needs to be found that addresses these mitigating factors and allows a more unbiased assessment of the strategic value of global sensing.

5.2 Gross potential of global sensing

We apply our empirical matching strategy as outlined in the protocol. As a first step we conduct a probit estimation (our dependent variable is binary in nature: global sensing firm or not) with the ANA variables. Table 10 of the annex outlines the results.[8] The coefficients of the probit estimation support the results from Sofka (2005). We refer to this paper for a discussion of the various effects. At this point we want to focus on performance effects and merely use the probit estimation as a vehicle to achieve meaningful propensity scores.

To enhance the quality of our matching estimation we exclude observations with extreme propensity scores since these are unlikely to produce meaningful benchmark comparisons.[9] The effect of this so-called common support conditioning on our sample is rather limited. Two global sensing observations have to be dropped, leaving us with 322 global sensing companies for further investigation. Subsequently, we conduct the matching for these firms. We add an additional quality check by investigating whether global sensing companies and their matched controls are still significantly different with regard to the variables from the probit estimation. For the vast majority of our variables this is not the case. We can assure that our matched pairs are similar with regard to their industry, size, degree of internationalization and regional location (West/East Germany). For full disclosure we present the mean differences before and after matching in Table 11 of the annex.

Finally, we focus on the outcome variables to compute the treatment effects. Table 3 displays the results. We start the discussion by outlining the merits of our matching procedure based on the first variable: share of turnover with market novelties. In an unmatched state comparing means among the two groups would have suggested that global sensing does in fact increase success with market novelties. After the matching, we know that this result is misleading, as it is effectively based on a comparison of apples and oranges. The matching tells us that when we compare similar companies between the groups, there is no significant difference in turnover with market novelties.

---

8 The estimation performs well with a fit of 0.54 (Aldrich Nelson Pseudo R^2). This makes us confident that we have achieved an adequate foundation for all subsequent steps of our matching procedure.

9 Observations larger than the smallest maximum and smaller than the largest minimum of both groups are eliminated.

Table 3: Gross potential from global sensing

Definition	*Variable*	*Mean*		*t-test*
		Global sensing	*Control*	*t*
Strategic outcome				
Share of turnover with market novelties	novel	11.343	9.292	1.55
Sales increase due to quality improvement in per cent	qual	2.654	1.876	1.81*
Cost reduction due to process innovation in per cent	costred	3.613	1.624	4.45***
Strategic potentials				
Innovation strategy industry leader with new products	stratfirstprod	2.180	1.789	4.97***
Innovation strategy technological leadership	strattechleader	2.348	1.978	4.48***
Innovation strategy cost leadership	stratcostleader	1.848	1.711	1.94*

* significant at 10%; ** significant at 5%; *** significant at 1%

When focusing on the results we find that global sensing does still generate competitive advantage. The internationalization in source usage does not readily translate into a higher share of turnover with market novelties but it does help to refine products (services) and processes. While success is still created within the company and its domestic competitive environment (Porter, 1990), responsiveness and efficiency can be achieved by learning from the foreign parts of the value chain (Bartlett and Goshal, 1987). What is more, this input generates strategic potentials across the board, in technology, costs and timing. While economic efficiency might be achieved in the home market (Porter, 1996), sustainable competitive advantage requires access to the scarce, regional pockets of competitive excellence across the globe (Doz et al., 2001; Porter, 1990). Hence, we can actually identify configurational, metanational advantages (Craig and Douglas, 2000; Doz et al., 2001) from using foreign business sources for innovation.

5.3 Net potential of global sensing

At this point of the analysis one might argue that our analytical approach measures sensing capabilities in general but not global sensing exclusively. We address this issue by fine-tuning our empirical approach. Instead of benchmarking global sensing firms against matched controls from all other firms we constrict this potential control group to firms with sensing activities (global or domestic). This reconfiguration emphasizes the ‘global’ aspect in global sensing and therefore provides additional insight. On the downside, limiting the pool of potential benchmark firms reduces the a priori probability of producing effective matches. We refine our matching procedure accordingly.

To be precise, we have previously outlined a matching procedure that finds the best matching control company for any given global sensing company. This technique is called “nearest neighbor” matching and is the general backbone of the matching analysis. However, in this second step of our investigation we will apply a different matching procedure to a sub-sample. In this sub-sample the number of global sensing and control firms is fairly equal. While it would still be possible to find a suitable control for every firm (a firm can serve as a control for more than one global sensing company) the danger of using a single control firm too often increases. Hence, for the sub sample we choose a different algorithm from the methods surveyed by Heckman et al. (1999). The matching protocol laid out in Figure 3 still applies with a notable exception in step 4. Instead of choosing one particular control firm we construct a weighted match from all control firms. The weights are derived from the differences in propensity scores. An exact match gets a large weight; a poor match has a small weight. The function to generate these weighted matches is called kernel. We utilize the widely-used Epanechnikov kernel (Mueser et al., 2003). Therefore, this procedure is called Epanechnikov kernel matching.

As indicated before, we investigate our net potential from global sensing by narrowing our sample to companies from Western Germany that had used an external business source for innovation (domestic or foreign). For these 405 observations we conduct a probit estimation with the same parameters as before. The results of this estimation are presented in Table 12 of the annex. The fit of this probit estimation is not as good as the previous one but still acceptable (Aldrich Nelson Pseudo R^2 0.28). This might be due to the significantly reduced sample size and the fact that there are no companies in our sample that use foreign business sources exclusively. This leads ultimately to a more homogeneous sample with less variance, which explains the lower fit of this probit model. Nevertheless, we are confident that our Epanechnikow kernel matching strategy delivers high quality results. We base this certainty on the fact that there are no significant differences between the variables of our probit estimation after matching (six observations were dropped due to common support; the full set of unmatched and matched mean differences is presented in Table 13 of the annex). Therefore, we compute the following effects.

Table 4: Net potential from global sensing (Sub sample: external source using companies located in Western Germany)

Definition	*Variable*	*Mean*		*t-test*
		Global sensing	*Control*	*t*
Strategic outcome				
Share of turnover with market novelties	novel	10.825	9.661	0.67
Sales increase due to quality improvement in per cent	qual	2.594	2.177	0.570
Cost reduction due to process innovation in per cent	costred	4.224	3.364	1.160
Strategic potentials				
Innovation strategy, industry leader with new products	stratfirstprod	2.230	2.215	1.190
Innovation strategy, technology leadership in the industry	strattechleader	2.517	2.333	2.030**
Innovation strategy, cost leadership	stratcostleader	1.897	1.975	-0.730

* significant at 10%; ** significant at 5%; *** significant at 1%

Even at first glance, it becomes visible that the special benefit from using foreign business sources for innovation stems from the learning leverage point (Bartlett and Goshal, 1987). For all other performance aspects the merits derived can hardly outweigh the increased costs from crossing physical and cultural borders. Still, when it comes to leading technology, companies need to source this input wherever it occurs on the globe. If these inputs can be leveraged through the value chain instead of foreign direct investments the risks from betting on the wrong horse in a volatile environment can be severely reduced (Doz et al., 2001). Therefore, we find our argumentation from the previous section condensed but substantiated.

6 Conclusion

Our study was designed to thoroughly investigate whether global sensing is a strategic capability. We incorporate several features in our evaluation scheme to ensure that our findings are of a proper quality. On the methodological side, we find the matching approach a very suitable tool for this kind of in-depth evaluation of strategic resources and capabilities. From our experience its unique positive features are twofold: first and most obviously, it controls for contextual factors in the environment while preserving heterogeneity. Secondly, the technique of choosing an almost ideal twin company and assessing the outcome effects based on remaining observable differences makes the matching procedure more accessible and comprehensible for practitioners. They find it easier to relate to the results if the procedure on which it is based intuitively makes sense to them and do not require going into too much empirical detail.

These methodological aspects aside, we find the strongest and most consistent support for global sensing as a strategic enabler for technological leadership. Companies that plan to build their competitive advantage around their technologically unique processes and competencies are more likely to search and find creative sparring partners outside of their home countries. We suggest that these reconnaissance activities are also more targeted and hence cost efficient for them. Pockets of elite technological expertise are less likely to be randomly scattered across the globe. Instead they need substantial physical investments (e.g. specialized labs) and, more importantly, a proven knowledge stock to arise. Hence they can be tracked and traced much more easily.

Secondly, we find no support for the notion that global sensing would provide companies with more success when bringing novel products and services to the market. We argue that global sensing delivers the best results at the beginning and the end of the innovation process. At initial levels new technological opportunities trigger projects, while market inputs at the final stages benefit customizing and debugging activities. At the intermediate stages of the innovation process firms may be more reliant on other competencies and capabilities. We suggest that these unique internal capabilities are still the prime sources of market success with new products while global sensing allows fine tuning and streamlining of products and processes. The results for cost reductions and quality improvements at the gross potential level of analysis support this argument. Nevertheless, longitudinal data would be required for more robust explanations.

We benefited from a large database across many industries, both from manufacturing and services. Still, at this point we can only empirically map the German perspective. We suggest that comparative international studies would yield some additional insights. It would be very interesting to see whether global sensing in the US and Japan has similar results. What is more, we expect a generally different attitude towards global sensing from developing countries.

In conclusion, the purpose of this study was to bring sensibility to the issue of global sensing. While we recommend companies to harvest the benefits of globalization through the access to exciting ideas worldwide, we also caution that global sensing is no magic wand. What is more, our results also highlight the fact that foreign external sources of innovation are generally not superior to domestic sources for competitive advantage. Hence, neglecting this domestic innovation environment just because “global sounds better” would be ill-advised. Just because globalization has opened up space for new branches on the company tree, there is no need to axe or drain local roots.

7 Annex

7.1 Methodological matching issues

Heckman et al. (1999) and Heckman et al. (1997) present a comprehensive survey of techniques to correct for selection biases. There is no universally superior estimation strategy. The method of choice has to be the most appropriate one for a given dataset (Heckman et al., 1998a). The difference-in-difference estimator for instance requires panel data which is not available to us. For cross-section data, instrumental variables (IV) estimators are a frequent choice. IV estimators are an option in our setting. Still, they require at least one variable that is related with the decision to sense globally but otherwise unrelated to the strategic outcome (Blundell and Costa Dias, 2000, 2002). Hence, the requirements for such a perfect instrumental variable are high. Given the limitations of our dataset and the previous conceptual discussion on relevant context factors, we find it difficult to identify an instrumental variable which would not ultimately impair our results. Hence, we opt for the matching procedure.

The matching procedure basically rests upon two central conditions: the conditional independence assumption (CIA) and the stable unit treatment value condition (SUTVA). Rubin (1977) introduced the conditional independence assumption. It implies that treatment and potential outcomes are independent for observations with the same set of matching characteristics (Almus and Czarnitzki, 2001). The validity of CIA cannot be tested empirically (Almus et al., 1999). Given the broad range of variables in our dataset and the fact that the Mannheim Innovation Panel data has been used in the past for several matching studies (Almus and Czarnitzki, 2001; Czarnitzki et al., 2004) as well as with respect to internationalisation activities (Arnold and Hussinger, 2004), we are confident that the CIA makes a reasonable approximation. Angrist et al. (1996) demand that the treatment status of a particular firm must not influence the outcomes of others. Since the usage of foreign suppliers, customers or competitors as a source for innovation (treatment) can not be observed by other firms, we consider it more than unlikely that this fact would influence their outcome variables. Therefore, SUTVA holds for our empirical investigation.

7.2 Operationalization of the ANA framework

Access

Access is captured as a firms' degree of internationalization. We use export intensity[10] as a measurement for internationalization performance and being part of a multinational group[11] for structural internationalization (Sullivan, 1994). To incorporate the supposed curved-linear relationship between the degree of internationalization and derived utility from using external sources from abroad, we additionally introduced the squared export intensity as a separate variable. To account for firm size we introduce the logarithm of the number of employees and for regional effects whether a company is located in the eastern part of Germany or not. For the effect of exceedingly large co-operations the squared values of firm size is added, too.

Need

This item operationalizes actual or perceived deficits within a company or its domestic environment. Shortcomings could be due to country-, industry- or firm-specific factors. We therefore introduce Germany's revealed comparative advantage (RCA)[12] among OECD countries in 2002 at the industry level as a measure for competitive performance and the German share of OECD business R&D expenditures (BERD) by industry in 1999[13] as a measure of competitive potential (Buckley et al., 1988). Openness to new products on domestic markets and domestic market dynamics are measured by the share of turnover with market novelties in the industry.

At a firm level we introduce self-reliance in innovation activities which suggests a pronounced need for external sources. Additionally, the share of turnover taken up by R&D expenditure[14] is a proxy for the importance of innovation activities for the company. By including the squared value of this variable in the model we address companies operating with an extreme degree of R&D intensity. This follows the idea that applied R&D is better decentralized while more fundamental R&D is better performed centrally at home (Dunning,

[10] We use the lagged values for 2001 in this case to achieve clarity in interpretation; for the 2002 data it would be unclear whether an increased export intensity was the result of source usage from abroad or its cause (endogeneity).

[11] In line with Veugelers and Cassiman (1999) we distinguish between multinational groups with headquarters in Germany and abroad to account for different levels of international exposure.

[12] The strength of the RCA analysis stems from the opportunity to assess how successful a country has been on foreign markets (exports) in comparison to the foothold foreign competitors were able to gain in that country's domestic market (imports). Additionally, this ratio is compared to the overall export/import ratio of a particular country to the world as a whole. To be precise, this concept measures not only whether exports of a specific product have outweighed imports, but also whether the trade position for this particular product has been stronger than the overall trade performance of the country considered. At the same time, its formulation in logarithmic terms yields continuous, unbound and symmetric results (Wolter, 1977).

[13] 1999 is the most recent year featuring a high level of data availability.

[14] As stated before, at this point it is not totally clear whether an increased R&D intensity is the result of the usage of foreign sources or its cause (endogeniety). To clarify this casual relationship with R&D intensity as the cause we rely on lagged values for 2001.

1992). While high R&D intensity alone can certainly not provide convincing evidence of basic R&D, it should (carefully) be treated as a reasonable indication in that direction. Finally, three firm-level dummy variables are introduced to the model to account for obstacles to innovation which might in turn trigger a search process for external innovation sources from abroad: high risks and the closely related high costs of innovation projects, a lack of technological information and unfavorable conditions in regulation or governmental bureaucracy (Buckley and Casson, 1998).

Absorptive capacity

Absorptive capacities are not a tangible concept but rather a combination of different competencies and capabilities. Hence companies cannot be easily surveyed to estimate the degree to which they possess these absorptive capacities. We use the employees' level of education and academic achievement (Rothwell and Dodgson, 1991), companies' relative strength in R&D[15] compared to the industry average(Cohen and Levinthal, 1989, 1990) and a variable for the importance management attributes to stimulating innovation (Lane and Lubatkin, 1998; Lord and Ranft, 2000).

Furthermore, border effects have been found to be less pronounced in certain industries, such as semiconductors (Irwin and Klenow, 1994). Hence, six additional, instrumental industry group[16] variables have been introduced to capture industry-specific aspects that would distort the explanatory power of our other exogenous variables.

7.3 Variables

Table 5: Definition of outcome variables

Variable	*Definition*
novel	Share of turnover with market novelties in per cent
qual	Sales increase due to quality improvement in per cent
costred	Cost reduction due to process innovation in per cent
stratfirstprod	Importance of innovation strategy, industry leader with new products on a four point Likert scale (3 equals “high”)
strattechleader	Importance of innovation strategy, technology leadership in the industry on a four point Likert scale (3 equals “high”)
stratcostleader	Importance of innovation strategy, cost leadership on a four point Likert scale (3 equals “high”)

Table 6: Definition of dependent variables

Variable	*Definition*
Foreign business source	Dummy variable is 1 if the company indicated that it used at least one customer, supplier or competitor as a source for innovation from a country other than Germany.

[15] Measured as a firm’s R&D expenditures divided by the industry average.

[16] These industry groups are more broadly defined as “other”, “medium high-tech” manufacturing, and “distributive”, “knowledge-intensive” and “technological” services. The base group in all cases is “other” manufacturing.

Table 7: Definition of exogenous variables

Variable	*Definition*
east	Dummy variable is 1 if the company is located in Eastern Germany.
lnempl	Natural logarithm of number of employees in the year 2002.
sqlnempl	Squared natural logarithm of number of employees in the year 2002.
exonturn01	Share of exports in turnover, 2001.
sqexonturn01	Squared share of exports in turnover, 2001.
fullforeigngroup	Dummy variable is 1 if the company is part of multinational group with foreign headquarters.
nationalintgroup	Dummy variable is 1 if the company is part of multinational group with German headquarters.
fulllrca	The quotient between exports and imports in an industry (NACE2) divided by the quotient between overall German exports and imports in 2002; in logs, multiplied by 100.
worldsharernd	German share of business expenditures on R&D among reporting OECD countries in current PPP USD in 1999 by industry (NACE2).
indumnove	Industry (NACE2) share of turnover with market novelties, 2002.
intdev	Dummy variable is 1 if the company develops its innovations predominantly internally.
mdontum01	Share of R&D expenditures in turnover, 2001.
sqrndonturn01	Squared share of R&D expenditures in turnover 2001.
hemyestechnologicalinfo	Dummy variable is 1 if the company indicated that a lack of technological information obstructed its innovation projects.
hemyescostrisk	Dummy variable is 1 if the company indicated that high economic risks or costs obstructed its innovation projects.
hemyesgov	Dummy variable is 1 if the company indicated that regulation or government bureaucracy obstructed its innovation projects.
grads	Share of employees who are graduates 2002.
quotmd01	The quotient between the firm's R&D expenditures and the industry (NACE2) average in 2001.
stimindex	Index value of management stimulation for innovation. The index was derived as follows: Companies indicated on a four-point scale according to what importance their company assigned to nine different measures of stimulating innovation, ranging from targeted recruiting to immaterial incentives and monetary bonuses. A principal component factor analysis was performed on these nine categories, yielding a single factor with an eigenvalue larger than one (5.94). The index represents these factor loadings after Varimax rotation rescaled between 0 and 1.

Table 8: Definition of instrument variables

Variable	*Definition*
Indugroup1	Dummy variable is 1 if company operates in other manufacturing.
Indugroup2	Dummy variable is 1 if company operates in medium high-tech manufacturing.
Indugroup3	Dummy variable is 1 if company operates in high-tech manufacturing.
Indugroup4	Dummy variable is 1 if company operates in distributive services.
Indugroup5	Dummy variable is 1 if company operates in knowledge-intensive services.
Indugroup6	Dummy variable is 1 if company operates in technological services.

7.4 Industry breakdown

Industry	**NACE Code**	**Industry Group**
Mining and quarrying	10 – 14	Other manufacturing
Food and tobacco	15 – 16	Other manufacturing
Textiles and leather	17 – 19	Other manufacturing
Wood / paper / publishing	20 – 22	Other manufacturing
Chemicals / petroleum	23 – 24	Medium high-tech

Industry	NACE Code	Industry Group
		manufacturing
Plastic / rubber	25	Other manufacturing
Glass / ceramics	26	Other manufacturing
Metal	27 – 28	Other manufacturing
Manufacture of machinery and equipment	29	Medium high-tech manufacturing
Manufacture of electrical machinery	30 – 32	High-tech manufacturing
Medical, precision and optical instruments	33	High-tech manufacturing
Manufacture of motor vehicles	34 – 35	Medium high-tech manufacturing
Manufacture of furniture, jewellery, sports equipment and toys	36 – 37	Other manufacturing
Electricity, gas and water supply	40 – 41	Other manufacturing
Construction	45	Other manufacturing
Retail and motor trade	50, 52	Distributive services
Wholesale trade	51	Distributive services
Transportation and communication	60 – 63, 64.1	Distributive services
Financial intermediation	65 – 67	Knowledge-intensive services
Real estate activities and renting	70 – 71	Distributive services
ICT services	72, 64.2	Technological services
Technical services	73, 74.2, 74.3	Technological services
Consulting	74.1, 74.4	Knowledge-intensive services
Other business-oriented services	74.5 – 74.8, 90	Distributive services

7.5 Descriptive statistics

Table 9: Descriptive statistics: means, standard errors in parentheses

Definition	*Complete sample*	*Global sensing firms*	*Rest*
Access			
Company is located in Eastern Germany (Dummy)	0.35	0.35	0.35
	(0.48)	(0.48)	(0.48)
Number of employees	429.64	1,336.62	210.34
	(3,589.78)	(7,437.40)	(1,553.77)
Number of employees (log)	3.93	4.77	3.73
	(1.72)	(1.91)	(1.61)
Squared number of employees (log)	18.42	26.40	16.49
	(15.83)	(21.04)	(13.62)
Share of exports in turnover 2001	14.21	31.35	10.07
	(22.84)	(27.20)	(19.53)
Squared share of exports in turnover 2001	723.46	1,720.20	482.46
	(1,635.64)	(2,211.80)	(1,357.96)
Company is part of multinational group with foreign headquarters (Dummy)	0.07	0.13	0.06
	(0.25)	(0.34)	(0.23)
Company is part of multinational group with German headquarters (Dummy)	0.10	0.20	0.07
	(0.30)	(0.40)	(0.30)
Need			
Revealed comparative advantage in industry	10.05	17.00	8.37

Definition	*Complete sample*	*Global sensing firms*	*Rest*
2002 (NACE2; in logs; multiplied by 100)			
	(67.09)	(42.29)	(71.72)
German share of global, business R&D in industry 1999	10.12	9.42	10.29
	(6.62)	(5.08)	(6.94)
Industry share of turnover with market novelties	3.15	4.37	2.86
	(3.59)	(3.81)	(3.47)
Company develops innovations primarily internally (Dummy)	0.36	0.76	0.26
	(0.48)	(0.43)	(0.44)
Share of R&D expenditures on turnover, 2001	2.90	7.54	1.78
	(8.05)	(11.70)	(6.41)
Squared share of R&D expenditures in turnover, 2001	73.24	193.43	44.17
	(383.75)	(590.47)	(307.34)
Obstacle - lack of technological information (Dummy)	0.06	0.14	0.04
	(0.23)	(0.34)	(0.19)
Obstacle - innovation costs or risk (Dummy)	0.23	0.48	0.17
	(0.42)	(0.50)	(0.37)
Obstacle - regulation or bureaucratic red tape (Dummy)	0.12	0.25	0.08
	(0.32)	(0.44)	(0.27)
Absorptive capacity			
Share of graduates among employees	23.10	31.11	21.16
	(26.69)	(26.46)	(26.39)
Relative position to industry average in R&D, 2001	0.64	1.95	0.32
	(4.72)	(8.45)	(3.14)
Index value of management stimulation for innovation	0.35	0.51	0.31
	(0.17)	(0.18)	(0.15)
Number of observations	1,664	324	1,340

7.6 Results of the matching procedure for gross potential from global sensing

Table 10: Results from probit estimation of nearest neighbor matching for gross potential from global sensing

Definitions	*Coeff.*	*Robust SE*
Access		
Company is located in Eastern Germany (Dummy)	0.258***	(0.098)
Number of employees (log)	-0.002	(0.101)
Squared number of employess (log)	0.009	(0.010)
Share of exports in turnover, 2001	0.030***	(0.005)
Squared share of exports in turnover, 2001	-0.001***	(0.001)
Company is part of multinational group with foreign headquarters (Dummy)	-0.100	(0.158)
Company is part of multinational group with German headquarters (Dummy)	-0.022	(0.143)

Definitions	Coeff.	Robust SE
Need		
Revealed comparative advantage in industry, 2002 (NACE2; in logs; multiplied by 100)	0.001	(0.001)
German share of global, business R&D in industry, 1999	-0.022**	(0.009)
Industry share of turnover with market novelties	-0.014	(0.014)
Company develops innovations primarily internally (Dummy)	0.479***	(0.107)
Share of R&D expenditures in turnover 2001	0.041***	(0.012)
Squared share of R&D expenditures in turnover 2001	-0.001**	(0.001)
Obstacle lack of technological information (Dummy)	0.273*	0.149
Obstacle innovation costs or risk (Dummy)	0.360***	(0.102)
Obstacle regulation or bureaucratic red tape (Dummy)	0.373***	(0.127)
Absorptive capacity		
Share of graduates among employees	0.005**	(0.002)
Relative position to industry average in R&D, 2001	0.001	(0.008)
Index value of management stimulation for innovation	1.728***	(0.284)
Instruments		
Industry group medium high-tech manufacturing	0.378**	(0.149)
Industry group high-tech manufacturing	0.199	(0.175)
Industry group distributive services	-0.119	(0.171)
Industry group knowledge-intensive services	-0.329	(0.220)
Industry group technological services	-0.085	(0.187)
Constant	-2.621***	(0.283)
Observations	1,664	
Wald chi2(75)	484.53	
Prob > chi2	0.000	
Log-likelihood	-516.173	
Aldrich Nelson Pseudo R2	0.539	

* significant at 10%; ** significant at 5%; *** significant at 1%, robust standard errors in parentheses.

Table 11: Mean differences before and after matching for the ANA-variables of the full sample

Variable	Sample	Mean Treated	Mean Control	t-test t
Access				
Company is located in Eastern Germany (Dummy)	Unmatched	0.349	0.351	-0.07
	Matched	0.348	0.329	0.52
Number of employees (log)	Unmatched	4.770	3.730	10.07***
	Matched	4.749	4.599	1.18
Squared number of employess (log)	Unmatched	26.4	16.49	10.43***
	Matched	26.135	24.332	1.32
Share of exports in turnover, 2001	Unmatched	31.346	10.067	16.18***
	Matched	31.175	28.762	1.23
Squared share of exports in turnover, 2001	Unmatched	1720.2	482.46	12.81***
	Matched	1709	1513.9	1.23
Company is part of multinational group with foreign headquarters (Dummy)	Unmatched	0.130	0.055	4.75***
	Matched	0.130	0.127	0.09

Variable	*Sample*	*Mean*		*t-test*
		Treated	*Control*	*t*
Company is part of multinational group with German headquarters (Dummy)	Unmatched	0.197	0.072	6.93***
	Matched	0.193	0.168	0.98
Need				
Revealed comparative advantage in industry, 2002 (NACE2; in logs; multiplied by 100)	Unmatched	17.001	8.365	2.08**
	Matched	17.088	19.66	-0.77
German share of global, business R&D in industry, 1999	Unmatched	9.422	10.289	-2.12**
	Matched	9.438	9.633	-0.52
Industry share of turnover with market novelties	Unmatched	4.368	2.860	6.88***
	Matched	4.372	4.267	0.34
Company develops innovations primarily internally (Dummy)	Unmatched	0.762	0.260	18.61***
	Matched	0.761	0.767	-0.14
Share of R&D expenditures in turnover 2001	Unmatched	7.540	1.78	12.04***
	Matched	7.500	6.979	0.62
Squared share of R&D expenditures in turnover 2001	Unmatched	193.43	44.173	6.36***
	Matched	193.32	174.69	0.38
Obstacle lack of technological information (Dummy)	Unmatched	0.136	0.037	7.08***
	Matched	0.134	0.090	1.84*
Obstacle innovation costs or risk (Dummy)	Unmatched	0.481	0.167	12.66***
	Matched	0.478	0.404	1.99**
Obstacle regulation or bureaucratic red tape (Dummy)	Unmatched	0.253	0.082	8.84***
	Matched	0.252	0.183	2.15**
Absorptive capacity				
Share of graduates among employees	Unmatched	31.11	21.161	6.09***
	Matched	31.08	29.716	0.66
Relative position to industry average in R&D, 2001	Unmatched	1.947	0.323	5.62***
	Matched	1.868	1.654	0.45
Index value of management stimulation for innovation	Unmatched	0.506	0.307	20.78***
	Matched	0.505	0.483	1.66*
Instruments				
Industry group medium high-tech manufacturing	Unmatched	0.330	0.125	9.12***
	Matched	0.329	0.292	1.05
Industry group high-tech manufacturing	Unmatched	0.173	0.049	7.87***
	Matched	0.171	0.177	-0.14
Industry group distributive services	Unmatched	0.043	0.172	-5.95***
	Matched	0.043	0.043	-0.02
Industry group knowledge-intensive services	Unmatched	0.037	0.149	-5.48***
	Matched	0.037	0.053	-0.97
Industry group technological services	Unmatched	0.157	0.147	0.47
	Matched	0.158	0.146	0.40

* significant at 10%; ** significant at 5%; *** significant at 1%

7.7 Results of the matching procedure for net potential from global sensing

Table 12: Results from probit estimation for net potential from global sensing

Definitions	***Coeff.***	***Robust SE***
Access		
Number of employees (log)	0.097	(0.149)
Squared number of employees (log)	0.001	(0.014)
Share of exports in turnover, 2001	0.017	(0.009)
Squared share of exports in turnover, 2001	-0.001	(0.001)
Company is part of multinational group with foreign headquarters (Dummy)	0.036*	(0.233)
Company is part of multinational group with German headquarters (Dummy)	-0.075	(0.195)
Need		
Revealed comparative advantage in industry, 2002 (NACE2; in logs; multiplied by 100)	-0.001	(0.001)
German share of global, business R&D in industry, 1999	-0.017	(0.013)
Industry share of turnover with market novelties	0.021	(0.023)
Company develops innovations primarily internally (Dummy)	0.008	(0.163)
Share of R&D expenditures in turnover 2001	0.028	(0.019)
	(0.019)	-0.001
Squared share of R&D expenditures in turnover 2001	-0.001	(0.001)
Obstacle lack of technological information (Dummy)	0.188	(0.196)
Obstacle innovation costs or risk (Dummy)	0.222	(0.141)
Obstacle regulation or bureaucratic red tape (Dummy)	0.198	(0.179)
Absorptive capacity		
Share of graduates among employees	0.008**	(0.004)
Relative position to industry average in R&D, 2001	0.001	(0.009)
Index value of management stimulation for innovation	0.445	(0.394)
Instruments		
Industry group medium high-tech manufacturing	0.326	(0.205)
Industry group high-tech manufacturing	-0.072	(0.267)
Industry group distributive services	0.120	(0.299)
Industry group knowledge-intensive services	-0.561*	(0.323)
Industry group technological services	-0.112	(0.267)
Constant	-1.314***	(0.470)
Observations	405	
Wald chi2(23)	72.75	
Prob > chi2	0.000	
Log-pseudolikelihood	-240.996	
Aldrich Nelson Pseudo R2	0.281	

* significant at 10%; ** significant at 5%; *** significant at 1%, robust standard errors in parentheses

Table 13: Mean differences before and after matching for the ANA-variables of the net potential from global sensing

Variable	*Sample*	*Mean*		*t-test*
		Global sensing	*Control*	*t*
Access				
Number of employees (log)	Unmatched	5.132	4.342	4.230***
	Matched	5.013	4.982	0.800
Squared number of employess (log)	Unmatched	30.232	21.960	4.180***
	Matched	28.532	27.872	1.170
Share of exports in turnover, 2001	Unmatched	33.370	17.119	6.560***
	Matched	32.337	32.832	0.200
Squared share of exports in turnover, 2001	Unmatched	1862.7	770.580	5.780***
	Matched	1774.3	1828.9	0.150
Company is part of multinational group with foreign headquarters (Dummy)	Unmatched	0.139	0.082	1.830*
	Matched	0.133	0.144	-0.150
Company is part of multinational group with German headquarters (Dummy)	Unmatched	0.239	0.153	2.180**
	Matched	0.232	0.210	0.700
Need				
Revealed comparative advantage in industry, 2002 (NACE2; in logs; multiplied by 100)	Unmatched	17.705	22.118	-0.840
	Matched	17.696	16.289	0.280
German share of global, business R&D in industry, 1999	Unmatched	9.640	9.791	-0.260
	Matched	9.688	9.741	-0.180
Industry share of turnover with market novelties	Unmatched	4.637	3.484	3.080***
	Matched	4.497	4.679	-0.100
Company develops innovations primarily internally (Dummy)	Unmatched	0.770	0.709	1.400
	Matched	0.768	0.760	0.25
Share of R&D expenditures in turnover 2001	Unmatched	5.899	3.677	2.470**
	Matched	5.651	5.703	0.200
Squared share of R&D expenditures in turnover 2001	Unmatched	129.090	81.070	1.090
	Matched	124.370	136.210	-0.150
Obstacle lack of technological information (Dummy)	Unmatched	0.177	0.102	2.180**
	Matched	0.177	0.166	0.300
Obstacle innovation costs or risk (Dummy)	Unmatched	0.512	0.408	2.100**
	Matched	0.502	0.494	0.370
Obstacle regulation or bureaucratic red tape (Dummy)	Unmatched	0.230	0.163	1.680*
	Matched	0.222	0.216	0.330
Absorptive capacity				
Share of graduates among employees	Unmatched	27.288	25.123	0.810
	Matched	26.730	26.793	0.190
Relative position to industry average in R&D, 2001	Unmatched	2.734	1.189	1.850*
	Matched	1.901	1.895	0.950

Variable	***Sample***	***Mean***		***t-test***
		Global sensing	*Control*	*t*
Index value of management stimulation for innovation	Unmatched	0.525	0.468	3.200***
	Matched	0.522	0.519	0.300
Instruments				
Industry group medium high-tech manufacturing	Unmatched	0.349	0.189	3.680***
	Matched	0.345	0.332	0.380
Industry group high-tech manufacturing	Unmatched	0.134	0.082	1.690*
	Matched	0.128	0.129	0.140
Industry group distributive services	Unmatched	0.053	0.071	-0.780
	Matched	0.054	0.051	0.070
Industry group knowledge-intensive services	Unmatched	0.043	0.143	-3.530***
	Matched	0.044	0.044	-0.02
Industry group technological services	Unmatched	0.153	0.194	-1.080
	Matched	0.153	0.168	-0.410

* significant at 10%; ** significant at 5%; *** significant at 1%

8 References

Al-Laham, A. and T.L. Amburgey (2005), Knowledge Sourcing in Foreign Direct Investments: An Empirical Examination of Target Profiles, *Management International Review* 45 (3), 247-275.

Almus, M. and D. Czarnitzki (2001), *The Effects of Public R&D Subsidies on Firms' Innovation Activities: The Case of Eastern Germany*, ZEW Discussion Paper No. 01-10, Mannheim.

Almus, M., J. Egeln, M. Lechner, F. Pfeiffer and H. Spengler (1999), *Wirkungen Gemeinnütziger Arbeitnehmerüberlassung in Rheinland-Pfalz*, Beiträge Zur Arbeitsmarkt- Und Berufsforschung 225, Nürnberg.

Amit, R. and P.J.H. Schoemaker (1993), Strategic Assets and Organizational Rent, *Strategic Management Journal* 14 (1), 33-46.

Angrist, J.D., G.W. Imbens and D.B. Rubin (1996), Identification of Causal Effects Using Instrumental Variables, *Journal of the American Statistical Association* 91 (434), 444-455.

Archibugi, D. and S. Iammarino (2002), The Globalization of Technological Innovation: Definition and Evidence, *Review of International Political Economy* 9 (1), 98-122.

Arnold, J.M. and K. Hussinger (2004), *Export Behavior and Firm Productivity in German Manufacturing*, ZEW Discussion Paper No. 04-12, Mannheim.

Atuahene-Gima, K. and L. Haiyang (2004), Strategic Decision Comprehensiveness and New Product Development Outcomes in New Technology Ventures, *Academy of Management Journal* 47 (4), 583-597.

Barney, J.B. (1991), Firm Resources and Sustained Competitive Advantage, *Journal of Management* 17 (1), 99-120.

Bartlett, C. and S. Goshal (1989), *Managing across Borders: The Transnational Solution*, Cambridge.

Bartlett, C.A. and S. Goshal (1987), Managing across Borders: New Organizational Responses, *Sloan Management Review* 29 (1), 43-54.

Birkinshaw, J. and N. Fry (1998), Subsidiary Initiatives to Develop New Markets., *Sloan Management Review* 39 (3), 51-62.

Blundell, R. and M. Costa Dias (2000), Evaluation Methods for Non-Experimental Data, *Fiscal Studies* 21 (4), 427-468.

Blundell, R. and M. Costa Dias (2002), *Alternative Approaches to Evaluation in Empirical Microeconomics*, cemmap Working Paper No. 02-10.

Boutellier, R., O. Gassmann, H. Macho and M. Roux (1998), Management of Dispersed Product Development Teams: The Role of Information Technologies, *R&D Management* 28 (1), 13-25.

Branstetter, L.G. (2001), Are Knowledge Spillovers International or Intranational in Scope? *Journal of International Economics* 53 (1), 53-80.

Brush, T.H. and K.W. Artz (1999), Toward a Contingent Resource-Based Theory: The Impact of Information Asymmetry on the Value of Capabilities in Veterinary Medicine, *Strategic Management Journal* 20 (3), 223-250.

Buckley, P.J. and M.C. Casson (1998), Models of the Multinational Enterprise, *Journal of International Business Studies* 29 (1), 21-44.

Buckley, P.J., C.L. Pass and K. Prescott (1988), Measures of International Competitiveness: A Critical Survey., *Journal of Marketing Management* 4 (2), 175-200.

Caves, R.E. (1971), International Corporations: The Industrial Economics of Foreign Investment, *Economica* 38 (149), 1-27.

Chesbrough, H.W. (2003), *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Boston.

Cohen, W.M. and D.A. Levinthal (1989), Innovation and Learning: The Two Faces of R&D, *The Economic Journal* 99, 569-596.

Cohen, W.M. and D.A. Levinthal (1990), Absorptive Capacity: A New Perspective on Learning and Innovation, *Administrative Science Quarterly* 35 (1), 128-153.

Conner, K.R. (1991), A Historical Comparison of Resource-Based Theory and Five Schools of Thought within Industrial Organization Economics: Do We Have a New Theory of the Firm? *Journal of Management* 17 (1), 121-154.

Craig, C.S. and S.P. Douglas (2000), Configural Advantage in Global Markets, *Journal of International Marketing* 8 (1), 6-26.

Czarnitzki, D., B. Ebersberger and A. Fier (2004), *The Relationship between R&D Collaboration, Subsidies and Patenting Activity: Empirical Evidence from Finland and Germany*, ZEW Discussion Paper No. 04-37, Mannheim.

Dierickx, I. and K. Cool (1989), Assett Stock Accumulation and Sustainability of Competitive Advantage, *Management Science* 35 (12), 1504-1511.

Doz, Y.L. and C.K. Prahalad (1984), Patterns of Strategic Control within Multinational Corporations, *Journal of International Business Studies* 15 (2), 55-72.

Doz, Y.L., J. Santos and P. Williamson (2001), *From Global to Metanational: How Companies Win in the Knowledge Economy*, Boston.

Dunning, J.H. (1981), *International Production and the Multinational Enterprise*, London.

Dunning, J.H. (1992), Multinational Enterprises and the Globalization of Innovatory Capacity, in: Granstrand, O., L. Hakanson and S. Sjölander (eds.), *Internationalization of R&D and Technology*, New York.

Eisenhardt, K.M. and J.A. Martin (2000), Dynamic Capabilities: What Are They? *Strategic Management Journal* 21 (10/11), 1105-1121.

Engelbrecht, H.-J. (1996), International R&D Spillovers, Human Capital and Productivity in Oecd Economies: An Empirical Investigation, *European Economic Review* 41, 1479-1488.

Gerfin, M. and M. Lechner (2002), A Microeconometric Evaluation of the Active Labour Market Policy in Switzerland, *Economic Journal* 112 (482), 854-893.

Ghemawat, P. (2001), Distance Still Matters: The Hard Reality of Global Expansion, *Harvard Business Review* 79 (8), 137-146.

Ghemawat, P. (2003), The Forgotton Strategy, *Harvard Business Review* 81 (11), 76-84.

Gottfredson, M., R. Puryear and S. Phillips (2005), Strategic Sourcing: From Periphery to the Core, *Harvard Business Review* 2005 (February), 132-139.

Govindarajan, V. and A.K. Gupta (2001), *The Quest for Global Dominance: Transforming Global Presence into Global Competitive Advantage* 1, San Francisco.

Gupta, A.K. and V. Govindarajan (2000), Knowledge Flows within Multinational Corporations, *Strategic Management Journal* 21 (4), 473-496.

Gupta, A.K. and E.D. Westney (2003), Introduction, in: Gupta, A. K. and E. D. Westney (eds.), *Smart Globalization: Designing Global Strategies, Creating Global Networks*, San Francisco, 1-12.

Hauschildt, J. (2004), *Innovationsmanagement* 3, Munich.

Heckman, J.J., H. Ichimura, J.A. Smith and P. Todd (1998a), Charaterizing Selection Bias Using Experimental Data, *Econometrica* 66 (5), 1017-1098.

Heckman, J.J., H. Ichimura and P. Todd (1998b), Matching as an Econometric Evaluation Estimator., *Review of Economic Studies* 65 (223), 261.

Heckman, J.J., R.J. Lalonde and J.A. Smith (1999), The Economics and Econometrics of Active Labour Market Programs, in: Ashenfelter, A. and D. Card (eds.), *Handbook of Labour Economics*, Amsterdam, 1866-2097.

Heckman, J.J., J.A. Smith and N. Clements (1997), Making the Most out of Program Evaluations and Social Experiments: Accounting for Heterogeneity in Program Impacts, *Review of Economic Studies* 64 (221), 487-536.

Henderson, R. and I. Cockburn (1994), Measuring Competence? Exploring Firm Effects in Pharmaceutical Research, *Strategic Management Journal* 15 (Special Issue Winter), 63-84.

Hoops, D.G., T.L. Madsen and G. Walker (2003), Guest Editors' Introduction to the Special Issue: Why Is There a Resource-Based View? Toward a Theory of Competitive Heterogeneity, *Strategic Management Journal* 24 (10), 889-902.

Hymer, S.H. (1976), *The International Operations of National Firms: A Study of Direct Investment*, Cambridge.

Irwin, D.A. and P.J. Klenow (1994), Learning-by-Doing Spillovers in the Semiconductor Industry., *Journal of Political Economy* 102 (6), 1200-1227.

Jaffe, A.B. and M. Trajtenberg (1999), International Knowledge Flows: Evidence from Patent Citations, *Economics of Innovation & New Technology* 8 (1/2), 105-137.

Janz, N., G. Ebling, S. Gottschalk and H. Niggemann (2001), The Mannheim Innovation Panels (Mip and Mip-S) of the Centre for European Economic Research (Zew), *Journal of Applied Social Science Studies* 121 (1), 123-129.

Klomp, L. and G. van Leeuwen (2001), Linking Innovation and Firm Performance: A New Approach, *International Journal of the Economics of Business* 8 (3), 343-364.

Kogut, B. and U. Zander (1992), Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology, *Organization Science* 3 (3), 383-397.

Lado, A.A., N.G. Boyd and P. Wright (1992), A Competency-Based Model of Sustainable Competitive Advantage: Toward a Conceptual Integration, *Journal of Management* 18 (1), 77-91.

Lane, P.J. and M. Lubatkin (1998), Relative Absorptive Capacity and Interorganizational Learning, *Strategic Management Journal* 19, 461-477.

Le Bas, C. and C. Sierra (2002), 'Location Versus Home Country Advantages in R&D Activities: Some Further Results on Multinationals' Locational Strategies., *Research Policy* 31 (4), 589-609.

Lechner, M. (1998), *Training the East German Labour Force: Microeconometric Evaluations of Continuous Vocational Training after Unification*, Studies in Contemporary Economics, Heidelberg.

Lechner, M. (2000), An Evaluation of Public-Sector-Sponsored Continuous Vocational Training Programs in East Germany, *Journal of Human Resources* 35 (2), 347-375.

Leuven, E. and B. Sianesi (2003), Psmatch2: Stata Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing, and Covariate Imbalance Testing, http://ideas.repec.org/c/boc/bocode/s432001.html.

Levitt, T. (1983), The Globalization of Markets, *Harvard Business Review* 67, 152-61.

Liesch, P.W. and G.A. Knight (1999), Information Internalization and Hurdle Rates in Small and Medium Enterprise Internationalization, *Journal of International Business Studies* 30 (1), 383-394.

Lord, M.D. and A.L. Ranft (2000), Organizational Learning About New International Markets: Exploring the Internal Transfer of Local Market Knowledge, *Journal of International Business Studies* 31 (4), 573-589.

Malmberg, A. and P. Maskell (2005), *Localized Learning Revisited*, DRUID Working Paper No. 05-19.

Maznevski, M.L. and K.M. Chudoba (2000), Bridging Space over Time: Global Virtual Team Dynamics and Effectiveness., *Organization Science: A Journal of the Institute of Management Sciences* 11 (5), 473-493.

Mezias, J.M. (2002), How to Identify Liabilities of Foreignness and Assess Their Effects on Multinational Corporations., *Journal of International Management* 8 (3), 265-283.

Mueser, P., K.R. Troske and A. Gorislavsky (2003), *Using State Administrative Data to Measure Program Performance*, IZA Discussion Paper No. 786.

O'Grady, S. and H.W. Lane (1996), The Psychic Distance Paradox, *Journal of International Business Studies* 27 (2), 309-334.

Ohmae, K. (1990), *The Borderless World: Power and Strategy in the Interlinked Economy*, New York.

Pearce, R.D. (1989), *The Internationalization of Research and Development by Multinational Enterprises*, New York.

Penrose, E.T. (1959), *The Theory of the Growth of the Firm*, New York.

Peteraf, M.A. (1993), The Cornerstones of Competitive Advantage: A Resource Based View, *Strategic Management Journal* 14 (3), 179-191.

Porter, M.E. (1990), *The Competitive Advantage of Nations*, New York.

Porter, M.E. (1996), What Is Strategy? *Harvard Business Review* 74 (6), 61-88.

Prahalad, C.K. and Y.L. Doz (1987), *The Multinational Mission: Balancing Local Demands and Global Vision* 1, New York.

Priem, R.L. and J.E. Butler (2001), Is the Resource-Based 'View" a Useful Perspective for Strategic Management Research? *Academy of Management Review* 26 (1), 22-40.

Rammer, C., B. Peters, T. Schmidt, B. Aschhoff, T. Doherr and H. Niggemann (2005), *Innovationen in Deutschland - Ergebnisse Der Innovationserhebung 2003 in Der Deutschen Wirtschaft*, Zew Wirtschaftsanalysen 78, Baden-Baden.

Rosenbaum, P.R. and D.B. Rubin (1983), The Central Role of the Propensity Score in Observational Studies for Causal Effects, *Biometrika* 70 (1), 41-55.

Rosenbaum, P.R. and D.B. Rubin (1985), Constructing a Control Group Using Multivariate Matched Sampling Methods That Incorporate the Propensity Score, *The American Statistician* 39 (1), 33-38.

Rothwell, R. and M. Dodgson (1991), External Linkages and Innovation in Small and Medium-Sized Enterprises, *R&D Management* 21, 125-137.

Rouse, M.J. and U.S. Daellenbach (1999), Rethinking Research Methods for the Resource-Based Perspective: Isolating Sources of Sustainable, *Strategic Management Journal* 20 (5), 487-494.

Rouse, M.J. and U.S. Daellenbach (2002), More Thinking on Research Methods for the Resource-Based Perspective, *Strategic Management Journal* 23 (10), 963-967.

Rubin, D.B. (1977), Assignment to Treatment Group on the Basis of a Covariate, *Journal of Educational Statistics* 2, 1-26.

Rugman, A.M. and A. Verbeke (2003), Extending the Theory of the Multinational Enterprise: Internalization and Strategic Management Perspectives, *Journal of International Business Studies* 34 (2), 125-137.

Rugman, A.M. and A. Verbeke (2004), A Perspective on Regional and Global Strategies of Multinational Enterprises, *Journal of International Business Studies* 35 (1), 3-18.

Sofka, W. (2005), *Global Idea Sourcing: An Empirical Investigation into the Mechanisms Behind the Usage of Foreign Business Sources for Innovation*, ZEW Discussion Paper No. 05-53, Mannheim.

Stock, G.N. and M.V. Tatikonda (2004), External Technology Integration in Product and Process Development, *International Journal of Operations & Production Management* 24 (7), 642-665.

Veugelers, R. and B. Cassiman (1999), *Importance of International Linkages for Local Know-How Flows: Some Econometric Evidence from Belgium*, CEPR Discussion Paper No. 2337, London.

Von Zedtwitz, M. (2004), Managing Foreign R&D Laboratories in China, *R&D Management* 34 (4), 439-452.

Von Zedtwitz, M. and O. Gassmann (2002a), Managing Customer Oriented Research, *International Journal of Technology Management* 24 (2/3), 165-193.

Von Zedtwitz, M. and O. Gassmann (2002b), Market Versus Technology Drive in R&D Internationalization: Four Different Patterns of Managing Research and Development, *Research Policy* 31 (4), 569-588.

Wernerfelt, B. (1984), A Resource-Based View of the Firm, *Strategic Management Journal* 5 (2), 171-180.

Wolter, F. (1977), *Factor Proportions, Technology and West-German Industry's International Trade Patterns*, Weltwirtschaftliches Archiv No. 113, Tübingen.

Zaheer, S. (1995), Overcoming the Liability of Foreignness., *Academy of Management Journal* 38 (2), 341-364.

Zander, U. and B. Kogut (1995), Knowledge and the Speed of the Transfer and Imitation of Organizational Capabilities: An Empirical Test, *Organization Science* 6 (1), 76-92.