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## On the Discrepancies between Macro and Micro Level Identification of Competitive Strategies

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**Abstract**

As economic internationalization advances, the question of how firms cope with increasing pressure for competitiveness gains momentum. While scholars agree that firms need a competitive advantage, they debate whether firms exploit the comparative advantage of their economy and specialize in that strategy facilitated by national institutions. 'No', argue strategic management proponents of the resource-based view. 'Yes', claim contributors to the competitiveness literature. My micro-level studies of these opposing views show that firms within one economy do not specialize in the institutionally supported strategy. The discrepancies between these findings and the analyses of the competitiveness literature are attributed to differences in the indicators employed to measure corporate strategies. Whenever macro-level indicators are used, the related loss of information on micro-level variety entails that specialization effects are pronounced – possibly exaggerated.

**Keywords**

Competitive advantage; comparative advantage; corporate strategies, varieties of capitalism; resource-based view; institutions, pharmaceutical industry

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## *Introduction*

How do firms adapt to the pressures of increasing international competition? Do they exploit the comparative advantage offered by national institutions and specialize in the facilitated competitive strategy? Agreement is broad amongst scholars of competitiveness that firms need a sustainable *competitive advantage* if they want to succeed in their business on the long run. Firms need to pursue a strategy through which they achieve superior performance than their competitors by offering special value to customers (Kogut 1985; Porter 1985; Barney 1991: 102-103; Teece et al. 1997; Walker 2003: 17-18). Customer value can be offered in the form of an entirely new, an improved, or a low-cost product (Porter 1985; Grant 1998: part III; Hall and Soskice 2001a: 36-44; Walker 2003: 20-34, see also section 2.1).

However, disagreement concerns the question as to whether firms should use the *comparative advantage* of their institutional environment as the main source of *competitive advantage*. Should firms choose their competitive strategy in line with national institutions? 'Ideally not', argue advocates of the resource-based view. Even though external threats and market opportunities should not be ignored, the actual competitive advantage of a firm can only arise from its internal strengths and weaknesses. Firms need to exploit their individual resources in order to distinguish themselves from competitors. Only if they use their exclusive capabilities can firms gain competitive advantage and implement a value-creating strategy not imitated by their rivals (e.g. Rumelt 1984; Wernerfelt 1984; Barney 1991; Conner 1991; Peteraf 1993).

'Yes!', claim proponents of the specialization argument – including scholars of classical and neoliberal trade theory[1], of the market-based view within strategic management studies[2], of the literature on national innovation systems[3], and of the varieties-of-capitalism contributions[4]. Since national institutions provide specific types of input factors – most importantly finance, standards, and labour qualifications – which, in turn, facilitate specific strategies, firms maximize their competitiveness if they choose *that* strategy supported by national institutions.

This article seeks to assess the two opposing arguments by asking: do firms within the one economy specialize in the same competitive strategy? To answer this question, the strategy of pharmaceutical firms in the UK, Germany, and Italy are identified. The study of *pharmaceutical firms*[5] seems particularly appropriate as competitive strategies can be

[1] See, for example Heckscher 1919; Ohlin 1933; Lindbeck and Snower 2001; Sinn 2005.
[2] Porter (1987; 1990) is to be named as the most important proponent of this view.
[3] See Pavitt and Patel 1999; Lundvall and Maskell 2000; Casper and Matraves 2003; Casper and Whitley 2004.
[4] See in particular Hall and Soskice 2001b; Amable 2003; Hancké and Herrmann 2007.
[5] I here follow the commonly acknowledged definitions of pharmaceutical, biotech, traditional pharmaceutical, and generics firms (Drews 2000; Orsenigo et al. 2001; Pammolli et al. 2002; Muffatto and Giardina 2003; Wittner 2003). The broad term of a 'pharmaceutical firm' is generally used for any company which is active in the pharmaceutical industry. Accordingly, the firm is assigned to this industry on the basis of the *product* which it manufactures, namely a drug that cures or alleviates a disease. The distinction between a biotechnology, a traditional pharmaceutical and a generics firm refers to the *technological approach* which the company in question uses. Thereby, 'biotechnology firms' are said to employ the most modern technology as they use processes on the level of the cell and sub-cell to create industrially useful substances. While 'traditional pharmaceutical firms' are aware of, and also resort to, biotechnological opportunities, they tend to use experimental and, hence, less deliberate approaches to drug design. Finally, 'generics firms' are the least technology-

identified in a straightforward way due to the scientifically established notion of a 'new chemical entity'.

The study of firms *in Germany, Italy, and the UK*, in turn, promises particularly insightful results for three reasons. First, factors which influence firms' strategy choices other than those institutions retained as essential by the competitiveness literature need to be controlled for. In the pharmaceutical industry, such factors are regulatory constraints, like patent legislation, safety regulation, and price controls (Thomas III 1994; Gambardella *et al.* 2001; Wittner 2003; Thomas III 2004). Importantly, these factors differ notably between the EU, the US, and other capitalist economies. However, following the single market project and the foundation of the European Medicines Agency in 1995, which coordinates the evaluation and supervision of health standards with respect to medicinal products across the European Union, regulatory requirements are today fairly homogeneous throughout the EU member states (Gambardella *et al.* 2001; Casper and Matraves 2003: 1868; Wittner 2003; EMEA 2006). To control for their influence on firms' strategy choices, an intra-EU comparison of countries seems appropriate. Second, competitive pressure on firms to take advantage of national institutions and specialize in the supported strategy is particularly high in the EU member states following the single market project.

Finally, within the EU, it is advisable to select those economies which are most different from each other as they offer firms an ideal institutional environment for the pursuit three, inherently different strategies: radical product innovation (henceforth RPI), diversified quality production (henceforth DQP), and low cost production (henceforth LCP). These are the UK, Germany, and Italy respectively. Across the competitiveness literature, there is broad agreement that the deregulated environment of the UK facilitates RPI, as economic interaction is flexible. This encourages outstanding employee performance, market races amongst firms to set new standards, and the provision of seed (venture) capital.[6] The regulating institutions in Germany, by contrast, support DQP, as they enable cooperative relations amongst firms and their stakeholders. Accordingly, employees invest in firm-specific skills, suppliers and producers cooperate to establish new standards, and banks offer 'patient' capital.[7] Finally, the low-wage levels and family-provided finance of the Italian economy are said to facilitate LCP.[8]

Contrary to most competitiveness studies measuring competitive strategies through macro-level indicators, strategies are here identified at the micro level, by considering the technology intensity of pharmaceutical firms. This makes it possible to reveal how many firms pursue the same strategies across *and* within different economies. Will this micro-level assessment support the strategy specialization argument? In answer to this question, section 1 conceptualizes and operationalizes competitive strategies. This approach is applied in section 2 when one of the largest pharmaceutical databases is sampled. To evaluate the results obtained, section 3 discusses whether competitive strategies are mutually exclusive. Building

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intensive, as they do not engage in any research and clinical development activities. Instead, they imitate drugs as soon as their patent protection expires.

[6] See in particular Porter 1990: 482-507; Pavitt and Patel 1999; Estevez-Abe et al. 2001; Hall and Soskice 2001a: 36-44; Tate 2001; Vitols 2001; Amable 2003; Casper and Matraves 2003; Casper and Whitley 2004; see also Lindgaard Christensen 1992; Freeman 1992; Walker 1993; Hollingsworth 2000.

[7] Proponents are in particular Porter 1990: 355-382; Pavitt and Patel 1999; Hollingsworth 2000; Estevez-Abe et al. 2001; Hall and Soskice 2001a: 36-44; Tate 2001; Vitols 2001; Amable 2003; Casper and Matraves 2003; Casper and Whitley 2004; Sinn 2005; see also Lindgaard Christensen 1992; Freeman 1992; Keck 1993.

[8] Estevez-Abe *et al.* 2001: 175-176; see Porter 1990: 421-453; Malerba 1993.

on these insights, the summary assessment of section 4 negates the specialization idea. Section 5 summarizes the previous findings and introduces the research puzzle to be solved in part II of the book: How can firms compete by pursuing a strategy that is not facilitated by national institutions?

### *1. How to distinguish competitive strategies: concepts and operationalization*

In line with major analysts of firm competitiveness (Porter 1980: chapter 1; Porter 1985: chapter 1; Andrews 1987: chapter 2; Grant 1998: chapter 1; Walker 2003: 17-18; see also Hall and Soskice 2001a: 14-17), a competitive strategy is understood here as a process that translates into the development of products which offer unique customer value. If pursued successfully, a competitive strategy enables firms to achieve a competitive advantage, i.e. superior performance than their competitors.

The competitiveness literature distinguishes between three, inherently different strategies on the basis of their technology intensity. If a sustainable advantage arises from the development of entirely new products, being the result of a *radical technological innovation*, the developing firm is said to pursue a strategy of 'radical product innovation'.[9] If a firm competes by selling known but improved products as a result of an *incremental technological innovation*, it is found to be engaged in diversified quality production.[10] Finally, if firms sell standardized goods, resulting from the *imitation* of an established technology, they are held to pursue a strategy of low cost production.[11] In this research project, I follow the differentiation proposed by the literature and distinguish accordingly between: *radical product innovation* (RPI), *diversified quality production* (DQP) and *low cost production* (LCP).

When consulting the literature for advice on how to measure strategy specialization, two peculiarities are striking. First, competitiveness scholars hardly provide reference points for assessing specialization patterns *within one economy*. They usually take the 'revealed comparative advantage' as indicator for strategy specialization which compares, for a certain industry, the export performance of one economy relative to the export performance of a reference group of countries. If firms in this economy export more than firms of the reference group, the former are said to have specialized in the production of the studied industry's goods[12]. Standardized measures of patent registrations or citations are used as an alternative measure for relative strategy specialization[13]. But do all, the absolute majority, or simply the plurality of firms *within one industry of one country* need to pursue the same strategy in order to constitute empirical instances of specialization effects?

These measures entail a second peculiarity. Strategy specialization is systematically assessed through macro characteristics of firms. That is, firms are attributed a strategy on the basis of the *industry* in which they are active. The finding that specific high-, medium-, or low-tech industries are more developed in one economy than in others is cited as empirical

[9] See Lundvall 1992a: 11-12; Lundvall 1992b: 58-59; Estevez-Abe et al. 2001: 149, 174; Casper 2001: 398; Hall and Soskice 2001a: 38-39.

[10] See in particular Streeck 1991; see also Porter 1985: 14; Lundvall 1992a: 11-12; Lundvall 1992b: 57-58; Estevez-Abe et al. 2001: 148-149, 174; Casper 2001: 399-400; Hall and Soskice 2001a: 39.

[11] Proponents are Porter 1985: 12-14; Estevez-Abe et al. 2001: 148, 175; Casper 2001: 398-399; see also Ohlin 1924: 89; Heckscher 1919: 55-58; Sinn 2005: 18-19.

[12] For examples see Fagerberg 1992; Dalum 1992; Keck 1993: 133-137; Hancké and Herrmann 2007; see also Porter 1990: 179-541; Amable 2003: 200-209; Sinn 2005.

[13] see Chesnais 1993: 220-226; Walker 1993: 168-169; Pavitt and Patel 1999; Estevez-Abe et al. 2001: 174-176; Hall and Soskice 2001a: 36-44; also Amable 2003: 200-209.

proof of the idea that firms in this economy have specialized in high-, medium, or respectively low-innovation strategies. But whenever technology intensity of entire industries is taken as a proxy for competitive strategies, this entails the simplifying assumption that all firms of this industry pursue the same strategy (Rumelt 1984: 559-560; Barney 1991: 100). Yet, isn't it more plausible to assume that firms can pursue different strategies?

A noteworthy exception to the identification of relative specialization patterns at the industry level is provided by innovation studies which compare the absolute development of 'market segments' (Casper et al. 1999) or 'sub-sectors' (Casper and Soskice 2004; Casper and Whitley 2004) within the biotech industry. These studies suggest that biotech firms developing *therapeutics* pursue a radical innovation strategy, as this market segment is characterized by discrete technological innovation. On the other hand, firms in the market segment of *platform technologies* are said to engage in diversified quality strategy, since this segment is particularly susceptible to 'cumulative or incremental patterns of technical change' (Casper and Soskice 2004: 368; see also Casper et al. 1999: 15). Mostly based on studies of the late 1990s, the share of radically innovative therapeutics firms is found to be above average in the UK, whereas the percentage of incrementally innovative platform providers is above average in Germany (Casper et al. 1999: 20-21; Casper and Soskice 2004: 365-366; Casper and Whitley 2004: 98).

However, two difficulties are related to identifying strategies of biotech firms via their industrial sub-sector. First, any young biotech industry is characterized by a high share of platform technology providers. Since it takes, by now, almost 15 years to turn a pharmaceutical discovery into a profitable drug (Muffatto and Giardina 2003: 109), many young biotech start-ups which ultimately aim at developing a therapeutic product (have to) commercialize their knowledge by providing platform technologies. But this usually is a temporary means to secure finance, rather than a strategy in itself (Freyberg 2004). Once providers of platform services have developed their discovery far enough to acquire venture capital, they often turn into dedicated therapeutics firms. With increasing maturity of a country's biotech industry, the share of platform-technology firms decreases and specialization patterns disappear – also in Germany (Ernst & Young 2005: 65; Ernst & Young 2006: 47). Second, 'platform-technology firms create the research tools used in therapeutics' (Casper et al. 1999: 21). In other words, they are service providers, whereas therapeutics firms seek to develop products (Freyberg 2004). Since the provision of services might follow a different operational logic than manufacturing activities, it seems risky to compare firms of the secondary and tertiary sector. Differences in the organizational structure might be a consequence of special sectoral requirements rather than of particular strategies.

To identify corporate strategies across *and* within different economies, I therefore decided to combine two micro-level indicators: the technological novelty of a firm's products, and its value chain focus. To this end, the scientifically established notion of a 'new chemical entity' (henceforth NCE) makes *therapeutics* firms particularly appropriate cases to study. An NCE constitutes a chemical entity which has not been discovered thus far. It is scientific practice to indicate whether active or excipient ingredients of a pharmaceutical product are NCEs, modifications of already discovered entities, or mere imitations. Accordingly, patent-protected pharmaceuticals can take one of two forms. They may be radically new as they are based on an NCE. Or, they are incrementally new in that they introduce slight changes to already discovered chemical entities, which improves the drugs' efficiency. For example, undesired side-effects are limited, or the frequency or quantity with which a drug has to be consumed is reduced. Yet not all pharmaceutical companies engage in research and development (henceforth R&D) activities. As soon as patent protection expires, (generics) firms compete by imitating a product's active or excipient compounds so as to sell the imitated drug at lowest possible prices (see Wittner 2003).

Using this classification, I propose the following differentiation between competitive strategies (see Bottazzi et al. 2001: 1162-1167). Pharmaceutical firms inventing drugs based on NCEs pursue an RPI strategy, whereas firms improving already discovered chemical entities compete through DQP. Firms which do not engage in R&D, but focus on imitating innovations made by others, pursue an LCP strategy.

The PHID database, one of the largest pharmaceutical databases worldwide, allows the identification of a firm's competitive strategy via the chemical entities employed in that firm's drugs[14]. Developed by a group of researchers at the University of Siena, the PHID database keeps track of 16751 pharmaceutical projects carried out by 3522 firms and public research organizations in 7 countries[15].[16] The latter include Germany, Italy, and the UK, in addition to France, Japan, Switzerland, and the USA[17]. In these countries, any firm that participates/d in the development of an innovative drug is incorporated in the database. More precisely, a firm is included as soon as it is, or has been, involved in at least one pharmaceutical project which has reached the stage of preclinical development since the 1980s. Even firms whose pharmaceutical projects are/were not granted patent protection are thus recorded. Only (generics) companies which abstain from traditional R&D activities are not considered in the database. Furthermore, and importantly for the aim of this study, pharmaceutical firms are considered only if their projects translate(d) into therapeutic drugs curing or alleviating human diseases. Providers of platform technologies active in the service sector are not included. The comparison of firms in the manufacturing and service sector is thus avoided (see Casper et al. 1999; Casper and Soskice 2004; Casper and Whitley 2004).

In addition to the novelty of chemical entities, the PHID database contains a second micro-level measure which allows the identification of a firm's strategy: its value-chain focus. The latter can be derived from the database's classification of firms as *developers*, *licensors* and *licensees*. To understand these terms, it is important to note that the pharmaceutical industry is characterized by a remarkable division of labour (see Gambardella et al. 2001: 36-53). Any drug that is sold on the market must have passed through three major stages. The first is the *research stage* (drug discovery and preclinical development) during which a firm discovers how a chemical entity interacts with other molecules in such a way that a curative effect can be obtained. The second, namely the *development stage* consists in turning this discovery into a pharmaceutical product. During the phases of 'clinical development I, II and III', a firm experiments in which form and dosage the drug should be administered. Furthermore, undesired side effects are recorded and, if possible, reduced or eliminated. Finally, any relevant information regarding both the drug's features and its production process are documented in the third, i.e. the *registration stage*. This documentation is then handed to the responsible national or international authorities in order to obtain a marketing authorization (see Muffatto and Giardina 2003: 112-116; Drews 1999: 117-154).

The Italian researchers administering the PHID database show that these three stages are often not carried out by the same firm. Instead, pharmaceutical companies tend to divide labour, and specialize in upstream, midstream, or downstream activities (see Orsenigo et al. 2001; Bottazzi et al. 2001; Owen-Smith et al. 2002; Pammolli et al. 2002). Interestingly,

[14] An overview of the database's population, the sampling strategy employed, and possible sampling biases is provided in the technical appendix.

[15] A firm is defined as a legal entity and its nationality is determined by the location of its headquarter.

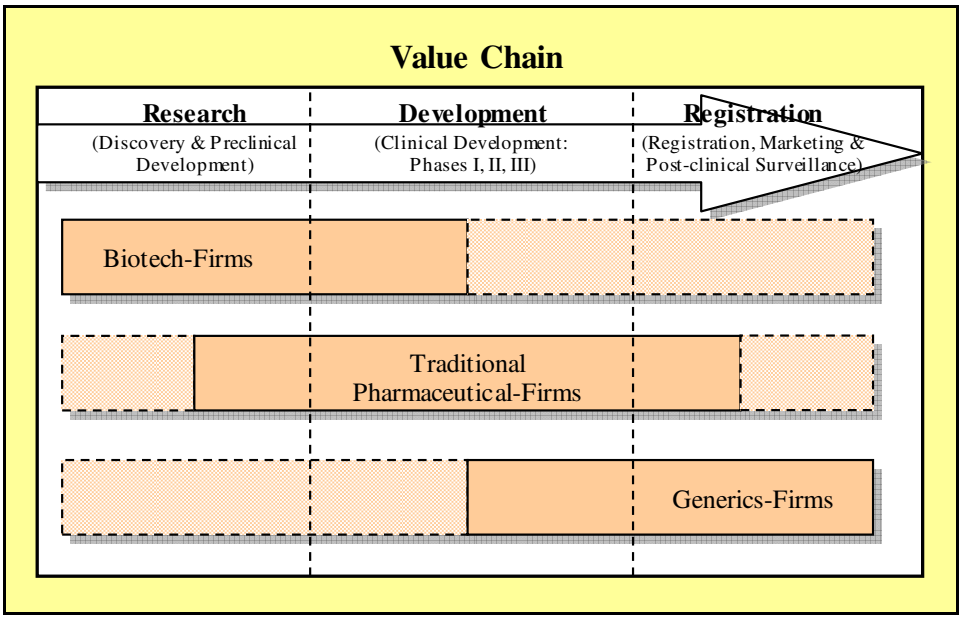
[16] Since this database is constantly updated, these figures refer to November 2004.

[17] To be precise, the PHID database covers 67 countries. However, the number of pharmaceutical projects considered in the other 60 countries is too limited to provide representative results.

labour division is not only pronounced between innovative pharmaceutical firms on the one hand, and generics firms on the other (see Pammolli et al. 2002). It is also importantly takes place amongst innovative firms (see Orsenigo et al. 2001; Bottazzi et al. 2001; Owen-Smith et al. 2002).

The latter labour division is reported in the PHID database by the previously mentioned distinction between *developers*, *licensors* and *licensees*. A *developer* is a firm with a fully integrated value chain, as it carries out all stages on its own. A drug is thus discovered, developed and registered by the same firm. A *licensor*, on the other hand, initiates a project which ultimately translates into a new drug. However, focusing on the research stage (i.e. on discovery and preclinical development), the licensor decides at a certain point to out-license its discovery to another firm which continues the clinical development and registration process. Accordingly, a *licensee* focuses on the stages of (late) clinical development and registration in order to translate the respective discovery into a marketable drug. Using this distinction, the Italian researchers show that biotech firms tend to be licensors, whereas traditional pharmaceutical firms are often licensees (Orsenigo et al. 2001). Graph 1 provides an overview of labour division in the pharmaceutical industry.

**Graph 1: Labour Division in the Pharmaceutical Industry**




Source: Own illustration based on the work of Gambardella et al. (2001), Orsenigo et al. (2001), and Pammolli et al. (2002)

Combining information on product novelty and value-chain focus makes it possible to identify radical product innovators, diversified quality producers, and low cost producers as follows.

- A firm pursues an RPI strategy whenever it is the *developer*, or *licensor* of a pharmaceutical project which translates into a drug based on an NCE. Since the discovery of the NCE is made by the licensor, the latter is ***radically innovative*** irrespective of

whether the licensing agreement is made at the development or the registration stage of a pharmaceutical project.

- Following this logic, a firm pursues a DQP strategy whenever it *develops* or *out-licenses* a project that improves a previously discovered chemical entity. In addition to this, a firm also pursues a DQP strategy if it *in-licenses* a pharmaceutical project based on an NCE *at the stage of clinical development*. At that moment, the previously unknown chemical entity has been discovered so that it is the task of the licensee to improve the chemical entity such as to optimize its effectiveness and dosage. Hence, both licensees of a clinical development agreement, and developers or licensors of an improved drug pursue a DQP strategy, as they are not radically but ***incrementally innovative***.
- This leaves us with a third group of firms that conclude *in-licensing* agreements with the purpose of registering and marketing both radically or incrementally new drugs. Interestingly, these firms concur with generics firms in that both abstain from engaging in expensive R&D activities. Instead, their strategy consists in producing and selling drugs at the ***lowest possible costs***.

### *2. Do firms in Germany, Italy, and the UK specialize in the same strategy?*

Will this micro-level approach to identifying competitive strategies provide empirical support for the idea that firms use the comparative institutional advantages of their economy and specialize in the facilitated strategy? Do British firms mostly engage in RPI, whereas German companies specialize in DQP, while their Italian counterparts prefer the pursuit of an LCP strategy? Tables 1 – 3 summarize the results obtained from sampling the PHID database. Given that it takes on average 14 years to develop a pharmaceutical product (Muffatto and Giardina 2003: 108-109), the sample has been limited to the last 20 years in order to cover a sufficiently long time span, while eliminating outdated results. Accordingly, only those firms were considered which are/were involved in the advancement of, at least, one pharmaceutical project since 1985.

The most important finding in answer to the question of strategy specialization is that the obtained strategy patterns of firms are virtually the same for the UK, Germany, and Italy! Since a considerable number of radical product innovators, diversified quality producers and of low cost producers can be found in the UK, Germany, and Italy alike, strong specialization effects cannot be assessed.

Regarding the sample size, it is noteworthy that the British sample is slightly larger as comparatively few biotech firms are included in the German, and hardly any in the Italian sample. The reason for this is the difference in age of the British, German, and Italian biotech industries. While this industry began to crystallize in Britain in the 1980s (see Ernst & Young 2003; Thomson Financial 2004), most biotech firms in Germany were founded in the mid- and late 1990s (ibid., see also Hinze et al. 2001: 18-24). Italian biotech firms are even younger, as they were mostly founded around the turn of the millennium (Chiesa 2004: 10-18; Pozzali 2004; Vingiani 2006). Therefore, many today successful biotech firms in Germany and Italy had not yet, or just recently, brought a pharmaceutical project beyond the stage of preclinical development – and were thus not included in the PHID database – when the latter was sampled in November 2004. This explains the smaller size of the German and Italian sample.

Interestingly, though, these age differences do *not* lead to differences in the share of firms pursuing an RPI strategy. Accordingly, tables 2.1 to 2.3 illustrate how labour division in Britain takes place *between* biotechnology and traditional pharmaceutical firms. In Germany and Italy, by contrast, the lower number of biotech firms makes that labour division is more

pronounced *within* the traditional pharmaceutical industry, namely between (small) research-oriented, and (large) development-oriented firms (see also Gambardella et al. 2001: 45).

A more in-depth interpretation of the results reported in tables 2.1 to 2.3 allows to classify firms with regard to the competitive strategy they pursue. The most clear-cut distinction between competitive strategies can be made between non-innovative low cost producers on the one hand, and innovation-driven pharmaceutical firms on the other. As mentioned above, generics firms are not included in the PHID database and, consequently, in any of the three samples, as they do not engage in R&D activities. Imitating a once patent-protected drug, generics producers are not legally obliged to perform clinical trials as long as they can demonstrate that the imitated drug is bioequivalent to the original pharmaceutical. Avoiding the extremely expensive stages of clinical development is precisely what allows generics firms to produce and market drugs at low prices. The absence of any generics firm from the sample thus shows that this category of firms indeed pursues an LCP strategy.

A second group of low cost producers consists in those firms that specialize in the registration phase of pharmaceutical products. In addition to these ***marketing specialists***, several pharmaceutical firms conclude marketing agreements at the registration stage, even though they are also active in R&D. It is noteworthy that these seemingly ambiguous cases are almost exclusively constituted by large, internationally active firms with an extensive product range. In these cases, the in-licensing of pharmaceutical products does not constitute a competitive strategy in itself, driven by technological considerations. It is rather a commercial tool to grant partner firms access to the home market in order to secure the own international presence. Since these pharmaceutical firms do not pursue a genuine LCP strategy, only the pure marketing specialists are counted as low cost producers.

Among the pharmaceutical firms which are active in R&D, the distinction between radical product innovators on the one hand, and diversified quality producers on the other, requires particular attention. Whilst one group of ***pure diversified quality producers*** which in-license pharmaceutical projects at the development stage can be unambiguously recognized, the identification of pure radical product innovators is more difficult.

## Table 1: Radical Product Innovators, Diversified Quality Producers and Low Cost Producers in the UK

| Firm Type | Company Name | Technology Focus | Number Employees | Firm Age | Developer NCE | Licensor NCE | Developer Non-NCE | Licensor Non-NCE | Licensee Dev.-Phase NCE | Licensee Dev.-Phase Non-NCE | Licensee Reg.-Phase | Competitive Strategy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Discoverers of NCE** | Cancer Research Technology | TrPh | 67 | 41 | | 1 | | 3 | | | | RPI |
| | Celltech Group | BioT | 724 | 24 | | 1 | | 1 | | | 1 | RPI |
| | Imperial Cancer Research | TrPh | 19 | 102 | | 1 | | 1 | | | | RPI |
| | Pharmagene | BioT | 79 | 7 | | 1 | | 1 | | | | RPI |
| | Protherics | BioT | 219 | 5 | | 2 | | 1 | | | | RPI |
| **Ambiguous Cases** | Acambis | BioT | 270 | 12 | | | 1* | | | | 1 | RPI |
| | Amarin | BioT | 24 | 15 | | | | 3 | | | 1 | RPI |
| | Antisoma | BioT | 45 | 16 | | | 1* | | | | | RPI |
| | CeNeS | BioT | 14 | 7 | | | 7* | | | | 1 | RPI |
| | Henderson Morley | BioT | 6 | 8 | | | 1* | | | | | RPI |
| | KS Biomedix | BioT | 65 | n.a. | | | 1* | | | | 2 | RPI |
| | Onyvax | BioT | 37 | 7 | | | 1* | | | | 1 | RPI |
| | PowderJect | BioT | 750 | 11 | | | | 2 | | | | RPI |
| | Scotia | BioT | n.a. | 20 | | | | 4 | | | | RPI |
| | SkyePharma | BioT | 476 | 8 | | | | 4 | | | 1 | RPI |
| | Xenova | BioT | 105 | 17 | | | | 3(*) | | | | RPI |
| **Diversified Quality Producers** | Axis Genetics | BioT | n.a. | n.a. | | | 1* | | | 2 | | DQP |
| | Britannia | TrPh | 130 | 23 | | | 1 | | | | | DQP |
| | Galen | TrPh | 104 | 36 | | | 1 | | | | | DQP |
| | Nycomed Amersham | TrPh | n.a. | 130 | | | 3 | 5 | | 3 | 3 | DQP |
| | Provalis | BioT | 107 | 7 | | | 1 | | | | | DQP |
| **DQPs and RPIs** | AstraZeneca | TrPh | 11500 | 91 | 4 | 6 | 16 | 8 | 1 | 12 | 9 | RPI / DQP |
| | GlaxoSmithKline | TrPh | 44679 | 174 | 6 | 20 | 22 | 60 | 3 | 41 | 26 | RPI / DQP |
| | Shire | TrPh | 475 | 18 | | 1 | | 9 | | 5 | 5 | RPI / DQP |
| **Pure Diversified Quality Producers** | Amersham Pharmacia Biotech | TrPh | 4500 | n.a. | | | | | | 1 | | DQP |
| | Bioglan | BioT | 567 | 72 | | | | | 1 | 1 | | DQP |
| | British Biotech | BioT | 250 | 18 | | | | | | 1 | | DQP |
| | Cambridge Antibody Technology | BioT | 290 | 14 | | | | | | 1 | | DQP |
| | Crusade Laboratories | BioT | n.a. | 5 | | | | | | 1 | | DQP |
| | DevCo | TrPh | 8 | 5 | | | | | | 1 | | DQP |
| | Napp | TrPh | 321 | 81 | | | | | | 1 | | DQP |
| | Oxford Glyco Sciences | BioT | 219 | n.a. | | | | | | 1 | | DQP |
| | Smith & Nephew | TrPh | 1419 | 73 | | | | | | 1 | | DQP |
| **Marketing Specialists** | Allergy Therapeutics | TrPh | 180 | 70 | | | | | | | 1 | LCP |
| | Biopharm (UK) | BioT | n.a. | n.a. | | | | | | | 1 | LCP |
| | Cambridge Laboratories | TrPh | 63 | 17 | | | | | | | 1 | LCP |
| | Virogen | BioT | n.a. | n.a. | | | | | | | 1 | LCP |

* Project(s) in-licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)

(*) Part of projects in-licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)

Source: PHID database (November 2004)

**Table 2: Radical Product Innovators, Diversified Quality Producers and Low Cost Producers in Germany**

| Firm Type | Company Name | Technology Focus | Number Employees | Firm Age | Developer NCE | Licensor NCE | Developer Non-NCE | Licensor Non-NCE | Licensee Dev.-Phase NCE | Licensee Dev.-Phase Non-NCE | Licensee Reg.-Phase | Competitive Strategy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Discoverers of NCE** | BASF | TrPh | 37444 | 139 | | 1 | | 1 | | | | RPI |
| | Merz | TrPh | 800 | 96 | | 1 | | 4 | | | | RPI |
| **Ambiguous Cases** | Curacyte | BioT | 22 | 5 | | | 1* | | | | | RPI |
| | Degussa | TrPh | 6000 | 5 | | | 1* | | | | | DQP |
| | Falk | TrPh | 99 | 44 | | | 1* | | | | | DQP |
| | GPC Biotech | BioT | 115 | 7 | | | 1* | | | | | RPI |
| | Jerini Bio Tools | BioT | 108 | 10 | | | 1* | | | | | RPI |
| | MediGene | BioT | 120 | 10 | | | 1* | | | | | RPI |
| | MorphoSys | BioT | 132 | 12 | | | 1* | | | | | RPI |
| | Scil Biomedicals | BioT | 100 | 5 | | | 1* | | | | 1 | RPI |
| | Wilex Biotechnology | BioT | 22 | 7 | | | 1* | | | | | RPI |
| **Diversified Quality Producers** | Altana | TrPh | 2800 | 27 | | | | 9 | | 1 | 5 | DQP |
| | Gruenenthal | TrPh | 1900 | 58 | | | 2 | | | | 5 | DQP |
| | Jenapharm | TrPh | 450 | 54 | | | 2 | | | | | DQP |
| | Madaus | TrPh | 930 | 85 | | | | 5 | 1 | 2 | | DQP |
| | Merck KGaA | TrPh | 1800 | 336 | | | 2 | 6 | | 4 | | DQP |
| | Merckle | TrPh | 2000 | 59 | | | 2 | | | | 1 | DQP |
| | Schwarz Pharma | TrPh | 1200 | 58 | | | 2 | | 1 | 2 | 7 | DQP |
| **DQPs and RPIs** | ASTA Medica | TrPh | 600 | 169 | | 1 | | 1 | 1 | 1 | 3 | RPI / DQP |
| | Bayer | TrPh | 5181 | 141 | 1 | 3 | 1 | 18 | 1 | 8 | 5 | RPI / DQP |
| | Boehringer Ingelheim | TrPh | 8000 | 119 | | 7 | 1 | 26 | | 5 | 11 | RPI / DQP |
| | Schering AG | TrPh | 10042 | 133 | 2 | 2 | 15 | 6 | | 8 | 4 | RPI / DQP |
| **Pure Diversified Quality Producers** | GLE Medicon | TrPh | n.a. | n.a. | | | | | | 1 | | DQP |
| | Medac | BioT | 400 | 34 | | | | | | 2 | | DQP |
| | Paion | BioT | 60 | 4 | | | | | | 1 | | DQP |
| | Revotar | BioT | 22 | 4 | | | | | | 1 | | DQP |
| **Marketing Specialists** | Plantorgan | TrPh | 100 | 30 | | | | | | | 1 | LCP |
| | Schwabe | TrPh | 695 | 138 | | | | | | | 1 | LCP |
| | Strathmann | TrPh | 460 | 30 | | | | | | | 1 | LCP |

* Project(s) in-licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)

(*) Part of projects in-licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)

Source: PHID database (November 2004)

**Table 3: Radical Product Innovators, Diversified Quality Producers and Low Cost Producers in Italy**

| Firm Type | Company Name | Technology Focus | Number Employees | Firm Age | Developer NCE | Licensor NCE | Developer Non-NCE | Licensor Non-NCE | Licensee Dev.-Phase NCE | Licensee Dev.-Phase Non-NCE | Licensee Reg.-Phase | Competitive Strategy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Discoverers of NCE** | Abiogen | BioT | 257 | 7 | 1 | 1 | | 7 | | | | RPI |
| | Alfa Wassermann | TrPh | 700 | 56 | | 1 | | 4 | | | 3 | RPI |
| | Ausonia | n.a. | n.a. | n.a. | | 1 | | 3 | | | | RPI |
| | Istituto di Ricerche Sigma Tau | TrPh | 67 | 19 | | 2 | | 5 | | | 5 | RPI |
| | Medioloanum | TrPh | 253 | 32 | | 1 | 1* | 4 | | | 1 | RPI |
| | Poli | TrPh | 126 | 25 | 1 | | 3(*) | | | | | RPI |
| | SPA | TrPh | 211 | 57 | | 1 | | 1 | | | | RPI |
| **Ambiguous Cases** | Fidia | TrPh | n.a. | 58 | | | 1* | | | | | DQP |
| | Italpharmaco | TrPh | 600 | 66 | | | 1* | | | | 1 | DQP |
| | Rotta Research | BioT | 188 | 43 | | | | 1 | | | | RPI |
| **Diversified Quality Producers** | Chiesi | TrPh | 2600 | 69 | | | 2 | 7 | 2 | 2 | | DQP |
| | Recordati | TrPh | 1013 | 78 | | | | 8 | 1 | 1 | 4 | DQP |
| | Zambon | TrPh | 836 | 98 | | | 3 | | 1 | 2 | 1 | DQP |
| **DQPs and RPIs** | Bracco | TrPh | 1456 | 77 | 1 | 1 | 1 | 3 | | 1 | 1 | RPI / DQP |
| | Menarini | TrPh | 2050 | 118 | 1 | | 4 | | 1 | 1 | 5 | RPI / DQP |
| **Pure Diversified Quality Producers** | Bruno | TrPh | n.a. | n.a. | | | | | 1 | 1 | | DQP |
| | Dompe | TrPh | 600 | 64 | | | | | | 1 | 2 | DQP |
| | Eurand | TrPh | 343 | 35 | | | | | | 1 | | DQP |
| | Geymonat | TrPh | 83 | 76 | | | | | 1 | 1 | | DQP |
| **Marketing Specialists** | Biotoscana | BioT | n.a. | n.a. | | | | | | | 1 | LCP |
| | Formenti | TrPh | 450 | 50 | | | | | | | 1 | LCP |
| | Guidotti | TrPh | 480 | 90 | | | | | | | 2 | LCP |
| | Lusopharmaco | TrPh | 600 | 53 | | | | | | | 2 | LCP |
| | Mipharm | TrPh | 243 | 6 | | | | | | | 1 | LCP |
| | Neopharmed | TrPh | 332 | n.a. | | | | | | | 1 | LCP |
| | Rottapharm | TrPh | 371 | 43 | | | | | | | 1 | LCP |
| | Segix | TrPh | 74 | 42 | | | | | | | 1 | LCP |

* Project(s) in-licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)

(*) Part of projects in-licensed at discovery (i.e. research or preclinical development) stage usually from PROs (universities or research institutes)

Source: PHID database (November 2004)

Interestingly, not a single firm exists that merely develops or out-licenses pharmaceutical products based on an NCE. The reason for this resides in the unpredictability of radical pharmaceutical innovation. As in any research project, the chance element involved in pharmaceutical research is high (Muffatto and Giardina 2003: 111). Hence, a pharmaceutical firm *cannot be sure* that it will discover an NCE. It can make all possible efforts, yet it may ultimately end up using its research outcomes for improving an already known chemical entity. The discovery of an NCE is therefore by far less frequent than the improvement of a known chemical entity (Bottazzi et al. 2001: 1163). However, a pharmaceutical firm *can decide to focus* on the research stage, i.e. on the discovery and preclinical development of pharmaceutical projects, in that it out-licenses their development and registration. Accordingly, licensors of both NCE and non-NCE projects are more innovative than their licensees. All pharmaceutical firms which have (developed and/or) out-licensed *at least 1* pharmaceutical project *based on an NCE* are therefore classified as radical product innovators because they are ***discoverers of NCEs*** with a strong propensity to out-license clinical development and registration.

This leaves us with a group of ***ambiguous cases***. It is composed of those firms which are either pure licensors of already discovered chemical entities or developers of known chemical entities that were in-licensed at the research stage from public research organizations (henceforth PROs): universities or research institutes. On the one hand, these firms are not particularly innovative as the resulting drugs are based on known chemical entities. On the other hand, they are innovative as the *licensors* focus on the research stage of a pharmaceutical project. Similarly, the *developers* of this group have a research focus, as they collaborate closely with PROs from which they in-licensed pharmaceutical projects before the development stage. Since their classification is not possible purely on the basis of their involvement in the different stages of pharmaceutical projects, these ambiguous firms have to be categorized on the basis of their technological approach. Accordingly, all biotechnology firms are classified as radical product innovators, because they use modern approaches of molecular biology and genomic sciences which, in turn, enable a more deliberate drug design. On the other hand, traditional pharmaceutical firms using experimental approaches to drug design (see Drews 2000) are classified as diversified quality producers.

Another, partly similar group of firms can be identified. It is similar to the group of ambiguous cases in that firms are either developers and/or licensors of already discovered chemical entities. However, contrary to the ambiguous cases, these firms do *not* in-license pharmaceutical projects at the *research* but at the *development stage*. This, in turn, suggests that they are incrementally rather than radically innovative. Accordingly, they are classified as ***diversified quality producers***. In addition, all those firms are also categorized as diversified quality producers which are exclusive developers of pharmaceutical products based on known chemical entities.

Finally, a last group of cases consists of those pharmaceutical companies which pursue both an ***RPI and a DQP*** strategy. On the one hand, they are radical product innovators, as they out-license (and develop) pharmaceutical products based on NCEs. On the other hand, these firms pursue a DQP strategy by developing drugs based on previously discovered chemical entities, or by in-licensing pharmaceutical projects at the development stage. These firms are therefore classified as radical product innovators and diversified quality producers alike.

While the identification of a firm's competitive strategy at the micro level is not without its problems, the classification approach thus far clearly illustrate one point. Patterns in the strategies of pharmaceutical firms are strikingly homogenous in Italy, Germany and the UK alike. Yet, the existence of this last group of DQP and RPI strategists raises an important question to be addressed before a final evaluation is possible. Are the three competitive strategies mutually exclusive or can one firm pursue two, or even three strategies at the same time?

### *3. Are competitive strategies mutually exclusive?*

To answer the previous question, it is important to note how the scope for different strategies varies over time. The pathbreaking findings of Abernathy and Utterback (Utterback 1994: 90-101) and further management studies of various industries (Levitt 1965; Klepper and Graddy 1990; Klepper and Simons 1997; Walker 2003: chapter 4) show that firms initiate a product's life cycle by proposing radically new product designs. Once a dominant design has emerged, firms usually start to change their strategy and turn from radical into incremental innovators or imitators. In other words, as time goes by, firms which initially pursued an RPI strategy turn either into diversified quality producers making slight improvements to a once radically new product, or into low cost producers selling at lowest possible prices.

Considering the outcome of this transformation process, Porter shows that DQP and LCP are mutually exclusive strategies because 'differentiation [i.e. DQP] is usually costly' (Porter 1985: 119-120) and therefore not compatible with LCP. The reason is that 'a firm must often incur costs to be unique (…). Providing superior applications engineering support usually requires additional engineers, for example, while a highly skilled sales force typically costs more than a less skilled one.' (ibid.: 127-128).

Porter (1990: 48-49) also points out that radical innovations are often made by outsiders to an industry. This supports Utterback's finding that the strongest resistance to radically new technologies often comes from the industry's DQP and LCP strategists which were radically innovative at the last innovation wave. Their behaviour is explained by the significant sunk costs that these firms had to make in order to produce highly sophisticated or particularly cheap goods. Inventing entirely new products would mean to compete against the own goods, and to risk that the latter will sooner or later become obsolete (Utterback 1994: 162-165, 223-226). Studies of traditional industries thus show that RPI, DQP and LCP are mutually exclusive as firms maximize their returns on investment if they pursue just one competitive strategy.

This argument also seems to apply to the pharmaceutical industry (Bottazzi et al. 2001: in particular 1163; Orsenigo et al. 2001). The finding that one clear-cut group of low cost producers (***marketing specialists***), ***(pure) diversified quality producers*** and radical product innovators (***NCE-discoverers*** *being often pure Licensors*) is contained in the firm sample confirms the idea that LCP, DQP and RPI are mutually exclusive strategies. But how to explain the occurrence of all the ***ambiguous cases*** and of those firms that pursue both an ***RPI and a DQP*** strategy?

Compared to traditional industries, the pharmaceutical industry is peculiar in two respects. First, like all *high-tech* industries, the technology intensity of pharmaceutical R&D allows for a comparatively frequent emergence of radically new products. But contrary to traditional industries, these products – based on NCEs – do not lead to a

wholesale transformation of the industry. Their effect rather is to improve the market position of the discovering firm. The technology intensity of the pharmaceutical industry thus makes RPI a particularly attractive strategy as the risk of making the firm's own products obsolete is low.

The second peculiarity of the pharmaceutical industry is that the development of new products is *extremely expensive* (see for example Muffatto and Giardina 2003: 108-110). Before obtaining a marketing authorization, a pharmaceutical firm must carry out numerous clinical tests to document all features and possible (side-)effects of its new product. This means that any radical product innovator which has brought a discovery to the stage of clinical development is faced with the following decision. Does it want to focus on RPI and out-license the development and registration of its discovery, or does it aspire to turn the discovery into marketable drugs on its own?

In the latter case, the firm will find it necessary to start pursuing a DQP strategy, as it can thereby cover the massive costs of clinical development. The longer a patent shelters a pharmaceutical product from low cost imitations, the higher the product's returns on investment. Once a patent expires, pharmaceutical firms therefore often seek to obtain a new patent, or to extend patent protection, by introducing slight improvements to the once radically new drug. Furthermore, a pharmaceutical firm is well-advised to in-license pharmaceutical projects in its field of expertise in order to use its development and registration facilities efficiently. Any research-intensive firm that wants to develop and register its pharmaceutical discoveries on its own will thus find it necessary to cover costs by pursuing a DQP strategy in parallel to an RPI strategy. This also opens up the opportunity for the radical product innovator to turn into a pure diversified quality producer.

Following this logic, it can be argued that the group of *ambiguous cases* consists mostly of those firms that have reached the development stage where they must decide whether to pursue a *pure RPI strategy* out-licensing clinical development and registration, *an RPI **and** a DQP strategy*, or whether to use their expertise for becoming *(pure) diversified quality producers*. If this lifecycle argument holds true, the *discoverers of NCEs*, the *DQP/RPI firms*, and the *(pure) diversified quality producers* should be older than those firms classified as *ambiguous cases*. To empirically assess this idea, an ambiguity score of 0 is assigned to all NCE-discoverers, DQP/RPI-firms, and (pure) diversified quality producers, whereas an ambiguity score of 1 is attributed to all ambiguous cases. The result of a bivariate correlation analysis provides empirical support, as it reveals a strong correlation between a firm's age and the pursuit of an unambiguous competitive strategy ($R = -.405$; $R^2 = .164$; $p < 0.001$).

Turning back to those firms which are both RPI and DQP strategists simultaneously, it is interesting to note that this group of firms consists exclusively of the industry's international giants. Closer analyses revealed that these RPI/DQP firms usually embed each strategy in a separate business unit. From an operational point of view, these business units are independent, because they encompass all departments necessary for discovering, developing and producing drugs. The RPI and DQP units are thus only interdependent in that they are financed by the same holding company. In a strict sense, *one* RPI/DQP firm does therefore not pursue *two* different competitive strategies. Instead, *two* different business units belonging to one holding company pursue *one* competitive strategy apiece. In sum, the argument that RPI, DQP, and LCP

are mutually exclusive strategies, as they all follow a different operational logic, is justified both from a theoretical and an empirical perspective.[18]

## *4. Final assessment*

Given that strategy patterns have proven to be strikingly homogenous across countries (section 2) and that the simultaneous pursuit of several strategies is not feasible (section 3), firms do not seem to exploit the comparative institutional advantage of their economy by specializing in the facilitated strategy. A final assessment shall provide an overview and further insights into this core argument of the competitiveness literature. Do firms in the UK specialize in the pursuit of an RPI strategy, whereas German companies rather pursue a DQP strategy, whilst their Italian counterparts engage mostly in LCP?

Table 4 summarizes the results obtained from sampling the PHID database[19] and contradicts the idea that the *majority* of firms in one economy specializes in the same strategy. Instead, table 4 shows that firms in Germany, Italy, and the UK pursue RPI, DQP, and LCP strategies to a similar extent. While 47.5% of pharmaceutical firms are *RPI* strategists in the UK, 39.4% of firms pursue this strategy in Germany, and 34.5% of their counterparts do so in Italy. A *DQP* strategy, is pursued by 51.5% of German, by 37.9% of Italian, and by 42.5% of British firms. Finally, the probability that firms engage in *LCP* is 27.6% in Italy, 10.0% in the UK and 9.1% in Germany. Thus, even though the share of firms engaged in the same strategy varies slightly from one economy to another, it is not drastically different between the considered countries.

**Table 4: Summary Results of RPI, DQP and LCP in the UK, Germany and Italy**

| | **Radical Product Innovators** | | **Diversified Quality Producers** | | **Low Cost Producers** | | **Sum** | |
|---|---|---|---|---|---|---|---|---|
| | **Nb Firms** | ***% Firms*** | **Nb Firms** | ***% Firms*** | **Nb Firms** | ***% Firms*** | **Nb Firms** | ***% Firms*** |
| **UK** | 19 | *47.5%* | 17 | *42.5%* | 4 | *10.0%* | 40 | *100.0%* |
| **Germany** | 13 | *39.4%* | 17 | *51.5%* | 3 | *9.1%* | 33 | *100.0%* |
| **Italy** | 10 | *34.5%* | 11 | *37.9%* | 8 | *27.6%* | 29 | *100.0%* |
| **Average** | 14.0 | *40.5%* | 15.3 | *44.0%* | 5.0 | *15.6%* | 34.0 | |
| **Above Average** | | *7.0%* | | *7.5%* | | *12.0%* | | |

Source: PHID database

[18] In this respect, it worthwhile to note that analyses presented in chapters 3 to 5 confirm the operational incompatibility of RPI, DQP and LCP as each strategy requires a very specific and distinct set of input factors.

[19] The nine firms which pursue both an RPI and a DQP strategy are counted as two cases each.

Nevertheless, slight specialization patterns can be observed. Table 4 accordingly reports the average probability with which firms in Germany, Italy and the UK pursue RPI, DQP, or LCP strategies. Interestingly, British firms are 7.0% more likely to engage in radical product innovation than the average pharmaceutical firm included in the sample. Similarly, the probability of pursuing a DQP strategy is 7.5% higher for a German firm than for the sample's average company. Finally, Italian firms show a preference for low cost production as they pursue this strategy 12.0% more often than the average pharmaceutical company. British companies thus seem to prefer RPI, German firms DQP, and Italian firms LCP strategy.

Does this finding suggest that firms in one economy specialize in the institutionally supported strategy as the *plurality*, rather than the majority, pursues this strategic approach? This idea would be supported empirically if the observed specialization patterns are pronounced enough to provide statistically significant results. A Chi-Square test assessing the strength of association between a firm's location and its strategy offers insights. Results are reported in table 5. At a glance, the table shows that differences in strategy-specialization patterns are too weak to be statistically significant. The specialization patterns observed in table 4 are thus more likely to result from an (un)fortunate coincidence than from firm preferences for different strategies. Hence, micro-level statistics do not lend empirical support to the idea that the plurality of an economy's firms specializes in the same economy.

**Table 5: Results of Cross Tabs Test (Country x Competitive Strategy)** [a]

| | | | Competitive Strategy | | | Total |
|---|---|---|---|---|---|---|
| | | | **RPI** | **DQP** | **LCP** | |
| **Country** | **UK** | *Count* | *19* | *17* | *4* | *40* |
| | | Expected Count | 16.5 | 17.6 | 5.9 | 40.0 |
| | **Germany** | *Count* | *13* | *17* | *3* | *33* |
| | | Expected Count | 13.6 | 14.6 | 4.9 | 33.0 |
| | **Italy** | *Count* | *10* | *11* | *8* | *29* |
| | | Expected Count | 11.9 | 12.8 | 4.3 | 29.0 |
| **Total** | | *Count* | *42* | *45* | *15* | *102* |
| | | Expected Count | 42.0 | 45.0 | 15.0 | 102.0 |

[a] Chi-Square = 5.996 (2 cells = 22.2 % with expected count less than 5); $p > 0.10$
Cramer's V = .171; $p > .10$

How are we to think about these results? How are the above micro-level findings compatible with the specialization argument of the competitiveness literature based on macro-level analyses? Ever since the seminal article of Robinson (1950; see also Coleman 1986; Coleman 1990) are social scientists warned not to test theories about

micro-level relationships on the basis of macro-level data, as the discrepancies between correlations of micro-level indicators and their aggregation at the macro level are substantial. The reason is that, depending on the array rules employed, important information on individual cases is lost when the latter are aggregated at a higher level. This makes that correlations of aggregated indicators deliver stronger results than correlations of the same, disaggregated measures. The higher the level of data aggregation, the less representative are macro-level correlations of micro-level effects (Feige and Watts 1972).

A similar argument seems to explain why the above specialization effects are weak compared to the specialization effects revealed by the competitiveness literature[20]. Whenever a firm's strategy is identified through a macro-level indicator, e.g. its industry, less information on each individual case is preserved than when the firm's strategy is identified through micro-level measures, such as product novelty and value-chain focus. This loss of information seems to explain why strategy specialization is stronger when measured by a macro indicator. Imagine that a firm's industry had been taken as a proxy for its strategy, so that all biotech firms were identified as radical product innovators, all traditional pharmaceutical firms as diversified quality producers, and all generics firms as low cost producers. Then columns two and three of tables 2.1 to 2.3 would reveal a strong specialization of British firms in RPI, of German and Italian firms in DQP, while no firm would specialize in LCP. Yet, such a macro-level assessment of competitive strategies would also entail the simplifying assumption that all firms in one industry pursue the same competitive strategy. All biotech firms engaged in DQP and all traditional pharmaceutical firms pursuing a RPI or LCP strategy would be ignored. It is this loss of information on micro-level variety that entails the overestimation of specialization trends when macro-level indicators are employed.

## *5. Conclusion and outlook on further research*

The micro-level assessment of competitive strategies in this article has clearly illustrated one point. Neither the majority, nor a statistically significant plurality, of pharmaceutical firms pursues the same competitive strategy in Germany, Italy, and the UK alike. This contradicts the argument of the competitiveness literature that firms respond to competitive pressures of economic internationalization by specializing in *that* strategy which is facilitated by national institutions. Since competitiveness scholars have based their argument mostly on studies which use macro-level indicators, like firms' industries, to identify competitive strategies, the related loss of information on micro-level variety explains why these studies reveal more pronounced specialization effects than the above strategy assessment. The here employed micro-level measure, combining firms' product novelty and their value-chain focus, illustrates that variety in the pursuit of different strategies is more pronounced than the use of macro-level indicators can reveal.

What does this finding teach us about the viability of the RBV approach on the one hand, and the competitiveness literature on the other? First, it casts doubt on one of

[20] For examples, see Porter 1990: 179-541; Keck 1993; Walker 1993; Pavitt and Patel 1999; Hall and Soskice 2001a: 36-44; Amable 2003; Hancké and Herrmann 2007.

the core argument of the competitiveness literature: *that* firms (start to) compete through the same strategy in response to globalization. Second, it indicates *why* the specialization effects revealed by this literature are, maybe overly, pronounced: because the use of macro-level indicators for competitive strategies might miss important micro-level information. However, what the previous results do not teach us is: *how* firms can so numerously compete through strategies that are not supported by national institutions?

To be clear, it is less surprising *that* firms within one economy, and even within one industry, engage in different strategies. In order to gain a competitive advantage, they need to distinguish themselves through a better strategy than the others. Each firm needs to do something different than its competitors so as to produce either newer, better, or cheaper products. However, a remaining puzzle to be solved by future research is: *how* firms can pursue diverse strategies. Is the RBV approach right in suggesting that firms, to pursue the same strategy, can randomly employ *different types* of one input factors, as long as the latter is turned into a valuable, rare, imperfectly imitable, and strategically non-substitutable resource (Barney 1991)? Does a systematic approach for such transformation procedures exist? Or, is the competitiveness literature nevertheless able to offer advice? Do firms need specific types of one input factor to pursue a given strategy? And, if so, how firms can secure the required factor types in those economies where they are not provided by national institutions? The present article therefore is only the beginning to a broader analysis of *how* firms cope with increasing pressures for competitiveness in the wake of globalization.

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