ISSN 1611-681X

# The Role of Demand in Innovation – A Lead Market Analysis for High-tech Industries in the EU-25

Thomas Cleff, Christoph Grimpe and Christian Rammer

Dokumentation Nr. 07-02

ZEW
Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

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Mannheim, November 2007

ISSN 1611-681X

Acknowledgement:
This document has been prepared as part of the “Innovation Watch – Systematic” project, sponsored by the European Commission, DG Enterprise and Industry. Financial support is gratefully acknowledged.

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## Non-technical summary

A Lead Market approach is used for each of 25 European Union member states (EU-25) to assess the likelihood that locally preferred innovation designs become successful in other countries. The analyses are conducted for 4 high-tech industries: automotive, chemicals, information and communication equipment, and machinery. The concept of Lead Markets suggests that for many innovations in a particular industry there are regional markets that initiate the international diffusion of a specific design of an innovation. Once a specific innovation design has been adopted by users in the Lead Market it is subsequently adopted by users in other countries as well. Lead Markets should be focal points for the development of global innovation designs.

By focusing on the design of the innovation which responds to the preferences within the Lead Market, a company can leverage the success experienced in the Lead Market for the product's global market launch. In order to follow this Lead Market strategy, it is necessary to assess the Lead Market potential of the industries in different countries before an innovation is developed and tested in the market. The method produces information that is of importance for the development phase and the market launch of globally standardised innovations.

This document presents an indicator-based methodology that attempts to approximate the Lead Market attributes of EU-25 countries for four high-tech industries. A Lead Market is defined as a country where users prefer and demand a specific innovation design that not only appeals to domestic users, but can subsequently be commercialised successfully in other countries as well. A system of five particular country-specific attributes - the so called Lead Market factors – is regarded as critical for the probability of the market becoming a Lead Market. These factors, which influence a country's Lead Market potential, are as follows: price advantage, demand advantage, export advantage, transfer advantage and market structure advantage. The aim of this document is to identify and operationalise indicators to measure and compare the Lead Market properties at international level. The indicators used are taken from the Community Innovation Surveys (CIS-3 and CIS-4), the Eurostat/OECD PPP and Expenditure Database at BH level, the UNCTAD FDI-Database, the EU Business Demography Statistics, and the Eurostat Foreign Trade Database (Comext). Based on the Lead Market analysis, implications for policy makers are outlined.

# 1 Introduction

In politics and business management alike, taking stock of the national innovative potential is an important strategic task. In the evaluation of technological performance on the political stage in particular, there has, for many years, been a tendency to concentrate on "supply-side" assessment of the national innovative potential. Patent applications, R&D expenditure and spending on education are naturally important input factors for the process by which innovations come about and are disseminated. However, it is always assumed that the supply of innovations created by a "technology push" will be matched by demand on the market.

There is surely no need to go as far as some economists, who claim that the graveyard of innovations that have not caught on is full to bursting (Real, 1990). Nevertheless, there is no argument about the fact that promising new sectors are, on the whole, supported rather than driven by technology. New technologies are not unimportant, but often tend to "play second fiddle" as new markets develop (Wengenroth, 2002). The literature offers up numerous examples of cases in which products that - from a technological point of view - were superior, failed to become the standard on the world market (cf. e.g. Beise, 2001). Innovation policies and company innovation strategies that define additional benefit exclusively in terms of the technological efficiency of products ultimately run the risk of producing goods that are inappropriate for the demand of different markets.

This paper is dedicated to a description of the worldwide market appeal of European companies' innovations. The focus will be placed on demand pull, an aspect that has largely been left on the sidelines of innovation research. The research is carried out within the framework of a Lead Market Analysis – a methodology that has been developed to assess the Lead Market potential of selected sectors in the EU-25 member states and to provide targeted policy recommendations on how to stimulate innovation activities in these markets. The sectors chosen for the analysis are four high- and medium-high-technology industries: automotive, chemicals, ICT, and machinery and equipment. It can be assumed that these sectors will be central for future innovation and growth impulses in Europe.

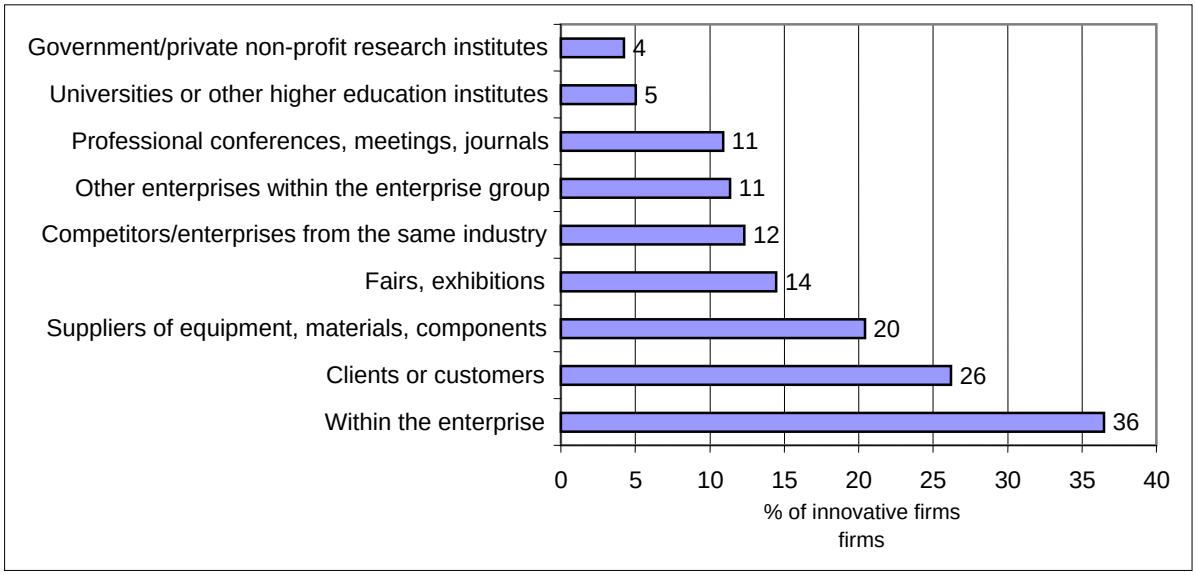
Another version of this paper has been prepared as part of the "Innovation Watch – Systematic" project, which has been sponsored by the European Commission, DG Enterprise and Industry, to monitor innovative capabilities of firms in the EU-25 member states and to provide implications for policy makers within the course of the Lisbon agenda to foster innovation in Europe.[1]

[1] Commission of the European Communities (2005).

## 2 The importance of customer acceptance for the innovation process

A large number of empirical studies show that customer proximity is of great importance for the innovation process.[2] The results of the third Community Innovation Survey (CIS-3) once again confirm the prominent role of clients in providing momentum for the innovation process. A total of 26 percent of innovators assess the importance of their customers' role as high. Only 12 percent of companies judged competitors and other firms from the same industry to be a highly important source of innovation, while 20 percent gave this rating to suppliers and 14 percent to fairs and exhibitions. Only 5 percent of innovators received their most important impulse to innovate from universities or other education institutes and only 4 percent from government or non-profit research institutes.

**Figure 2-1: Sources of innovation with a high importance for innovative firms**

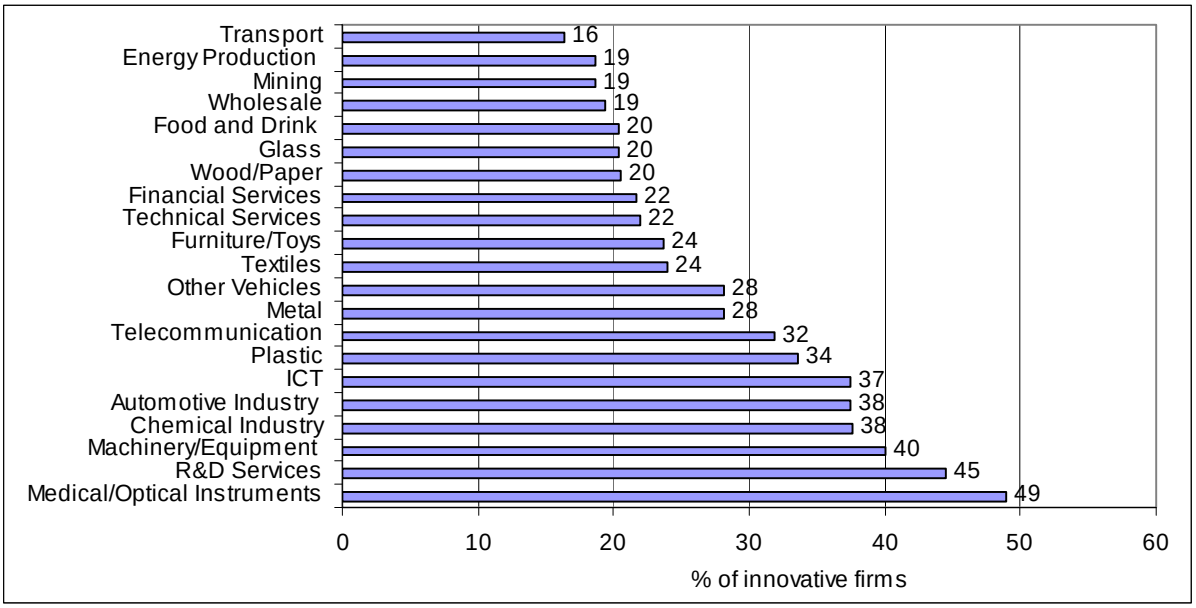



Source: CIS-3, unweighted, ZEW calculations.

It is in the field of product innovations that customers have the most influence. Nearly 33 percent of such innovations and nearly 35 percent of the market novelties can be traced back to customer input. Whether or not it is considered necessary to involve customers closely in the innovation process varies from sector to sector. Customers are notably perceived to be highly important in the innovation process in sectors such as medical/optical instruments (49 percent), R&D services (45 percent) and Machinery/Equipment (40 percent). The least perceived importance can be found in sectors such as Transport (16 percent), Energy Production (19 percent) and Mining (19 percent).

[2] See e.g. Gemünden, H.G., Heydebreck, P. and Herder, R. (1992); Cooper, R.G., Kleinschmidt, E.J. (1987).

**Figure 2-2: The importance of a high customer involvement for innovative firms**

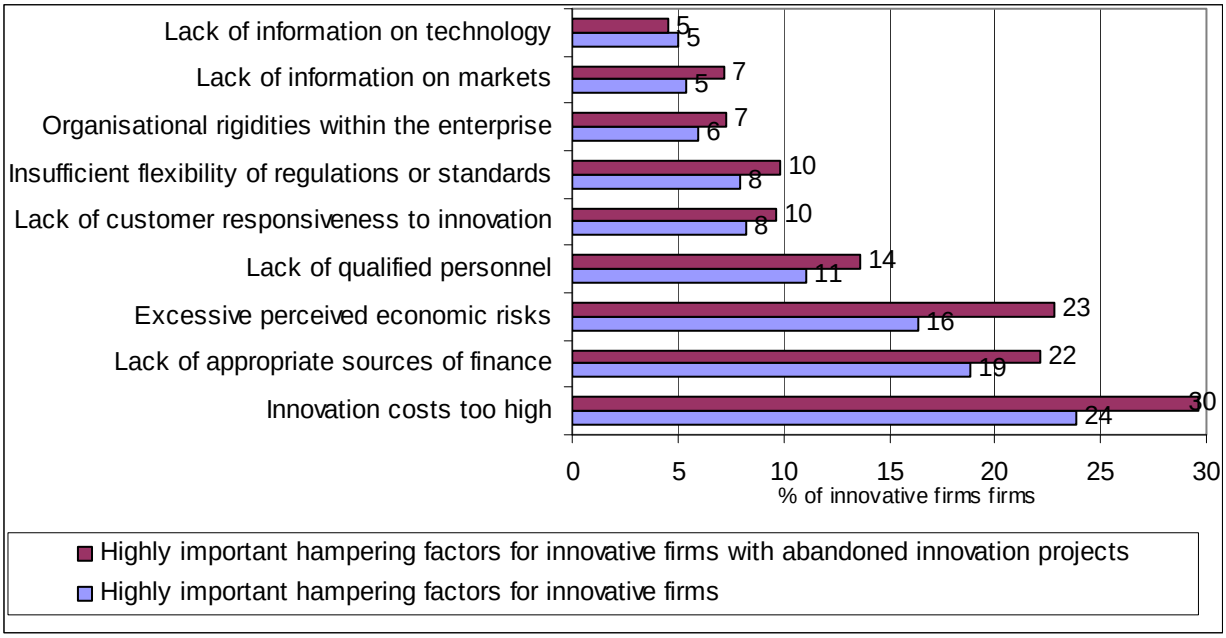



Source: CIS-3, unweighted, ZEW calculations.

Customer preferences must therefore be identified and used to establish the main parameters for planning the innovation process. However, this requirement is easier to formulate theoretically than to carry out in practice, as a closer look at the obstacles faced when trying to realise innovations in Europe reveals. As we might expect, financial difficulties top the list of obstacles. In total, 24 percent of respondents who were innovators pointed to the costs of innovation, 16 percent excessive economic risk and 19 percent lack of appropriate sources of finance as particularly large obstacles to innovation. However, a lack of customer acceptance also featured as a barrier to innovation for 8 percent of the companies surveyed.

Another angle on the issue can be gained by looking at how the factors that constitute barriers affect the progress of innovation projects. It is notable that when projects overrun, there is an above-average probability that this is because of organisational problems, a lack of suitably-qualified personnel, and problems with legal regulations or insufficient technical information. Financial barriers, on the other hand, are responsible more frequently than average for a decision not to embark upon a possible innovation project at all (Cleff, 2006a). As a rule, the sunk costs that result in these two cases are far lower than for projects abandoned later in the innovation process. Lack of customer acceptance is important in the list of reasons for abandoning projects (10 percent). The particular problem when this occurs is that the project is usually not abandoned until after the bulk of research and development activities have been carried out. Sometimes pilot products have even been tried out on the market. As such, the innovation activities have already caused considerable costs.

**Figure 2-3: Factors hampering innovation activities**

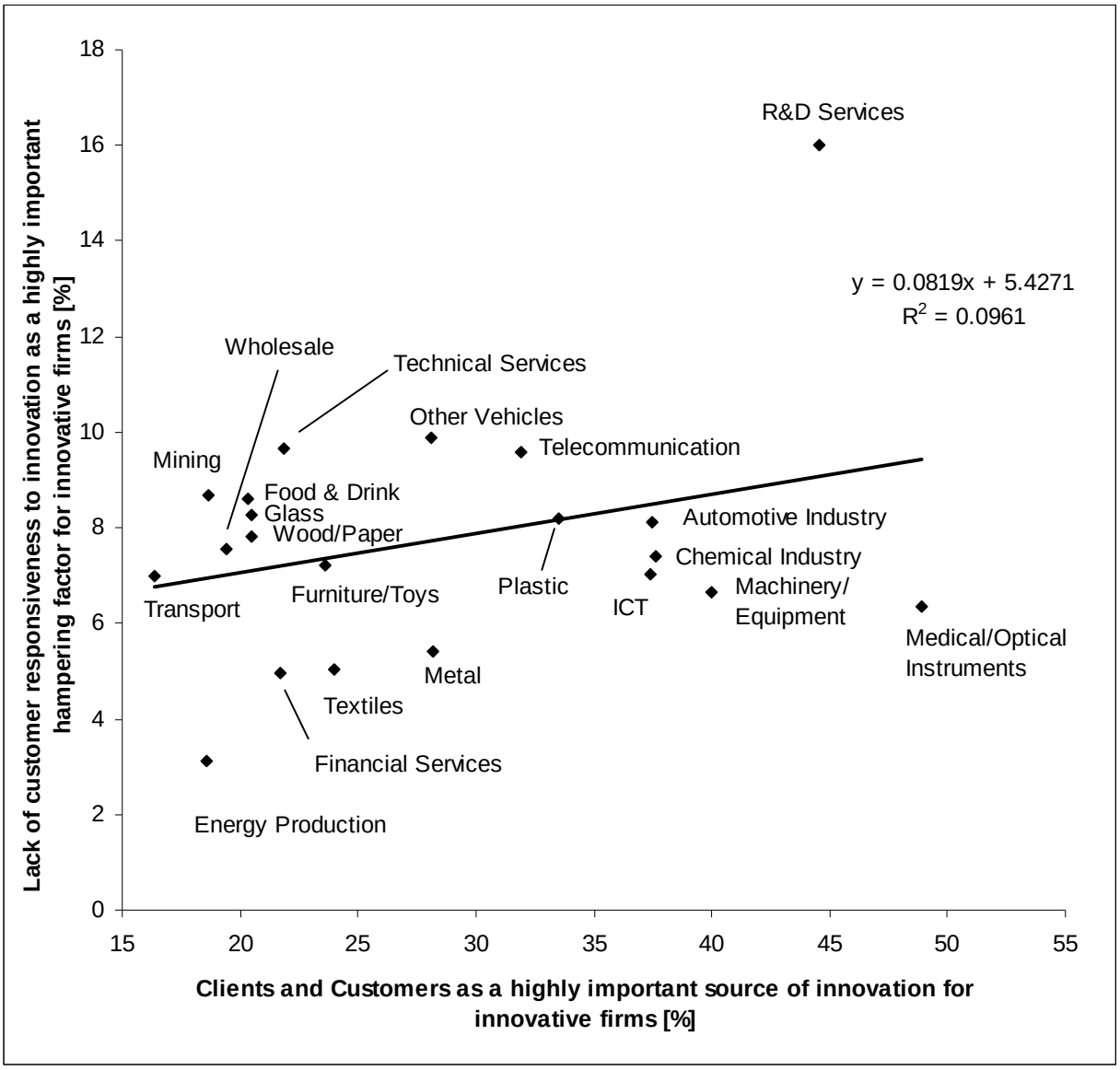



Source: CIS-3, unweighted, ZEW calculations.

When it comes to the lack of customer acceptance as a hampering factor for innovation, the various sectors are again affected to different extents. It proves to be a particularly frequent obstacle in the R&D Services sector (16 percent) and in Other Transport Vehicles (10 percent). In contrast, this obstacle is only cited by 3 percent of companies in the field of Energy Production and 5 percent of those in Textiles and Financial Services. The different sectors appear to have varying degrees of success in incorporating their customers' wishes into the innovation process. There are a number of reasons for this:

At first it seems reasonable to think that sectors in which customers drive innovations should experience fewer problems with customer acceptance, meaning also that companies would be less likely to cite a lack of customer acceptance as a barrier to innovation. Yet the representation in the following Figure shows the opposite. As the importance of the customer for the innovation process increases, so too does the company's awareness of the customer as a potential obstacle to innovation. Companies that aim to work closely with their customers are often faced with a range of completely different demands, since their clients live in different contexts or, in the case of companies that mainly supply other firms, the various firms supplied may produce entirely unrelated goods. The customers' preference structures are therefore not necessarily congruent. This effect is of above average strength for the sectors that lie above the regression line in the diagram below. These include R&D Services, Telecommunication, Technical Services and Other Transport Vehicles. Cleff (2006a) demonstrated that companies often react to this with market segmentation, product differentiation or customer-specific product development.

**Figure 2-4: Clients and customers as important source and hampering factor for innovative firms**



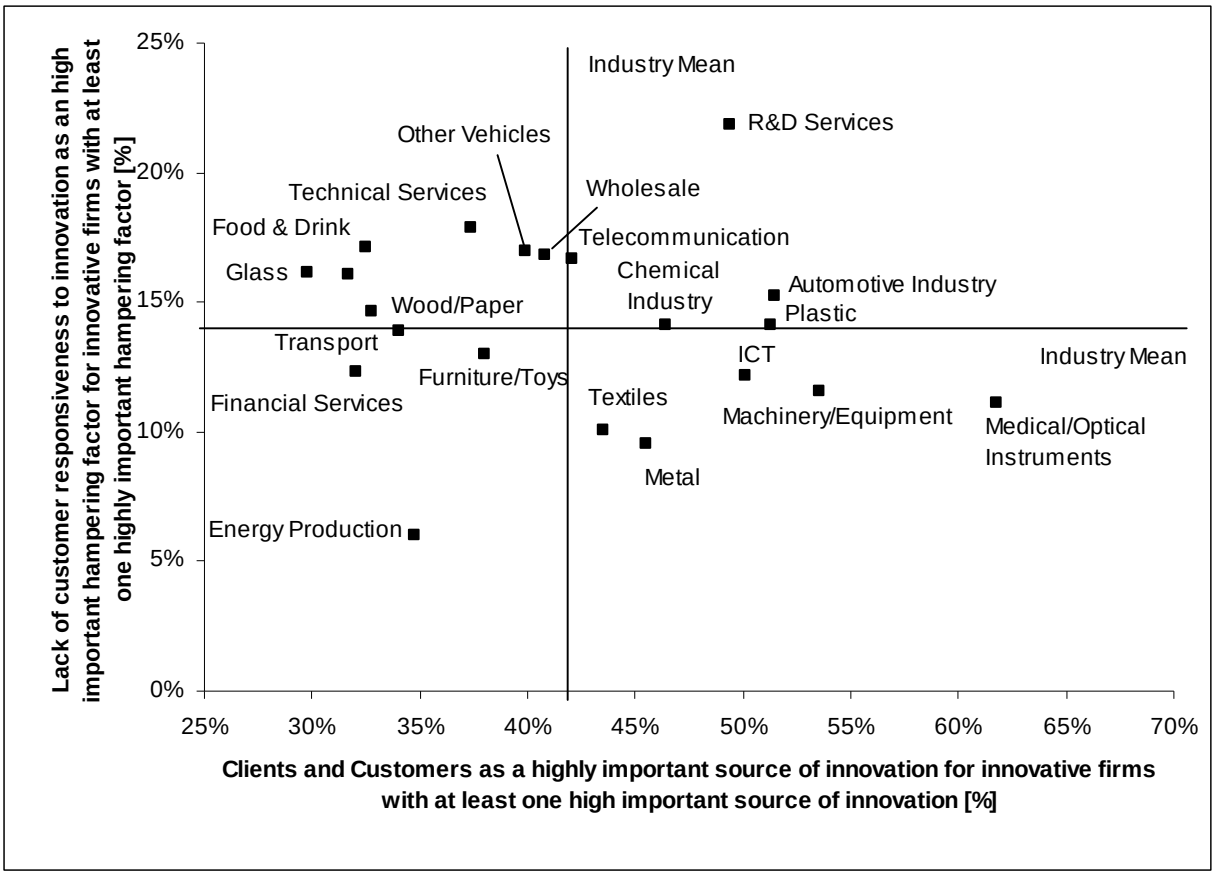

Source: CIS-3, unweighted, ZEW calculations.

As a starting point, the diagram above simply documents the relative frequencies of innovative firms that cite clients and customers as a highly important source of innovation and, at the same time, that view a lack of customer responsiveness to innovation as a highly important hampering factor. This raises the question of how the importance of demand for the innovation process should be ranked compared to other key sources of information from outside the firm.[3] In the Biotechnology sector, for example, demand is likely only to be one important source of innovation among many, like commercial laboratories/R&D enterprises, universities or other high education institutes and government or private non-profit research institutes. The other sources may well be more technological in nature - e.g. R&D enterprises

[3] Suppliers of equipment, materials, components or software; competitors and other firms from the same industry; consultants; commercial laboratories/R&D enterprises; universities or other high education institutes; government or private non-profit research institutes.

or consultants. To reflect this, the following figure compares clients' and customers' roles as a source of innovation with their role as a hampering factor. This is done by plotting the relative frequency of innovative firms that cite clients and customers as an important source of innovation against the relative frequency of those that list clients and customers as a hampering factor, provided that they named at least one important source of innovation and at least one important hampering factor.

**Figure 2-5: Clients and customers as important source and hampering factor for innovative firms with at least one important source and at least one important hampering factor for innovation**



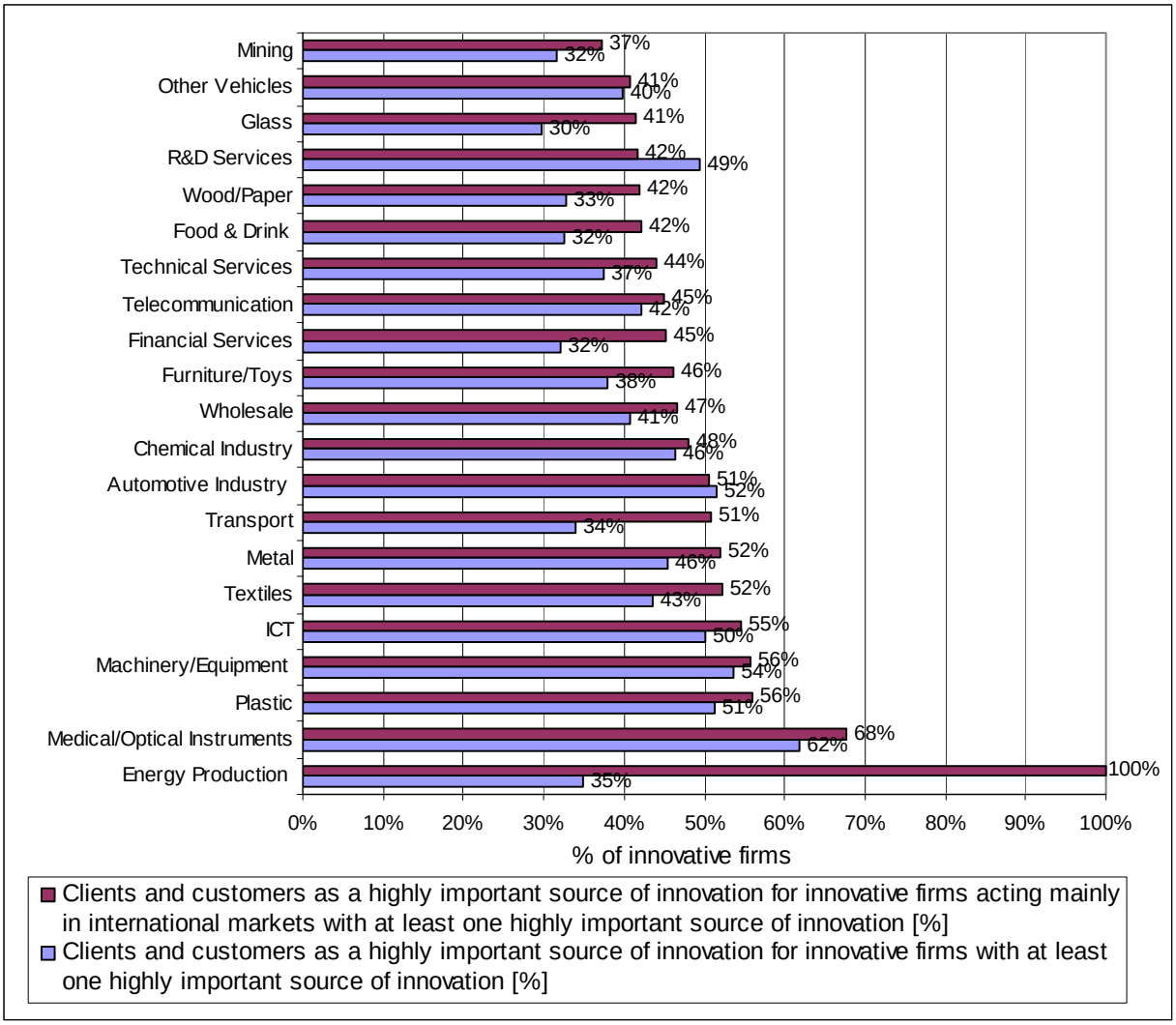

Source: CIS-3, unweighted, ZEW calculations.

The following sectors consider demand - compared to other sources of information - to be highly important more frequently than average: The Medical/Optical Instruments industry, the Automotive industry, Machinery/Equipment, ICT, the R&D Services industry, the Plastics industry, the Chemicals industry as well as the Textiles and Metals industry. In the Automotive industry and in R&D Services, demand is also named as a hampering factor for innovation more frequently than average. In these sectors, demand is therefore of above-average importance both as a source of innovation and a hampering factor. Sectors like the Medical/Optical instruments, Machinery/Equipment and ICT industries are in a better position than most in this respect: in spite of an above-average importance of demand, the frequency with which innovations are hampered is below average. In contrast, sectors such as Food & Drink, Glass or Financial services use other sources of innovation comparatively more often than they use clients and customers. In the Food & Drink sector, for example, supplier

industries in particular fulfil this function. It thus seems that special measures are required in the Food & Drink sector to improve demand-side involvement in the innovation process. This is because, in spite of the fact that demand is of below-average importance as a source of innovation, it is of above-average importance as a barrier to innovation.

It is clear from the graph below that the relative importance of demand compared to other sources of innovation increases as soon as firms become active mainly on international markets.

**Figure 2-6: Clients and customers as a high important source for innovative firms with at least one important source of innovation**

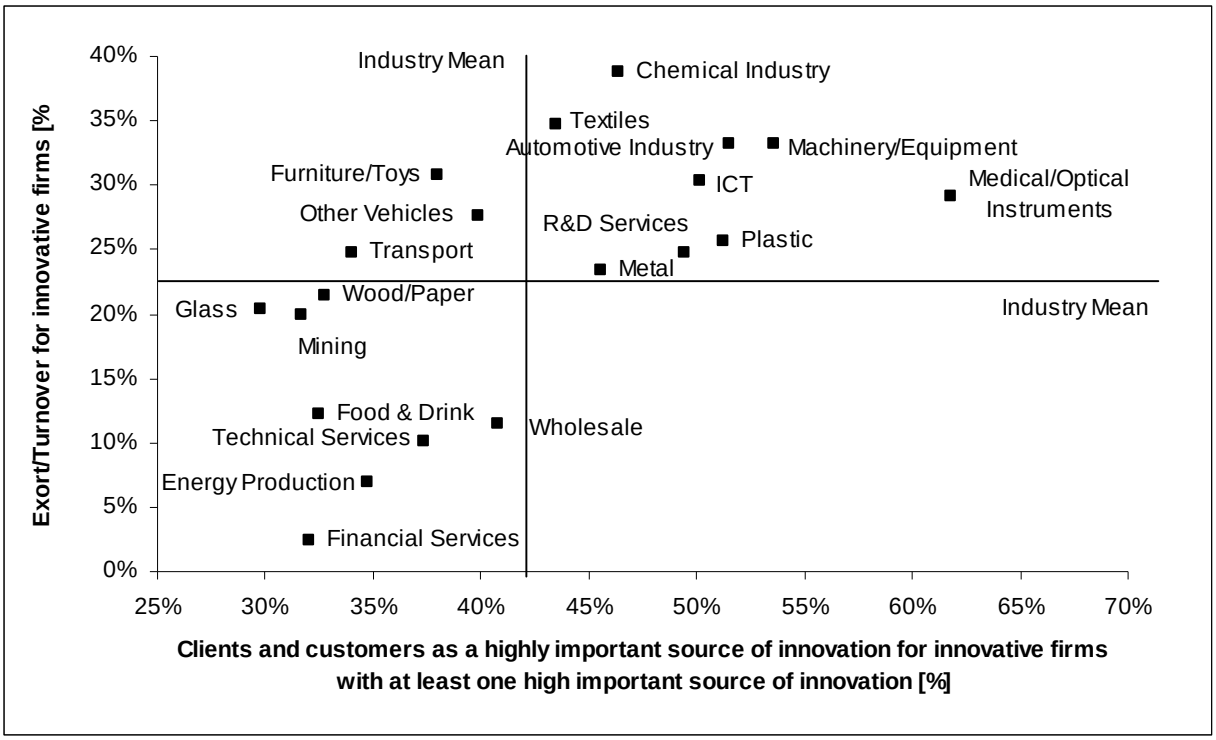



Source: CIS-3, unweighted, ZEW calculations.

In markets with a strong international focus, innovations must also aim to meet the needs of foreign customers. It is more difficult to take such international customer needs into account, because customer preferences can vary between different countries/markets. This is the crux of the problem for innovation strategy. The company's customers may be in different regional or national contexts and sometimes at different stages of technological development. Nonetheless, they all expect innovations perfectly adapted to their respective technical applications.

How do individual sectors manage to utilise demand as a source of innovation in a way that leads to success, not only in the home market but also in international markets? If innovations bring in high export revenues in a context where customers are important in pushing innovation, this is a sign that the innovation design that meets demand preferences can also come to dominate abroad. The sectors to which this applies appear in the upper right quadrant of Figure 2-7 below. They include ICT, Machinery/Equipment, Chemicals and R&D Services. In contrast, sectors in which innovations are, to a great extent, responses to customers' wishes, but which only achieve a low export ratio, have something of a problem. In particular, Financial Services, Energy Production, Technical Services, Wholesale and Food & Drink only achieve below-average export ratios. One reason for this is that innovations in Financial Services, Energy Production and Technical Services sectors are mainly driven by technology. When it comes to Food and Drink, it seems very plausible that this result also stems from the lack of demand involvement in the innovation process. The Furniture/Toys and Other Vehicles industries, on the other hand, were successful exporters, even though they made less than average use of demand as a source of innovation.

**Figure 2-7: Demand and export of innovative firms**




Source: CIS-3, unweighted, ZEW calculations.

However, increasing costs for R&D and the increasing need for standardisation and interface compatibility mean that there are economic and practical barriers to national or customer-specific solutions. These barriers compel manufacturers of new products to choose a particular path for their technological development or to opt for a particular design of innovation. Customers will only be prepared to forgo innovations tailored to their needs if the cost savings offered by a new design, which result from standardisation and network effects, are high enough to justify abandoning the current technology. The question remains, however,

of where – i.e. in which region and with which customers – the “successful” innovations of the future will be designed. We can consider “successful” designs to be those which

- firstly enjoy early national success,
- are then successfully commercialised worldwide and
- force other innovation designs out of the market in the medium term, to become the world standard.

The answer to this question goes hand-in-hand with the answer to another, the question of which customers a company must concentrate on in its future R&D and innovation activity. That is to say, which customers have a close relationship to the so-called Lead Market? Lead Markets are regional markets (usually countries) that generally take up a particular innovation design earlier than other countries. They have specific properties (Lead Market factors) that increase the probability of a wide take-up of the same innovation design in other countries (Commission of the European Communities, 2006). Where the scientific and technical knowledge for this purpose was actually generated is mostly not relevant, as companies in the Lead Market can appropriate this knowledge. More important for competitiveness is the ability to learn on this market about the applications and production of innovations (Meyer-Krahmer, 1997). A Lead Market is characterised by the fact that the innovation designs adopted there have an advantage over other country-specific innovation designs competing globally to set the international standard. This advantage makes consumers from other countries follow the technological standard of the Lead Market and adopt the design preferred by users there. In some cases this means abandoning a design that was previously preferred on the national market (Beise et al., 2002).

Therefore, a theoretical Lead Market model should respond to the following question: Under which market circumstances are a country’s demand characteristics appropriate to the adoption of technological innovations that will succeed internationally and mark out the technological path to be followed worldwide? The Lead Market model - developed at the Centre for European Economic Research (ZEW), Mannheim - focuses on the mechanisms at a national level in a Lead Market and how these lead to innovation designs being squeezed out of other markets internationally. These mechanisms can essentially be understood in terms of the five Lead Market factors described in the following section.

# 3 The Lead Market model

The Lead Market construct was first suggested in the 1980s by Porter (1986) and Bartlett/Ghoshal (1990) and is receiving increasing attention worldwide (e.g., Gerybadze et al. 1997, Johansson 2000, Commission of the European Communities, 2006). Bartlett/Ghoshal (1990, p. 243) consider Lead Markets as "markets that provide the stimuli for most global products and processes of a multinational company". Local "innovation in such markets become useful elsewhere as the environmental characteristics that stimulated such innovations diffuse to other locations". It is often observable that a technical design preferred by the Lead Market squeezes out other designs initially preferred in other countries and becomes the globally dominant design. A Lead Market can be defined as a country where users prefer and demand a specific innovation design that not only appeals to domestic users, but can subsequently be commercialised successfully in other countries as well. Beise (2001) and Beise/Cleff (2003) have been investigating Lead Markets on the basis of detailed case studies. They derived a system of five particular country-specific attributes, the so called Lead Market factors, that increase the international competitiveness of innovations and increase the probability of the market becoming a Lead Market:

The price of an innovation is the main aspect in Levitt's (1983) globalisation hypothesis, in which the consumers in foreign markets "capitulate" to the attraction of lower prices and abandon their initial innovation. Markets can gain a price advantage if the relative price of the nationally preferred innovation design decreases. This should compensate for differences between the design and the demand preferences in foreign countries. Price reductions occur mainly due to cost reductions based on static and dynamic economies of scale. Country-specific factors behind economies of scale can be the absolute or the relative market size and market growth.

A national demand advantage results from local conditions that facilitate the adoption of nationally preferred innovation designs in foreign markets. This advantage occurs mainly because a country stands at the forefront of an international trend. This trend can for instance be a demographic trend, an environmental trend, other socio-economic trends or simply a higher per-capita income (Vernon, 1966). A trend can also mean a time lead in the build-up of infrastructure complementary to the innovation. When other countries catch up, they will prefer the innovation that is already established in the leading country. Another possible causal factor for a leading demand is that users in the country are sophisticated, in the sense that they know more about what characteristics an innovation should have.

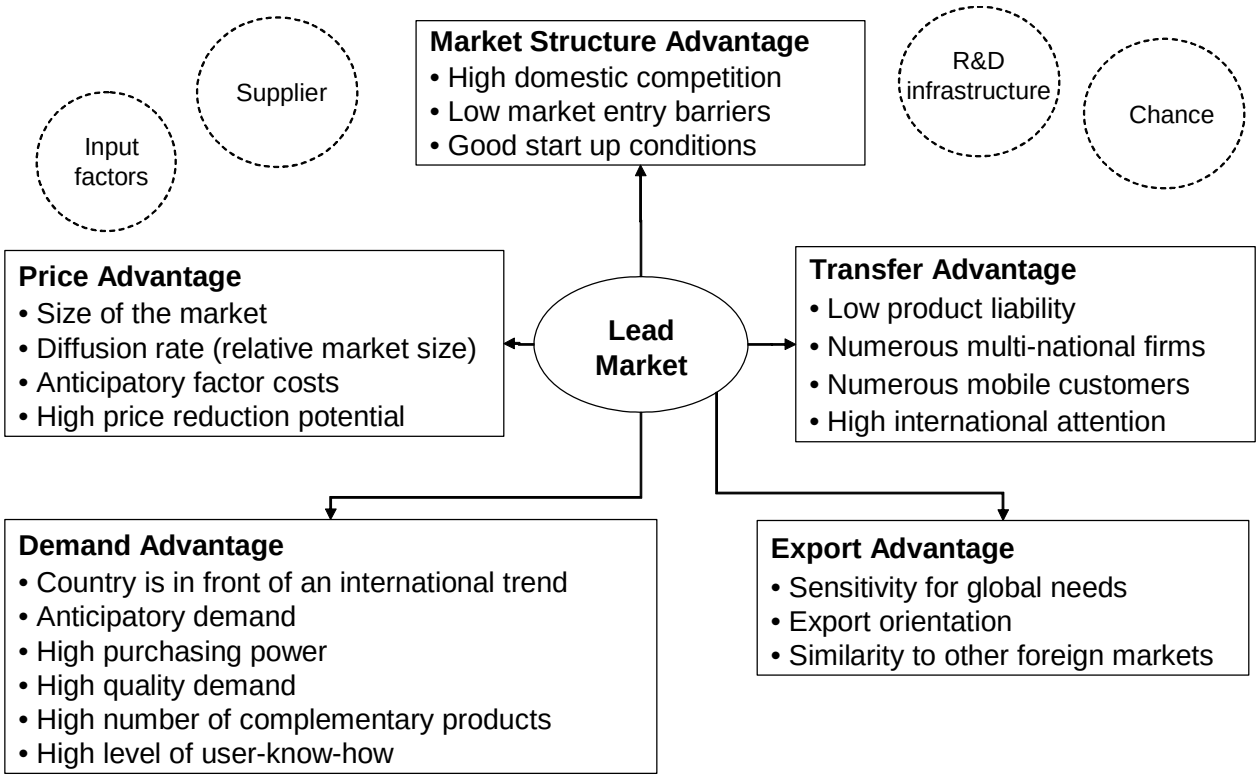
The attributes of a market that support the foreign demand and the export of innovation can be summarised as export advantage. This advantage appears if the domestic demand responds sensitively to global developments. In such cases, domestic users are frequently more aware of global problems and needs than potential adopters in other countries. Domestic firms are pushed into a global perspective and increase their ability to meet global problems before firms in other countries. Additionally, innovations can be exported more easily if the foreign and domestic market conditions are very similar or if the innovation design can respond to needs in a variety of environments (Dekimpe et al., 1998 and Vernon, 1979).

A country can have a transfer advantage if its market has strong communication ties with other countries (Takada/Jain 1991). The adoption of one innovation design in one country can influence the adoption decisions of users in other countries, because the perceived benefit of an adopted design increases for users in other countries. The perceived benefit increases when information on the usability of the innovation design is made available. Information on the innovation not only enhances the awareness of the innovation design but also reduces the uncertainty surrounding new products and processes (Mansfield 1968 and Kalish et al. 1995 and Porter 1990).

The degree of competition in the domestic market is the last Lead Market factor, the so called market structure advantage. In general, Lead Markets are very competitive markets. First of all, buyers tend to be more demanding when the sellers face competition than when they are tightly regulated or hold a monopoly (Porter 1990). Second, competing firms are under more pressure to follow those who have already adopted a new technology (Mansfield 1968, p. 144). And third, more innovation designs are tested in a competitive market than in a monopolised market. A competitive market is subsequently more apt to find a design that is not only the best within the domestic environment but also the best across all national environments.

The five Lead Market factors and their most important variables are summarised in the following illustration. For more theoretical details concerning the Lead Market approach refer to Beise (2001).

**Figure 3-1: The five Lead Market Factors**




Source: Adopted from Beise (2001), p. 85.

# 4 Lead Market analysis of the Automotive industry

The five Lead Market factors discussed above apply to all countries. In this section we will analyse which countries in particular have Lead Market properties in the Automotive industry. It should be noted that the Lead Market potentials established are for the aggregated sector. In reality, Lead Market potentials within a sector can vary from one product group to another, or even between individual products. The loss of accuracy that results from such aggregation must be taken into account in the analysis. That being said, observations of Lead Market potential that are aggregated at the sector level are still of great interest, as they offer a means of explaining the future competitiveness of different markets. The investigation presented here focuses on the activities of companies from the NACE 34 sector within the EU-25 countries.

## 4.1 Demand Advantage

A market is said to have a demand advantage if the environmental conditions there foster an innovation design that also anticipates future customer preferences in other markets. Lead Markets are able to anticipate global trends. Therefore the difference between different countries' markets does not lie in the direction in which they develop, but merely in the speed with which they move in the direction of the global trend. The innovation design on the Lead Market thus has a "head start". A head start may also come about when the country is the quickest to build up an infrastructure of complementary goods required by the innovation. An example of this would be a car powered by alternative fuel. The utility of the car increases only when a suitable network of refuelling stations is built up. The innovation designs from markets at the forefront of a trend offer other markets the answers and solutions to their questions and problems of tomorrow.

One consequence of the different speeds at which markets adapt to or adopt an international trend – following Linder (1961) and Vernon (1966) – comes in the form of demand advantages, which can be expressed as per capita spending on certain products or as the proportion of a country's total consumption accounted for by these products. The idea behind this is that demand for certain goods varies from country to country and that this affects the innovative performance of the companies based there. Companies make greater efforts to develop and improve products in sectors that account for larger proportions of a country's aggregate demand. Porter (1990, p. 87) encapsulates the idea when he writes: "The more significant role of segment structure at home is in shaping the attention and priorities of a nation's firms. The relatively large segments in a nation receive the greatest attention by the nation's firms." A greater share of total consumption is a sign that consumers in a country place more value on a certain product. This indicator can be used to compare the situation with other countries.

It is possible to directly compare the sector-specific demand specialisation of different countries by subtracting the weighted average share of total demand within the EU-25 from the share of demand for one country. If the share of total demand accounted for by products from a given sector in one country is lower than the average share for these products in the other EU-25 countries, the country in question has a low demand specialisation with respect

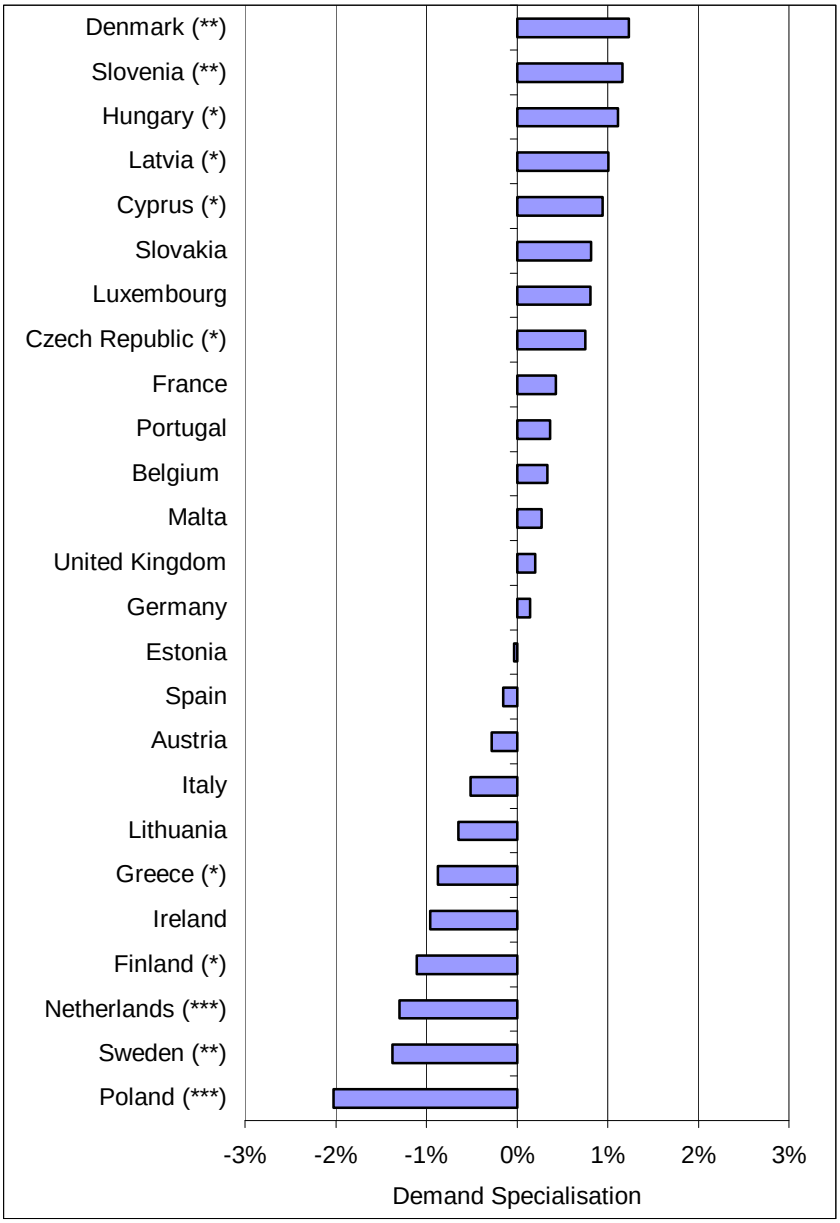
to the sector. In this case, the value of the specialisation index is negative. A specialisation index of zero means that the proportional demand for a sector in the country concerned is equal to the weighted EU-25 average for the same sector. The index takes on a positive value when the propensity to demand such products on the particular market is higher than average.

To calculate an individual country's demand specialisation, we need to know how final demand is structured. Eurostat's Purchasing Power Parities (PPP) statistics can be used to find this out. These statistics give a differentiated picture of a country's final demand (for consumer goods, investment goods and goods provided by the state), grouping the goods into 282 categories (the so-called "basic headings"). The demand is calculated by taking production output, adding imports and subtracting exports. The data for the observation period between 2000 and 2004 are available for academic research purposes and quote values in terms of the national currencies of the time.[4] All the national currencies were converted into ECU (later Euro) amounts, using the average annual exchange rate. The basic headings used to categorise goods are not directly based on NACE classification. It was therefore first necessary to allocate 2-digit NACE codes to the products, so that a clear picture of the importance of certain sectors for a country's total demand could emerge.[5] It should be noted at this point that not all products always fit easily into a single 2-digit NACE sector. The result is that sectors which primarily produce intermediary products rather than end products are underrepresented in the PPP statistics in terms of the demand they receive. This is of particular relevance for the wood, paper, steel, metal, chemical, energy and plastics sectors.

[4] For 2000 to 2003 the PPPs are scaled such that the PPP for EU-15 is equal to one. For 2004 the PPPs are scaled such that the PPP for EU-25 is equal to one. All PPPs correspond to national currency in use, i.e. from 2002 the PPP of the euro zone (EUR12) correspond to the Euro.

[5] See Table 10-1.

**Figure 4-1: Demand specialisation in the Automotive industry compared to the weighted EU-25-average for the years 2000 to 2004**




Note: (***), (**) and (*) means significant at 1%, 5% and 10% respectively.

Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

The countries with a demand specialisation well above the EU-25 average are Denmark (because of the high taxation of vehicles), Slovenia, Hungary and Latvia, all of which scored around one percentage point above the average. Shares of demand that were significantly below average could be found in Poland (-2 percentage points), Norway, Sweden, the Netherlands and Finland (all at -1 percentage point).

Government intervention seldom proves an effective means of bringing a country to the forefront of an international trend in the demand for a certain innovation and creating a demand advantage. Demand preferences are very much culturally determined and can therefore only be changed in the long term. At best, political measures may improve the situation by speeding up technical approval procedures to increase the adaptation and

adoption of innovations and by providing incentives to react more quickly to certain innovation trends, in the form of tax (=price or cost) reductions.

Over the observation period between 2000 and 2004, the demand propensity increased significantly in Latvia (increase of around 1 percentage point per year)[6] and in Denmark (up approximately 0.6 percentage points per year).[7] Compared to the overall development in Europe (EU-25), the demand propensity in Portugal fell by 0.5 percentage points annually and that in Poland by 0.6 percentage points.[8] Thus in Latvia and Denmark, it is not only the demand propensities that are above average – the growth rates of the automotive sectors in these countries are too.

What options in the innovation process are left open to companies from sectors with below-average shares of demand? One possibility is to substitute the inadequate demand in the home country with international demand (see the sections below on price and export advantages). This creates a necessity to involve foreign customers in the innovation process to a greater extent. Another option is to lower relative prices in order to stimulate the domestic and foreign demand. However, this can only be sustained in the long-term if cost advantages are realised.

### 4.2 Price Advantage

According to Levitt (1983), in the context of the internationalisation of innovations, an innovation design sold at a lower relative price on a Lead Market can squeeze out existing – but relatively more expensive – innovation designs on other markets abroad. The limits on price reduction in this case are determined by the potential to reduce production and factor costs now and in the future. Price reductions can be achieved by cost reductions, which, in turn, can result from size advantages.[9] The effects of this price mechanism are stronger when the relative price differences at the start of the innovation competition are greater. Its effectiveness also increases with increased dynamism of the relative price development in favour of the innovation design. Only when the relative price difference in favour of the innovations on the Lead Market is so great that the transaction costs incurred in changing over to the innovation design can be compensated, will firms and customers in other markets abroad switch over to the Lead Market design.

Price advantages can only be used as Lead Market factors if there is price competition. Therefore in highly regulated or isolated markets it may not be possible to exploit the price advantage of an innovation design. Competitive markets exist for most goods produced by the automotive industry and for many knowledge-intensive and automobile-related services. This

[6] Significant at 10% level.

[7] Significant at 5% level.

[8] Significant at 5% level.

[9] One example of a country-specific size advantage is the potential market size, which offers the potential to exploit economies of scale and learning effects in order to create a price advantage. However, even at the stage of operationalising the potential market size, there are problems in defining and delineating relevant markets. A series of Lead Market studies (Beise/Cleff, 2003) have shown that aggregating “culturally and economically similar” areas was not an adequate way of identifying the different relevant markets, in that it did not allow for sufficient differentiation. For example, heavy goods vehicles in the USA are very different from those in Europe for legal reasons. The scope of the two relevant markets is affected accordingly. For passenger cars - as another product from the same industry -, however, no strong difference of this sort comes into play.

means that price advantages are indeed of relevance in this context (Beise et al., 2002). For this reason, it is worth investigating which countries already have long-term price advantages. The size of the price and cost advantage can be taken directly from international Purchasing Power Parities (PPP) statistics.

To enable the international comparison of purchasing power in a world of floating exchange rates, the OECD and Eurostat calculate Purchasing Power Parities (PPP). These provide a means of showing the price level for certain groups of goods, controlled for differences in quality. PPPs are price relatives that show the ratio of the prices in national currencies of the same good/service in different countries.[10]

Similarly to the data for demand specialisation, this price information is available for the period 2000-2004 and is classified using the 282 basic headings.[11] National currencies were converted to ECU and later Euro using the average annual exchange rate. As the PPPs only refer to groups of goods, they were categorised according to the NACE classification of economic activities. The good-specific PPPs are then weighted using the demand propensity.[12] This provides a basis for the calculation of relative prices within a country, by taking the ratio of sector-specific PPP to the average PPP for all sectors in a country's economy. A relative PPP level calculated in this way controls for country-specific differences in pro-capita income and the different price levels that result. The negative logarithmic quotient of a sector's relative PPP level and the price level for the same country's economy is a direct measure of sector-specific price differences between countries.[13] A positive log-value for a country means that the price level in question was below the average for the EU-25 countries in 2004. A negative value implies that the price level is above average. The following figure shows the price differences of the EU-25 countries for 2004, calculated from the smoothed time series for the years 2000 to 2004 in the automotive industry.

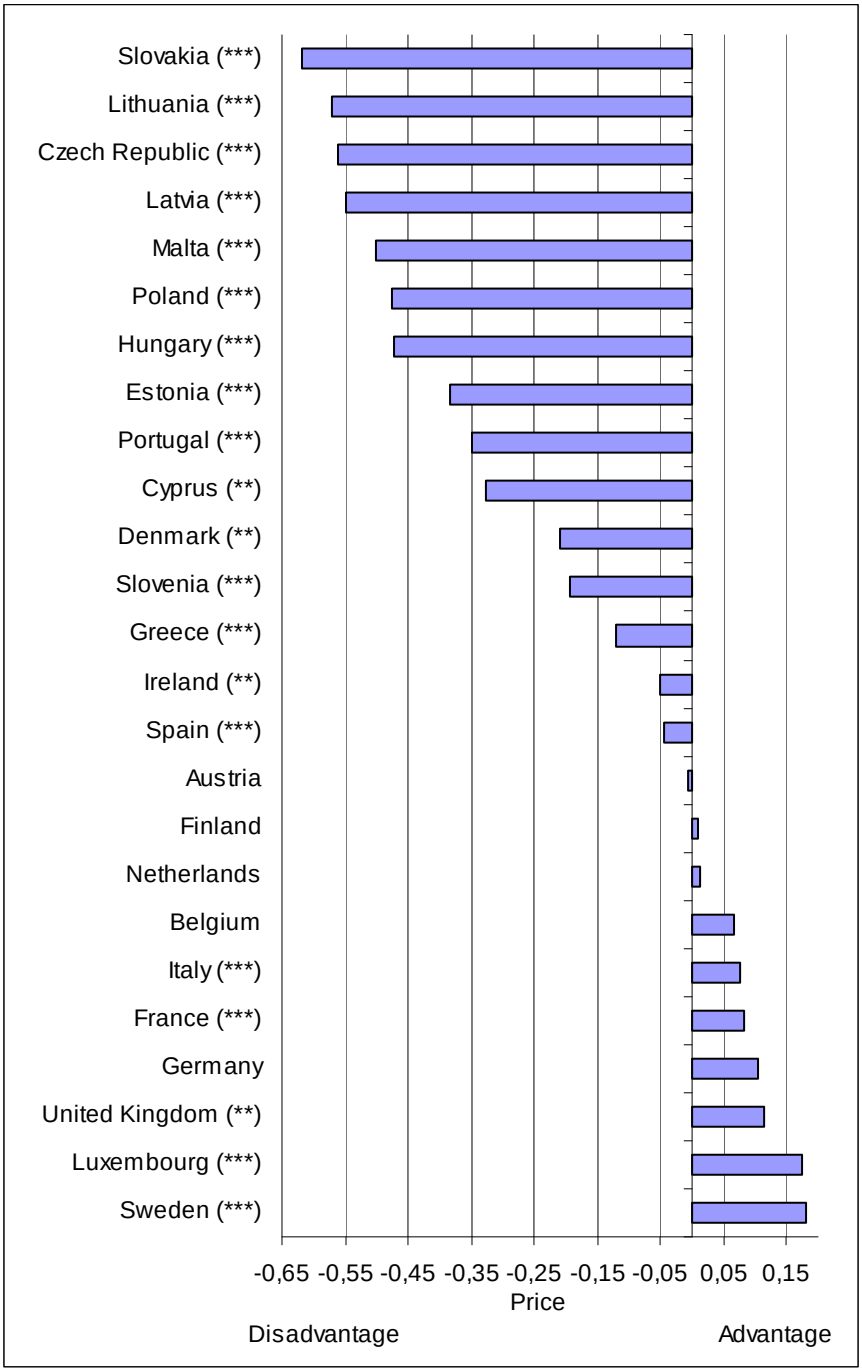
[10] "For example, if the price of a hamburger in France is 2.84 euros and in the United States it is 2.20 dollars, the PPP for hamburgers between France and the United States is 2.84 euros to 2.20 dollars or 1.29 euros to the dollar. In other words, for every dollar spent on hamburgers in the United States, 1.29 euros would have to be spent in France in order to obtain the same quantity and quality – or volume – of hamburgers. […] PPPs are still price relatives when they refer to a product group or to an aggregate. It is just that in moving up the levels of aggregation the price relatives refer to increasingly complex assortments of goods and services. Thus, if the PPP for GDP between France and the United States is 0.97 euros to the dollar, it means that 0.97 euros has to be spent in France to obtain the same volume of final goods and services that one dollar purchases in the United States. This does not imply that the baskets of goods and services purchased in both countries will be identical. The composition of the baskets will vary between countries reflecting their economic, social and cultural differences, but both baskets will, in principle, provide equivalent satisfaction or utility" (OECD/Eurostat 2006, p. 2).

[11] For 2000 to 2003 the PPPs are scaled such that the PPP for EU-15 is equal to one. For 2004 the PPPs are scaled such that the PPP for EU-25 is equal to one. All PPPs correspond to national currency in use, i.E. from 2002 the PPP of the euro zone (EUR12) correspond to the Euro.

[12] It should be noted at this point that, as was the case when demand specialisation was aggregated at sector level, it is not always possible to allocate a product to one distinct sector grouping. As the composition of national baskets of goods changes over time, some distortion of the sectoral allocation can occur in the PPP statistics.

[13] $ln\left(\frac{PPP^{\text{sector}}_{\text{Country}=i}}{PPP^{\text{all sectors}}_{\text{Country}=i}}\right) * (-1)$.

**Figure 4-2: Price advantages and disadvantages of different markets for 2004 [from the smoothed time series for the years 2000 to 2004] in the Automotive industry**




Note: (***),(**) and (*) means significant at 1%, 5% and 10% respectively.

Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

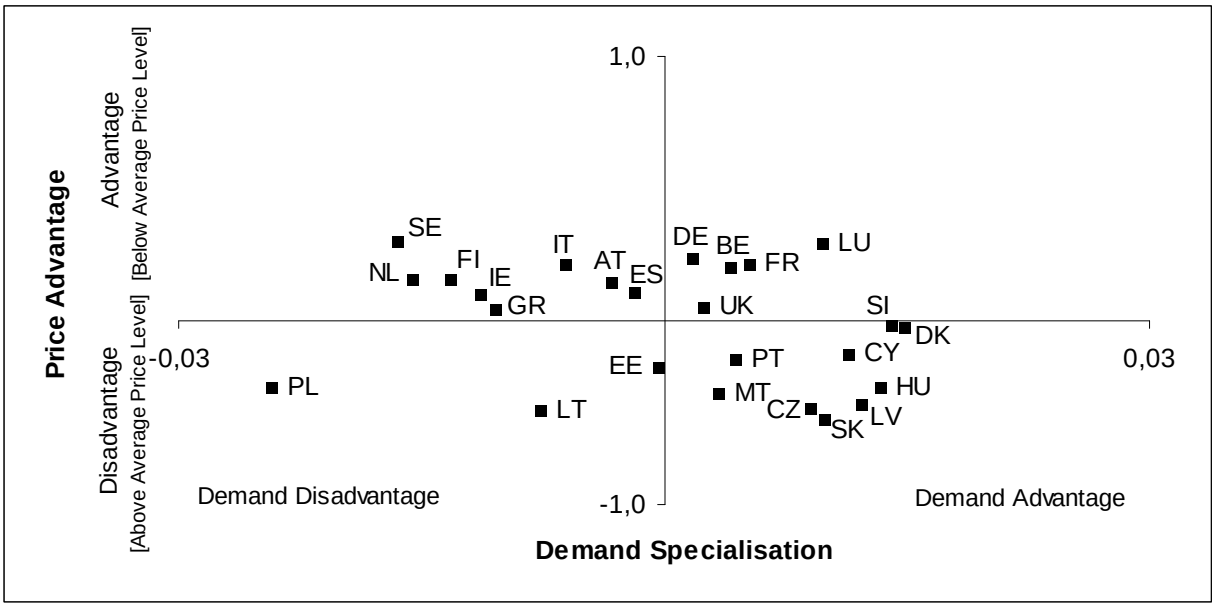
It becomes apparent that the relative prices in the automotive industry are higher in Eastern European and Scandinavian countries (except Sweden) than in the remaining Western European countries. Comparatively low relative prices can be found in countries with a tradition of car manufacture, namely Germany, France, Italy, Sweden and the UK.

When considering these statistics it is important to be aware that the price level is not the only indicator of a price advantage, because it is strongly influenced by company strategies and competitive behaviour (see section 4.5). Nevertheless, a low price level and relatively

high propensity to consume can be a sign of a price-dependent demand advantage. When this is the case, the demand reacts to a low price level with an above average increase in their demand for the product. In other words, the price elasticity is very high. A low price level thus makes for a clear demand advantage when it is accompanied by high demand specialisation.

In Figure 4-3, the relative PPP level is plotted against demand specialisation for all countries. The countries that are of interest to us are those located in the upper right quadrant. These are countries with both a low relative price level and a high propensity to consume. The countries in question are Germany, France, the UK, Belgium and Luxembourg. The price level in these countries constitutes a Lead Market advantage. Drops in prices are met by a large increase in demand. Innovation designs that exploit this price elasticity can spread quickly and make use of market size advantages to increase their ability to compete on price. This market characteristic should spur suppliers of innovations to follow a price-cutting strategy from the outset. Innovations designed within this system of incentives should have a marketing advantage over alternative innovation designs, on the basis of price.

**Figure 4-3: Price advantages and demand specialisation in the Automotive industry**




Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

Lead Market advantages can also exist when a low price level comes together with an average, or even slightly below-average, propensity to consume. In these markets, too, the quantity demanded is above average. However, the low price level means that demand specialisation does not appear significantly positive. In some countries, the propensity to consume remains low in spite of a relatively low price level, i.e. the relatively low prices do not lead to increased demand. This is particularly the case in Italy and Austria. When the opposite is true and a high price level is found with high demand specialisation, this suggests that price elasticity on the market is low. The fact that this group of goods makes up a large proportion of total demand is essentially due to the high prices, while the propensity to consume remains comparatively low. Typical examples of this are the countries from Eastern Europe, Denmark and Portugal. On the whole, these markets are unfavourable for innovators.

Finally, a group of countries can be identified in which the price level is relatively high and the demand specialisation below average. In such cases, the high price level leads to a higher than average (compared with other countries) drop in demand. The high price level is a disadvantage for export-oriented innovators, as it prevents lower-cost innovation designs from coming into being. The countries Poland, Ireland, Greece and Lithuania in particular are faced with this problem.

Of all the Lead Market factors, the price or cost advantage seems to be the easiest to influence by means of political intervention. One form this intervention may take is the use of taxation on particular factors or goods to directly affect the price and cost structure of innovation designs. Any such tax policy should be "trend-oriented" and anticipate future cost developments at an international level. Only then will the industries in question be able to produce innovations that will also subsequently be demanded in other markets. In contrast, a policy of taxation and subsidisation that went against the international cost trend would only increase the probability of idiosyncratic innovation.

Price advantages can also be promoted by policies aimed at fostering competition, since intense competition lowers prices for end users. A final important point is the aspect of cost advantages resulting from the size of the market. In the European Union, the market is already large, so innovation policies should be able to set parameters that allow firms to make the most of the size advantage which, in principle, already exists. Such policies include preventing the home market from splitting into regional markets, for example. One example of how this problem can arise is if approval procedures or regulations differ from one region to another.

### 4.3 Export Advantage

The key characteristic of a Lead Market is that innovations realised there will not be limited to a certain country or region, but should be well-suited for export. Vernon (1979) and particularly Dekimpe et al. (1998) find that the exportability of innovations is higher when the exporting and importing markets are more similar in cultural and economic terms. In such cases, customers only suffer a relatively small loss of utility when changing over to a "foreign" innovation design. The number of country-specific innovation designs thus falls comparatively quickly. However, exportability may not only depend on how similar markets are. The "adaptability" of an innovation to different market surroundings is also decisive for its chances on the international market. International marketing proves less complicated when certain features of the innovation design have been planned from the outset to facilitate its use in different environments without the need for any substantial changes.

The Lead Market approach is not based on the traditional view that export successes are indicators of a country's technological – or, more generally, economic – competitiveness. Instead, pronounced export activity is seen as an input factor for a country's success in innovation. A strong position in terms of exports in the past may encourage innovators to make their products suitable for international markets. This, in turn, promotes innovation designs that will be a success when exported.

Interaction with customers and demand orientation are not export factors in themselves. Only interaction with the "right" customer and the presence of the "right" market conditions

actually lead to innovations that will be taken up in the world market. Innovations driven by demand which only come into use in their home country and thus have no impact on exports are a sign of idiosyncratic demand. In this case, there is a demand preference for innovation designs that do not represent a competitive advantage in other national markets. There are a range of possible root causes of idiosyncratic demand, which may be natural (specific environmental conditions), may have come about through national legislation (regulations that are not extended to the international sphere), or may be due to an insistence on sticking to the individual national standards set by large clients (e.g. postal service, railways, electricity suppliers). On the other hand, idiosyncratic demand may simply be a result of consumers' or business customers' preferences being different from those in other countries.

To assess what affect demand in a particular market has on exports we can again make use of the share of aggregate national demand from Eurostat's Purchasing Power Parities (PPP) statistics, in combination with the European foreign trade statistics.[14] The two sets of statistics are based on different systems of classification, so correspondence tables must first be used to convert to the NACE nomenclature before they can be compared.

The first step is to find the extent of export success for every country. An above-average export performance shows that new products are successfully marketed internationally. The greater a country's export surplus within a group of homogeneous products in bilateral trade, the higher the estimated competitiveness will be (Grubel 1975). To measure competitive advantages between two countries, the ratio of export surpluses to total trade volume (CAtik) within a product group p should therefore be applied: $CA_{tik} = \frac{x_{tik} - m_{tik}}{(x_{tik} + m_{tik})}$.[15] The chosen indicator of competitive advantage corresponds to the objectives set out by a company when identifying potential supplier countries (Cleff 2006b). The Revealed Comparative Advantage - RCA (Balassa 1965) - applied in the tradition of economics for determining comparative advantages, is considered not to be an appropriate indicator in this case. A positive competitive advantage of a country can be hidden to some extent behind a low RCA if the ratio of exports to imports of a particular product group is indeed higher than 1, but the corresponding ratio in total trade of a country turns out to be higher. This can lead to an underestimation of the product-specific absolute competitiveness of nations that have a high overall product export surplus, and vice versa (Cleff 2006b).

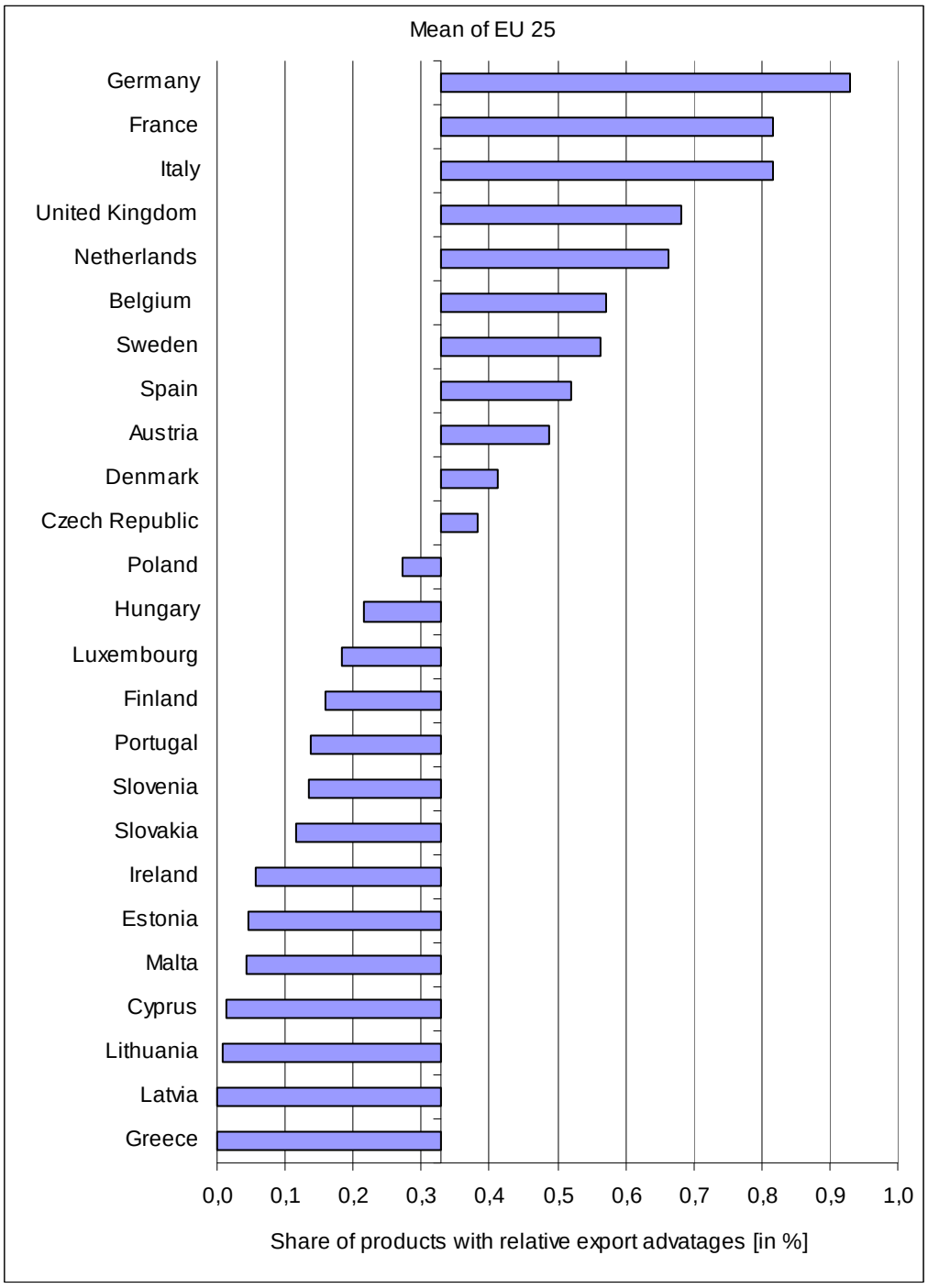
The average CA of all countries that export the product in question within the different European countries is used as a reference value for export success. Countries with a smoothed product-specific CA significantly above the average for the last ten years are considered to have an above-average product-specific relative export advantage. If a country has a high share of product-specific relative export advantages in a given industry, this indicates a

[14] The European foreign trade statistics offer data on an 8-digit-aggregational level – the Combined Nomenclature. The Combined Nomenclature is based on the 6-digit Harmonised System, which was extended by 2 digits for the European Trade Statistics. Thus the first three levels of the Harmonised System HS2, HS4 and HS6 correspond to the Combined Nomenclature, completed by a further level KN8. These data are available for the years 1988 to 2005 and in contrast to the data of the OECD, only encompass trade between individual EU states and all other states in the world. Therefore trade flows outside of the EU, such as those between Japan and the USA, are not determined.

[15] The variable $x_{tik}$ stands for the export value from the supplier country k ($k \in \{1,..., n\}$) to the supplied countries i ($i \in \{1,..., m\}$) in a specific year t. The variable $m_{tik}$ represents the respective import value.

country-specific export advantage there. On the basis of the foreign trade statistics for the Automotive industry, the following diagram shows in how many product groups an above-average relative export advantage is recorded for each of the EU-25 countries.

**Figure 4-4: Share of product-specific relative export advantages in the Automotive industry, for EU-25**




Source: ZEW: Global Sourcing Management Tool, 2007.

Germany, France, Italy, UK, the Netherlands, Belgium, Sweden and Spain have particularly large export advantages, with more than 50% of their Automotive industries' products proving successful abroad. Austria, Denmark and the Czech Republic follow,

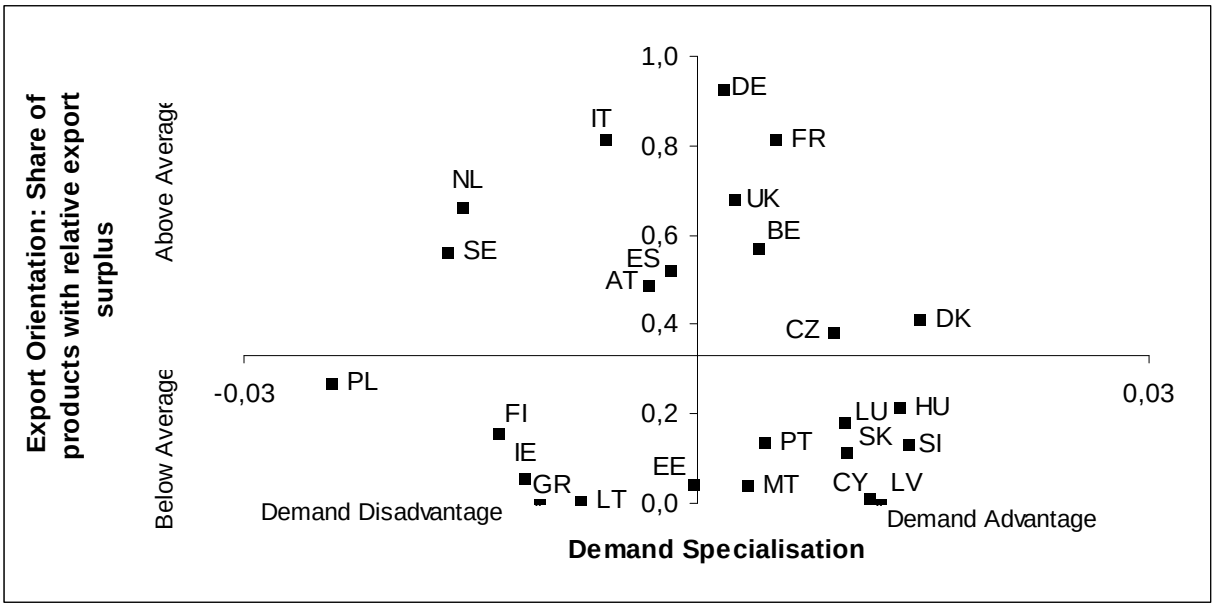
although their export advantages in the industry are essentially average. The other countries have values well below average.

It is assumed that a Lead Market is always present when demand in a country provides innovating companies with a considerable quantitative impulse to innovate and, at the same time, the companies generate a large proportion of their turnover abroad. If quantities of product innovations exported are high and the impulse to innovate came from customers in the home market, this shows that demand at home prefers an innovation design that has the potential to succeed internationally. Conversely, it is a sign of an idiosyncratic market when companies only export a small share of their goods because they respond too much to the "eccentric" customers' wishes at the home market. In this case, customers appear to prefer product solutions that cannot be marketed internationally (idiosyncratic demand).

Therefore if a country's various export successes, measured as the share of products with above average relative export advantage, can be put down to above-average customer demand, this is a sign that the country has a particular Lead Market characteristic. This is because domestic demand that translates into success on the export market is a typical characteristic of a Lead Market.

Figure 4-5 shows the extent of demand advantage against the size of the export advantage for the automotive industry in the form of a portfolio. In the upper right quadrant of the portfolio are countries that develop technologies driven by demand and at the same time exploit the lead-market properties of home demand for successful exports (Lead Market sectors). The home markets in these countries – Germany, France, Belgium, UK and Denmark - offer particularly favourable conditions for the launch and testing of new products, with the aim of successfully marketing the innovation designs tested at home in other countries.

**Figure 4-5: Lead Market Matrix in the Automotive industry: classification according to export orientation and utilisation of home market demand**




Source: ZEW: Global Sourcing Management Tool, 2007 and Eurostat/OECD PPP-Statistics for 2000 to 2004.

Exportable innovations may also originate from sources other than the home market. Innovating companies that are highly export-oriented but do not, to any great extent, rely on

home demand as a source of innovation can be categorised into three different types. In the first type, the drive behind innovations that are suited to the world market comes from the company's own R&D, or from technological know-how purchased externally (e.g. from technology suppliers or academic research).

The second possibility is to base new products on the innovations of foreign competitors, i.e. imitation. The third category comprises firms that are driven to innovate by demand from abroad. This could indicate that the home market is a successful lag market. In this case, home companies may not be leaders in launching product innovations that have international staying-power, but they are good at quickly picking up on new trends from abroad then converting these into export success. For simplicity, we shall denote all of these effects as "technological impulses to export". The upper left quadrant in the diagram above contains the countries Italy, the Netherlands, Sweden, Spain and Austria, which primarily bring out innovations driven by technology and then translate these into export success.

Finally, if product innovators have little export success and home demand plays no meaningful role as a source of innovation, companies focus on technology specific to the home market. In this case, innovators concentrate on product innovations based of their own R&D or external sources of knowledge, but which do not provide solutions suitable for export. We can speak of idiosyncratic technology in this context. In the diagrams above, the countries in the lower left quadrant - in particular Poland, Finland, Ireland, Greece and Lithuania - belong to this group of markets.

The most problematic area from an innovation strategy perspective is surely the lower right quadrant. The difficulty is that these countries are largely dependent on demand to drive their innovation activities, yet the demand on their home market is idiosyncratic. The home market acts as an obstacle to export activities, since catering for home demand makes for innovations that are difficult to sell in other countries. Portugal, Hungary, Slovakia, Slovenia, Latvia and Estonia are notable examples of countries with such markets.

If innovation policy is to be efficient from this point of view, it must adapt the incentives it offers, to focus more strongly on exports. This applies in particular to technology development projects that receive government subsidies. The potential exportability of the technology could be included as a criterion for subsidisation. Politicians can also support international and flexible Lead Market strategies by not insisting on national solutions, but instead taking experiences from potential Lead Markets into account, for example when approving products and formulating regulations for specific markets. The legislature, too, can influence export orientation, by taking note of international trends and thus preventing infrastructure for science and technology (educational institutions, research establishments, standards agencies etc.) from becoming idiosyncratic.

### 4.4 Transfer Advantage

The concept of transfer advantage covers a range of "classic" diffusion factors. The decision to adopt a particular innovation design in a country is often dependent on which technology has already been adopted in the Lead Market and on the experiences gained during its introduction there. The demonstration effect when the innovation is adopted increases the incentive for users in other countries to adopt the same innovation design, firstly

because of the information that is available about the innovation and its use and secondly because of the decreased risk, i.e. reduced uncertainty as to whether the new product or process is reliable. If a product has been successfully tried out in the Lead Market, it makes sense to adopt it in other markets too (Kalish et al., 1995). In this case, the Lead Market takes on the role of a test or reference market and is closely observed by agents in other markets. The Lead Market serves as an example for the evaluation of problems and dangers in the introduction of the new technology, thereby reducing uncertainty. More importantly still, the utility of the Lead Market customers affects customers beyond the boundaries of the market.

A country's market therefore has a transfer advantage if it raises the perceived utility of customers on other markets as well as those at home. The reputation and high level of development of the Lead Market's users is considered to be a hallmark for high-quality innovation designs. The quality of demand is especially determined by user's know-how and experience with similar products. For example, the markets in countries which often feature in the mass media and television series are potentially Lead Markets for lifestyle products. In a similar way, smaller markets can also bring out products that are competitive worldwide (Beise et al., 2002).

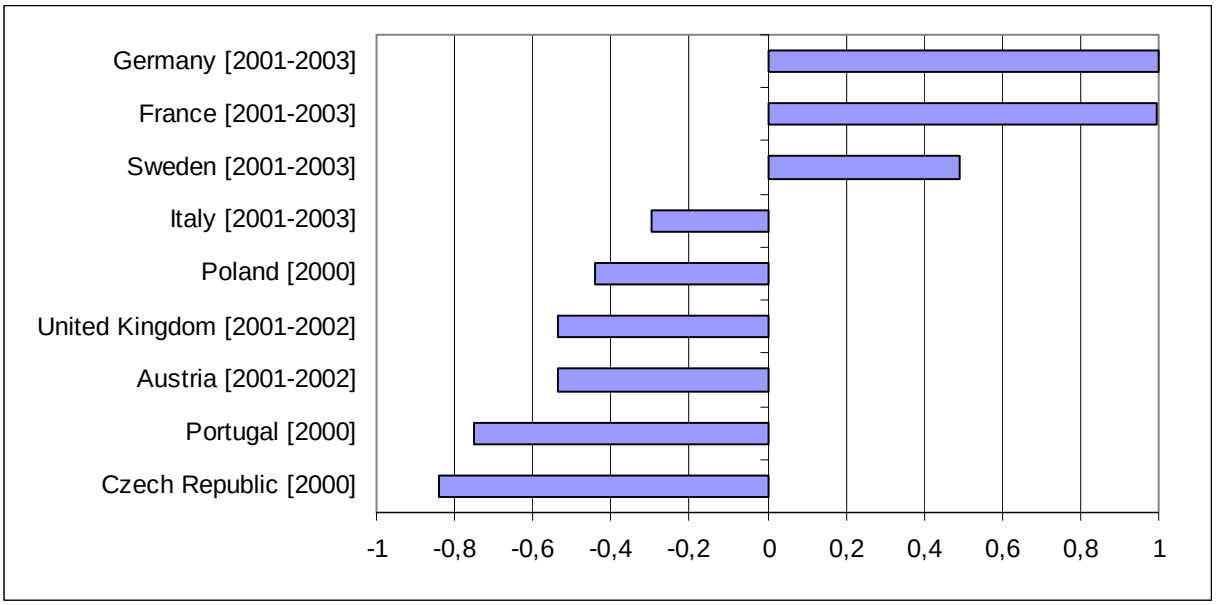
Transfer advantage is difficult to quantify, as analyses related to innovation projects have shown (Beise/Cleff, 2003). Since the differences between countries are less pronounced at the industry level than at the level of individual products, it is almost impossible to find general indicators for the industry level.

Cleff (2006b) used the amount of foreign direct investment (FDI) as a proxy for the potential international diffusion of innovations. One benefit of foreign subsidiaries is that they provide companies with information about the particular nature of demand in a country. Another advantage for companies with subsidiaries in several countries comes in the form of economies of scale. This means that the company can launch a single innovation design internationally, even if the design itself is not optimally suited to the conditions in one of the local markets. This means, for example, that companies may use the same software, the same component assemblies and the same machines in all markets, even though the relative factor prices differ from country to country. Since it is assumed that the parent company is generally the first to make use of innovations or generally makes the decisions about which innovation design to pursue, countries that engage in a large amount of FDI have a transfer advantage.

Unfortunately, data on the quantity of FDI by industry, which would enable a cross-country comparison for the automotive industry, are only available for nine of the EU-25 countries. The data come from the "United Nations Conference on Trade and Development (UNCTAD)" or Eurostat publications. If we compare the total value of FDI for the specific industries with the help of a measure of specialisation,[16] rather than the number of investments made, we come to the results shown in the figure below.

[16] The measure of specialisation is calculated by taking the quotient of (1) the industry-specific total stock of FDI by home companies abroad divided by the respective total of FDI by foreign companies in the home market and (2) the overall total of FDI by home companies abroad divided by the respective total of FDI by foreign companies in the home market. To attain a

**Figure 4-6: Specialisation of FDI in the Automotive industry (Average for the given years)**




Source: United Nations Conference on Trade and Development (UNCTAD) 2007.

If the proportion of investment abroad is above average, the resulting value is positive. Otherwise the value returned is negative. It becomes apparent that the automotive industries in Germany, France and Sweden specialise in FDI more than is average, while the other countries have below-average values. The German Automotive industry in particular has followed a strategy of internationalisation for a number of years. In this strategy, innovations that attract high demand in Germany are subsequently used in cars developed and manufactured in other parts of Europe. Examples of this include high-pressure fuel injection, airbags and electronic systems for automobiles.

Countries that succeed in propagating their international standards in innovation design are best placed to realise a transfer advantage. Transfer advantage is the Lead Market factor that has received the most attention in innovation policy. It is common for government funding for innovations to aim to promote the demonstration effect in the diffusion of innovations (e.g. through application centres designed to give businesses the chance to experience new process technologies). This can be a particularly decisive factor for the international diffusion of a technology if there is a large amount of uncertainty about how readily it can be implemented in practice and how efficient it is in economic terms. However, there is a considerable risk that idiosyncratic technologies will be subsidised, particularly in lag market industries. The degree of openness of a standard should therefore be used as a criterion to determine whether a technology is eligible to receive government subsidies. Equally, increased bargaining power

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final value between -1 and +1, we take the hyperbolic tangent of the quotient then subtract one:

$$hyptan\left(\frac{DI^{\text{sector}}_{\text{home to foreign market}}}{DI^{\text{sector}}_{\text{foreign to homemarket}}} \Big/ \frac{DI^{\text{overall country}}_{\text{home to foreign market}}}{DI^{\text{overall country}}_{\text{foreign to homemarket}}}\right) - 1 .$$

for European politicians and companies in international standardisation committees can help to improve the transfer advantage.

### 4.5 Market Structure Advantage

From empirical studies about successful innovation designs from the Lead Market (Beise, 2001), a notable characteristic of these markets is particularly strong competition. The realisation that international innovation success is correlated with the intensity of competition may not be new (cf. Posner, 1961 and Dosi et al., 1990), but Porter (1990) was the first to find a conceptual link to a cause, namely that customers in very competitive markets can be "choosier" than in oligopolies or monopolies. Faced with strong competition, innovators are compelled to react increasingly to technological development (Mansfield, 1968, p. 144). The resulting competition between very different innovation designs often leads to a refined innovation that best fits customers' needs. This innovation design, which offers maximum utility to customers thanks to the competition on the national market, also has the best chances of winning through in international competition. Competition can therefore be understood as a process of decentralised coordination, by which all the participants attempt to achieve a better innovation design, so that the final design will also have a better chance of succeeding in international markets.

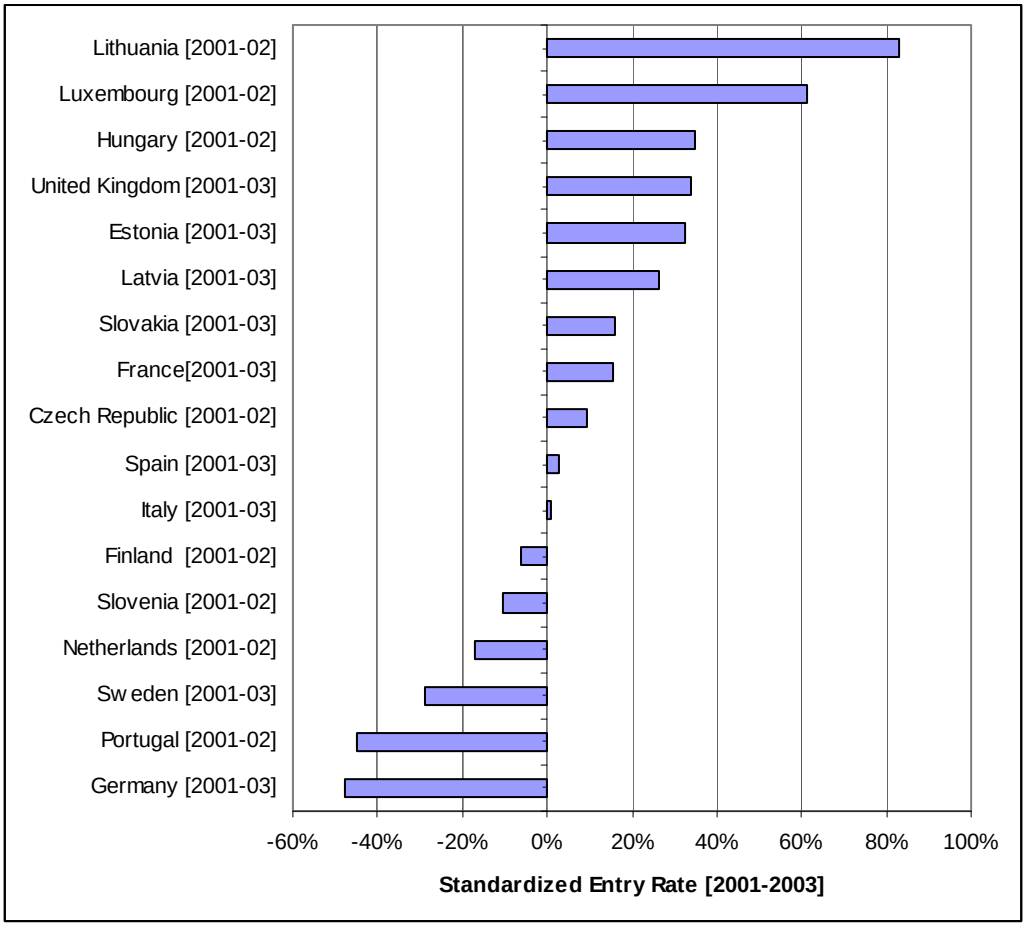
There are a range of known measurement concepts that could be used to establish the intensity of competition. Putting such concepts into practice often proves impossible, however, because of a lack of internationally comparable figures.[17] Using the fact that markets with different degrees of concentration establish their prices differently, an approximation can be found for the intensity of competition on a market. Monopolists set their prices to maximise profits without being subjected to pricing pressure from competitors. In a market with perfect competition, firms theoretically adjust their supply to fit the market price. In this case, the price level is lower than that in a monopoly. Taking this relationship as a starting-point, we can assume under certain conditions – namely that we are dealing with homogeneous goods/services – that the price level on a market decreases with increasingly intense competition. The price level can thus be taken as an indirect indicator of competition on a market. As a cautionary reminder at this stage, it should be noted that the price level has already been used to illustrate the aspect of price advantage, as a relatively low price level is conducive to Lead Market advantages, which arise from the increased inclination to adopt an innovation and its quicker diffusion, in international comparison (cf. section 4.2). Since a low price level is always a positive aspect of demand structure, either as an indicator of prices or of competition, the ultimate result is unaffected by which Lead Market factor the indicator is allocated to. The same indicators can therefore be used to show advantages in price and market structure. This also suggests that although these two Lead Market characteristics can

[17] In traditional industrial economics, the intensity of competition can be measured using a range of parameters of concentration (e.g. a company's turnover as a share of market volume). Commonly-used parameters are the concentration ratio, the Gini coefficient and the Herfindahl-Hirschman Index. Since these require all the shares of a particular characteristic to be precisely allocated to individual subjects or objects, the two indicators can only be used if the available data is sufficiently detailed. Even in national statistics from large countries, this is rarely the case. Experience has shown that such data are most likely to be available on oligopolistic markets that have large companies which are therefore obliged to publish their sales figures. On the other hand, the concentration ratio, CRx, only uses the market share of the x-largest market player to determine market concentration and, as such, is an accommodating method when data is limited. However, even for this method, there is a severe shortage of internationally comparable data.

be separated in theory, it is not necessarily possible in practice. The results from section 4.2 should therefore be taken into account.

Furthermore, it is possible to show the intensity of competition on a market by referring to the occurrence of barriers to entry, because the formation of new firms not only promotes innovation but intensifies competition in their markets (Gerolski, 1991). "Especially for upcoming technologies and when new product markets develop, divergent innovation designs compete with each other. Start-ups are likely to bring in new solutions and challenge established companies that enter these new markets, too" (Rammer, 2006). The logarithmic quotient of a sector's average[18] market entry rate of new firms in a given country and the respective entry rate in the EU is an indirect measure to compare the sector-specific competition in different countries.[19] A negative (positive) log-value for a country means that the entry rate –and thus also competition on that market - is below (above) the average for the EU countries.

**Figure 4-7: Standardised entry rate in the Automotive industry (Nace 34 & 35)**




Source: Eurostat and ZEW Foundation Panel (for Germany).

[18] The means were calculated for the entry rates given in Figure 4-7.

[19] $ln\left(\frac{\text{Entry Rate}^{\text{sector}}_{\text{Country}=i}}{\text{Entry Rate}^{\text{sector}}_{\text{all EU-Countries}}}\right)$.

In the Automotive industry, relatively concentrated markets with comparatively weak competition are to be found in particular in Germany, Portugal and Sweden. Competition in Hungary, the UK, Estonia and Latvia, on the other hand, is well above the European average.

It should be noted at this point that there is a clear division between fostering market structures that stimulate innovation and promoting "national champions" to increase international competitiveness. The Lead Market approach is not based on targeting and strengthening individual actors, but instead on strengthening competition between all actors. The idea is that confronting innovators with free competition on the market at an early stage is a more effective way of increasing international competitiveness than offering protection from competition in the hope of building up a strong national position. From a technology policy point of view, this means focussing on measures that guarantee favourable conditions for the development of successful innovation designs. It is particularly important to ensure that (international) competition is enforced in industries in which the home country has few structural advantages. This can be achieved by implementing legal measures to prevent cartels, promoting start-ups, supporting newer technology companies and breaking down non-tariff barriers to international trade.

## 4.6 Conclusions

In the above sections we investigated the influence of demand on the innovation capability and competitiveness of the Automotive industry in each of the EU-25 countries. Although demand is one of the decisive factors for the development of innovations, it has hardly been integrated in analyses of research and technology policy to date. The Lead Market approach brings market demand into the discussion, with the result that innovations can no longer be understood as purely supply-oriented and pre-competitive.

To evaluate the role demand and market structures play in the creation of innovations with international potential, country-specific properties – the so-called Lead Market factors - are derived. These help to explain a country's Lead Market potential in a given industry. If these factors are particularly favourable in a certain industry, the chances that innovations favoured by the national market will meet with high demand abroad are likely to be increased. Findings about the Lead Market potential of different markets must have an influence on the formation of business and political strategies for innovation. Furthermore, the findings could constitute a starting-point for the formation of innovation strategies in firms and for more efficient innovation policies. For these reasons, an attempt was made to determine the Lead Market potential of the EU-25 countries in the automotive industry on the basis of quantitative indicators. The following table summarises these results once more.

**Table 4-1: Lead Market potential of the EU-25 countries in the Automotive industry**

| Country | Advantage | | | | |
|---|---|---|---|---|---|
| | Price [PPP Statistics] | Demand [PPP Statistics] | Export [Trade Statistics] | Transfer [FDI] | Market Structure [Entry Rate] |
| Austria | + | - | + | NA | NA |
| Belgium | + | + | + | NA | NA |
| Cyprus | - | + | - | NA | NA |
| Czech Republic | - | + | + | - | + |
| Denmark | - | + | + | NA | NA |
| Estonia | - | - | - | NA | + |
| Finland | - | - | - | NA | NA |
| France | + | + | + | + | + |
| Germany | + | + | + | + | - |
| Greece | - | - | - | NA | NA |
| Hungary | - | + | - | NA | + |
| Ireland | - | - | - | NA | NA |
| Italy | + | - | + | - | + |
| Latvia | - | + | - | NA | + |
| Lithuania | - | - | - | NA | + |
| Luxembourg | + | + | - | NA | + |
| Malta | - | + | - | NA | NA |
| Netherlands | - | - | + | NA | - |
| Poland | - | - | - | - | NA |
| Portugal | - | + | - | - | - |
| Slovakia | - | + | - | NA | + |
| Slovenia | - | + | - | NA | - |
| Spain | - | - | + | NA | + |
| Sweden | + | - | + | + | - |
| United Kingdom | + | | + | - | + |

Note: +: above average advantage; -: below average advantage; NA: Not Available

# 5 Lead Market analysis of the Chemicals industry

The five Lead Market factors discussed above apply to all countries. In this section we will analyse which countries in particular have Lead Market properties in the Chemicals industry. It should be noted that the Lead Market potentials established are for the aggregated sector. In reality, Lead Market potentials within a sector can vary from one product group to another, or even between individual products. The loss of accuracy that results from such aggregation must be taken into account in the analysis. That being said, observations of Lead Market potential that are aggregated at the sector level are still of great interest, as they offer a means of explaining the future competitiveness of different markets. The investigation presented here focuses on the activities of companies from the NACE 24 sector within the EU-25 countries.

## 5.1 Demand Advantage

A market has a so-called demand advantage if the environmental conditions there foster an innovation design that also anticipates future customer preferences in other markets. Lead Markets are able to anticipate global trends. Therefore the difference between different countries' markets does not lie in the direction in which they develop, but merely in the speed with which they move in the direction of the global trend. The innovation design on the Lead Market thus has a "head start". A head start may also come about when the country is the quickest to build up an infrastructure of complementary goods required by the innovation. The innovation designs from markets at the forefront of a trend offer other markets the answers and solutions to their questions and problems of tomorrow.

One consequence of the different speeds at which markets adapt to or adopt an international trend – following Linder (1961) and Vernon (1966) – comes in the form of demand advantages, which can be expressed as per capita spending on certain products or as the proportion of a country's total consumption accounted for by these products. The idea behind this is that demand for certain goods varies from country to country and that this affects the innovative performance of the companies based there. Companies make greater efforts to develop and improve products in sectors that account for larger proportions of a country's aggregate demand. Porter (1990, p.87) encapsulates the idea when he writes: "The more significant role of segment structure at home is in shaping the attention and priorities of a nation's firms. The relatively large segments in a nation receive the greatest attention by the nation's firms." A greater share of total consumption is a sign that consumers in a country place more value on a certain product. This indicator can be used to compare the situation with other countries.

It is possible to directly compare the sector-specific demand specialisation of different countries by subtracting the weighted average share of total demand within the EU-25 from the share of demand for one country. If the share of total demand accounted for by products from a given sector in one country is lower than the average share for these products in the other EU-25 countries, the country in question has a low demand specialisation with respect to the sector. In this case, the value of the specialisation index is negative. A specialisation index of zero means that the proportional demand for a sector in the country concerned is

equal to the weighted EU-25 average for the same sector. The index takes on a positive value when the propensity to demand such products on the particular market is higher than average.

To calculate an individual country's demand specialisation, we need to know how final demand is structured. Eurostat's Purchasing Power Parities (PPP) statistics can be used to find this out. These statistics give a differentiated picture of a country's final demand (for consumer goods, investment goods and goods provided by the state), grouping the goods into 282 categories (the so-called "basic headings"). The demand is calculated by taking production output adding imports and subtracting exports. The data for the observation period between 2000 and 2004 are available for academic research purposes and quote values in terms of the national currencies of the time.[20] All the national currencies were converted into ECU (later Euro) amounts, using the average annual exchange rate. The basic headings used to categorise goods are not directly based on NACE classification. It was therefore first necessary to allocate 2-digit NACE codes to the products, so that a clear picture of the importance of certain sectors for a country's total demand could emerge.[21] It should be noted at this point that not all products always fit easily into a single 2-digit NACE sector. The result is that sectors which primarily produce intermediary products rather than end products are underrepresented in the PPP statistics in terms of the demand they receive. This is of particular relevance for the Wood, Paper, Steel, Metal, Chemical, Energy and Plastics sectors.

[20] For 2000 to 2003 the PPPs are scaled such that the PPP for EU-15 is equal to one. For 2004 the PPPs are scaled such that the PPP for EU-25 is equal to one. All PPPs correspond to national currency in use, i.e. from 2002 the PPP of the euro zone (EUR12) correspond to the Euro.

[21] See Table 10-1.

**Figure 5-1: Demand specialisation in the Chemical Industry compared to the weighted EU-25-average for the years 2000 to 2004**

Note: (***),(**) and (*) means significant at 1%, 5% and 10% respectively.

Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

The countries with a demand specialisation well above the EU-25 average are Lithuania, Poland and Portugal, all of which scored around one percentage point above the average. Shares of demand that were significantly below average could be found in the Netherlands, Greece, Sweden, Finland and Belgium (-1 percentage points).

Government intervention seldom proves an effective means of bringing a country to the forefront of an international trend in the demand for a certain innovation and creating a demand advantage. Demand preferences are very much culturally determined and can therefore only be changed in the long term. At best, political measures may improve the situation by speeding up technical approval procedures to increase the adaptation and

adoption of innovations and by providing incentives to react more quickly to certain innovation trends, in the form of tax (=price or cost) reductions. Over the observation period between 2000 and 2004, the demand propensity did not increase significantly in any country of the EU-25.

What options in the innovation process are left open to companies from sectors with below-average shares of demand? One possibility is to substitute the inadequate demand in the home country with international demand (see the sections below on price and export advantages). This creates a necessity to involve foreign customers in the innovation process to a greater extent. Another option is to lower relative prices in order to stimulate domestic and foreign demand. However, this can only be sustained in the long-term if cost advantages are realised.

### 5.2 Price Advantage

According to Levitt (1983), in the context of the internationalisation of innovations, an innovation design sold at a lower relative price on a Lead Market can squeeze out existing – but relatively more expensive – innovation designs on other markets abroad. The limits on price reduction in this case are determined by the potential to reduce production and factor costs now and in the future. Price reductions can be achieved by cost reductions, which, in turn, can result from size advantages.[22] The effects of this price mechanism are stronger when the relative price differences at the start of the innovation competition are greater. Its effectiveness also increases with increased dynamism of the relative price development in favour of the innovation design. Only when the relative price difference in favour of the innovations on the Lead Market is so great that the transaction costs incurred in changing over to the innovation design can be compensated, will firms and customers in other markets abroad switch over to the Lead Market design.

Price advantages can only be used as Lead Market factors if there is price competition. Therefore in highly regulated or isolated markets it may not be possible to exploit the price advantage of an innovation design. Competitive markets exist for most goods produced by the Chemicals industry and for many knowledge-intensive and related services. This means that price advantages are indeed of relevance in this context (Beise et al., 2002). For this reason, it is worth investigating which countries already have long-term price advantages. The size of the price and cost advantage can be taken directly from international Purchasing Power Parities (PPP) statistics.

To enable the international comparison of purchasing power in a world of floating exchange rates, the OECD and Eurostat calculate Purchasing Power Parities (PPP). These provide a means of showing the price level for certain groups of goods, controlled for

[22] One example of country-specific size advantages is the potential market size, which offers the potential to exploit economies of scale and learning effects in order to create a price advantage. However, even at the stage of operationalising the potential market size, there are problems in defining and delineating relevant markets. A series of Lead Market studies (Beise/Cleff, 2003) have shown that aggregating “culturally and economically similar” areas was not an adequate way of identifying the different relevant markets, in that it did not allow for sufficient differentiation. For example, heavy goods vehicles in the USA are very different from those in Europe for legal reasons. The scope of the two relevant markets is affected accordingly. For passenger cars - as another product from the same industry -, however, no strong difference of this sort comes into play.

differences in quality. PPPs are price relatives that show the ratio of the prices in national currencies of the same good/service in different countries.[23]

Similarly to the data for demand specialisation, this price information is available for the period 2000-2004 and is classified using the 282 basic headings.[24] National currencies were converted to ECU and later Euro using the average annual exchange rate. As the PPPs only refer to groups of goods, they were categorised according to the NACE classification of economic activities. The good-specific PPPs are then weighted using the demand propensity.[25] This provides a basis for the calculation of relative prices within a country, by taking the ratio of sector-specific PPP to the average PPP for all sectors in a country's economy. A relative PPP level calculated in this way controls for country-specific differences in pro-capita income and the different price levels that result. The negative logarithmic quotient of a sector's relative PPP level and the price level for the same country's economy is a direct measure of sector-specific price differences between countries.[26] A positive log-value for a country means that the price level in question was below the average for the EU-25 countries in 2004. A negative value implies that the price level is above average. The following figure shows the price differences of the EU-25 countries for 2004, calculated from the smoothed time series for the years 2000 to 2004 in the Chemicals industry.

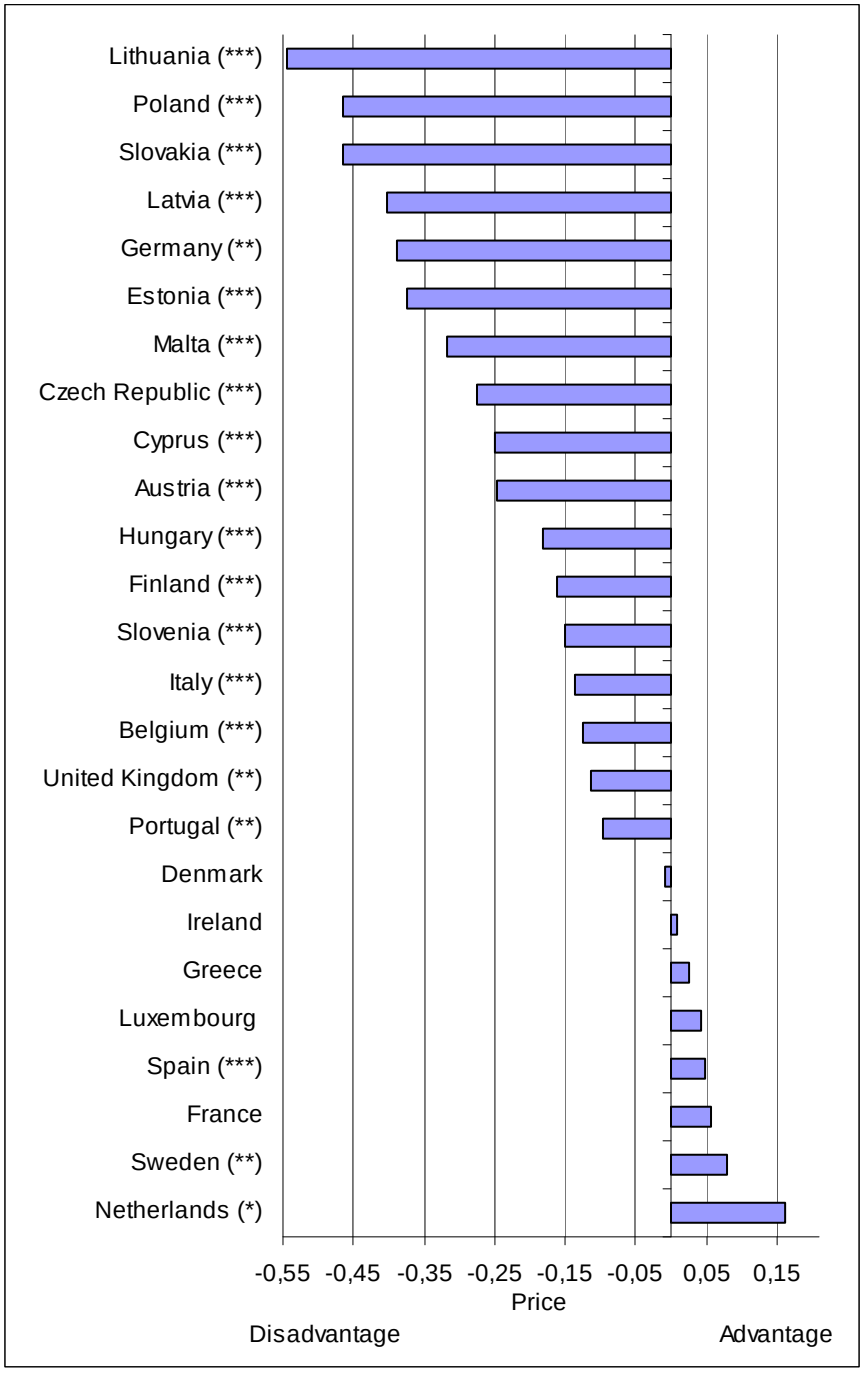
[23] "For example, if the price of a hamburger in France is 2.84 euros and in the United States it is 2.20 dollars, the PPP for hamburgers between France and the United States is 2.84 euros to 2.20 dollars or 1.29 euros to the dollar. In other words, for every dollar spent on hamburgers in the United States, 1.29 euros would have to be spent in France in order to obtain the same quantity and quality – or volume – of hamburgers. […] PPPs are still price relatives when they refer to a product group or to an aggregate. It is just that in moving up the levels of aggregation the price relatives refer to increasingly complex assortments of goods and services. Thus, if the PPP for GDP between France and the United States is 0.97 euros to the dollar, it means that 0.97 euros has to be spent in France to obtain the same volume of final goods and services that one dollar purchases in the United States. This does not imply that the baskets of goods and services purchased in both countries will be identical. The composition of the baskets will vary between countries reflecting their economic, social and cultural differences, but both baskets will, in principle, provide equivalent satisfaction or utility" (OECD/Eurostat 2006, p. 2).

[24] For 2000 to 2003 the PPPs are scaled such that the PPP for EU-15 is equal to one. For 2004 the PPPs are scaled such that the PPP for EU-25 is equal to one. All PPPs correspond to national currency in use, i.e. from 2002 the PPP of the euro zone (EUR12) correspond to the Euro.

[25] It should be noted at this point that, as was the case when demand specialisation was aggregated at sector level, it is not always possible to allocate a product to one distinct sector grouping. As the composition of national baskets of goods changes over time, some distortion of the sectoral allocation can occur in the PPP statistics.

[26] $ln\left(\frac{PPP^{\text{sector}}_{\text{Country}=i}}{PPP^{\text{all sectors}}_{\text{Country}=i}}\right) * (-1)$ .

**Figure 5-2: Price advantages and disadvantages of different markets for 2004 [from the smoothed time series for the years 2000 to 2004] in the Chemicals industry**




Note: (***),(**) and (*) means significant at 1%, 5% and 10% respectively.

Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

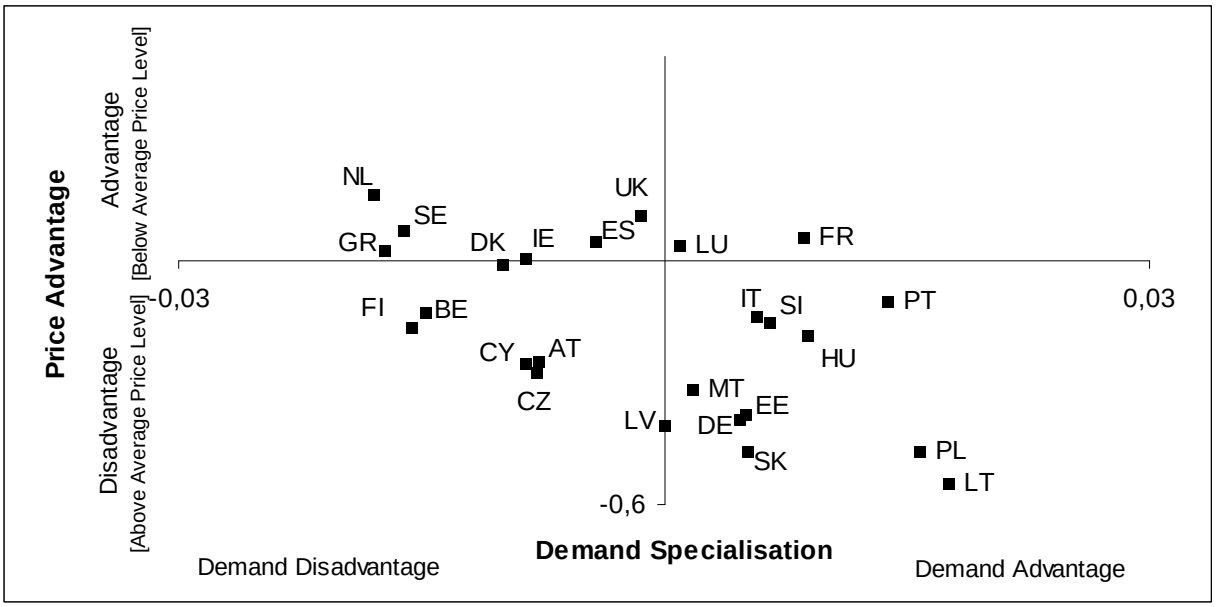
It becomes apparent that the relative prices in the Chemicals industry are higher in Eastern European countries, in Finland, Italy, Belgium, UK and Portugal than in the remaining Western European countries. Comparatively low relative prices can be found in the Netherlands, Sweden and France.

When considering these statistics it is important to be aware that the price level is not the only indicator of a price advantage, because it is strongly influenced by company strategies

and competitive behaviour (see section 5.5). Nevertheless, a low price level and relatively high propensity to consume can be a sign of a price-dependent demand advantage. When this is the case, buyers react to a low price level with an above average increase in their demand for the product. In other words, the price elasticity is very high. A low price level thus makes for a clear demand advantage when it is accompanied by high demand specialisation.

In Figure 5-3, the relative PPP level is plotted against demand specialisation for all countries. The countries that are of interest to us are those located in the upper right quadrant. These are countries with both a low relative price level and a high propensity to consume. The countries in question are Luxembourg and France. The price level in these countries constitutes a Lead Market advantage. Drops in price are met by a large increase in demand. Innovation designs that exploit this price elasticity can spread quickly and make use of market size advantages to increase their ability to compete on price. This market characteristic should spur suppliers of innovations to follow a price-cutting strategy from the outset. Innovations designed within this system of incentives should have a marketing advantage over alternative innovation designs, on the basis of price.

**Figure 5-3: Price advantages and demand specialisation in the Chemicals industry**




Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

Lead Market advantages can also exist when a low price level comes together with an average, or even slightly below-average, propensity to consume. In these markets, too, the quantity demanded is above average. However, the low price level means that demand specialisation does not appear significantly positive. In some countries, the propensity to consume remains low in spite of a relatively low price level, i.e. the relatively low prices do not lead to increased demand. This is particularly the case in Spain and Great Britain. When the opposite is true and a high price level is found with high demand specialisation, this suggests that price elasticity on the market is low. The fact that this group of goods makes up a large proportion of total demand is essentially due to the high prices, while the propensity to consume remains comparatively low. Typical examples of this are the countries from Eastern

Europe (except the Czech Republic), Germany, Portugal and the Baltic countries. On the whole, these markets are often unfavourable for innovators.

Finally, a group of countries can be identified in which the price level is relatively high and the demand specialisation below average. In such cases, the high price level leads to a higher than average (compared with other countries) drop in demand. The high price level is a disadvantage for export-oriented innovators, as it prevents lower-cost innovation designs from coming into being. The countries Finland, Belgium, the Czech Republic, Cyprus and Austria in particular are faced with this problem.

Of all the Lead Market factors, the price or cost advantage seems to be the easiest to influence by means of political intervention. One form this intervention may take is the use of taxation on particular factors or goods to directly affect the price and cost structure of innovation designs. Any such tax policy should be "trend-oriented" and anticipate future cost developments at an international level. Only then will the industries in question be able to produce innovations that will also subsequently be demanded in other markets. In contrast, a policy of taxation and subsidisation that went against the international cost trend would only increase the probability of idiosyncratic innovation.

Price advantages can also be promoted by policies aimed at fostering competition, since intense competition lowers prices for end users. A final important point is the aspect of cost advantages resulting from the size of the market. In the European Union, the market is already large, so innovation policies should be able to set parameters that allow firms to make the most of the size advantage which, in principle, already exists. Such policies include preventing the home market from splitting into regional markets, for example. One example of how this problem can arise is if approval procedures or regulations differ from one region to another.

### 5.3 Export Advantage

The key characteristic of a Lead Market is that innovations realised there will not be limited to a certain country or region, but should be well-suited for export. Vernon (1979) and particularly Dekimpe et al. (1998) find that the exportability of innovations is higher when the exporting and importing markets are more similar in cultural and economic terms. In such cases, customers only suffer a relatively small loss of utility when changing over to a "foreign" innovation design. The number of country-specific innovation designs thus falls comparatively quickly. However, exportability may not only depend on how similar markets are. The "adaptability" of an innovation to different market surroundings is also decisive for its chances on the international market. International marketing proves less complicated when certain features of the innovation design have been planned from the outset to facilitate its use in different environments without the need for any substantial changes.

The Lead Market approach is not based on the traditional view that export successes are indicators of a country's technological – or, more generally, economic – competitiveness. Instead, pronounced export activity is seen as an input factor for a country's success in innovation. A strong position in terms of exports in the past may encourage innovators to make their products suitable for international markets. This, in turn, promotes innovation designs that will be a success when exported.

Interaction with customers and demand orientation are not export factors in themselves. Only interaction with the "right" customer and the presence of the "right" market conditions actually lead to innovations that will be taken up in the world market. Innovations driven by demand which only come into use in their home country and thus have no impact on exports are a sign of idiosyncratic demand. In this case, there is a demand preference for innovation designs that do not represent a competitive advantage in other national markets. There are a range of possible root causes of idiosyncratic demand, which may be natural (specific environmental conditions), may have come about through national legislation (regulations that are not extended to the international sphere), or may be due to an insistence on sticking to the individual national standards set by large clients (e.g. postal service, railways, electricity suppliers). On the other hand, the idiosyncratic demand may simply be a result of the consumers' or business customers' preferences being different from those in other countries.

To assess what affect demand in a particular market has on exports we can again make use of the share of aggregate national demand from Eurostat's Purchasing Power Parities (PPP) statistics, in combination with the European foreign trade statistics.[27] The two sets of statistics are based on different systems of classification, so correspondence tables must first be used to convert to the NACE nomenclature before they can be compared.

The first step is to find the extent of export success for every country. An above-average export performance shows that new products are successfully marketed internationally. The more a country succeeds in working out an export surplus within a group of homogeneous products in bilateral trade, the higher the estimated competitiveness will be (Grubel 1975). To measure competitive advantages between two countries, the ratio of export surpluses to total trade volume ($CA_{tik}$) within a product group p should therefore be applied: $CA_{tik} = \frac{x_{tik} - m_{tik}}{(x_{tik} + m_{tik})}$.[28] The chosen indicator of competitive advantage corresponds to the objectives set out by a company when identifying potential supplier countries (Cleff 2006b). The Revealed Comparative Advantage - RCA (Balassa 1965) - applied in the tradition of economics for determining comparative advantages, is considered not to be an appropriate indicator in this case. A positive competitive advantage of a country can be hidden to some extent behind a low RCA if the ratio of exports to imports of a particular product group is indeed higher than 1, but the corresponding ratio in total trade of a country turns out to be higher. This can lead to an underestimation of the product-specific absolute competitiveness of nations that have a high overall product export surplus, and vice versa (Cleff 2006b).

The average CA of all countries that export the product in question within the different European countries is used as a reference value for export success. Countries with a smoothed product-specific CA significantly above the average for the last ten years are considered to

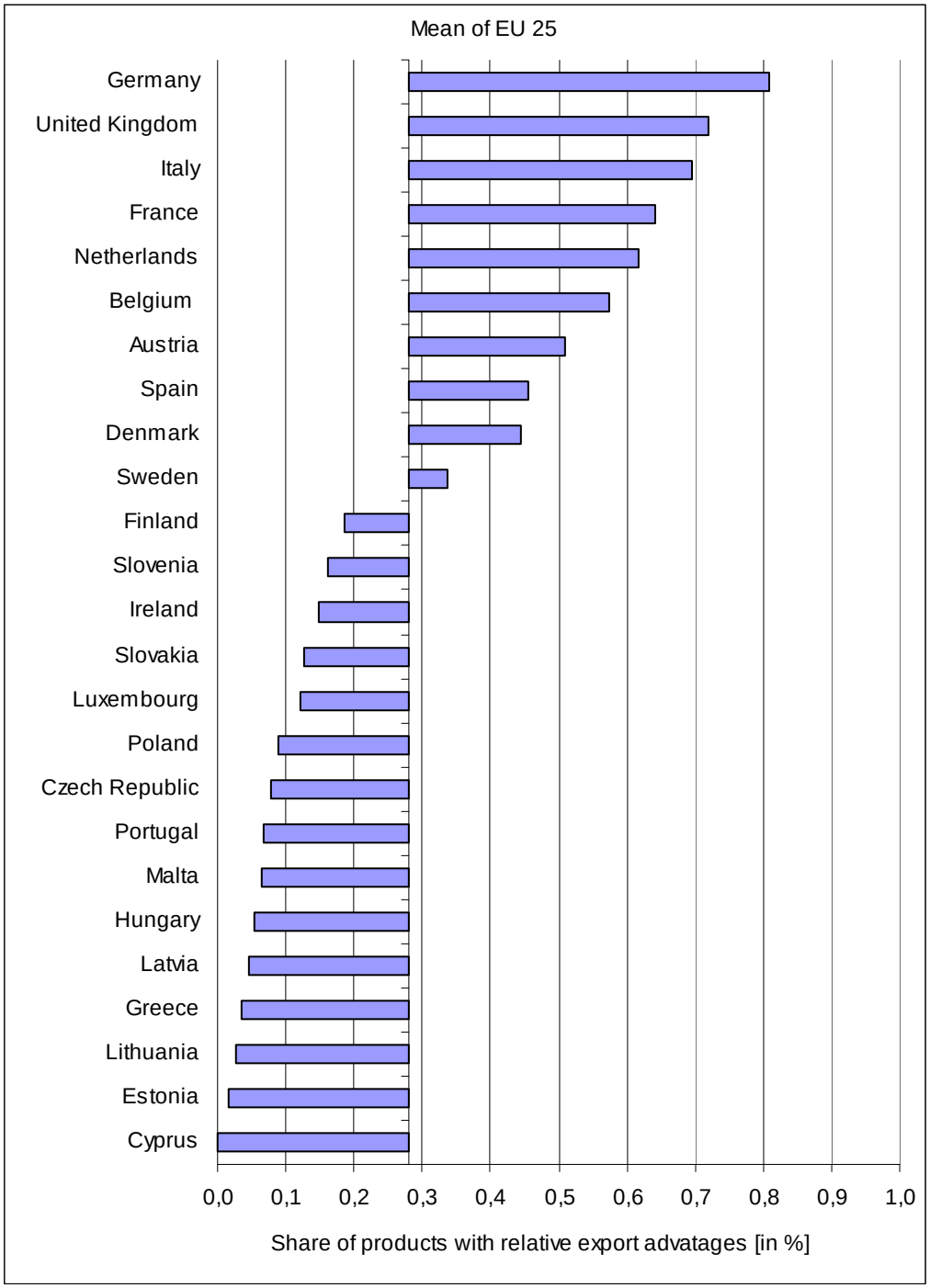
[27] The European foreign trade statistics offer data on an 8-digit-aggregational level – the Combined Nomenclature. The Combined Nomenclature is based on the 6-digit Harmonised System, which was extended by 2 digits for the European Trade Statistics. Thus the first three levels of the Harmonised System HS2, HS4 and HS6 correspond to the Combined Nomenclature, completed by a further level KN8. These data are available for the years 1988 to 2005 and in contrast to the data of the OECD, only encompass trade between individual EU states and all other states in the world. Therefore trade flows outside of the EU, such as those between Japan and the USA, are not determined.

[28] The variable $x_{tik}$ stands for the export value from the supplier country k ($k \in \{1,..., n\}$) to the supplied countries i ($i \in \{1,..., m\}$) in a specific year t. The variable $m_{tik}$ represents the respective import value.

have an above-average product-specific relative export advantage. If a country has a high share of product-specific relative export advantages in a given industry, this indicates a country-specific export advantage there.

On the basis of the foreign trade statistics for the Chemicals industry, the following diagram shows in how many product groups an above-average relative export advantage is recorded for each of the EU-25 countries.

**Figure 5-4: Share of product-specific relative export advantages in the Chemicals industry, for EU-25**




Source: ZEW: Global Sourcing Management Tool, 2007.

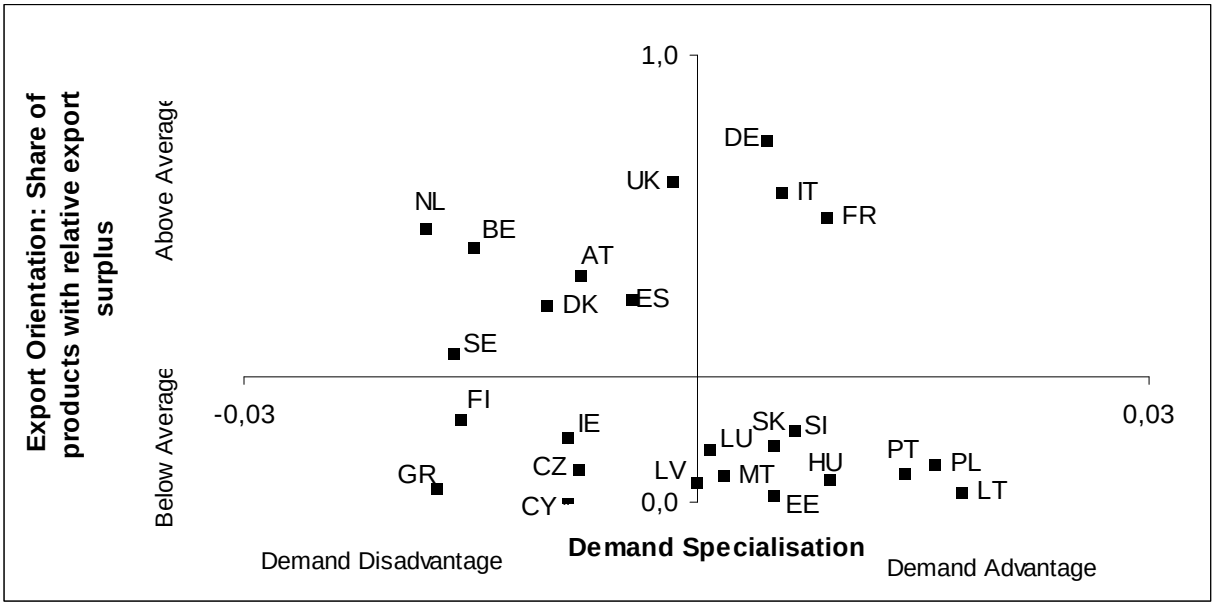
Germany, UK, France, Italy, the Netherlands, Belgium and Austria have particularly large export advantages, with more than 50% of products of their Chemicals industries proving successful abroad. Spain, Denmark and Sweden follow, although their export advantages in the industry are only slightly above average. The other countries have values well below average.

It is assumed that a Lead Market is always present when demand in a country provides innovating companies with a considerable quantitative impulse to innovate and, at the same time, the companies generate a large proportion of their turnover abroad. If quantities of product innovations exported are high and the impulse to innovate came from customers in the home market, this shows that demand at home prefers an innovation design that has the potential to succeed internationally. Conversely, it is a sign of an idiosyncratic market when companies only export a small share of their goods because they are overly influenced by the "eccentric" wishes of customers in the home market. In this case, customers appear to prefer product solutions that cannot be marketed internationally (idiosyncratic demand).

Therefore if a country's various export successes, measured as the share of products with above average relative export advantage, can be put down to above-average customer demand, this is a sign that the country has a particular Lead Market characteristic. This is because domestic demand that translates into success on the export market is a typical characteristic of a Lead Market.

Figure 5-5 shows the extent of demand advantage against the size of the export advantage for the Chemicals industry in the form of a portfolio. In the upper right quadrant of the portfolio are countries that develop technologies driven by demand and at the same time exploit the lead-market properties of home demand for successful exports (Lead Market sectors). The home markets in these countries – Germany, France and Italy - offer particularly favourable conditions for the launch and testing of new products, with the aim of successfully marketing the innovation designs tested at home in other countries.

**Figure 5-5: Lead Market Matrix in the Chemical Industry: classification according to export orientation and utilisation of home market demand**




Source: ZEW: Global Sourcing Management Tool, 2007 and Eurostat/OECD PPP-Statistics for 2000 to 2004.

Exportable innovations may also originate from sources other than the home market. Innovating companies that are highly export-oriented but do not, to any great extent, rely on home demand as a source of innovation can be categorised into three different types. In the first type, the drive behind innovations that are suited to the world market comes from the company's own R&D or from technological know-how purchased externally (e.g. from technology suppliers or academic research).

The second possibility is to base new products on the innovations of foreign competitors, i.e. imitation. The third category comprises firms that are driven to innovate by demand from abroad. This could indicate that the home market is a successful lag market. In this case, home companies may not be leaders in launching product innovations that have international staying-power, but they are good at quickly picking up on new trends from abroad then converting these into export success. For simplicity, we shall denote all of these effects as "technological impulses to export". The upper left quadrant in the diagram above contains the countries Belgium, the Netherlands, Sweden, Denmark, Spain and Austria, which primarily bring out innovations driven by technology and then translate these into export success.

Finally, if product innovators have little export success and home demand plays no meaningful role as a source of innovation, companies focus on technology specific to the home market. In this case, innovators concentrate on product innovations based of their own R&D or external sources of knowledge, but which do not provide solutions suitable for export. We can speak of idiosyncratic technology in this context. In the diagrams above, the countries in the lower left quadrant - in particular Poland, Finland, Ireland, Greece, the Czech Republic, Cyprus and Latvia - belong to this group of markets.

The most problematic area from an innovation strategy perspective is surely the lower right quadrant. The difficulty is that these countries are largely dependent on demand to drive their innovation activities, yet the demand on their home market is idiosyncratic. The home market acts as an obstacle to export activities, since catering for home demand makes for innovations that are difficult to sell in other countries. The Eastern European countries, Portugal, Luxembourg, Malta, Lithuania and Estonia are notable examples of countries with such markets.

If innovation policy is to be efficient from this point of view, it must adapt the incentives it offers to focus more strongly on exports. This applies in particular to technology development projects that receive government subsidies. The potential exportability of the technology could be included as a criterion for subsidisation. Politicians can also support international and flexible Lead Market strategies by not insisting on national solutions, but instead taking experiences from potential Lead Markets into account, for example when approving products and formulating regulations for specific markets. The legislature, too, can influence export orientation, by taking note of international trends and thus preventing infrastructure for science and technology (educational institutions, research establishments, standards agencies etc.) from becoming idiosyncratic.

### 5.4 Transfer Advantage

The concept of transfer advantage covers a range of "classic" diffusion factors. The decision to adopt a particular innovation design in a country is often dependent on which

technology has already been adopted in the Lead Market and on the experiences gained during its introduction there. The demonstration effect when the innovation is adopted increases the incentive for users in other countries to adopt the same innovation design, firstly because of the information that is available about the innovation and its use and secondly because of the decreased risk, i.e. reduced uncertainty as to whether the new product or process is reliable. If a product has been successfully tried out in the Lead Market, it makes sense to adopt it in other markets too (Kalish et al., 1995). In this case, the Lead Market takes on the role of a test or reference market and is closely observed by agents in other markets. The Lead Market serves as an example for the evaluation of problems and dangers in the introduction of the new technology, thereby reducing uncertainty. More importantly still, the utility of the Lead Market customers affects customers beyond the boundaries of the market.

A country's market therefore has a transfer advantage if it raises the perceived utility of customers on other markets as well as those at home. The reputation and high level of development of the Lead Market's users is considered to be a hallmark for high-quality innovation designs. The quality of demand is especially determined by user's know-how and experience with similar products. For example, the markets in countries which often feature in the mass media and television series are potentially Lead Markets for lifestyle products. In a similar way, smaller markets can also bring out products that are competitive worldwide (Beise et al., 2002).

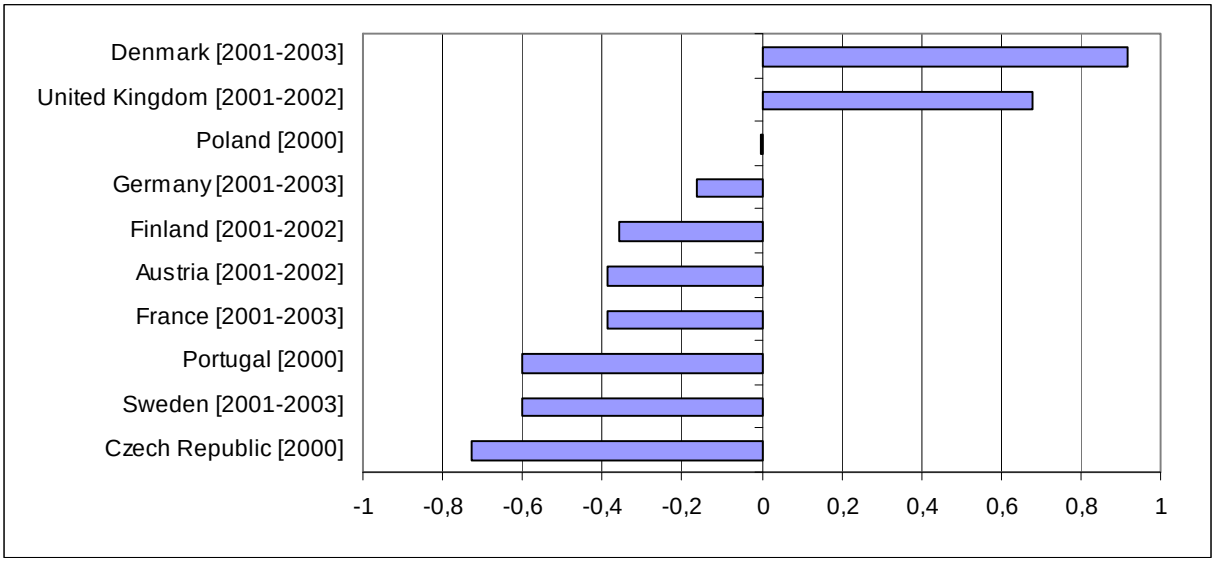
Transfer advantage is difficult to quantify, as analyses related to innovation projects have shown (Beise/Cleff, 2003). Since the differences between countries are less pronounced at the industry level than when it comes to individual products, it is almost impossible to find general indicators for the industry level.

Cleff (2006b) used the amount of foreign direct investment (FDI) as a proxy for the potential international diffusion of innovations. One benefit of foreign subsidiaries is that they provide companies with information about the particular nature of demand in a country. Another advantage for companies with subsidiaries in several countries comes in the form of economies of scale. This means that the company can launch a single innovation design internationally, even if the design itself is not optimally suited to the conditions in one of the local markets. This means, for example, that companies may use the same software, the same component assemblies and the same machines in all markets, even though the relative factor prices differ from country to country. Since it is assumed that the parent company is generally the first to make use of innovations or generally makes the decisions about which innovation design to pursue, countries that engage in a large amount of FDI have a transfer advantage.

Unfortunately, data on the quantity of FDI by industry, which would enable a cross-country comparison for the Chemicals industry, are only available for ten of the EU-25 countries. The data come from the "United Nations Conference on Trade and Development (UNCTAD)" or Eurostat publications. If we compare the total value of FDI for the specific industries with the help of a measure of specialisation,[29] rather than the number of investments made, we come to the results shown in the figure below.

[29] The measure of specialisation is calculated by taking the quotient of (1) the industry-specific total stock of FDI by home companies abroad divided by the respective total of FDI by foreign companies in the home market and (2) the overall total of FDI by home companies abroad divided by the respective total of FDI by foreign companies in the home market. To attain a

**Figure 5-6: Specialisation of FDI in the Chemical Industry (Average for the given years)**




Source: United Nations Conference in Trade and Development (UNCTAD) 2007.

If the proportion of investment abroad is above average, the resulting value is positive. Otherwise the value returned is negative. It becomes apparent that the Chemicals industries in Denmark and the UK specialise in FDI more than is average, while the other countries have below-average values.

Countries that succeed in propagating their international standards in innovation design are best placed to realise a transfer advantage. Transfer advantage is the Lead Market factor that has received the most attention in innovation policy. It is common for government funding for innovations to aim to promote the demonstration effect in the diffusion of innovations (e.g. through application centres designed to give businesses the chance to experience new process technologies). This can be a particularly decisive factor for the international diffusion of a technology if there is a large amount of uncertainty about how readily it can be implemented in practice and how efficient it is in economic terms. However, there is a considerable risk that idiosyncratic technologies will be subsidised, particularly in lag market industries. The degree of openness of a standard should therefore be used as a criterion to determine whether a technology is eligible to receive government subsidies. Equally, increased bargaining power for European politicians and companies in international standardisation committees can help to improve the transfer advantage.

## 5.5 Market Structure Advantage

From empirical studies about successful innovation designs from the Lead Market (Beise, 2001), a notable characteristic of these markets is particularly strong competition. The

final value between -1 and +1, we take the hyperbolic tangent of the quotient then subtract one:

$$hyptan\left(\frac{DI^{\text{sector}}_{\text{home to foreign market}}}{DI^{\text{sector}}_{\text{foreign to homemarket}}} \Big/ \frac{DI^{\text{overall country}}_{\text{home to foreign market}}}{DI^{\text{overall country}}_{\text{foreign to homemarket}}}\right) - 1 .$$

realisation that international innovation success is correlated with the intensity of competition may not be new (cf. Posner, 1961 and Dosi et al., 1990), but Porter (1990) was the first to find a conceptual link to a cause, namely that customers in very competitive markets can be "choosier" than in oligopolies or monopolies. Faced with strong competition, innovators are compelled to react increasingly to technological development (Mansfield, 1968, p. 144). The resulting competition between very different innovation designs often leads to a refined innovation that best fits customers' needs. This innovation design, which offers maximum utility to customers thanks to the competition on the national market, also has the best chances of winning through in international competition. Competition can therefore be understood as a process of decentralised coordination, by which all the participants attempt to achieve a better innovation design, so that the final design will also have a better chance of succeeding in international markets.

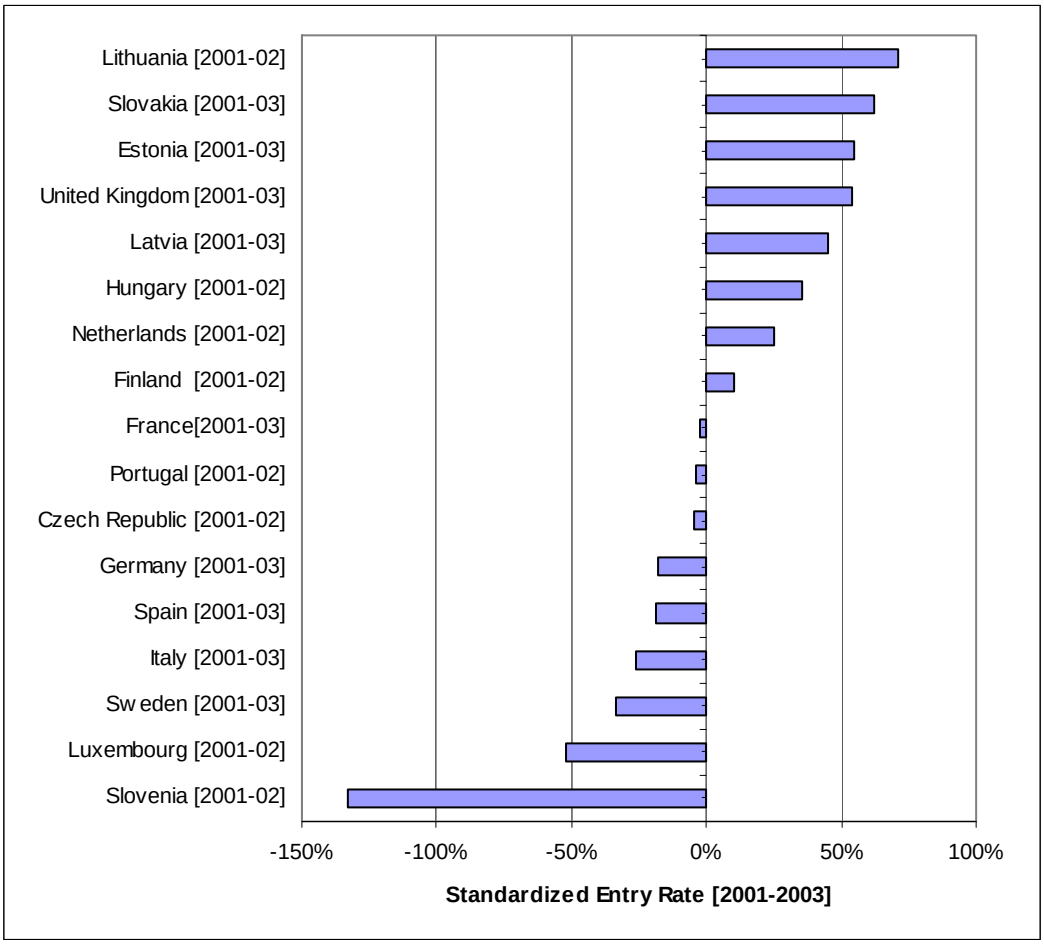
There are a range of known measurement concepts that could be used to establish the intensity of competition. Putting such concepts into practice often proves impossible, however, because of a lack of internationally comparable figures.[30] Using the fact that markets with different degrees of concentration establish their prices differently, an approximation can be found for the intensity of competition on a market. Monopolists set their prices to maximise profits without being subjected to pricing pressure from competitors. In a market with perfect competition, firms theoretically adjust their supply to fit the market price. In this case, the price level is lower than that in a monopoly. Taking this relationship as a starting-point, we can assume under certain conditions – namely that we are dealing with homogeneous goods/services – that the price level on a market decreases with increasingly intense competition. The price level can thus be taken as an indirect indicator of competition on a market. As a cautionary reminder at this stage, it should be noted that the price level has already been used to illustrate the aspect of price advantage, as a relatively low price level is conducive to Lead Market advantages, which arise from the increased inclination to adopt an innovation and its quicker diffusion, in international comparison (cf. section 5.2). Since a low price level is always a positive aspect of demand structure, either as an indicator of prices or of competition, the ultimate result is unaffected by which Lead Market factor the indicator is allocated to. The same indicators can therefore be used to show advantages in price and market structure. This also suggests that although these two Lead Market characteristics can be separated in theory, it is not necessarily possible in practice. The results from section 5.2 should therefore be taken into account.

Furthermore, it is possible to show the intensity of competition on a market by referring to the occurrence of barriers to entry, because the formation of new firms not only promotes innovation but intensifies competition in their markets (Gerolski, 1991). "Especially for upcoming technologies and when new product markets develop, divergent innovation designs

[30] In traditional industrial economics, the intensity of competition can be measured using a range of parameters of concentration (e.g. a company's turnover as a share of market volume). Commonly-used parameters are the concentration ratio, the Gini coefficient and the Herfindahl-Hirschman Index. Since these require all the shares of a particular characteristic to be precisely allocated to individual subjects or objects, the two indicators can only be used if the available data is sufficiently detailed. Even in national statistics from large countries, this is rarely the case. Experience has shown that such data are most likely to be available on oligopolistic markets that have large companies which are therefore obliged to publish their sales figures. On the other hand, the concentration ratio, CRx, only uses the market share of the x-largest market player to determine market concentration and, as such, is an accommodating method when data is limited. However, even for this method, there is a severe shortage of internationally comparable data.

compete with each other. Start-ups are likely to bring in new solutions and challenge established companies that enter these new markets, too" (Rammer, 2006). The logarithmic quotient of a sector's average[31] market entry rate of new firms in a given country and the respective entry rate in the EU is an indirect measure to compare the sector-specific competition in different countries.[32] A negative (positive) log-value for a country means that the entry rate –and thus also competition on that market - is below (above) the average for the EU countries.

**Figure 5-7: Standardized Entry Rate in the Chemical Industry (Nace 24)**




Source: Eurostat and ZEW Foundation Panel (for Germany).

In the Chemicals industry, relatively concentrated markets with comparatively weak competition are to be found in particular in Slovenia, Luxembourg, Sweden, Italy, Spain and Germany. Competition in Lithuania, Slovakia, Estonia and the UK, on the other hand, is well above the European average.

It should be noted at this point that there is a clear division between fostering market structures that stimulate innovation and promoting "national champions" to increase

[31] The Means were calculated for the entry rates given in Figure 5-7.

[32] $ln\left(\frac{\text{Entry Rate}^{\text{sector}}_{\text{Country}=i}}{\text{Entry Rate}^{\text{sector}}_{\text{all EU-Countries}}}\right)$.

international competitiveness. The Lead Market approach is not based on targeting and strengthening individual actors, but instead on strengthening competition between all actors. The idea is that confronting innovators with free competition on the market at an early stage is a more effective way of increasing international competitiveness than offering protection from competition in the hope of building up a strong national position. From a technology policy point of view, this means focussing on measures that guarantee favourable conditions for the development of successful innovation designs. It is particularly important to ensure that (international) competition is enforced in industries in which the home country has few structural advantages. This can be achieved by implementing legal measures to prevent cartels, promoting start-ups, supporting newer technology companies and breaking down non-tariff barriers to international trade.

## 5.6 Conclusions

In the above sections we investigate the influence of demand on the innovation capability and competitiveness of the Chemical Industry in each of the EU-25 countries. Although demand is one of the decisive factors for the development of innovations, it has hardly been integrated in analyses of research and technology policy to date. The Lead Market approach brings market demand into the discussion, with the result that innovations can no longer be understood as purely supply-oriented and pre-competitive.

To evaluate the role demand and market structures play in the creation of innovations with international potential, country-specific properties – the so-called Lead Market factors – are derived. These help to explain a country's Lead Market potential in a given industry. If these factors are particularly favourable in a certain industry, the chances that innovations favoured by the national market will meet with high demand abroad are likely to be increased. Findings about the Lead Market potential of different markets must have an influence on the formation of business and political strategies for innovation. Furthermore, the findings could constitute a starting-point for the formation of innovation strategies in firms and for more efficient innovation policies. For these reasons, an attempt was made to determine the Lead Market potential of the EU-25 countries in the Chemical Industry on the basis of quantitative indicators. The following table summarises these results once more.

**Table 5-1: Lead Market potential of the EU-25 countries in the Chemical Industry**

| Country | Advantage | | | | |
|---|---|---|---|---|---|
| | Price [PPP Statistics] | Demand [PPP Statistics] | Export [Trade Statistics] | Transfer [FDI] | Market Structure [Entry Rate] |
| Austria | - | - | + | - | NA |
| Belgium | - | - | + | NA | NA |
| Cyprus | - | - | - | NA | NA |
| Czech Republic | - | - | - | - | - |
| Denmark | - | - | + | + | NA |
| Estonia | - | + | - | NA | + |
| Finland | - | - | - | - | + |
| France | + | + | + | - | - |
| Germany | - | + | + | - | - |
| Greece | + | - | - | NA | NA |
| Hungary | - | + | - | NA | + |
| Ireland | + | - | - | NA | NA |
| Italy | - | + | + | NA | - |
| Latvia | - | - | - | NA | + |
| Lithuania | - | + | - | NA | + |
| Luxembourg | + | + | - | NA | - |
| Malta | - | + | - | NA | NA |
| Netherlands | + | - | + | NA | + |
| Poland | - | + | - | - | NA |
| Portugal | - | + | - | - | - |
| Slovakia | - | + | - | NA | + |
| Slovenia | - | + | - | NA | - |
| Spain | + | - | + | NA | - |
| Sweden | + | - | + | - | - |
| United Kingdom | - | - | + | + | + |

Note: +: above average advantage; -: below average advantage; NA: Not Available

# 6 Lead Market analysis of the ICT industry

The five Lead Market factors discussed above apply to all countries. In this section we will analyse which countries in particular have Lead Market properties in the ICT Industry. It should be noted that the Lead Market potentials established are for the aggregated sector. In reality, Lead Market potentials within a sector can vary from one product group to another, or even between individual products. The loss of accuracy that results from such aggregation must be taken into account in the analysis. That being said, observations of Lead Market potential that are aggregated at the sector level are still of great interest, as they offer a means of explaining the future competitiveness of different markets. The investigation presented here focuses on the activities of companies from the NACE sectors 30, 31, 32, 33 and 72 within the EU-25 countries.

## 6.1 Demand Advantage

A market has a so-called demand advantage if the environmental conditions there foster an innovation design that also anticipates future customer preferences in other markets. Lead Markets are able to anticipate global trends. Therefore the difference between different countries' markets does not lie in the direction in which they develop, but merely in the speed with which they move in the direction of the global trend. The innovation design on the Lead Market thus has a "head start". A head start may also come about when the country is the quickest to build up an infrastructure of complementary goods required by the innovation. The innovation designs from markets at the forefront of a trend offer other markets the answers and solutions to their questions and problems of tomorrow.

One consequence of the different speeds at which markets adapt to or adopt an international trend – following Linder (1961) and Vernon (1966) – comes in the form of demand advantages, which can be expressed as per capita spending on certain products or as the proportion of a country's total consumption accounted for by these products. The idea behind this is that demand for certain goods varies from country to country and that this affects the innovative performance of the companies based there. Companies make greater efforts to develop and improve products in sectors that account for larger proportions of a country's aggregate demand. Porter (1990, p.87) encapsulates the idea when he writes: "The more significant role of segment structure at home is in shaping the attention and priorities of a nation's firms. The relatively large segments in a nation receive the greatest attention by the nation's firms." A greater share of total consumption is a sign that consumers in a country place more value on a certain product. This indicator can be used to compare the situation with other countries.

It is possible to directly compare the sector-specific demand specialisation of different countries by subtracting the weighted average share of total demand within the EU-25 from the share of demand for one country. If the share of total demand accounted for by products from a given sector in one country is lower than the average share for these products in the other EU-25 countries, the country in question has a low demand specialisation with respect to the sector. In this case, the value of the specialisation index is negative. A specialisation index of zero means that the proportional demand for a sector in the country concerned is

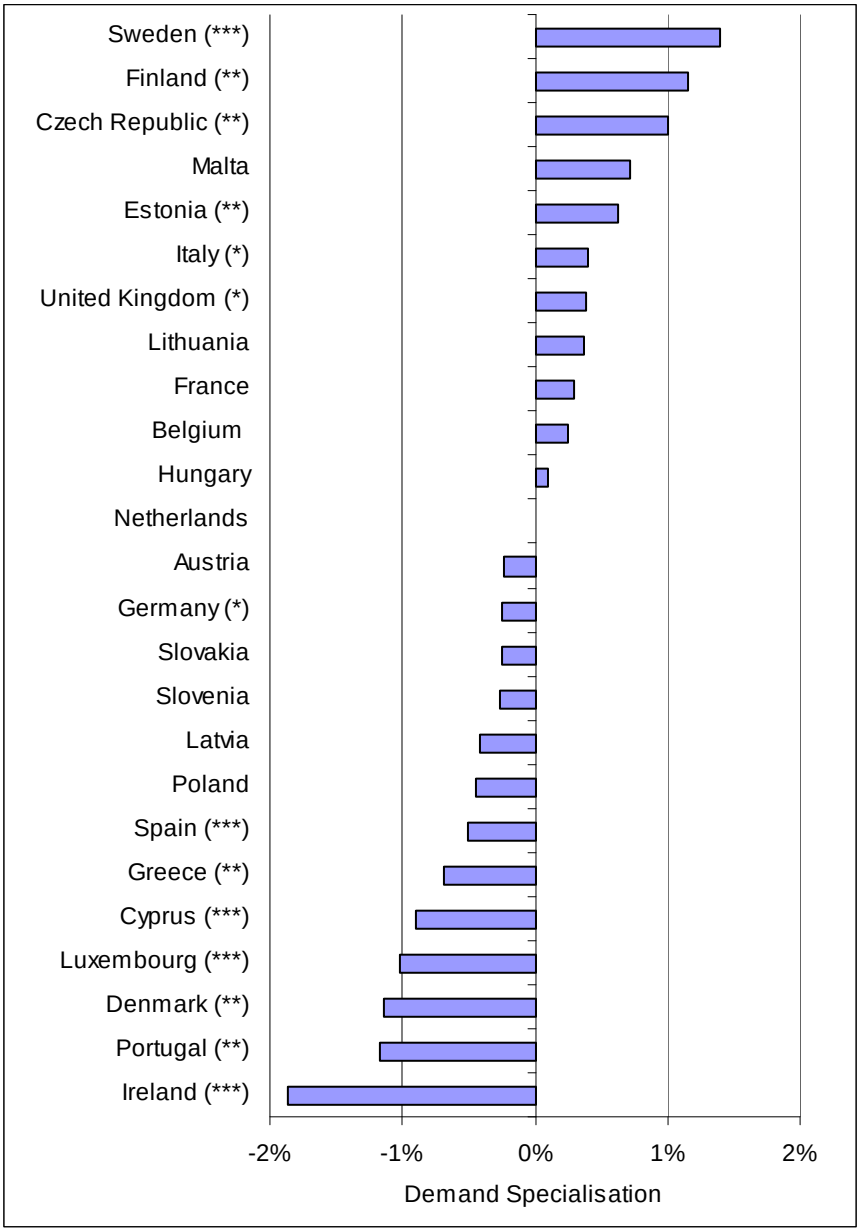
equal to the weighted EU-25 average for the same sector. The index takes a positive value when the propensity to demand such products on the particular market is higher than average.

To calculate an individual country's demand specialisation, we need to know how final demand is structured. Eurostat's Purchasing Power Parities (PPP) statistics can be used to find this out. These statistics give a differentiated picture of a country's final demand (for consumer goods, investment goods and goods provided by the state), grouping the goods into 282 categories (the so-called "basic headings"). The demand is calculated by taking production output, adding imports and subtracting exports. The data for the observation period between 2000 and 2004 are available for academic research purposes and quote values in terms of the national currencies of the time.[33] All the national currencies were converted into ECU (later Euro) amounts, using the average annual exchange rate. The basic headings used to categorise goods are not directly based on the NACE classification. It was therefore first necessary to allocate 2-digit NACE codes to the products, so that a clear picture of the importance of certain sectors for a country's total demand could emerge.[34] It should be noted at this point that not all products always fit easily into a single 2-digit NACE sector. The result is that sectors which primarily produce intermediary products rather than end products are underrepresented in the PPP statistics in terms of the demand they receive. This is of particular relevance for the wood, paper, steel, metal, chemical, energy and plastics sectors.

[33] For 2000 to 2003 the PPPs are scaled such that the PPP for EU-15 is equal to one. For 2004 the PPPs are scaled such that the PPP for EU-25 is equal to one. All PPPs correspond to national currency in use, i.e. from 2002 the PPP of the euro zone (EUR12) correspond to the Euro.

[34] See Table 10-1.

**Figure 6-1: Demand specialisation in the ICT Industry compared to the weighted EU-25-average for the years 2000 to 2004**




Note: (***),(**) and (*) means significant at 1%, 5% and 10% respectively.

Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

The countries with a demand specialisation well above the EU-25 average are Sweden, Finland and the Czech Republic, all of which scored around one percentage point above the average. Shares of demand that were significantly below average could be found in Ireland (-2 percentage points), Portugal, Denmark and Luxembourg (all at -1 percentage point).

Government intervention seldom proves an effective means of bringing a country to the forefront of an international trend in the demand for a certain innovation or creating a demand advantage. Demand preferences are very much culturally determined and can therefore only be changed in the long term. At best, political measures may improve the situation by speeding up technical approval procedures to increase the adaptation and adoption of

innovations and by providing incentives to react more quickly to certain innovation trends, in the form of tax (=price or cost) reductions.

Over the observation period between 2000 and 2004, the demand propensity increased significantly in Malta (increase of around 0.4 percentage point per year) and in France (up approximately 0.3 percentage points per year). Compared to the overall development in Europe (EU-25), the demand propensity in Denmark, Sweden, Portugal, Estonia and Hungary fell by at least 0.2 percentage points annually.[35] Thus in Malta and France, it is not only the demand propensities that are above average – the growth rates of the ICT industry in these countries are too.

What options in the innovation process are left open to companies from sectors with below-average shares of demand? One possibility is to substitute the inadequate demand in the home country with international demand (see the sections below on price and export advantages). This creates a necessity to involve foreign customers in the innovation process to a greater extent. Another option is to lower relative prices in order to stimulate the domestic and foreign demand. However, this can only be sustained in the long-term if cost advantages are realised.

## 6.2 Price Advantage

According to Levitt (1983), in the context of the internationalisation of innovations, an innovation design sold at a lower relative price on a Lead Market can squeeze out existing – but relatively more expensive – innovation designs on other markets abroad. The limits on price reduction in this case are determined by the potential to reduce production and factor costs now and in the future. Price reductions can be achieved by cost reductions, which, in turn, can result from size advantages.[36] The effects of this price mechanism are stronger when the relative price differences at the start of the innovation competition are greater. Its effectiveness also increases with increased dynamism of the relative price development in favour of the innovation design. Only when the relative price difference in favour of the innovations on the Lead Market is so great that the transaction costs incurred in changing over to the innovation design can be compensated, will firms and customers in other markets abroad switch over to the Lead Market design.

Price advantages can only be used as Lead Market factors if there is price competition. Therefore in highly regulated or isolated markets it may not be possible to exploit the price advantage of an innovation design. Competitive markets exist for most goods produced by the ICT industry and for many knowledge-intensive and related services. This means that price advantages are indeed of relevance in this context (Beise et al., 2002). For this reason, it is worth investigating which countries already have long-term price advantages. The size of the

[35] Significant at 5% level.

[36] One example of country-specific size advantages is the potential market size, which offers the potential to exploit economies of scale and learning effects in order to create a price advantage. However, even at the stage of operationalising the potential market size, there are problems in defining and delineating relevant markets. A series of Lead Market studies (Beise/Cleff, 2003) have shown that aggregating "culturally and economically similar" areas was not an adequate way of identifying the different relevant markets, in that it did not allow for sufficient differentiation. For example, heavy goods vehicles in the USA are very different from those in Europe for legal reasons. The scope of the two relevant markets is affected accordingly. For passenger cars - as another product from the same industry -, however, no strong difference of this sort comes into play.

price and cost advantage can be taken directly from international Purchasing Power Parities (PPP) statistics.

To enable the international comparison of purchasing power in a world of floating exchange rates, the OECD and Eurostat calculate Purchasing Power Parities (PPP). These provide a means of showing the price level for certain groups of goods, controlled for differences in quality. PPPs are price relatives that show the ratio of the prices in national currencies of the same good/service in different countries.[37]

Similarly to the data for demand specialisation, this price information is available for the period 2000-2004 and is classified using the 282 basic headings.[38] National currencies were converted to ECU and later Euro using the average annual exchange rate. As the PPPs only refer to groups of goods, they were categorised according to the NACE classification of economic activities. The good-specific PPPs are then weighted using the demand propensity.[39] This provides a basis for the calculation of relative prices within a country, by taking the ratio of sector-specific PPP to the average PPP for all sectors in a country's economy. A relative PPP level calculated in this way controls for country-specific differences in pro-capita income and the different price levels that result. The negative logarithmic quotient of a sector's relative PPP level and the price level for the same country's economy is a direct measure of sector-specific price differences between countries.[40] A positive log-value for a country means that the price level in question was below the average for the EU-25 countries in 2004. A negative value implies that the price level is above average. The following figure shows the price differences of the EU-25 countries for 2004, calculated from the smoothed time series for the years 2000 to 2004 in the ICT industry.

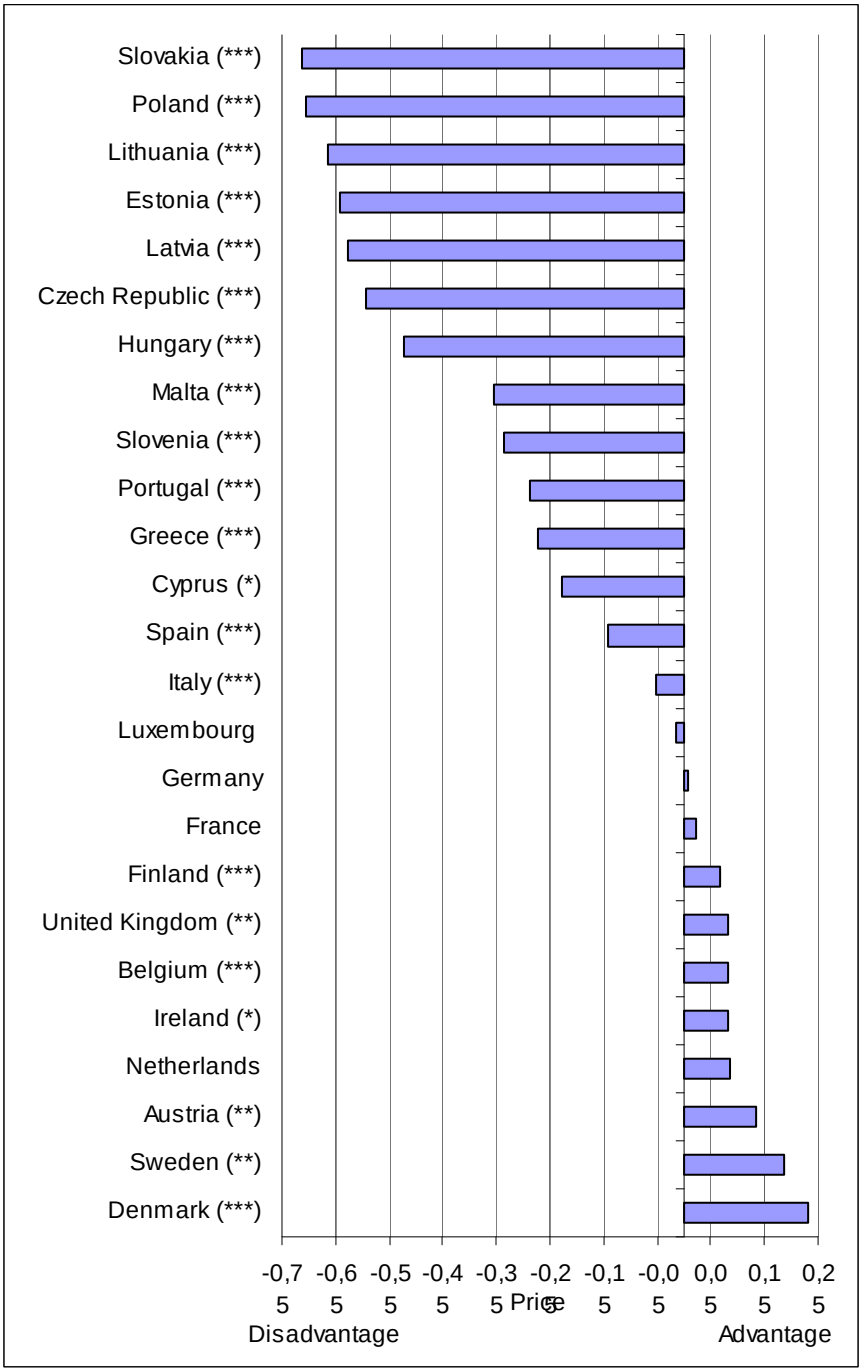
[37] "For example, if the price of a hamburger in France is 2.84 euros and in the United States it is 2.20 dollars, the PPP for hamburgers between France and the United States is 2.84 euros to 2.20 dollars or 1.29 euros to the dollar. In other words, for every dollar spent on hamburgers in the United States, 1.29 euros would have to be spent in France in order to obtain the same quantity and quality – or volume – of hamburgers. […] PPPs are still price relatives when they refer to a product group or to an aggregate. It is just that in moving up the levels of aggregation the price relatives refer to increasingly complex assortments of goods and services. Thus, if the PPP for GDP between France and the United States is 0.97 euros to the dollar, it means that 0.97 euros has to be spent in France to obtain the same volume of final goods and services that one dollar purchases in the United States. This does not imply that the baskets of goods and services purchased in both countries will be identical. The composition of the baskets will vary between countries reflecting their economic, social and cultural differences, but both baskets will, in principle, provide equivalent satisfaction or utility" (OECD/Eurostat 2006, p. 2).

[38] For 2000 to 2003 the PPPs are scaled such that the PPP for EU-15 is equal to one. For 2004 the PPPs are scaled such that the PPP for EU-25 is equal to one. All PPPs correspond to national currency in use, i.E. from 2002 the PPP of the euro zone (EUR12) correspond to the Euro.

[39] It should be noted at this point that, as was the case when demand specialisation was aggregated at sector level, it is not always possible to allocate a product to one distinct sector grouping. As the composition of national baskets of goods changes over time, some distortion of the sectoral allocation can occur in the PPP statistics.

[40] $ln\left(\frac{PPP^{\text{sector}}_{\text{Country}=i}}{PPP^{\text{all sectors}}_{\text{Country}=i}}\right) * (-1)$.

**Figure 6-2: Price advantages and disadvantages of different markets for 2004 [from the smoothed time series for the years 2000 to 2004] in the ICT industry**




Note: (***),(**) and (*) means significant at 1%, 5% and 10% respectively.

Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

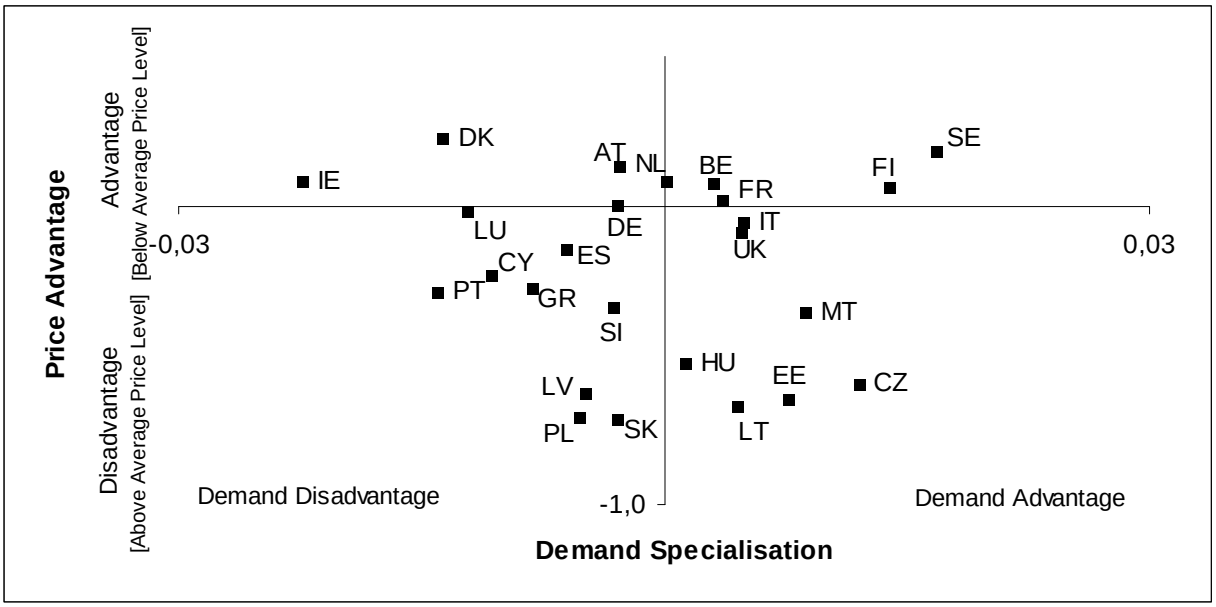
It becomes apparent that the relative prices in the ICT industry are higher in Eastern European and Baltic countries than in the remaining Western European countries. Comparatively low relative prices can be found in Denmark, Sweden and Austria.

When considering these statistics it is important to be aware that the price level is not the only indicator of a price advantage, because it is strongly influenced by company strategies and competitive behaviour (see section 6.5). Nevertheless, a low price level and relatively

high propensity to consume can be a sign of a price-dependent demand advantage. When this is the case, the demand reacts to a low price level with an above average increase in their demand for the product. In other words, the price elasticity is very high. A low price level thus makes for a clear demand advantage when it is accompanied by high demand specialisation.

In Figure 6-3, the relative PPP level is plotted against demand specialisation for all countries. The countries that are of interest to us are those located in the upper right quadrant. These are countries with both a low relative price level and a high propensity to consume. The countries in question are Belgium, France, Finland and Sweden. The price level in these countries constitutes a Lead Market advantage. Drops in prices are met by a large increase in demand. Innovation designs that exploit this price elasticity can spread quickly and make use of market size advantages to increase their ability to compete on price. This market characteristic should spur suppliers of innovations to follow a price-cutting strategy from the outset. Innovations designed within this system of incentives should have a marketing advantage over alternative innovation designs, on the basis of price.

**Figure 6-3: Price advantages and demand specialisation in the ICT industry**




Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

Lead Market advantages can also exist when a low price level comes together with an average, or even slightly below-average, propensity to consume. In these markets, too, the quantity demanded is above average. However, the low price level means that demand specialisation does not appear significantly positive. In some countries, the propensity to consume remains low in spite of a relatively low price level, i.e. the relatively low prices do not lead to increased demand. This is particularly the case in Germany and Austria. When the opposite is true and a high price level is found with high demand specialisation, this suggests that price elasticity on the market is low. The fact that this group of goods makes up a large proportion of total demand is essentially due to the high prices, while the propensity to consume remains comparatively low. Typical examples of this are Hungary, Italy, Great

Britain, Malta, Estonia, the Czech Republic and Lithuania. On the whole, these markets are often unfavourable for innovators.

Finally, a group of countries can be identified in which the price level is relatively high and the demand specialisation below average. In such cases, the high price level leads to a higher than average (compared with other countries) drop in demand. The high price level is a disadvantage for export-oriented innovators, as it prevents lower-cost innovation designs from coming into being. The countries Portugal, Greece, Poland, Slovakia, Latvia, Slovenia, Cyprus and Spain in particular are faced with this problem.

Of all the Lead Market factors, the price or cost advantage seems to be the easiest to influence by means of political intervention. One form this intervention may take is the use of taxation on particular factors or goods to directly affect the price and cost structure of innovation designs. Any such tax policy should be "trend-oriented" and anticipate future cost developments at an international level. Only then will the industries in question be able to produce innovations that will also subsequently be demanded in other markets. In contrast, a policy of taxation and subsidisation that went against the international cost trend would only increase the probability of idiosyncratic innovation.

Price advantages can also be promoted by policies aimed at fostering competition, since intense competition lowers prices for end users. A final important point is the aspect of cost advantages resulting from the size of the market. In the European Union, the market is already large, so innovation policies should be able to set parameters that allow firms to make the most of the size advantage which, in principle, already exists. Such policies include preventing the home market from splitting into regional markets, for example. One example of how this problem can arise is if approval procedures or regulations differ from one region to another.

### 6.3 Export Advantage

The key characteristic of a Lead Market is that innovations realised there will not be limited to a certain country or region, but should be well-suited for export. Vernon (1979) and particularly Dekimpe et al. (1998) find that the exportability of innovations is higher when the exporting and importing markets are more similar in cultural and economic terms. In such cases, customers only suffer a relatively small loss of utility when changing over to a "foreign" innovation design. The number of country-specific innovation designs thus falls comparatively quickly. However, exportability may not only depend on how similar markets are. The "adaptability" of an innovation to different market surroundings is also decisive for its chances on the international market. International marketing proves less complicated when certain features of the innovation design have been planned from the outset to facilitate its use in different environments without the need for any substantial changes.

The Lead Market approach is not based on the traditional view that export successes are indicators of a country's technological – or, more generally, economic – competitiveness. Instead, pronounced export activity is seen as an input factor for a country's success in innovation. A strong position in terms of exports in the past may encourage innovators to make their products suitable for international markets. This, in turn, promotes innovation designs that will be a success when exported.

Interaction with customers and demand orientation are not export factors in themselves. Only interaction with the "right" customer and the presence of the "right" market conditions actually lead to innovations that will be taken up in the world market. Innovations driven by demand which only come into use in their home country and thus have no impact on exports are a sign of idiosyncratic demand. In this case, there is a demand preference for innovation designs that do not represent a competitive advantage in other national markets. There are a range of possible root causes of idiosyncratic demand, which may be natural (specific environmental conditions), may have come about through national legislation (regulations that are not extended to the international sphere), or may be due to an insistence on sticking to the individual national standards set by large clients (e.g. postal service, railways, electricity suppliers). On the other hand, the idiosyncratic demand may simply be a result of the consumers' or business customers' preferences being different from those in other countries.

To assess what affect demand in a particular market has on exports we can again make use of the share of aggregate national demand from Eurostat's Purchasing Power Parities (PPP) statistics, in combination with the European foreign trade statistics.[41] The two sets of statistics are based on different systems of classification, so correspondence tables must first be used to convert to the NACE nomenclature before they can be compared.

The first step is to find the extent of export success for every country. An above-average export performance shows that new products are successfully marketed internationally. The more a country succeeds in working out an export surplus within a group of homogeneous products in bilateral trade, the higher the estimated competitiveness will be (Grubel 1975). To measure competitive advantages between two countries, the ratio of export surpluses to total trade volume ($CA_{tik}$) within a product group p should therefore be applied: $CA_{tik} = \frac{x_{tik} - m_{tik}}{(x_{tik} + m_{tik})}$.[42] The chosen indicator of competitive advantage corresponds to the objectives set out by a company when identifying potential supplier countries (Cleff 2006b). The Revealed Comparative Advantage - RCA (Balassa 1965) - applied in the tradition of economics for determining comparative advantages, is considered not to be an appropriate indicator in this case. A positive competitive advantage of a country can be relatively hidden behind a low RCA if the ratio of exports to imports of a particular product group is indeed higher than 1, but the corresponding ratio in total trade of a country turns out to be higher. This can lead to an underestimation of the product-specific absolute competitiveness of nations that have a high overall product export surplus, and vice versa (Cleff 2006b).

The average CA of all countries that export the product in question within the different European countries is used as a reference value for export success. Countries with a smoothed product-specific CA significantly above the average for the last ten years are considered to

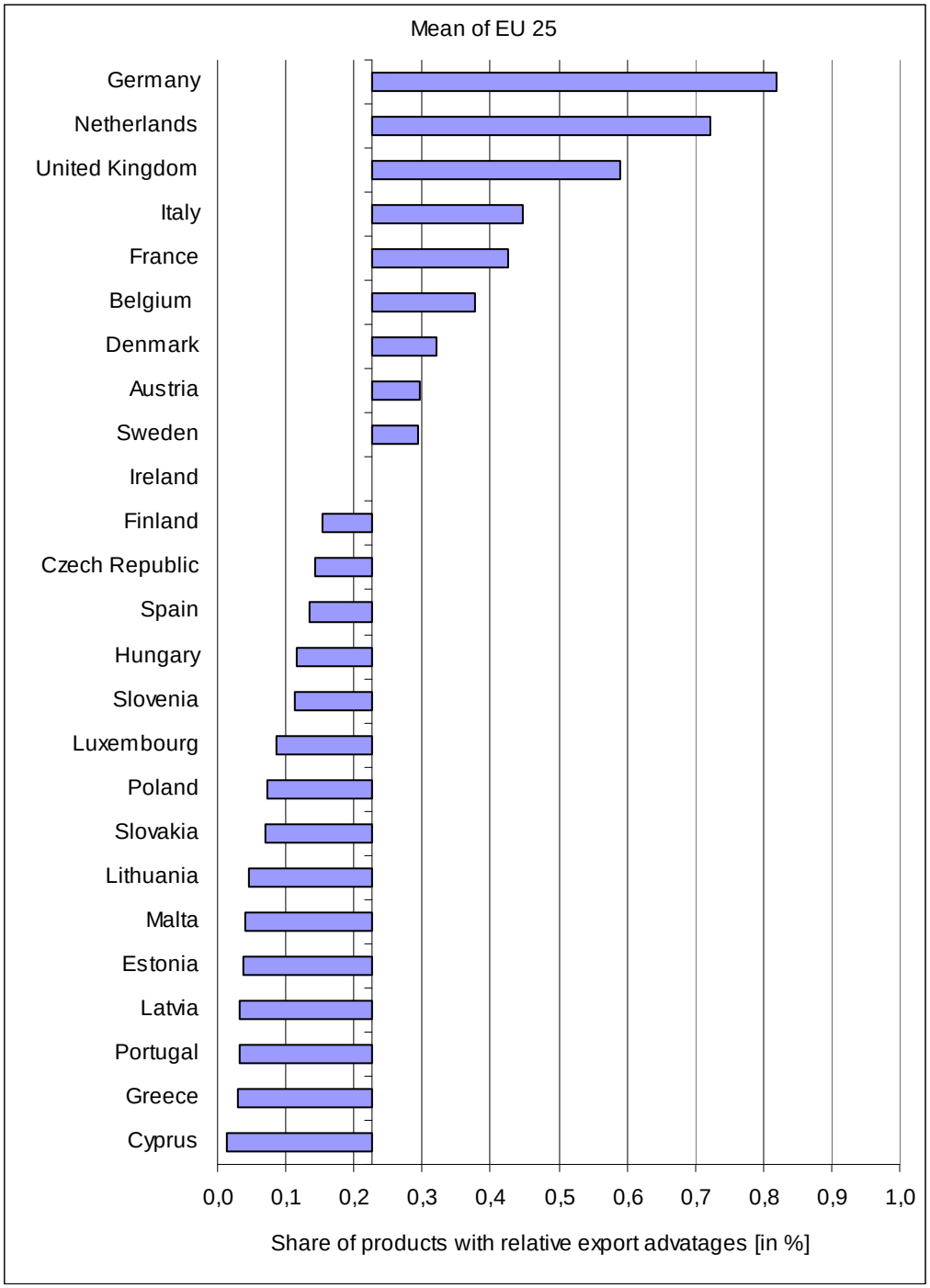
[41] The European foreign trade statistics offer data on an 8-digit-aggregational level – the Combined Nomenclature. The Combined Nomenclature is based on the 6-digit Harmonised System, which was extended by 2 digits for the European Trade Statistic. Thus the first three levels of the Harmonised System HS2, HS4 and HS6 correspond to the Combined Nomenclature, completed by a further level KN8. These data are available for the years 1988 to 2005 and in contrast to the data of the OECD, only encompass the trade of individual EU states with all other states in the world. Therefore trade flows outside of the EU, such as those between Japan and the USA, are not determined.

[42] The variable $x_{tik}$ stands for the export value from the supplier country k ($k \in \{1,..., n\}$) to the supplied countries i ($i \in \{1,..., m\}$) in a specific year t. The variable $m_{tik}$ represents the respective import value.

have an above-average product-specific relative export advantage. If a country has a high share of product-specific relative export advantages in a given industry, this indicates a country-specific export advantage there.

On the basis of the foreign trade statistics for the ICT industry, the following diagram shows in how many product groups an above-average relative export advantage is recorded for each of the EU-25 countries.

**Figure 6-4: Share of product-specific relative export advantages in the ICT industry, for EU-25**




Source: ZEW: Global Sourcing Management Tool, 2007.

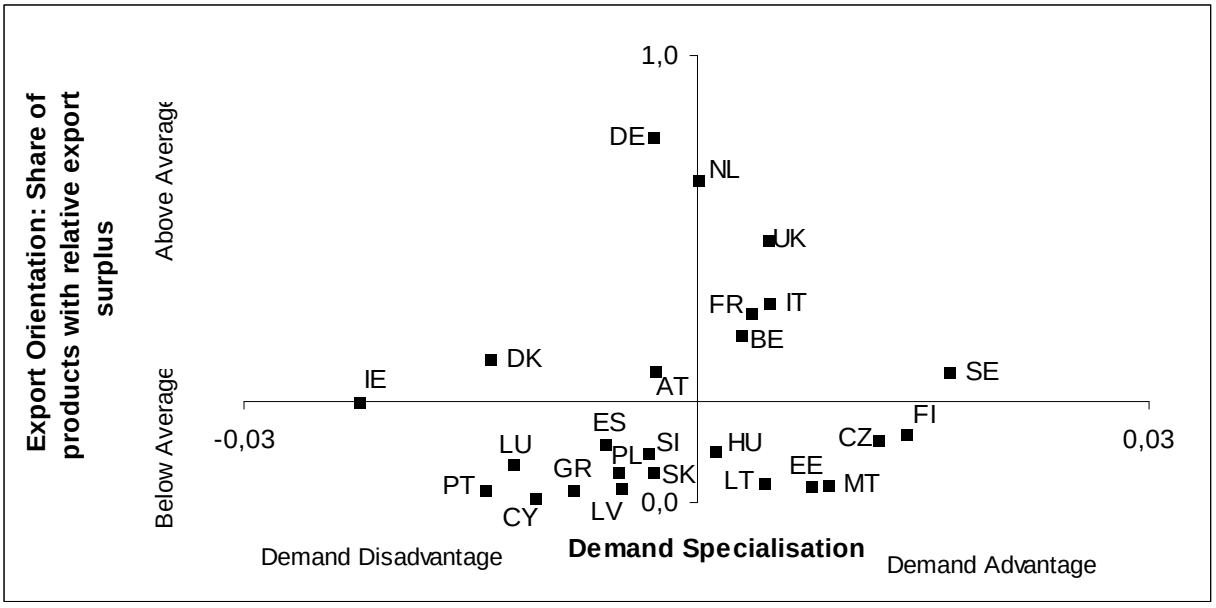
Germany and the Netherlands have particularly large export advantages, with more than 70% of products from their ICT industries proving successful abroad. The UK, Italy, France, Belgium, Austria, Denmark and Sweden follow, although their export advantages in the industry are slightly above average. The other countries have values well below average.

It is assumed that a Lead Market is always present when demand in a country provides innovating companies with a considerable quantitative impulse to innovate and, at the same time, the companies generate a large proportion of their turnover abroad. If quantities of product innovations exported are high and the impulse to innovate came from customers in the home market, this shows that demand at home prefers an innovation design that has the potential to succeed internationally. Conversely, it is a sign of an idiosyncratic market when companies only export a small share of their goods because they respond too much to the "eccentric" customers' wishes in the home market. In this case, customers appear to prefer product solutions that cannot be marketed internationally (idiosyncratic demand).

Therefore if a country's various export successes, measured as the share of products with above-average relative export advantage, can be put down to above-average customer demand, this is a sign that the country has a particular Lead Market characteristic. This is because domestic demand that translates into success on the export market is a typical characteristic of a Lead Market.

Figure 6-5 shows the extent of demand advantage against the size of the export advantage for the ICT Industry in the form of a portfolio. In the upper right quadrant of the portfolio are countries that develop technologies driven by demand and at the same time exploit the lead-market properties of home demand for successful exports (Lead Market sectors). The home markets in these countries – Belgium, the Netherlands, UK, Italy, Sweden and France - offer particularly favourable conditions for the launch and testing of new products, with the aim of successfully marketing the innovation designs tested at home in other countries.

**Figure 6-5: Lead Market Matrix in the ICT industry: classification according to export orientation and utilisation of home market demand**




Source: ZEW: Global Sourcing Management Tool, 2007 and Eurostat/OECD PPP-Statistics for 2000 to 2004.

Exportable innovations may also originate from sources other than the home market. Innovating companies that are highly export-oriented but do not, to any great extent, rely on home demand as a source of innovation can be categorised into three different types. In the first type, the drive behind innovations that are suited to the world market comes from the company's own R&D or technological know-how purchased externally (e.g. from technology suppliers or academic research).

The second possibility is to base new products on the innovations of foreign competitors, i.e. imitation. The third category comprises firms that are driven to innovate by demand from abroad. This could indicate that the home market is a successful lag market. In this case, home companies may not be leaders in launching product innovations that have international staying-power, but they are good at quickly picking up on new trends from abroad then converting these into export success. For simplicity, we shall denote all of these effects as "technological impulses to export". The upper left quadrant in the diagram above contains the countries Denmark, Austria and Germany, which primarily bring out innovations driven by technology and then translate these into export success.

Finally, if product innovators have little export success and home demand plays no meaningful role as a source of innovation, companies focus on technology specific to the home market. In this case, innovators concentrate on product innovations based of their own R&D or external sources of knowledge, but which do not provide solutions suitable for export. We can speak of idiosyncratic technology in this context. In the diagrams above, the countries in the lower left quadrant - in particular Luxembourg, Portugal, Cyprus, Greece, Poland, Latvia, Spain, Slovenia and Slovakia - belong to this group of markets.

The most problematic area from an innovation strategy perspective is surely the lower right quadrant. The difficulty is that these countries are largely dependent on demand to drive their innovation activities, yet the demand on their home market is idiosyncratic. The home market acts as an obstacle to export activities, since catering for home demand makes for innovations that are difficult to sell in other countries. Hungary, Finland, Malta, Estonia, Lithuania and the Czech Republic are notable examples of countries with such markets.

If innovation policy is to be efficient from this point of view, it must adapt the incentives it offers to focus more strongly on exports. This applies in particular to technology development projects that receive government subsidies. The potential exportability of the technology could be included as a criterion for subsidisation. Politicians can also support international and flexible Lead Market strategies by not insisting on national solutions, but instead taking experiences from potential Lead Markets into account, for example when approving products and formulating regulations for specific markets. The legislature, too, can influence export orientation, by taking note of international trends and thus preventing infrastructure for science and technology (educational institutions, research establishments, standards agencies etc.) from becoming idiosyncratic.

### 6.4 Transfer Advantage

The concept of transfer advantage covers a range of "classic" diffusion factors. The decision to adopt a particular innovation design in a country is often dependent on which technology has already been adopted in the Lead Market and on the experiences gained

during its introduction there. The demonstration effect when the innovation is adopted increases the incentive for users in other countries to adopt the same innovation design, firstly because of the information that is available about the innovation and its use and secondly because of the decreased risk, i.e. reduced uncertainty as to whether the new product or process is reliable. If a product has been successfully tried out in the Lead Market, it makes sense to adopt it in other markets too (Kalish et al., 1995). In this case, the Lead Market takes on the role of a test or reference market and is closely observed by agents in other markets. The Lead Market serves as an example for the evaluation of problems and dangers in the introduction of the new technology, thereby reducing uncertainty. More importantly still, the utility of the Lead Market customers affects customers beyond the boundaries of the market.

A country's market therefore has a transfer advantage if it raises the perceived utility of customers on other markets as well as those at home. The reputation and high level of development of the Lead Market's users is considered to be a hallmark for high-quality innovation designs. The quality of demand is especially determined by users' know-how and experience with similar products. For example, the markets in countries which often feature in the mass media and television series are potentially Lead Markets for lifestyle products. In a similar way, smaller markets can also bring out products that are competitive worldwide (Beise et al., 2002).

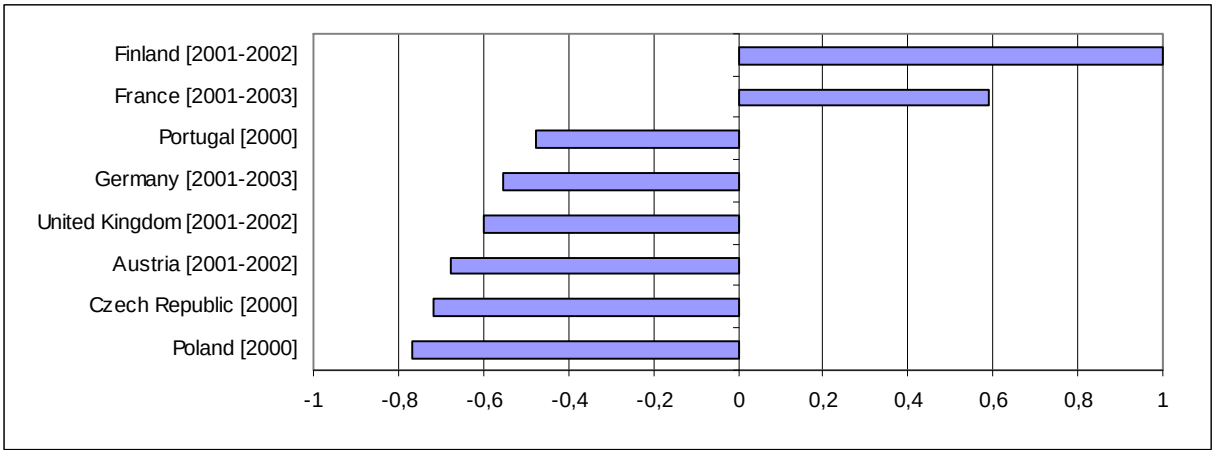
Transfer advantage is difficult to quantify, as analyses related to innovation projects have shown (Beise/Cleff, 2003). Since the differences between countries are less pronounced at the industry level than when it comes to individual products, it is almost impossible to find general indicators for the industry level.

Cleff (2006b) used the amount of foreign direct investment (FDI) as a proxy for the potential international diffusion of innovations. One benefit of foreign subsidiaries is that they provide companies with information about the particular nature of demand in a country. Another advantage for companies with subsidiaries in several countries comes in the form of economies of scale. The company can launch a single innovation design internationally, even if the design itself is not optimally suited to the conditions in one of the local markets. This means, for example, that companies may use the same software, the same component assemblies and the same machines in all markets, even though the relative factor prices differ from country to country. Since it is assumed that the parent company is generally the first to make use of innovations or generally makes the decisions about which innovation design to pursue, countries that engage in a large amount of FDI have a transfer advantage.

Unfortunately, data on the quantity of FDI by industry, which would enable a cross-country comparison for the ICT industry, are only available for eight of the EU-25 countries. The data come from the "United Nations Conference on Trade and Development (UNCTAD)" or Eurostat publications. If we compare the total value of FDI for the specific industries with the help of a measure of specialisation,[43] rather than the number of investments made, we come to the results shown in the figure below.

[43] The measure of specialisation is calculated by taking the quotient of (1) the industry-specific total stock of FDI by home companies abroad divided by the respective total of FDI by foreign companies in the home market and (2) the overall total of FDI by home companies abroad divided by the respective total of FDI by foreign companies in the home market. To attain a

**Figure 6-6: Specialisation of FDI in the ICT industry (Average for the given years)**




Source: United Nations Conference on Trade and Development (UNCTAD) 2007.

If the proportion of investment abroad is above average, the resulting value is positive. Otherwise the value returned is negative. It becomes apparent that the ICT industries in Finland and France specialise in FDI more than is average, while the other countries have below-average values.

Countries that succeed in propagating their international standards in innovation design are best placed to realise a transfer advantage. Transfer advantage is the Lead Market factor to which most attention is paid in innovation policy. It is common for government funding for innovations to aim to promote the demonstration effect in the diffusion of innovations (e.g. through application centres designed to give businesses the chance to experience new process technologies). This can be a particularly decisive factor for the international diffusion of a technology if there is a large amount of uncertainty about how readily it can be implemented in practice and how efficient it is in economic terms. However, there is a considerable risk that idiosyncratic technologies will be subsidised, particularly in lag market industries. The degree of openness of a standard should therefore be used as a criterion to determine whether a technology is eligible to receive government subsidies. Equally, increased bargaining power for European politicians and companies in international standardisation committees can help to improve the transfer advantage.

## 6.5 Market Structure Advantage

From empirical studies about successful innovation designs from the Lead Market (Beise, 2001), a notable characteristic of these markets is particularly strong competition. The realisation that international innovation success is correlated with the intensity of competition may not be new (cf. Posner, 1961 and Dosi et al., 1990), but Porter (1990) was the first to find

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final value between -1 and +1, we take the hyperbolic tangent of the quotient then subtract one:

$$hyptan\left(\frac{DI^{\text{sector}}_{\text{home to foreign market}}}{DI^{\text{sector}}_{\text{foreign to homemarket}}} \Big/ \frac{DI^{\text{overall country}}_{\text{home to foreign market}}}{DI^{\text{overall country}}_{\text{foreign to homemarket}}}\right) - 1 .$$

a conceptual link to a cause, namely that customers in very competitive markets can be "choosier" than in oligopolies or monopolies. Faced with strong competition, innovators are compelled to react increasingly to technological development (Mansfield, 1968, p. 144). The resulting competition between very different innovation designs often leads to a refined innovation that best fits customers' needs. This innovation design, which offers maximum utility to customers thanks to the competition on the national market, also has the best chances of winning through in international competition. Competition can therefore be understood as a process of decentralised coordination, by which all the participants attempt to achieve a better innovation design, so that the final design will also have a better chance of succeeding in international markets.

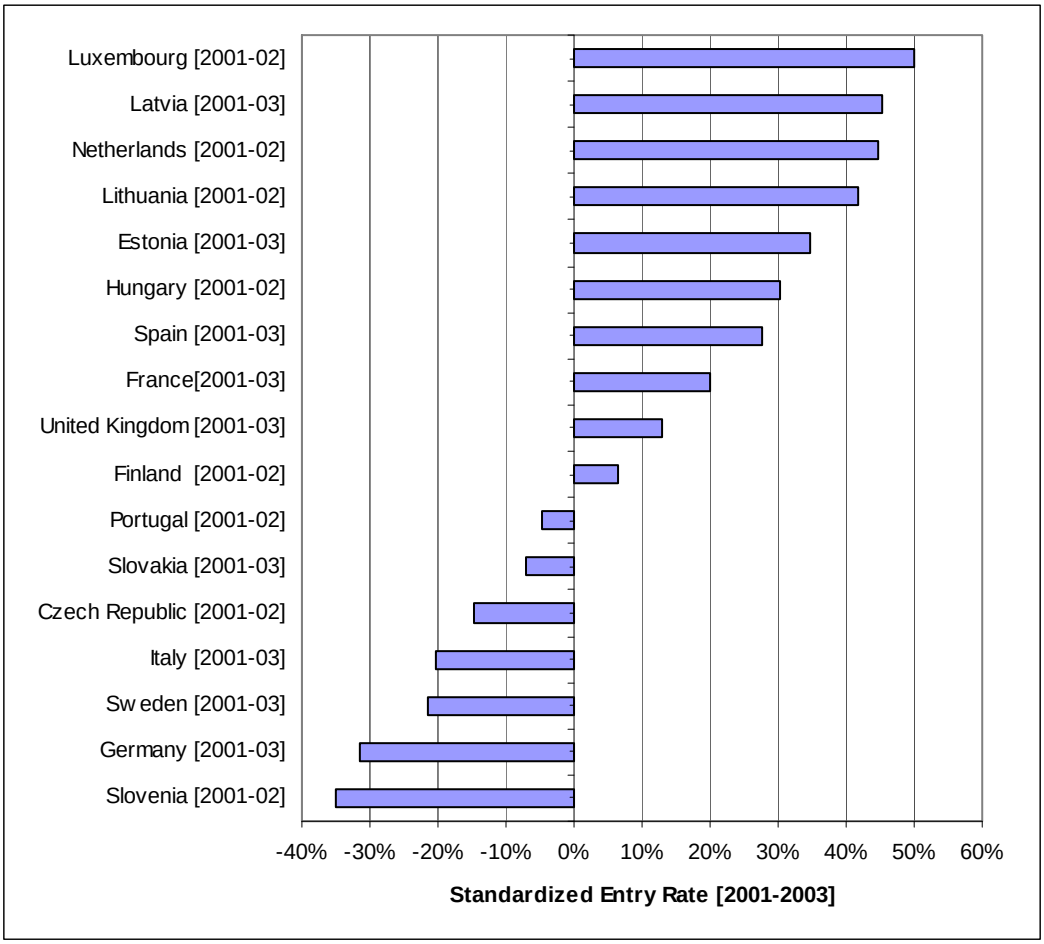
There are a range of known measurement concepts that could be used to establish the intensity of competition. Putting such concepts into practice often proves impossible, however, because of a lack of internationally comparable figures.[44] Using the fact that markets with different degrees of concentration establish their prices differently, an approximation can be found for the intensity of competition on a market. Monopolists set their prices to maximise profits without being subjected to pricing pressure from competitors. In a market with perfect competition, firms theoretically adjust their supply to fit the market price. In this case, the price level is lower than that in a monopoly. Taking this relationship as a starting-point, we can assume under certain conditions – namely that we are dealing with homogeneous goods/services – that the price level on a market decreases with increasingly intense competition. The price level can thus be taken as an indirect indicator of competition on a market. As a cautionary reminder at this stage, it should be noted that the price level has already been used to illustrate the aspect of price advantage, as a relatively low price level is conducive to Lead Market advantages, which arise from the increased inclination to adopt an innovation and its quicker diffusion, in international comparison (cf. section 6.2). Since a low price level is always a positive aspect of demand structure, either as an indicator of prices or of competition, the ultimate result is unaffected by which Lead Market factor the indicator is allocated to. The same indicators can therefore be used to show advantages in price and market structure. This also suggests that although these two Lead Market characteristics can be separated in theory, it is not necessarily possible in practice. The results from section 6.2 should therefore be taken into account.

Furthermore, it is possible to show the intensity of competition on a market by referring to the occurrence of barriers to entry, because the formation of new firms not only promotes innovation but intensifies competition in their markets (Gerolski, 1991). "Especially for upcoming technologies and when new product markets develop, divergent innovation designs compete with each other. Start-ups are likely to bring in new solutions and challenge established companies that enter these new markets, too" (Rammer, 2006). The logarithmic

[44] In traditional industrial economics, the intensity of competition can be measured using a range of parameters of concentration (e.g. a company's turnover as a share of market volume). Commonly-used parameters are the concentration ratio, the Gini coefficient and the Herfindahl-Hirschman Index. Since these require all the shares of a particular characteristic to be precisely allocated to individual subjects or objects, the two indicators can only be used if the available data is sufficiently detailed. Even in national statistics from large countries, this is rarely the case. Experience has shown that such data are most likely to be available on oligopolistic markets that have large companies which are therefore obliged to publish their sales figures. On the other hand, the concentration ratio, CRx, only uses the market share of the x-largest market player to determine market concentration and, as such, is an accommodating method when data is limited. However, even for this method, there is a severe shortage of internationally comparable data.

quotient of a sector's average[45] market entry rate of new firms in a given country and the respective entry rate in the EU is an indirect measure to compare the sector-specific competition in different countries.[46] A negative (positive) log-value for a country means that the entry rate –and thus also competition on that market - is below (above) the average for the EU countries.

**Figure 6-7: Standardized Entry Rate in the ICT industry**




Source: Eurostat and ZEW Foundation Panel (for Germany).

In the ICT industry, relatively concentrated markets with comparatively weak competition are to be found in particular in Slovenia, Germany, Italy and Sweden. Competition in Luxembourg, the Netherlands, the Baltic countries and Hungary, on the other hand, is well above the European average.

It should be noted at this point that there is a clear division between fostering market structures that stimulate innovation and promoting "national champions" to increase international competitiveness. The Lead Market approach is not based on targeting and strengthening individual actors, but instead on strengthening competition between all actors.

[45] The Means were calculated for the entry rates given in Figure 6-7.

[46] $ln\left(\frac{\text{Entry Rate}^{\text{sector}}_{\text{Country}=i}}{\text{Entry Rate}^{\text{sector}}_{\text{all EU-Countries}}}\right)$.

The idea is that confronting innovators with free competition on the market at an early stage is a more effective way of increasing international competitiveness than offering protection from competition in the hope of building up a strong national position. From a technology policy point of view, this means focussing on measures that guarantee favourable conditions for the development of successful innovation designs. It is particularly important to ensure that (international) competition is enforced in industries in which the home country has few structural advantages. This can be achieved by implementing legal measures to prevent cartels, promoting start-ups, supporting newer technology companies and breaking down non-tariff barriers to international trade.

## 6.6 Conclusions

In the above sections we investigate the influence of demand on the innovation capability and competitiveness of the ICT industry in each of the EU-25 countries. Although demand is one of the decisive factors for the development of innovations, it has hardly been integrated in analyses of research and technology policy to date. The Lead Market approach brings market demand into the discussion, with the result that innovations can no longer be understood as purely supply-oriented and pre-competitive.

To evaluate the role demand and market structures play in the creation of innovations with international potential, country-specific properties – the so-called Lead Market factors - are derived. These help to explain a country's Lead Market potential in a given industry. If these factors are particularly favourable in a certain industry, the chances that innovations favoured by the national market will meet with high demand abroad are likely to be increased. Findings about the Lead Market potential of different markets must have an influence on the formation of business and political strategies for innovation. Furthermore, the findings could constitute a starting-point for the formation of innovation strategies in firms and for more efficient innovation policies. For these reasons, an attempt was made to determine the Lead Market potential of the EU-25 countries in the ICT industry on the basis of quantitative indicators. The following table summarises these results once more.

**Table 6-1: Lead Market potential of the EU-25 countries in the ICT industry**

| Country | Advantage | | | | |
|---|---|---|---|---|---|
| | Price [PPP Statistics] | Demand [PPP Statistics] | Export [Trade Statistics] | Transfer [FDI] | Market Structure [Entry Rate] |
| Austria | + | - | + | - | NA |
| Belgium | + | + | + | NA | NA |
| Cyprus | - | + | - | NA | NA |
| Czech Republic | - | - | - | - | - |
| Denmark | + | - | + | NA | NA |
| Estonia | - | + | - | NA | + |
| Finland | + | + | - | + | + |
| France | + | + | + | + | + |
| Germany | + | - | + | - | - |
| Greece | - | - | - | NA | NA |
| Hungary | - | + | - | NA | + |
| Ireland | + | - | - | NA | NA |
| Italy | - | + | + | NA | - |
| Latvia | - | - | - | NA | + |
| Lithuania | - | + | - | NA | + |
| Luxembourg | - | - | - | NA | + |
| Malta | - | + | - | NA | NA |
| Netherlands | + | - | + | NA | + |
| Poland | - | - | - | - | NA |
| Portugal | - | - | - | - | - |
| Slovakia | - | - | - | NA | - |
| Slovenia | - | - | - | NA | - |
| Spain | - | - | - | NA | + |
| Sweden | + | + | + | NA | - |
| United Kingdom | + | + | + | - | + |

Note: +: above average advantage; -: below average advantage; NA: Not Available

# 7 Lead Market analysis of the Machinery and Equipment industry

The five Lead Market factors discussed above apply to all countries. In this section we will analyse which countries in particular have Lead Market properties in the Machinery/Equipment industry. It should be noted that the Lead Market potentials established are for the aggregated sector. In reality, Lead Market potentials within a sector can vary from one product group to another, or even between individual products. The loss of accuracy that results from such aggregation must be taken into account in the analysis. That being said, observations of Lead Market potential that are aggregated at the sector level are still of great interest, as they offer a means of explaining the future competitiveness of different markets. The investigation presented here focuses on the activities of companies from the NACE 29, 33.2 and 33.3 sectors within the EU-25 countries.

## 7.1 Demand Advantage

A market has a so-called demand advantage if the environmental conditions there foster an innovation design that also anticipates future customer preferences in other markets. Lead Markets are able to anticipate global trends. Therefore the difference between different countries' markets does not lie in the direction in which they develop, but merely in the speed with which they move in the direction of the global trend. The innovation design on the Lead Market thus has a "head start". A head start may also come about when the country is the quickest to build up an infrastructure of complementary goods required by the innovation. An example of this would be a machine powered by alternative fuel. The utility of the machine increases only when a suitable network of refuelling stations is built up. The innovation designs from markets at the forefront of a trend offer other markets the answers and solutions to their questions and problems of tomorrow.

One consequence of the different speeds at which markets adapt to or adopt an international trend – following Linder (1961) and Vernon (1966) – comes in the form of demand advantages, which can be expressed as per capita spending on certain products or as the proportion of a country's total consumption accounted for by these products. The idea behind this is that demand for certain goods varies from country to country and that this affects the innovative performance of the companies based there. Companies make greater efforts to develop and improve products in sectors that account for larger proportions of a country's aggregate demand. Porter (1990, p.87) encapsulates the idea when he writes: "The more significant role of segment structure at home is in shaping the attention and priorities of a nation's firms. The relatively large segments in a nation receive the greatest attention by the nation's firms." A greater share of total consumption is a sign that consumers in a country place more value on a certain product. This indicator can be used to compare the situation with other countries.

It is possible to directly compare the sector-specific demand specialisation of different countries by subtracting the weighted average share of total demand within the EU-25 from the share of demand for one country. If the share of total demand accounted for by products from a given sector in one country is lower than the average share for these products in the other EU-25 countries, the country in question has a low demand specialisation with respect

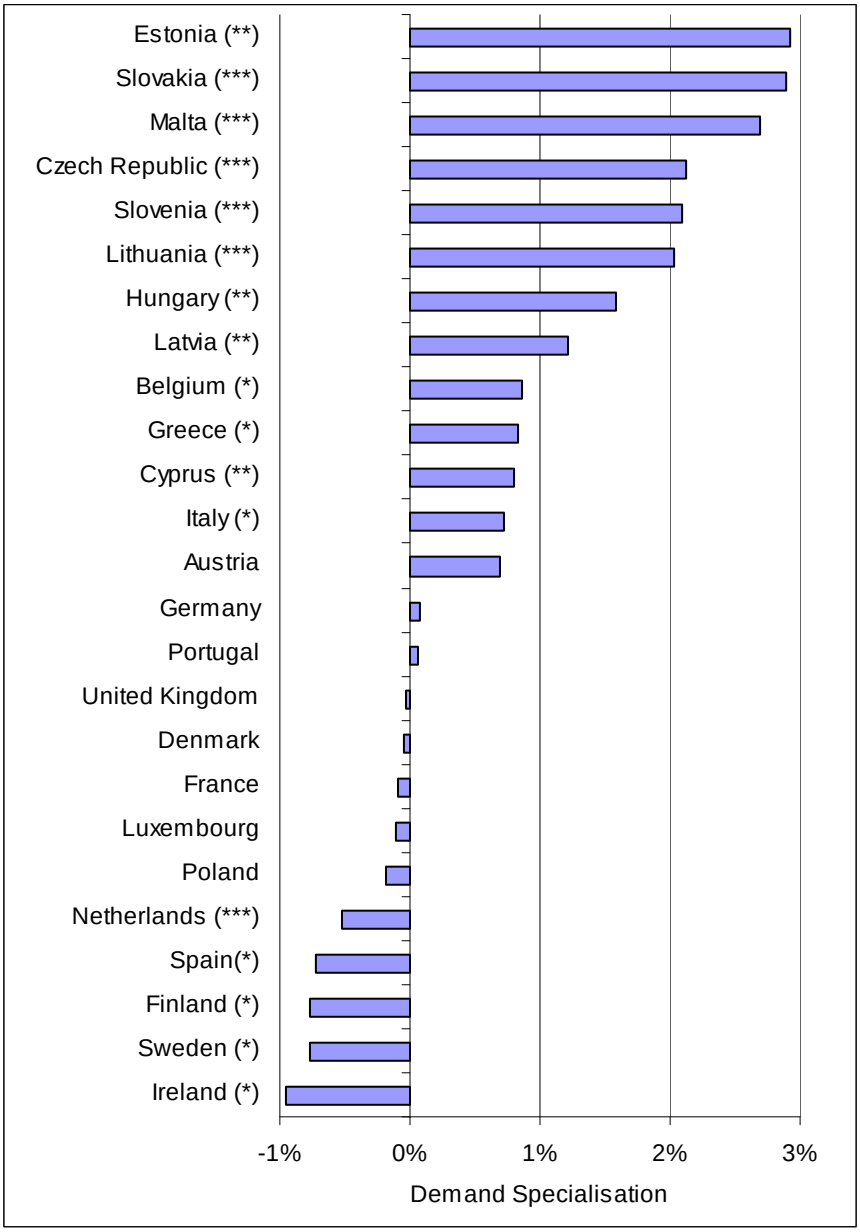
to the sector. In this case, the value of the specialisation index is negative. A specialisation index of zero means that the proportional demand for a sector in the country concerned is equal to the weighted EU-25 average for the same sector. The index takes on a positive value when the propensity to demand such products on the particular market is higher than average.

To calculate an individual country's demand specialisation, we need to know how final demand is structured. Eurostat's Purchasing Power Parities (PPP) statistics can be used to find this out. These statistics give a differentiated picture of a country's final demand (for consumer goods, investment goods and goods provided by the state), grouping the goods into 282 categories (the so-called "basic headings"). The demand is calculated by taking production output, adding imports and subtracting exports. The data for the observation period between 2000 and 2004 are available for academic research purposes and quote values in terms of the national currencies of the time.[47] All the national currencies were converted into ECU (later Euro) amounts, using the average annual exchange rate. The basic headings used to categorise goods are not directly based on the NACE classification. It was therefore first necessary to allocate 2-digit NACE codes to the products, so that a clear picture of the importance of certain sectors for a country's total demand could emerge.[48] It should be noted at this point that not all products always fit easily into a single 2-digit NACE sector. The result is that sectors which primarily produce intermediary products rather than end products are underrepresented in the PPP statistics in terms of the demand they receive. This is of particular relevance for the Wood, Paper, Steel, Metal, Chemical, Energy and Plastics sectors.

[47] For 2000 to 2003 the PPPs are scaled such that the PPP for EU-15 is equal to one. For 2004 the PPPs are scaled such that the PPP for EU-25 is equal to one. All PPPs correspond to national currency in use, i.e. from 2002 the PPP of the euro zone (EUR12) correspond to the Euro.

[48] See Table 10-1.

**Figure 7-1: Demand specialisation in the Machinery/Equipment industry compared to the weighted EU-25 average for the years 2000 to 2004**




Note: (***),(**) and (*) means significant at 1%, 5% and 10% respectively.

Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

The countries with a demand specialisation well above the EU-25 average are many of the Countries in Eastern Europe, Belgium, Italy and Austria. Shares of demand that were significantly below average could be found in Scandinavia, Ireland, Spain, the Netherlands and Poland.

Government intervention seldom proves an effective means of bringing a country to the forefront of an international trend in the demand for a certain innovation and creating a demand advantage. Demand preferences are very much culturally determined and can therefore only be changed in the long term. At best, political measures may improve the situation by speeding up technical approval procedures to increase the adaptation and

adoption of innovations and by providing incentives to react more quickly to certain innovation trends, in the form of tax (=price or cost) reductions.

Over the observation period between 2000 and 2004, the demand propensity increased significantly in Estonia (increase of around 1 percentage point per year) and in Lithuania (up approximately 0.5 percentage points per year). Compared to the overall development in Europe (EU-25), the demand propensity in Poland and Slovakia fell by 0.4 percentage points annually.[49] Thus in Estonia and Lithuania, it is not only the demand propensities that are above average – the growth rates of the Machinery/Equipment sectors in these countries are too.

What options in the innovation process are left open to companies from sectors with below-average shares of demand? One possibility is to substitute the inadequate demand in the home country with international demand (see the sections below on price and export advantages). This creates a necessity to involve foreign customers in the innovation process to a greater extent. Another option is to lower relative prices in order to stimulate domestic and foreign demand. However, this can only be sustained in the long-term if cost advantages are realised.

## 7.2 Price Advantage

According to Levitt (1983), in the context of the internationalisation of innovations, an innovation design sold at a lower relative price on a Lead Market can squeeze out existing – but relatively more expensive – innovation designs on other markets abroad. The limits on price reduction in this case are determined by the potential to reduce production and factor costs now and in the future. Price reductions can be achieved by cost reductions, which, in turn, can result from size advantages.[50] The effects of this price mechanism are stronger when the relative price differences at the start of the innovation competition are greater. Its effectiveness also increases with increased dynamism of the relative price development in favour of the innovation design. Only when the relative price difference in favour of the innovations on the Lead Market is so great that the transaction costs incurred in changing over to the innovation design can be compensated, will firms and customers in other markets abroad switch over to the Lead Market design.

Price advantages can only be used as Lead Market factors if there is price competition. Therefore in highly regulated or isolated markets it may not be possible to exploit the price advantage of an innovation design. Competitive markets exist for most goods produced by the Machinery/Equipment industry and for many knowledge-intensive and related services. This means that price advantages are indeed of relevance in this context (Beise et al., 2002). For this reason, it is worth investigating which countries already have long-term price advantages.

[49] Significant at 5% level.

[50] One example of country-specific size advantages is the potential market size, which offers the potential to exploit economies of scale and learning effects in order to create a price advantage. However, even at the stage of operationalising the potential market size, there are problems in defining and delineating relevant markets. A series of Lead Market studies (Beise/Cleff, 2003) have shown that aggregating "culturally and economically similar" areas was not an adequate way of identifying the different relevant markets, in that it did not allow for sufficient differentiation. For example, heavy goods vehicles in the USA are very different from those in Europe for legal reasons. The scope of the two relevant markets is affected accordingly. For passenger cars - as another product from the same industry -, however, no strong difference of this sort comes into play.

The size of the price and cost advantage can be taken directly from international Purchasing Power Parities (PPP) statistics.

To enable the international comparison of purchasing power in a world of floating exchange rates, the OECD and Eurostat calculate Purchasing Power Parities (PPP). These provide a means of showing the price level for certain groups of goods, controlled for differences in quality. PPPs are price relatives that show the ratio of the prices in national currencies of the same good/service in different countries.[51]

Similarly to the data for demand specialisation, this price information is available for the period 2000-2004 and is classified using the 282 basic headings.[52] National currencies were converted to ECU and later Euro using the average annual exchange rate. As the PPPs only refer to groups of goods, they were categorised according to the NACE classification of economic activities. The good-specific PPPs are then weighted using the demand propensity.[53] This provides a basis for the calculation of relative prices within a country, by taking the ratio of sector-specific PPP to the average PPP for all sectors in a country's economy. A relative PPP level calculated in this way controls for country-specific differences in pro-capita income and the different price levels that result. The negative logarithmic quotient of a sector's relative PPP level and the price level for the same country's economy is a direct measure of sector-specific price differences between countries.[54] A positive log-value for a country means that the price level in question was below the average for the EU-25 countries in 2004. A negative value implies that the price level is above average. The following figure shows the price differences of the EU-25 countries for 2004, calculated from the smoothed time series for the years 2000 to 2004 in the Machinery/Equipment industry.

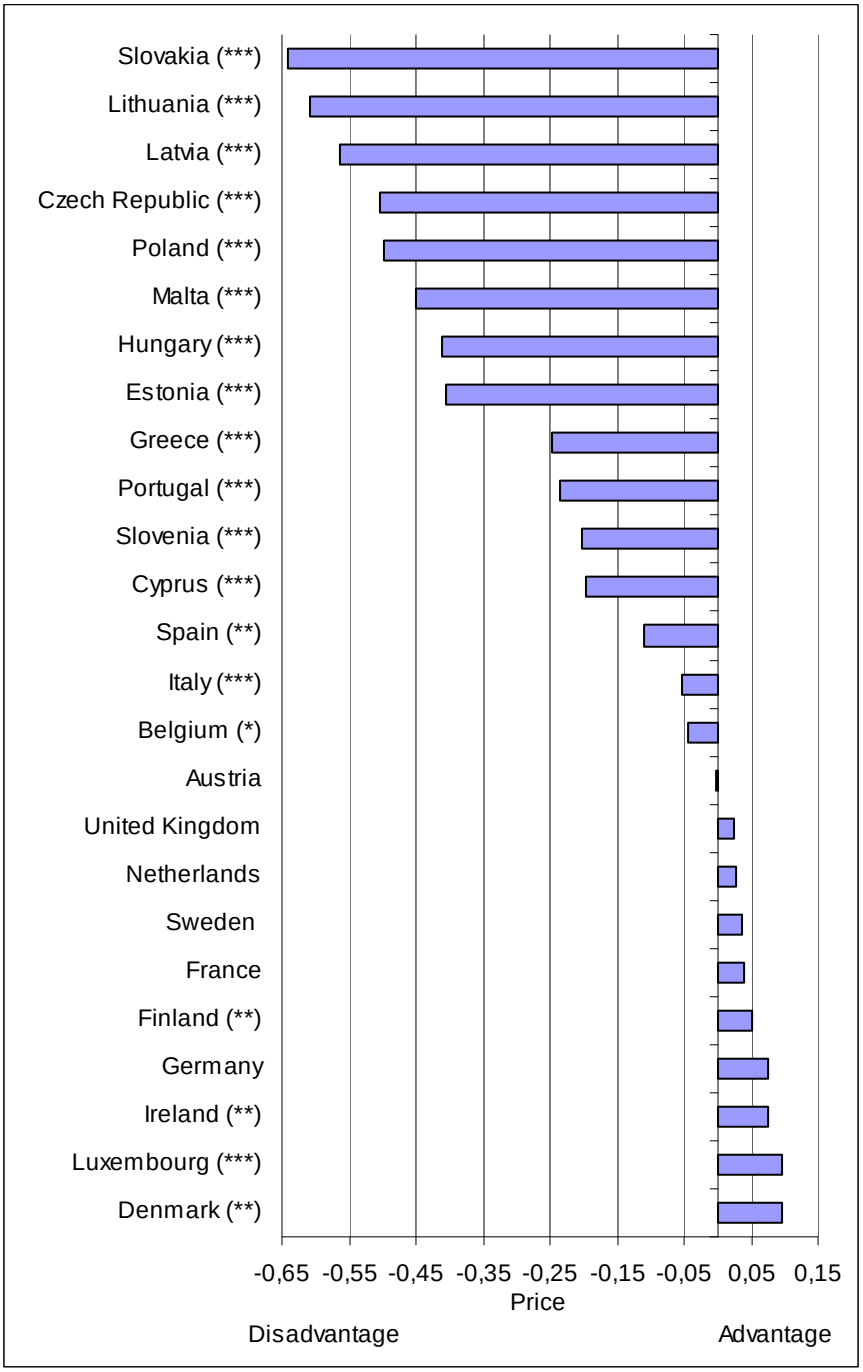
[51] "For example, if the price of a hamburger in France is 2.84 euros and in the United States it is 2.20 dollars, the PPP for hamburgers between France and the United States is 2.84 euros to 2.20 dollars or 1.29 euros to the dollar. In other words, for every dollar spent on hamburgers in the United States, 1.29 euros would have to be spent in France in order to obtain the same quantity and quality – or volume – of hamburgers. […] PPPs are still price relatives when they refer to a product group or to an aggregate. It is just that in moving up the levels of aggregation the price relatives refer to increasingly complex assortments of goods and services. Thus, if the PPP for GDP between France and the United States is 0.97 euros to the dollar, it means that 0.97 euros has to be spent in France to obtain the same volume of final goods and services that one dollar purchases in the United States. This does not imply that the baskets of goods and services purchased in both countries will be identical. The composition of the baskets will vary between countries reflecting their economic, social and cultural differences, but both baskets will, in principle, provide equivalent satisfaction or utility" (OECD/Eurostat 2006, p. 2).

[52] For 2000 to 2003 the PPPs are scaled such that the PPP for EU-15 is equal to one. For 2004 the PPPs are scaled such that the PPP for EU-25 is equal to one. All PPPs correspond to national currency in use, i.E. from 2002 the PPP of the euro zone (EUR12) correspond to the Euro.

[53] It should be noted at this point that, as was the case when demand specialisation was aggregated at sector level, it is not always possible to allocate a product to one distinct sector grouping. As the composition of national baskets of goods changes over time, some distortion of the sectoral allocation can occur in the PPP statistics.

[54] $ln\left(\frac{PPP^{\text{sector}}_{\text{Country}=i}}{PPP^{\text{all sectors}}_{\text{Country}=i}}\right) * (-1)$.

**Figure 7-2: Price advantages and disadvantages of different markets for 2004 [from the smoothed time series for the years 2000 to 2004] in the Machinery/Equipment industry**




Note: (***),(**) and (*) mean significant at 1%, 5% and 10% respectively.

Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

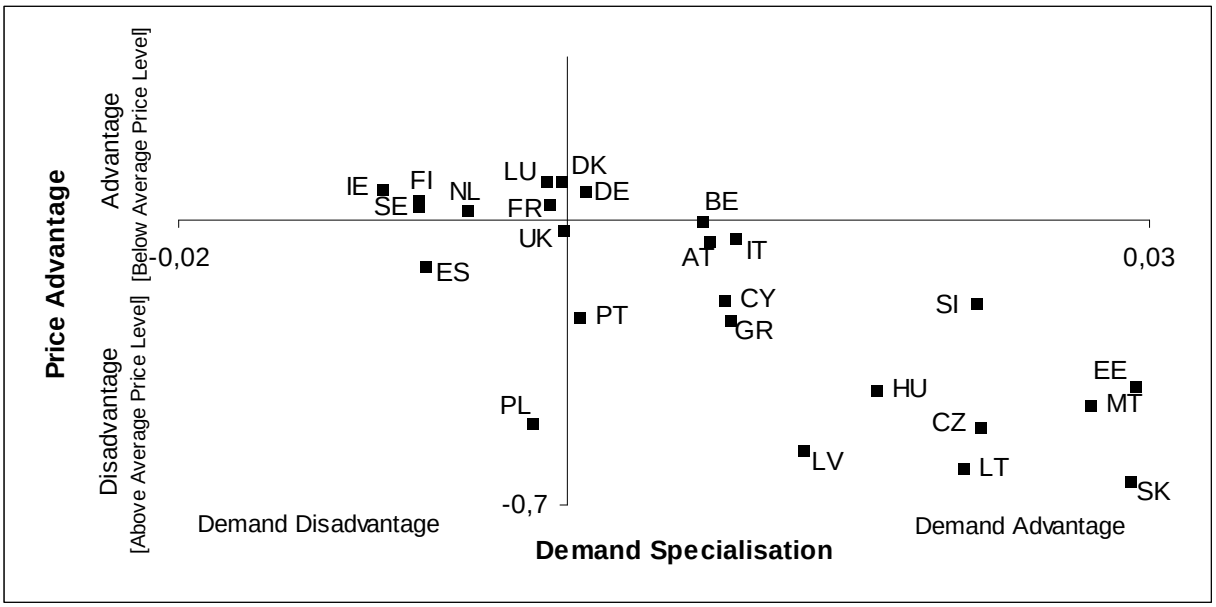
It becomes apparent that the relative prices in the Machinery/Equipment industry are higher in Eastern Europe, Portugal, Spain and Italy than in the remaining Western European countries. Comparatively low relative prices can be found in Denmark, Luxembourg, Sweden Germany and Finland.

When considering these statistics it is important to be aware that the price level is not the only indicator of a price advantage, because it is strongly influenced by company strategies

and competitive behaviour (see section 7.5). Nevertheless, a low price level and relatively high propensity to consume can be a sign of a price-dependent demand advantage. When this is the case, the demand reacts to a low price level with an above average increase in their demand for the product. In other words, the price elasticity is very high. A low price level thus makes for a clear demand advantage when it is accompanied by high demand specialisation.

In Figure 7-3, the relative PPP level is plotted against demand specialisation for all countries. The countries that are of interest to us are those located in the upper right quadrant. These are countries with both a low relative price level and a high propensity to consume. The countries in question are Germany and Belgium. The price level in these countries constitutes a Lead Market advantage. Drops in prices are met by a large increase in demand. Innovation designs that exploit this price elasticity can spread quickly and make use of market size advantages to increase their ability to compete on price. This market characteristic should spur suppliers of innovations to follow a price-cutting strategy from the outset. Innovations designed within this system of incentives should have a marketing advantage over alternative innovation designs, on the basis of price.

**Figure 7-3: Price advantages and demand specialisation in the Machinery/Equipment industry**




Source: Eurostat/OECD PPP-Statistics for 2000 to 2004.

Lead Market advantages can also exist when a low price level comes together with an average, or even slightly below-average, propensity to consume. In these markets, too, the quantity demanded is above average. However, the low price level means that demand specialisation does not appear significantly positive. In some countries, the propensity to consume remains low in spite of a relatively low price level, i.e. the relatively low prices do not lead to increased demand. This is particularly the case in France, Luxembourg and Denmark. When the opposite is true and a high price level is found with high demand specialisation, this suggests that price elasticity on the market is low. The fact that this group of goods makes up a large proportion of total demand is essentially due to the high prices,

while the propensity to consume remains comparatively low. Typical examples of this are the countries from Eastern Europe. On the whole, these markets are unfavourable for innovators.

Finally, a group of countries can be identified in which the price level is relatively high and the demand specialisation below average. In such cases, the high price level leads to a higher than average (compared with other countries) drop in demand. The high price level is a disadvantage for export-oriented innovators, as it prevents lower-cost innovation designs from coming into being. The countries Poland and Spain are faced with this problem.

Of all the Lead Market factors, the price or cost advantage seems to be the easiest to influence by means of political intervention. One form this intervention may take is the use of taxation on particular factors or goods to directly affect the price and cost structure of innovation designs. Any such tax policy should be "trend-oriented" and anticipate future cost developments at an international level. Only then will the industries in question be able to produce innovations that will also subsequently be demanded in other markets. In contrast, a policy of taxation and subsidisation that went against the international cost trend would only increase the probability of idiosyncratic innovation.

Price advantages can also be promoted by policies aimed at fostering competition, since intense competition lowers prices for end users. A final important point is the aspect of cost advantages resulting from the size of the market. In the European Union, the market is already large, so innovation policies should be able to set parameters that allow firms to make the most of the size advantage which, in principle, already exists. Such policies include preventing the home market from splitting into regional markets. One example of how this problem can arise is if approval procedures or regulations differ from one region to another.

### 7.3 Export Advantage

The key characteristic of a Lead Market is that innovations realised there will not be limited to a certain country or region, but should be well-suited for export. Vernon (1979) and particularly Dekimpe et al. (1998) find that the exportability of innovations is higher when the exporting and importing markets are more similar in cultural and economic terms. In such cases, customers only suffer a relatively small loss of utility when changing over to a "foreign" innovation design. The number of country-specific innovation designs thus falls comparatively quickly. However, exportability may not only depend on how similar markets are. The "adaptability" of an innovation to different market surroundings is also decisive for its chances on the international market. International marketing proves less complicated when certain features of the innovation design have been planned from the outset to facilitate its use in different environments without the need for any substantial changes.

The Lead Market approach is not based on the traditional view that export successes are indicators of a country's technological – or, more generally, economic – competitiveness. Instead, pronounced export activity is seen as an input factor for a country's success in innovation. A strong position in terms of exports in the past may encourage innovators to make their products suitable for international markets. This, in turn, promotes innovation designs that will be a success when exported.

Interaction with customers and demand orientation are not export factors in themselves. Only interaction with the "right" customer and the presence of the "right" market conditions

actually lead to innovations that will be taken up in the world market. Innovations driven by demand which only come into use in their home country and thus have no impact on exports are a sign of idiosyncratic demand. In this case, there is a demand preference for innovation designs that do not represent a competitive advantage in other national markets. There are a range of possible root causes of idiosyncratic demand, which may be natural (specific environmental conditions), may have come about through national legislation (regulations that are not extended to the international sphere), or may be due to an insistence on sticking to the individual national standards set by large clients (e.g. postal service, railways, electricity suppliers). On the other hand, the idiosyncratic demand may simply be a result of the consumers' or business customers' preferences being different from those in other countries.

To assess what affect demand in a particular market has on exports we can again make use of the share of aggregate national demand from Eurostat's Purchasing Power Parities (PPP) statistics, in combination with the European foreign trade statistics.[55] The two sets of statistics are based on different systems of classification, so correspondence tables must first be used to convert to the NACE nomenclature before they can be compared.

The first step is to find the extent of export success for every country. An above-average export performance shows that new products are successfully marketed internationally. The more a country succeeds in working out an export surplus within a group of homogeneous products in bilateral trade, the higher the estimated competitiveness will be (Grubel 1975). To measure competitive advantages between two countries, the ratio of export surpluses to total trade volume ($CA_{tik}$) within a product group p should therefore be applied: $CA_{tik} = \frac{x_{tik} - m_{tik}}{\left(x_{tik} + m_{tik}\right)}$.[56] The chosen indicator of competitive advantage corresponds to the objectives set out by a company when identifying potential supplier countries (Cleff 2006b). The Revealed Comparative Advantage - RCA (Balassa 1965) - applied in the tradition of economics for determining comparative advantages, is considered not to be an appropriate indicator in this case. A positive competitive advantage of a country can be hidden to some extent behind a low RCA if the ratio of exports to imports of a particular product group is indeed higher than 1, but the corresponding ratio in total trade of a country turns out to be higher. This can lead to an underestimation of the product-specific absolute competitiveness of nations that have a high overall product export surplus, and vice versa (Cleff 2006b).

The average CA of all countries that export the product in question within the different European countries is used as a reference value for export success. Countries with a smoothed product-specific CA significantly above the average for the last ten years are considered to have an above-average product-specific relative export advantage. If a country has a high

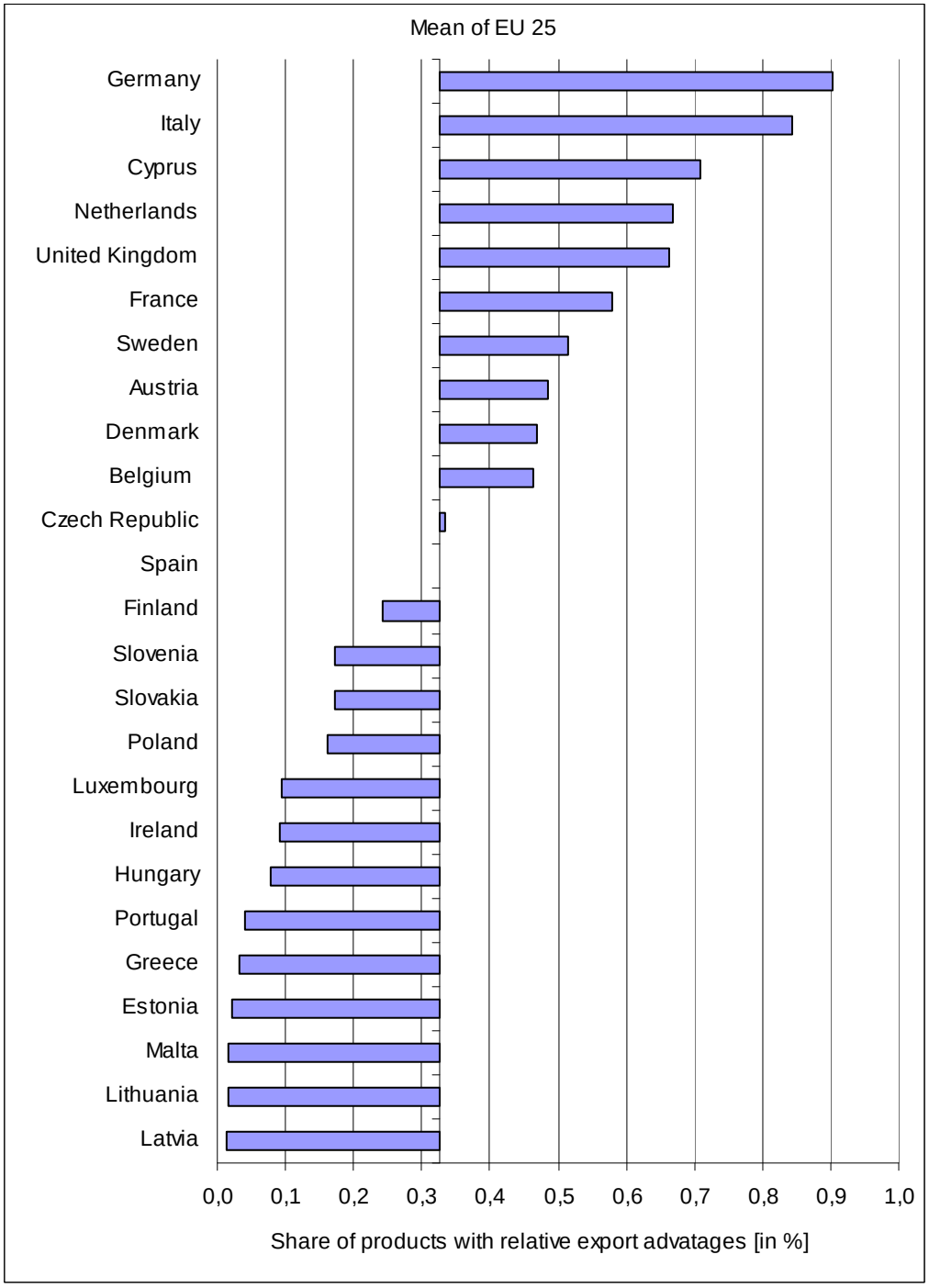
[55] The European foreign trade statistics offer data on an 8-digit-aggregational level – the Combined Nomenclature. The Combined Nomenclature is based on the 6-digit Harmonised System, which was extended by 2 digits for the European Trade Statistic. Thus the first three levels of the Harmonised System HS2, HS4 and HS6 correspond to the Combined Nomenclature, completed by a further level KN8. These data are available for the years 1988 to 2005 and in contrast to the data of the OECD, only encompass the trade of individual EU states with all other states in the world. Therefore trade flows outside of the EU, such as those between Japan and the USA, are not determined.

[56] The variable $x_{tik}$ stands for the export value from the supplier country k ($k \in \{1,..., n\}$) to the supplied countries i ($i \in \{1,..., m\}$) in a specific year t. The variable $m_{tik}$ represents the respective import value.

share of product-specific relative export advantages in a given industry, this indicates a country-specific export advantage there.

On the basis of the foreign trade statistics for the Machinery/Equipment Industry, the following diagram shows in how many product groups an above-average relative export advantage is recorded for each of the EU-25 countries.

**Figure 7-4: Share of product-specific relative export advantages in the Machinery/Equipment industry, for EU-25**




Source: ZEW: Global Sourcing Management Tool, 2007.

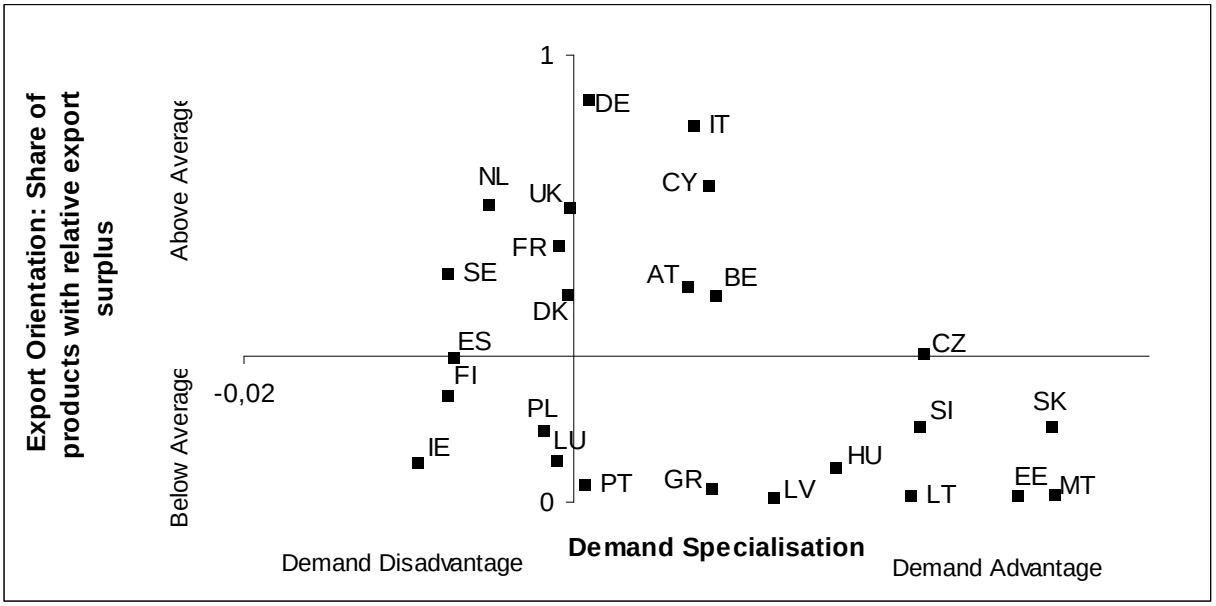
Germany, Italy, the UK, the Netherlands, France and Sweden have particularly large export advantages, with more than 50% of products of the Machinery/Equipment industry respectively proving successful abroad. Austria, Denmark, Belgium and the Czech Republic follow, although their export advantages in the industry are only slightly above average. The other countries have values well below average.

It is assumed that a Lead Market is always present when demand in a country provides innovating companies with a considerable quantitative impulse to innovate and, at the same time, the companies generate a large proportion of their turnover abroad. If quantities of product innovations exported are high and the impulse to innovate came from customers in the home market, this shows that demand at home prefers an innovation design that has the potential to succeed internationally. Conversely, it is a sign of an idiosyncratic market when companies only export a small share of their goods because they respond too much to the "eccentric" customers' wishes at the home market. In this case, customers appear to prefer product solutions that cannot be marketed internationally (idiosyncratic demand).

Therefore if a country's various export successes, measured as the share of products with above average relative export advantage, can be put down to above-average customer demand, this is a sign that the country has a particular Lead Market characteristic. This is because domestic demand that translates into success on the export market is a typical characteristic of a Lead Market.

Figure 7-5 shows the extent of demand advantage against the size of the export advantage for the Machinery/Equipment industry in the form of a portfolio. In the upper right quadrant of the portfolio are countries that develop technologies driven by demand and at the same time exploit the lead-market properties of home demand for successful exports (Lead Market sectors). The home markets in these countries – Germany, Italy, Cyprus, Belgium and Austria - offer particularly favourable conditions for the launch and testing of new products, with the aim of successfully marketing the innovation designs tested at home in other countries.

**Figure 7-5: Lead Market Matrix in the Machinery/Equipment industry: classification according to export orientation and utilisation of home market demand**




Source: ZEW: Global Sourcing Management Tool, 2007 and Eurostat/OECD PPP-Statistics for 2000 to 2004.

Exportable innovations may also originate from sources other than the home market. Innovating companies that are highly export-oriented but do not, to any great extent, rely on home demand as a source of innovation can be categorised into three different types. In the first type, the drive behind innovations that are suited to the world market comes from the company's own R&D or technological know-how purchased externally (e.g. from technology suppliers or academic research).

The second possibility is to base new products on the innovations of foreign competitors, i.e. imitation. The third category comprises firms that are driven to innovate by demand from abroad. This could indicate that the home market is a successful lag market. In this case, home companies may not be leaders in launching product innovations that have international staying-power, but they are good at quickly picking up on new trends from abroad then converting these into export success. For simplicity, we shall denote all of these effects as "technological impulses to export". The upper left quadrant in the diagram above contains the countries Sweden, the Netherlands, France and Great Britain, which primarily bring out innovations driven by technology and then translate these into export success.

Finally, if product innovators have little export success and home demand plays no meaningful role as a source of innovation, companies focus on technology specific to the home market. In this case, innovators concentrate on product innovations based of their own R&D or external sources of knowledge, but which do not provide solutions suitable for export. We can speak of idiosyncratic technology in this context. In the diagrams above, the countries in the lower left quadrant - in particular Finland, Ireland, Poland and Luxembourg - belong to this group of markets.

The most problematic area from an innovation strategy perspective is surely the lower right quadrant. The difficulty is that these countries are largely dependent on demand to drive their innovation activities, yet the demand on their home market is idiosyncratic. The home market acts as an obstacle to export activities, since catering for home demand makes for innovations that are difficult to sell in other countries. The Eastern European Countries, Greece and Portugal are notable examples of countries with such markets.

If innovation policy is to be efficient from this point of view, it must adapt the incentives it offers to focus more strongly on exports. This applies in particular to technology development projects that receive government subsidies. The potential exportability of the technology could be included as a criterion for subsidisation. Politicians can also support international and flexible Lead Market strategies by not insisting on national solutions, but instead taking experiences from potential Lead Markets into account, for example when approving products and formulating regulations for specific markets. The legislature, too, can influence export orientation, by taking note of international trends and thus preventing infrastructure for science and technology (educational institutions, research establishments, standards agencies etc.) from becoming idiosyncratic.

### 7.4 Transfer Advantage

The concept of transfer advantage covers a range of "classic" diffusion factors. The decision to adopt a particular innovation design in a country is often dependent on which technology has already been adopted in the Lead Market and on the experiences gained

during its introduction there. The demonstration effect when the innovation is adopted increases the incentive for users in other countries to adopt the same innovation design, firstly because of the information that is available about the innovation and its use and secondly because of the decreased risk, i.e. reduced uncertainty as to whether the new product or process is reliable. If a product is successfully tried out in the Lead Market, it makes sense to adopt it in other markets too (Kalish et al., 1995). In this case, the Lead Market takes on the role of a test or reference market and is closely observed by agents in other markets. The Lead Market serves as an example for the evaluation of problems and dangers in the introduction of the new technology, thereby reducing uncertainty. More importantly still, the utility of the Lead Market customers affects customers beyond the boundaries of the market.

A country's market therefore has a transfer advantage if it raises the perceived utility of customers on other markets as well as those at home. The reputation and high level of development of the Lead Market's users is considered to be a hallmark for high-quality innovation designs. The quality of demand is especially determined by user's know-how and experience with similar products. For example, the markets in countries which often feature in the mass media and television series are potentially Lead Markets for lifestyle products. In a similar way, smaller markets can also bring out products that are competitive worldwide (Beise et al., 2002).

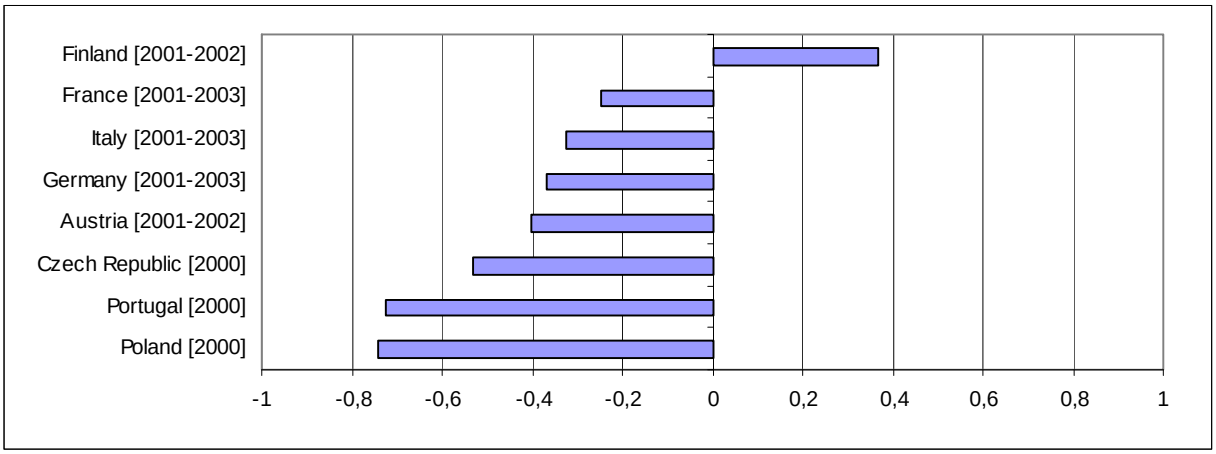
Transfer advantage is difficult to quantify, as analyses related to innovation projects have shown (Beise/Cleff, 2003). Since the differences between countries are less pronounced at the industry level than when it comes to individual products, it is almost impossible to find general indicators for the industry level.

Cleff (2006b) used the amount of foreign direct investment (FDI) as a proxy for the potential international diffusion of innovations. One benefit of foreign subsidiaries is that they provide companies with information about the particular nature of demand in a country. Another advantage for companies with subsidiaries in several countries comes in the form of economies of scale. This means that the company can launch a single innovation design internationally, even if the design itself is not optimally suited to the conditions in one of the local markets. This means, for example, that companies may use the same software, the same component assemblies and the same machines in all markets, even though the relative factor prices differ from country to country. Since it is assumed that the parent company is generally the first to make use of innovations or generally makes the decisions about which innovation design to pursue, countries that engage in a large amount of FDI have a transfer advantage.

Unfortunately, data on the quantity of FDI by industry, which would enable a cross-country comparison for the Machinery/Equipment industry, are only available for eight of the EU-25 countries. The data come from the "United Nations Conference on Trade and Development (UNCTAD)" or Eurostat publications. If we compare the total value of FDI for the specific industries with the help of a measure of specialisation,[57] rather than the number of investments made, we come to the results shown in the figure below.

[57] The measure of specialisation is calculated by taking the quotient of (1) the industry-specific total stock of FDI by home companies abroad divided by the respective total of FDI by foreign companies in the home market and (2) the overall total of FDI by home companies abroad divided by the respective total of FDI by foreign companies in the home market. To attain a

**Figure 7-6: Specialisation of FDI in the Machinery/Equipment industry (Average for the given years)**




Source: United Nations Conference on Trade and Development (UNCTAD) 2007.

If the proportion of investment abroad is above average, the resulting value is positive. Otherwise the value returned is negative. It becomes apparent that the Machinery/Equipment industry in Finland specialises in FDI more than is average, while the other countries have below-average values.

Countries that succeed in propagating their international standards in innovation design are best placed to realise a transfer advantage. Transfer advantage is the Lead Market factor to which most attention is paid in innovation policy. It is common for government funding for innovations to aim to promote the demonstration effect in the diffusion of innovations (e.g. through application centres designed to give businesses the chance to experience new process technologies). This can be a particularly decisive factor for the international diffusion of a technology if there is a large amount of uncertainty about how readily it can be implemented in practice and how efficient it is in economic terms. However, there is a considerable risk that idiosyncratic technologies will be subsidised, particularly in lag market industries. The degree of openness of a standard should therefore be used as a criterion to determine whether a technology is eligible to receive government subsidies. Equally, increased bargaining power for European politicians and companies in international standardisation committees can help to improve the transfer advantage.

## 7.5 Market Structure Advantage

From empirical studies about successful innovation designs from the Lead Market (Beise, 2001), a notable characteristic of these markets is particularly strong competition. The realisation that international innovation success is correlated with the intensity of competition

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final value between -1 and +1, we take the hyperbolic tangent of the quotient then subtract one:

$$hyptan\left(\frac{DI^{\text{sector}}_{\text{home to foreign market}}}{DI^{\text{sector}}_{\text{foreign to homemarket}}} \Big/ \frac{DI^{\text{overall country}}_{\text{home to foreign market}}}{DI^{\text{overall country}}_{\text{foreign to homemarket}}}\right) - 1 .$$

may not be new (cf. Posner, 1961 and Dosi et al., 1990), but Porter (1990) was the first to find a conceptual link to a cause, namely that customers in very competitive markets can be "choosier" than in oligopolies or monopolies. Faced with strong competition, innovators are compelled to react increasingly to technological development (Mansfield, 1968, p. 144). The resulting competition between very different innovation designs often leads to a refined innovation that best fits customers' needs. This innovation design, which offers maximum utility to customers thanks to the competition on the national market, also has the best chances of winning through in international competition. Competition can therefore be understood as a process of decentralised coordination, by which all the participants attempt to achieve a better innovation design, so that the final design will also have a better chance of succeeding in international markets.

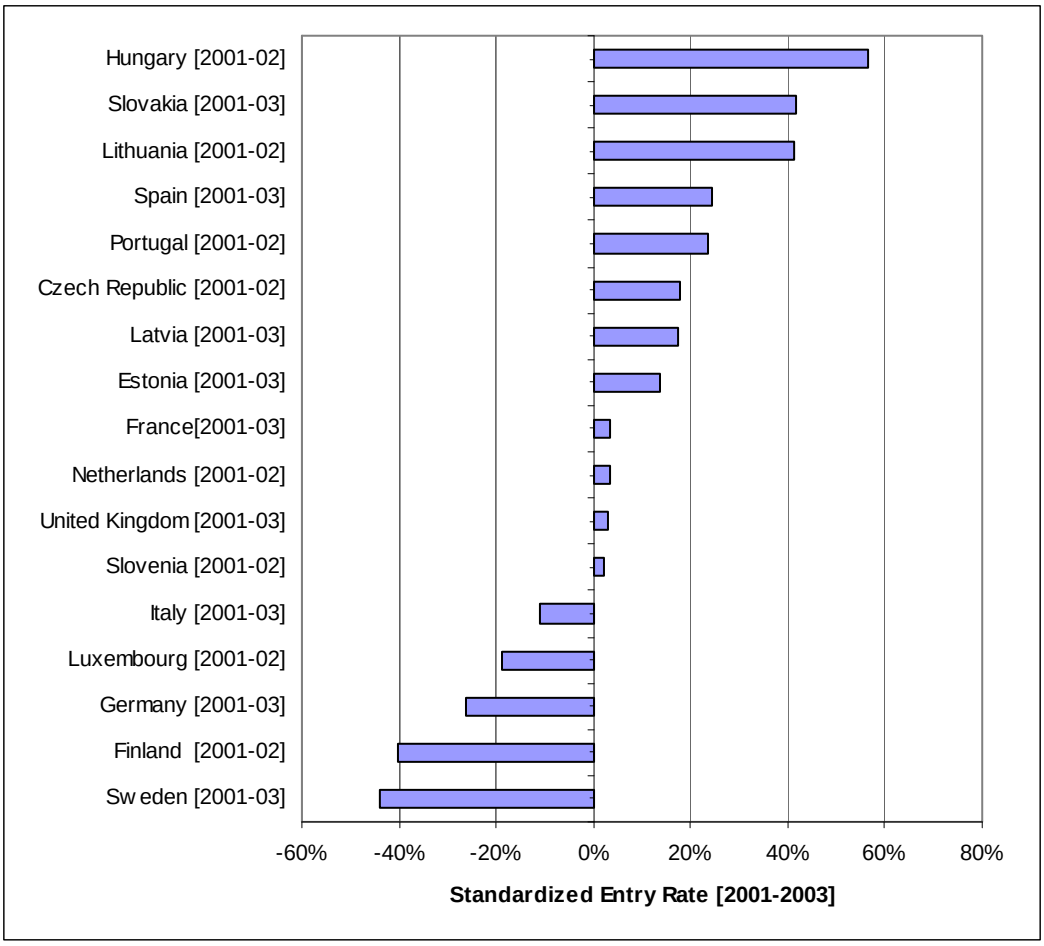
There are a range of known measurement concepts that could be used to establish the intensity of competition. Putting such concepts into practice often proves impossible, however, because of a lack of internationally comparable figures.[58] Using the fact that markets with different degrees of concentration establish their prices differently, an approximation can be found for the intensity of competition on a market. Monopolists set their prices to maximise profits without being subjected to pricing pressure from competitors. In a market with perfect competition, firms theoretically adjust their supply to fit the market price. In this case, the price level is lower than that in a monopoly. Taking this relationship as a starting-point, we can assume under certain conditions – namely that we are dealing with homogeneous goods/services – that the price level on a market decreases with increasingly intense competition. The price level can thus be taken as an indirect indicator of competition on a market. As a cautionary reminder at this stage, it should be noted that the price level has already been used to illustrate the aspect of price advantage, as a relatively low price level is conducive to Lead Market advantages, which arise from the increased inclination to adopt an innovation and its quicker diffusion, in international comparison (cf. section 7.2). Since a low price level is always a positive aspect of demand structure, either as an indicator of prices or of competition, the ultimate result is unaffected by which Lead Market factor the indicator is allocated to. The same indicators can therefore be used to show advantages in price and market structure. This also suggests that although these two Lead Market characteristics can be separated in theory, it is not necessarily possible in practice. The results from section 7.2 should therefore be taken into account.

Furthermore, it is possible to show the intensity of competition on a market by referring to the occurrence of barriers to entry, because the formation of new firms not only promotes innovation but intensifies competition in their markets (Gerolski, 1991). "Especially for upcoming technologies and when new product markets develop, divergent innovation designs compete with each other. Start-ups are likely to bring in new solutions and challenge

[58] In traditional industrial economics, the intensity of competition can be measured using a range of parameters of concentration (e.g. a company's turnover as a share of market volume). Commonly-used parameters are the concentration ratio, the Gini coefficient and the Herfindahl-Hirschman Index. Since these require all the shares of a particular characteristic to be precisely allocated to individual subjects or objects, the two indicators can only be used if the available data is sufficiently detailed. Even in national statistics from large countries, this is rarely the case. Experience has shown that such data are most likely to be available on oligopolistic markets that have large companies which are therefore obliged to publish their sales figures. On the other hand, the concentration ratio, CRx, only uses the market share of the x-largest market player to determine market concentration and, as such, is an accommodating method when data is limited. However, even for this method, there is a severe shortage of internationally comparable data.

established companies that enter these new markets, too" (Rammer, 2006). The logarithmic quotient of a sector's average[59] market entry rate of new firms in a given country and the respective entry rate in the EU is an indirect measure to compare the sector-specific competition in different countries.[60] A negative (positive) log-value for a country means that the entry rate –and thus also competition on that market - is below (above) the average for the EU countries.

**Figure 7-7: Standardized Entry Rate in the Machinery/Equipment industry (Nace 29)**




Source: Eurostat and ZEW Foundation Panel (for Germany).

In the Machinery/Equipment industry, relatively concentrated markets with comparatively weak competition are to be found in particular in Sweden, Finland, Germany, Luxembourg and Italy. Competition in Hungary, Slovakia, Lithuania, Spain and Portugal on the other hand, is well above the European average.

It should be noted at this point that there is a clear division between fostering market structures that stimulate innovation and promoting "national champions" to increase international competitiveness. The Lead Market approach is not based on targeting and

[59] The Means were calculated for the entry rates given in Figure 7-7.

[60] $ln\left(\frac{\text{Entry Rate}^{\text{sector}}_{\text{Country}=i}}{\text{Entry Rate}^{\text{sector}}_{\text{all EU-Countries}}}\right)$.

strengthening individual actors, but instead on strengthening competition between all actors. The idea is that confronting innovators with free competition on the market at an early stage is a more effective way of increasing international competitiveness than offering protection from competition in the hope of building up a strong national position. From a technology policy point of view, this means focussing on measures that guarantee favourable conditions for the development of successful innovation designs. It is particularly important to ensure that (international) competition is enforced in industries in which the home country has few structural advantages. This can be achieved by implementing legal measures to prevent cartels, promoting start-ups, supporting newer technology companies and breaking down non-tariff barriers to international trade.

## 7.6 Conclusions

In the above sections we investigated the influence of demand on the innovation capability and competitiveness of the Machinery/Equipment industry in each of the EU-25 countries. Although demand is one of the decisive factors for the development of innovations, it has hardly been integrated in analyses of research and technology policy to date. The Lead Market approach brings market demand into the discussion, with the result that innovations can no longer be understood as purely supply-oriented and pre-competitive.

To evaluate the role demand and market structures play in the creation of innovations with international potential, country-specific properties – the so-called Lead Market factors - are derived. These help to explain a country's Lead Market potential in a given industry. If these factors are particularly favourable in a certain industry, the chances that innovations favoured by the national market will meet with high demand abroad are likely to be increased. Findings about the Lead Market potential of different markets must have an influence on the formation of business and political strategies for innovation. Furthermore, the findings could constitute a starting-point for the formation of innovation strategies in firms and for more efficient innovation policies. For these reasons, an attempt was made to determine the Lead Market potential of the EU-25 countries in the Machinery/Equipment industry on the basis of quantitative indicators. The following table summarises these results once more.

**Table 7-1: Lead Market potential of the EU-25 countries in the Machinery/Equipment industry**

| Country | Advantage | | | | |
|---|---|---|---|---|---|
| | Price [PPP Statistics] | Demand [PPP Statistics] | Export [Trade Statistics] | Transfer [FDI] | Market Structure [Entry Rate] |
| Austria | - | | + | - | NA |
| Belgium | - | + | + | NA | NA |
| Cyprus | - | + | + | NA | NA |
| Czech Republic | - | + | + | - | + |
| Denmark | + | - | + | NA | NA |
| Estonia | - | + | - | NA | N+ |
| Finland | + | - | - | + | - |
| France | + | - | + | - | + |
| Germany | + | + | + | - | - |
| Greece | - | + | - | NA | NA |
| Hungary | - | + | - | NA | + |
| Ireland | + | + | - | NA | NA |
| Italy | - | - | + | - | - |
| Latvia | - | + | - | NA | + |
| Lithuania | - | + | - | NA | + |
| Luxembourg | + | - | - | NA | - |
| Malta | - | + | - | NA | NA |
| Netherlands | + | - | + | NA | + |
| Poland | - | - | - | - | NA |
| Portugal | - | + | - | - | + |
| Slovakia | - | + | - | NA | + |
| Slovenia | - | + | - | NA | + |
| Spain | - | - | - | NA | + |
| Sweden | + | - | + | NA | - |
| United Kingdom | + | - | + | NA | + |

Note: +: above average advantage; -: below average advantage; NA: Not Available

# 8 Implications for innovation

## 8.1 Implications for innovation strategy

In innovation strategies based on the lead market approach, market research on the lead market – not necessarily the home market - takes centre stage when product innovations are in the development phase. In countries that do not have sufficient lead market attributes, product innovations must be targeted to fit the preferences of users in the lead market. At the same time, it is vital to take account of factor prices and how they will develop, as well as the cost of the infrastructure used. Furthermore, an analysis of the lead market must be carried out to find out what complementary products exist, what innovation designs competitors have come up with and what laws and regulations are in force. All of these parameters influence new product development. The observation of the lead market can take on varying degrees of intensity. These range from simply making use of listening posts in the lead market to testing and/or launching new products there.

All too often, companies lack the capacity to conduct such activities. If this is the case, there are a number of other possible strategies to ensure that adequate attention is paid to the lead market:

- Developing a new innovation at home but taking account of information about the specific conditions on the lead market.
- Developing dual-use innovations, which satisfy demand both on the lead market and at home.
- Avoiding technological designs that would be atypical on the lead market when developing an innovation for the home market.

A good way for a company to establish links with a lead market is via cooperation partners, particularly when the company has not yet built up any resources or accumulated any experience on the market. Compared to establishing a subsidiary in a potential lead market, cooperation with an existing company has the advantage that such a company already has longstanding relationships with customers and, as such, can offer considerable insight into conditions on the lead market. This is of particular significance during the market launch, since that is when the most important information for the further development of the product comes to light. Furthermore, cooperations cost less than building up a subsidiary and thus involve less entrepreneurial risk.

## 8.2 Implications for innovation policy

A country can seek to improve its lead market position by strengthening its lead market factors and dealing with any disadvantageous characteristics the market may have. Of the five lead market factors, only few are of an "inherent" nature and thus cannot be changed. Most of the factors can be influenced by political measures (cf. Beise et al., 2002). When formulating innovation policy or deciding on what basis to award subsides in a particular industry, more emphasis should be placed on the situation in the relevant lead market. Several factors can make a great difference in this case: Does demand in a country promote innovation on the part

of the companies there in a way that strengthens these companies' position in international competition (i.e. they can play a lead market role)? Is demand at home following a unique path of its own (i.e. the home market is idiosyncratic)? Or are innovations not driven by demand at all, but instead by technology? For the lead markets identified within the scope of this paper, the need for political action is limited to securing these lead market properties:

- Forcing or protecting competition at home (including the promotion of start-ups, especially in the fast-changing field of cutting-edge technologies). This does not, however, mean dissolving natural monopolies (e.g. rail networks, etc.) to create competitive markets, as doing so would be disadvantageous for the local infrastructure.
- Dismantling regulatory frameworks which prescribe technological solutions that are too narrowly defined.
- Supporting companies' efforts to internationalise (making direct investment easier, breaking down barriers to trade, unifying international standards).

Lag markets are characterised by the fact that they take up innovations that have proved successful in other countries. This is not necessarily because there is no desire to innovate on the home market. Companies in lead markets would often like to adopt certain (national) innovation designs, but the advantages of doing so are outweighed by those of using an innovation design from abroad. Examples of when this can occur are when the home market is small or when there is a high degree of uncertainty about the reliability of the home innovation design. It is often not possible to influence these mechanisms on a lag market in a decisive manner by means of policy. For example, we can hardly expect that any European country will overtake America as a lead market for computers. If this is so, innovation policies should abandon subsidising local technologies in favour of promoting instruments that make it easier to take over designs from the lead market. This will serve to prevent the production of idiosyncratic innovations, which would later be crowded out by the lead market design worldwide.

It is advisable to make internationally-oriented innovation policies, to make use of the cost advantages of new technologies quickly. Such policies could include supporting small and medium-sized enterprises in their efforts to adopt technologies or in their applied research, provided it is targeted at finding new solutions within the scope of the dominant innovation design. Fast diffusion also creates opportunities to develop the dominant design further, either with a view to occupying new niches in the market, or in order to offer complementary products and services and win market share from lead market companies. Countries that are "fast followers" can often attain a high share of the world market, because they are able to learn from the pioneers but do not bear the same development costs.

However, any strategy of being a "fast follower" should also be lead-market oriented. To this end, it is advisable for firms to have some direct, on-the-spot presence, enabling them to receive signals from customers and further develop products. The information disadvantage for lag market companies can also be redressed by means of cooperation with firms from the lead market. Schemes to promote research should also be open to such international cooperation projects.

Idiosyncratic markets, on the other hand, are characterised by the adoption of a national innovation design, which competes unsuccessfully with other innovation designs, limiting the

industry's export potential. The challenge for innovation policy here is to combat idiosyncratic demand structures. Possible ways of doing this are to relax national regulations or adapt them to better fit with lead markets, internationalise technical norms and pluralize government and monopolistic demand by opening the relevant markets. Politicians involved in such processes should, however, be aware that implementing such fundamental structural changes to the basic functioning of a sector's innovation system is a difficult process which requires long-term commitment.

It should also be stressed once more at this juncture that the lead market concept by no means claims to be the single valid model to explain the international success of innovations. Instead, the aim is to include the distinctive features of demand on a given market in discussions of innovation policy, as an additional explanatory factor. The sense of taking the lead market concept into consideration in innovation policy is therefore not to oppose the approaches followed up to now by means of a polarising model, but to refine the traditional instruments used in subsidisation and regulatory policy.

***Promoting research:***

- Key research areas to be promoted should above all be defined on the basis of an analysis of global trends.
- Since competition between different innovation designs improves the international competitiveness of innovations, policies aiming to promote research should focus less on laying down technical specifications and more on setting policy targets for innovation.
- The same can be said about the lack of (lead) market analysis in the context of programmes to promote technology. Such analyses provide information about the countries that offer the best prospects for the introduction of new technologies and product innovations. This information is necessary to tailor technology to these markets as early as in the development stage.
- In order to incorporate demand pull from lead markets directly in technological development and quickly utilise the experiences of users in the lead market, a consistent approach must be taken to enable partners from lead markets to expand their "competence networks".

***Regulatory policy***

- To enable competition between different innovation designs, regulatory policy, too, must bring its goal closer in line with the lead market approach. In the field of technology regulation, the past emphasis on setting technical or process-related targets must be shifted towards setting performance targets. In other words, laying down threshold values is more important than determining the means with which these thresholds are to be reached.
- The targets set should increasingly apply throughout Europe. Only then can the size advantages of the European market unfold.
- If European standards cannot be spread worldwide, the result is necessarily idiosyncratic markets. This problem can only be overcome if politicians and actors on the relevant markets are prepared to demonstrate more courage in taking on international standards from the lead market.

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# 10 Appendix

**Table 10-1: Correspondence table between NACE code and Basic Heading**

| NACE | Basic Heading |
|---|---|
| 15 | 1101121; 1101122; 1101123; 1101124; 1101125; 1101126; 1101127; 1101131; 1101132; 1101133; 1101161; 1101162; 1101163; 1101172; 1101223; 1101171; 1101173; 1101174; 1101175; 1101182; 1101142;1101143; 1101144; 1101151; 1101152; 1101153; 1101184; 1101191; 1101112; 1101113; 1101173; 1101183; 1101213; 1101115; 1101211; 1101212; 1102111; 1102121; 1102122; 1102131; 1101221; 1101222 |
| 16 | 1102211; 1102212; |
| 17 | 1103111; 1105211; 1105221 |
| 23 | 1107221 |
| 24 | 1102311; 1106111; 1106121; 1302111; 1302112; 1302113; 1302221; 1302222; 1302223; 1106314; 1106315; 1106132; 1105611 |
| 29 | 1501122; 1501121; 1501131; 1501133; 1501134; 1501135; 1501136; 1105413; 1105511; 1105521; 1105522; 1105612; 1105311; 1105312; 1105313; 1105314; 1105315; 1105321; 1112121; 1112131 |
| 30 | 1501141; 1109131; 1501142 |
| 32 | 1108211; 1109111; 1109112; 1501144; |
| 33 | 1106131; 1109121; 1501145 |
| 34 | 1107111; 1107112; 1107113; 1107114; 1107115; 1107141; 1501212; 1501211; 1107211; |
| 35 | 1501221; 1501222; 1501223; 1107121; 1107131 |
| 40 | 1104511; 1104521; 1104522; 1104531; 1104541; 1104551 |
| 72 | 1503121; 1109151 |

Source: ZEW.

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| 00-08 | Helmut Schröder Thomas Zwick | Identifizierung neuer oder zu modernisierender, dienstleistungsbezogener Ausbildungsberufe und deren Qualifikationsanforderungen |
| | | Band 1: Gesundheitswesen; Botanische/Zoologische Gärten/Naturparks; Sport |
| | | Band 2: Werbung; Neue Medien; Fernmeldedienste; Datenverarbeitung und Datenbanken |
| | | Band 3: Technische Untersuchung und Beratung; Architektur- und Ingenieurbüros; Unternehmens- und Public-Relations-Beratung |
| | | Band 4: Verwaltung von Grundstücken, Gebäuden und Wohnungen; Mit dem Kredit- und Versicherungsgewerbe verbundene Tätigkeiten; Wirtschaftsprüfung und Steuerberatung; Messewirtschaft |
| | | Band 5: Vermietung beweglicher Sachen ohne Bedienungspersonal; Gewerbsmäßige Vermittlung und Überlassung von Arbeitskräften; Personen- und Objektschutzdienste; Verkehrsvermittlung; Reiseveranstalter und Fremdenführer |
| 00-09 | Wolfgang Franz, Martin Gutzeit, Jan Lessner, Walter A. Oechsler, Friedhelm Pfeiffer, Lars Reichmann, Volker Rieble, Jochen Roll | Flexibilisierung der Arbeitsentgelte und Beschäftigungseffekte. Ergebnisse einer Unternehmensbefragung. |

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| 00-10 | Norbert Janz | Quellen für Innovationen: Analyse der ZEW-Innovationserhebungen 1999 im Verarbeitenden Gewerbe und im Dienstleistungssektor. |
| 00-11 | Matthias Krey, Sigurd Weinreich | Internalisierung externer Klimakosten im Pkw-Verkehr in Deutschland. |
| 00-12 | Karl Ludwig Brockmannn<br>Christoph Böhringer<br>Marcus Stronzik | Flexible Instrumente in der deutschen Klimapolitik – Chancen und Risiken. |
| 00-13 | Marcus Stronzik, Birgit Dette,<br>Anke Herold | „Early Crediting“ als klimapolitisches Instrument. Eine ökonomische und rechtliche Analyse. |
| 00-14 | Dirk Czarnitzki,<br>Christian Rammer<br>Alfred Spielkamp | Interaktion zwischen Wissenschaft und Wirtschaft in Deutschland. Ergebnisse einer Umfrage bei Hochschulen und öffentlichen Forschungseinrichtungen. |
| 00-15 | Dirk Czarnitzki, Jürgen Egeln<br>Thomas Eckert, Christina Elschner | Internetangebote zum Wissens- und Technologietransfer in Deutschland. Bestandsaufnahme, Funktionalität und Alternativen. |
| 01-01 | Matthias Almus, Susanne Prantl,<br>Josef Brüderl, Konrad Stahl,<br>Michael Woywode | Die ZEW-Gründerstudie – Konzeption und Erhebung. |
| 01-02 | Charlotte Lauer | Educational Attainment: A French-German Comparison. |
| 01-03 | Martin Gutzeit<br>Hermann Reichold<br>Volker Rieble | Entgeltflexibilisierung aus juristischer Sicht. Juristische Beiträge des interdisziplinären Symposiums „Flexibilisierung des Arbeitsentgelts aus ökonomischer und juristischer Sicht“ am 25. und 26. Januar 2001 in Mannheim. |
| 02-01 | Dirk Engel, Helmut Fryges | Aufbereitung und Angebot der ZEW Gründungsindikatoren. |
| 02-02 | Marian Beise, Thomas Cleff,<br>Oliver Heneric,<br>Christian Rammer | Lead Markt Deutschland. Zur Position Deutschlands als führender Absatzmarkt für Innovationen. Thematische Schwerpunktstudie im Rahmen der Berichterstattung zur Technologischen Leistungsfähigkeit im Auftrag des bmb+f (Endbericht). |
| 02-03 | Sandra Gottschalk, Norbert Janz,<br>Bettina Peters, Christian Rammer,<br>Tobias Schmidt | Innovationsverhalten der deutschen Wirtschaft: Hintergrundbericht zur Innovationserhebung 2001. |
| 03-01 | Otto H. Jacobs, Ulrich Schreiber,<br>Christoph Spengel,<br>Gerd Gutekunst, Lothar Lammersen | Stellungnahme zum Steuervergünstigungsabbaugesetz und zu weiteren steuerlichen Maßnahmen. |
| 03-02 | Jürgen Egeln, Sandra Gottschalk,<br>Christian Rammer, Alfred Spielkamp | Spinoff-Gründungen aus der öffentlichen Forschung in Deutschland. |
| 03-03 | Jürgen Egeln, Thomas Eckert<br>Heinz Griesbach, Christoph Heine<br>Ulrich Heublein, Christian Kerst,<br>Michael Leszczensky, Elke Middendorf,<br>Karl-Heinz Minks, Brigitta Weitz | Indikatoren zur Ausbildung im Hochschulbereich. Studie zum Innovationssystem Deutschlands. |
| 03-04 | Jürgen Egeln, Sandra Gottschalk,<br>Christian Rammer, Alfred Spielkamp | Public Research Spin-offs in Germany. |
| 03-05 | Denis Beninger | Emploi et social en France: Description et évaluation. |
| 03-06 | Peter Jacobebbinghaus,<br>Viktor Steiner | Dokumentation des Steuer-Transfer-Mikrosimulationsmodells STSM. |
| 03-07 | Andreas Ammermüller,<br>Bernhard Boockmann,<br>Alfred Garloff, Anja Kuckulenz,<br>Alexander Spermann | Die ZEW-Erhebung bei Zeitarbeitsbetrieben. Dokumentation der Umfrage und Ergebnisse von Analysen. |
| 03-08 | David Lahl<br>Peter Westerheide | Auswirkungen der Besteuerung von Kapitaleinkünften und Veräußerungsgewinnen auf Vermögensbildung und Finanzmärkte – Status quo und Reformoptionen. |
| 03-09 | Margit A. Vanberg | Die ZEW/Creditreform Konjunkturumfrage bei Dienstleistern der Informations-gesellschaft. Dokumentation der Umfrage und Einführung des ZEW-Indikators der Dienstleister der Informationsgesellschaft. |
| 04-01 | Katrin Schleife | Dokumentation der Ruhestandsregelungen in verschiedenen Ländern. |
| 04-02 | Jürgen Egeln, Thomas Eckert,<br>Christoph Heine, Christian Kerst,<br>Birgitta Weitz | Indikatoren zur Ausbildung im Hochschulbereich. |
| 05-01 | Jürgen Egeln<br>Christoph Heine | Indikatoren zur Ausbildung im Hochschulbereich. |
| 05-02 | Margit Kraus<br>Dan Stegarescu | Non-Profit-Organisationen in Deutschland. Ansatzpunkte für eine Reform des Wohlfahrtsstaats. |
| 06-01 | Michael Gebel | Monitoring und Benchmarking bei arbeitsmarktpolitischen Maßnahmen. |
| 06-02 | Christoph Heine, Jürgen Egeln,<br>Christian Kerst, Elisabeth Müller,<br>Sang-Min Park | Bestimmungsgründe für die Wahl von ingenieur- und naturwissenschaftlichen Studiengängen. Ausgewählte Ergebnisse einer Schwerpunktstudie im Rahmen der Berichterstattung zur technologischen Leistungsfähigkeit Deutschlands. |
| 06-03 | Christian Rammer, Jörg Ohmstedt,<br>Hanna Binz, Oliver Heneric | Unternehmensgründungen in der Biotechnologie in Deutschland 1991 bis 2004. |
| 06-04 | Alfred Spielkamp<br>Christian Rammer | Balanceakt Innovation. Erfolgsfaktoren im Innovationsmanagement kleiner und mittlerer Unternehmen. |

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| 06-05 | ZEW: Thies Büttner, Thomas Cleff, Jürgen Egeln, Georg Licht, Georg Metzger, Michael Oberesch, Christian Rammer<br>DIW: Heike Belitz, Dietmar Edler, Hella Engerer, Ingo Geishecker, Mechthild Schrooten, Harald Trabold, Axel Werwatz, Christian Wey | Innovationsbarrieren und internationale Standortmobilität. Eine Studie im Auftrag der IG BCE, Chemieverbände Rheinland-Pfalz und der BASF Aktiengesellschaft. |
| 07-01 | Christoph Grimpe | Der ZEW-ZEPHYR M&A-Index – Konzeption und Berechnung eines Barometers für weltweite Fusions- und Akquisitionstätigkeit |
| 07-02 | Thomas Cleff, Christoph Grimpe, Christian Rammer | The Role of Demand in Innovation – A Lead Market Analysis for High-tech Industries in the EU-25 |