ANALYSIS OF KNOWLEDGE-BASED COMPETITIVENESS AND ITS POLICY IMPLICATIONS

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Abstract:

The paper presents new and comprehensive analytical approach allowing for assessment of country competitiveness and its policy implications. Competitive advantage of EU members is analyzed in terms of matrix and diamond to identify policy appropriateness with regard to the achieved development of country competitiveness. Matrix specifies competitive advantage as low-cost/price based vs. innovation based, and innovation capacity as based on external vs. internal technology knowledge. Country positions in the matrix are further differentiated as to development stages of competitiveness (driven by factors, efficiency, or innovation) and mode of knowledge exploitation (passive technology transfer, adoption to local needs, own innovation capacity). Diamond evaluates country positions according to four pillars, each of which includes four indicators ranked ascendingly as to their role in achieving innovation-based competitiveness. Pillars include four sets of indicators - on production technology development, completeness of value chain, competitive pressure, and advancement of networking. Specific attention was given to the role of technology transfer within global value chain considering the position of new EU entrants. Analytical results within EU quite clearly show the cross-country gaps vis-à-vis the targeted innovation-based competitiveness. These pose number of far reaching policy implications when making the related innovation policy support more effective and efficient.

Key words:

knowledge-based competitiveness, inovation policy, value chain, national innovation systems

1. Introduction

The paper presents an analytical framework for comprehensive assessment and comparison of EU country positions. The framework comprises the competitive advantage matrix and diamond concepts. Empirical data are based on expert surveys carried out within Global Competitiveness Report by the Word Economic Forum (WEF 2004) and some additional indicators. The matrix and diamond structures are based on the concept of competitiveness presented by Sala-i-Martin and Artadi (2004) with reference to Porter (2003), more precisely, on differentiating between sources of competitiveness according to (qualitatively advanced) stages of development (driven by production factors, efficiency, or innovations). Economic success based on competitiveness at lower stages of development ultimately leads to the loss of competitiveness due to increasing prices of input, in particular wages.

Achieving long-term sustainable growth therefore requires gradual advancement towards qualitatively higher sources of competitive advantage. Although this differentiation appears to be very significant for the assessment of positions of EU members, it has not received adequate attention until now. As a result, the outcome of analyses carried out to date (benchmarking) and the formulation of related political recommendations do not consider adequately country specifics - often at very different development stages of competitive advantage and innovation capacity. This difference is particularly apparent within the enlarged EU in the case of new and some other less developed members.

2. Theoretical and methodological starting points

The key concept applied in evaluating the nature of competitive advantage is distinguishing between its **price/cost and qualitative** sources. This differentiation according to Porter (WEF 2003) reflects to a certain degree the economic level achieved and the conditions for its further improvement. Competitive advantage of more developed countries tends to be quality-based owing to their more advanced domestic knowledge base. On the other hand, cost-based competitiveness supported by low wages and undervalued currency is predominant in less developed countries. Positively perceived increase of such a competitiveness, e.g. as increasing export performance, therefore cannot be sufficient. The **growth of productivity** in production factors is vital for increasing economic level, i.e. the value of products and services per unit of input. The higher the prices of output and the more efficient use of input, the higher income is generated, leading to greater contribution to the growth of the total product and the living standard. In the case of less developed countries that succeed in maximising their cost-based competitiveness, **gradual transition** to quality-based competitive advantage is a condition for achieving sustainable long-term growth performance. Increasing economic standards and price levels followed by appreciation of the local currencies in these countries inevitably lead to the loss of their cost-based competitiveness.

Generation and development of quality-based competitive advantage requires improvement in **technology skills and innovation capacity**. This in turn requires long-term investment of adequate resources in the development of

local knowledge base and efficient system for their use. Naturally, availability of resources depends on the economic level achieved, efficient use depends on institutional quality and history of knowledge-based activities (regarding the extent and quality of accumulated technology outputs), i.e. is path dependent. This is why the group of countries in positions of **technology leaders** (on the best practice frontier) includes, at the same time, the countries with the highest level of economic development whose long-term technology advantage is based mainly on their own innovation capacity. The higher quality of their knowledge base creates favourable conditions for its further improvement. On the other hand, the low quality of knowledge base **in less developed countries** represents the greatest barrier in its growth. Over time, the difference between the two groups of countries can therefore increase. This problem is especially significant for new EU members, where the knowledge base is still underdeveloped and no major changes can be reasonably expected within a short time horizon.

Opportunities arising from **technology catch-up** based on adopting (standardised) technology from more advanced countries (technology transfer) are one of the advantages available to less developed economies. However, the catch-up is not automatic and depends to a great extent on an adequate level of the local knowledge base as one of the determinants of **absorption capacity**. Technology transfer occurs via various channels (especially through imports and foreign direct investment, as well as exports). A country position in the (multinational) **value chain** bears special significance for the effectiveness of technology transfer and for generation of conditions for creating quality-based competitive advantage. Value chain fragmentation means that its individual segments are moved to geographically separate locations. However, segments with high knowledge intensity are moved to host countries rather rarely and the role of technology transfer in less developed countries may therefore remain (very) limited.[1]

The subsequent analytical base concept of the **national innovation system**, introduced in the late 80's (see Freeman, 1988, Dosi et al., 1988) and elaborated on in the 90's (Lundvall, 1992, Nelson, 1993, Edquist, 1997), highlights interaction between the key agents in the development of quality-based competitive advantage. National innovation systems are defined as national institutions and their incentive structures and competences which determine the pace and focus of technology learning (or the extent and structure of activities driving changes) in the relevant economy. Although the range of agents in a national innovation system is very broad, a major role in its performance is played by innovative firms and their technology learning and accumulation processes.[2] As the world becomes increasingly global, the significance of technology competition as an effective incentive mechanism is strengthened. At the same time, the raising costs of innovation activities in leading technology segments promote opening national innovation systems and establishing strategic partnerships among multinational companies for research and development. For summary of current trends in NIS research see for example Balzat, Hanusch (2003). Applications of the innovation system concept are gradually differentiated according to the analytical level as regional approach (for summary see Doloreux, Parto, 2004), industry approach (see e.g. Malerba, 2002) or technology approach (Carlsson et al., 2002).

3. Competitive advantage matrix

Quality-based competitive advantage is a source of long-term sustainable growth and consequently also of economic prosperity. Achieving and developing this advantage is conditional on an adequate range of **quality intensive factors**, i.e. technology, human resources, adequate institutional environment, and comprehensive and sophisticated business operations and strategies allowing the efficient use of these factors. Positions of countries or enterprises in the multinational value chain become increasingly significant in globalized economy. These positions are characterised by the completeness of the value chain, i.e. whether it includes segments with higher qualitative intensity (research and development, internal marketing and distribution strategies, sales under own renowned brand) or whether it is limited to activities less intensive in terms of technology and skills (assembly operations using imported parts and components). The characteristics of competitiveness assessment referred to previously are presented for EU members - first in the form of a competitive advantage matrix which distinguishes between the quality and cost factors, and internal and external sources of technology knowledge.

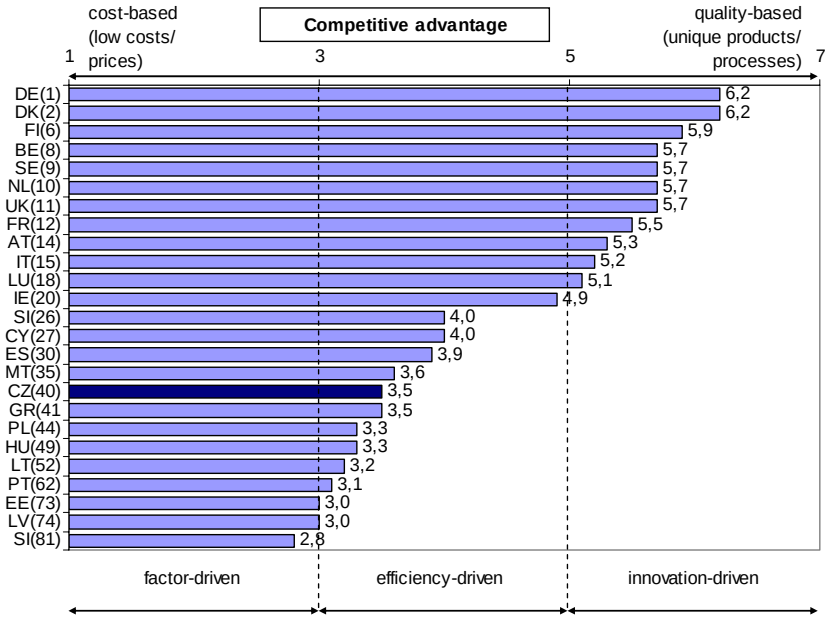
The key characteristics of competitive advantage are evaluated in the matrix according to its sources and the level of innovation capacity. This differentiation is based on the concept of global competitiveness index presented by Sala-i-Martin and Artadi (2004) with reference to Porter (2003). This concept identifies qualitatively different sources of competitiveness that prevail in the three development stages. At the initial **factor-driven stage** companies compete mainly with price, i.e. exploit the advantage of cheap input using adopted technology. Success depends on meeting the basic conditions of macroeconomic stability, personal security, institutional quality, technical infrastructure and human capital. At the **efficiency-driven stage** a firm's productivity is determined particularly by the quality of products (no longer their price alone) and efficient production procedures.

[1] Another problem relating to this issue concerns the persisting dualist character of the economic structure. In this case the qualitatively higher type of competitive advantage is limited to a selected technologically more sophisticated segment of the national economy (in less advanced countries typically connected with the presence of foreign capital), while the remaining, less advanced segments lag behind on a long-term basis in terms of the level of technology, productivity and export performance. As the inflow of financial and human capital tends to concentrate in already developed areas (on international and regional scale), the duality of national economy may become increasingly pronounced if the more developed segment remains relatively isolated from the rest of the economy.

[2] NIS includes educational institutions, research facilities, businesses investing in research and development, financial institutions involved in financing research and development (especially in the form of venture capital), joint ventures of businesses and research organizations, professional associations defining technical standards, patent organisations, data information centres, etc.

Technology capacity, i.e. access to the best technology available, even if adopted from abroad, is now the key qualitative characteristic of competitiveness. Other major efficiency enhancers include the effectiveness of individual markets (product, financial and labour), availability of developed human capital and external openness. At the **innovation-driven stage**, i.e. the qualitatively highest stage, innovation performance, i.e. ability to create new products and processes using the latest production and organisation procedures, is of key significance. Companies compete with their unique strategies based on sophisticated operations characterised increasingly by (qualitative) development of clusters (their internal and external linkages). Innovation performance is supported by specific institutions and incentives.

Figure 1: Sources of competitive advantage, 2004



Note: Ranking within 104 countries. 7 – the best result, 1 – the worst result. Source: WEF (2004), modified.

The initial assessment of the EU-25 members is based on an indicator distinguishing between two opposite **sources of competitive advantage** – on the one hand, low costs or local natural resources (sensitive to price-based competitiveness or price fluctuations), and, on the other hand, unique products and processes which are difficult to imitate. Movement between the two extreme positions can be described as a transition from cost/price-based competitive advantage to quality-based advantage. Three development stages of sources of competitiveness can be identified on a scale from 1 (the worst result) to 7 (the best result) – factor-driven (interval 1 - 3), efficiency-driven (interval 3 - 5) and innovation-driven (interval 5 - 7). Obviously, this identification is approximate and is used mainly as initial illustration of the applied qualitative segmentation.[3] Positions of EU members are identified according to the results of expert survey undertaken by the World Economic Forum (WEF 2004), see figure 1. EU members are either at the efficiency-driven or innovation-driven stage. Two groups of countries can be clearly identified within the EU-25 accordingly. The first twelve (including borderline Ireland) can be described as countries with innovation-driven competitive advantage, while the remaining thirteen (including borderline Slovakia) as countries with efficiency-driven advantage. The competitive advantage in the first group can be classified as quality-based, while the advantage in the second group is more cost-based. Differences between EU members are significant not only in terms of the assigned values, but also as to the ranking within the entire group of 104 countries.

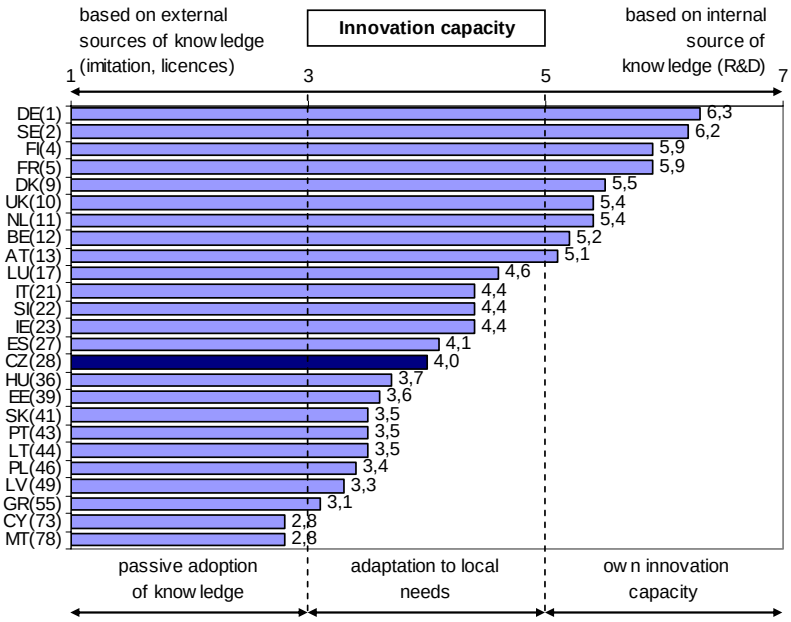
3.1 Sources of technology knowledge and level of innovation capacity

Sources of technology knowledge or the level of (internal) innovation capacity represent the other closely related criterion for assessing sources and development stages of competitive advantage. Again, two opposite positions are identified – acquiring knowledge mainly through licences and imitation of foreign technology as opposed to acquiring knowledge through own research activities leading to creation and introduction of new products and processes. Once again, certain intermediate stages reflecting the level of development in the domestic knowledge base can be identified between the two extremes. According to the basic structure, the individual stages advance from passive adoption of external knowledge through the ability to adapt external knowledge to the local needs to prevalence of own innovation capacity. **Technological openness** of domestic economic agents, i.e. their awareness of new technology and intensive interest in its acquiring and using, is the basic condition for successful technology transfer. The effectiveness of technology transfer is greatly influenced by the level of development in the domestic knowledge base. Naturally, this becomes more important with increasing significance of own innovation capacity. However, even passive adoption of foreign technology requires certain (minimum) level of knowledge. The importance and stan-

[3] The concept applied by Sala-i-Martin and Artadi (2004) uses GDP per capita values to differentiate between qualitative stages of competitiveness (transition stages are also identified).

dard of these conditions increase in the following development stage, allowing adaptation of transferred technology to local needs. Intensity of technology transfer through foreign direct investment depends on positions of affiliates in host countries within the multinational **value chain** and these positions are in turn influenced by the level of development in the domestic knowledge base. In addition, the position in the multinational value chain also influences the intensity of technology transfer via export and import. A position with greater qualitative intensity is associated with greater technology sophistication of imported production equipment and exported products and a broader range of performed activities (including international distribution and marketing), which allow closer contact with sophisticated demand and competition in technology more intensive product segments.

Figure 2: Sources of technology knowledge and level of innovation capacity, 2004



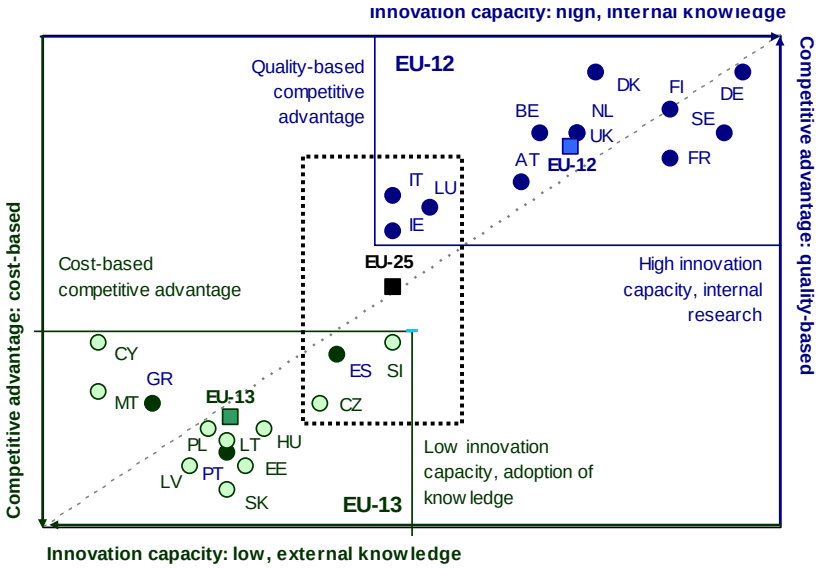
Note: Ranking within 104 countries. 7 – the best result, 1 – the worst result. Source: WEF (2004), modified.

According to the international comparison within the EU-25 (figure 2), most members are at the stage of **adaptation** of external (adopted) knowledge to local needs and only few at the stage with prevailing own innovation capacity, i.e. with developed innovation capabilities based on internal source of knowledge. The gap between the two country groups is less significant than the difference according to the sources of competitive advantage, especially due to borderline positions of Luxembourg, Italy and Ireland (with the worst ranking within the EU-12) and Slovenia (with the best ranking among new members and the broader EU-13 group). Aside from the specific case of Luxembourg, evaluation of Italy and Ireland reflects the lower intensity of research and development in these countries compared to other developed EU members, or in the case of Ireland the persisting importance of external sources of technology knowledge acquired through research and transfer activities of foreign companies.

Competitive advantage matrix

The indicators of sources of competitive advantage and of technology knowledge (level of innovation capacity) can be combined to show country positions in the **competitive advantage matrix** (see figure 3). The matrix identifies relatively clearly lagging in the group of new and less developed EU members (EU-13) compared to the more advanced members (EU-12). Greatly differing country positions in the competitiveness matrix often signal the necessity to specify analytical instruments for assessment and policy measures for related economic and political support at the national level. Lagging of the EU-13 is demonstrated in the prevailing **cost-based** competitive advantage, i.e. low importance of unique products and processes; competitiveness is more efficiency-driven. This lagging is also clearly shown in the persisting reliance on **external sources** of technology knowledge, i.e. low importance of internal knowledge sources (research and development activities). Own innovation capacity is insufficiently developed, although most countries within this group demonstrate the ability to adapt external technology knowledge to local needs. Although the two groups within the EU-25 are relatively clearly divided in terms of sources of competitive advantage (the average result of 5.6 in EU-12 compared to 3.4 in EU-13), lagging is (slightly) less pronounced in the level of innovation capacity (the average result of 5.4 compared to 3.5). The EU-12 countries score better on the competitive advantage quality at the given level of innovation capacity, while in the EU-13 the competitive advantage quality tends to lag behind their achieved level of innovation capacity.

Figure 3: Competitive advantage matrix

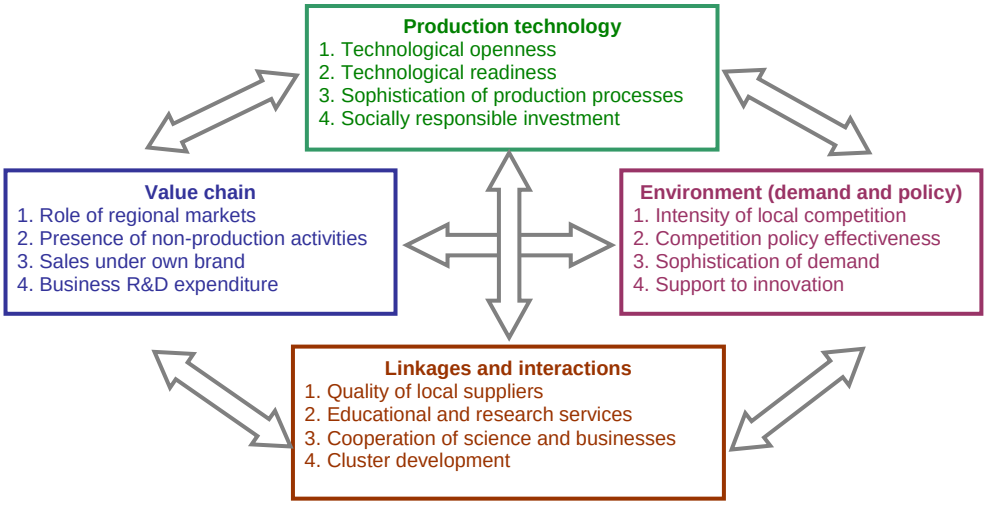


Source: WEF (2004), modified.

3.2 Competitive advantage diamond

More detailed specification of competitive advantage characteristics is based on the initial definition of its qualitatively differentiated development stages. In this concept the **competitive advantage diamond** defines its four key aspects, each of which is assessed by four individual indicators differentiated according to their importance in transition of the economy to quality-based competitive advantage (or innovation-driven competitiveness stage). The structure of the diamond presented in this paper is the author's own design based on Porter's concept of importance of different factors in different competitiveness development stages. Values of individual indicators are based on WEF survey (2004) and once again are stated on a scale from 7 (the best result) to 1 (the worst result). The structure of the competitive advantage diamond follows the findings from competitive advantage matrix, i.e. the selection of indicators reflects the specifics of **qualitative positions** of country groups within the EU-25. Therefore, on the one hand, certain factors that can be considered fundamental for long-term economic development were omitted (their presence is practically a condition for joining the European Union even for the less developed countries). On the other hand, specific importance of geographical and qualitative fragmentation of a value chain of multinational companies was considered, which is demonstrated in differences between qualitative intensity of domestic (with more developed knowledge) and host (with less advanced knowledge) EU members.

Figure 4: Diamond model for competitive advantage



Source: The author's structure using WEF indicators (2004).

The competitive advantage diamond (figure 4) comprises (1) a production technology component evaluated according to qualitative characteristics of business operations and decision-making, including their social context, (2) a value chain component with a focus on the presence of individual segments with different qualitative intensity, (3) an environmental component including the aspect of demand sophistication (from intensity of competition to sophistication of

buyers) and quality of political support (from the competitive environment to innovation activities), and (4) a linkages component which assesses the quality and intensity of interactions among the involved agents. Individual characteristics of each of the components are arranged in ascending order from one to four according to their importance for quality-based competitive advantage (or its higher stage). Obviously, certain (sometimes even significant) structural differences between companies, industries or regions within the economy may appear in the qualitatively differentiated characteristics of the competitive advantage diamond. The overall assessment at the national level will therefore reflect the perception of prevailing qualitative evaluation of individual characteristics. In addition, there are differences in qualitative assessment between individual components of the diamond which enable identification of areas with significant lagging or advance. Ideally, the position (of a country, region or industry) should be at a similar level within the same tier of the diamond (1 to 4) across all components.

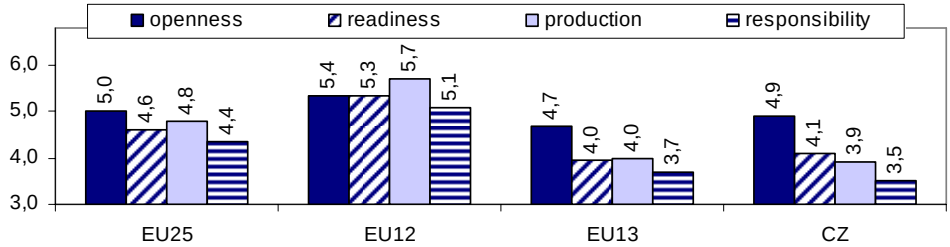
3.2.1 Production technology

The first component of the competitive advantage diamond is the assessment of the qualitative level of the **production technology development**. The quality intensity is industry and company-specific and shows up in various importance of the generators and users of new technology within the economic structure. The production technology component assesses particularly the qualitative stages of company operations, while taking into consideration social context of corporate decision making at the highest stage. Technological standard is of key importance for increasing the efficiency of production activities, i.e. for efficient use of input.4 Whether the technology used is developed by local companies or adopted from abroad is irrelevant in evaluation of this component (the source of knowledge gets on importance in the value chain component). However, development of domestic knowledge base is an important condition as adoption of external technology requires adequate level of absorption capacity (especially internal or external availability of related qualitatively intensive input and density and intensity of linkages within the institutional infrastructure).5

The first indicator in the **production technology** component within the diamond is (1) technological openness, i.e. whether companies are open to and active in absorption of new technology. Where technological openness is sufficient, effective use of new technology is further conditional on an adequate level of (2) technological readiness or capacity, i.e. accessibility of new knowledge through alternative technology transfer channels. As a technological capacity increases, (3) sophistication of business operations and strategies increases to the point where the best and most efficient process technology available is used (i.e. the best practice frontier technology) as opposed to labour intensive production methods. As company operations and strategies reach their qualitatively highest stage, (4) socially responsible decision making and investment in production technology becomes increasingly important in company planning (beyond the scope of legislation requirements in this area).

Positions of the Czech Republic and groups of the EU-25, EU-12 (developed members) and EU-13 (less developed members, i.e. new members plus Spain, Portugal and Greece) are shown in figure 5. Values of individual indicators in the production technology component in the Czech Republic are arranged in international comparison from the most positively perceived technological openness to the indicator with the worst evaluation – importance of socially responsible corporate decision making. The extent of the Czech Republic (and EU-13) lagging behind the EU-12 shows progressive tendency in the same order. On average, companies in less developed EU members are technologically open but lack adequate technological capacity and ability to use new technology efficiently. The most significant lagging behind more advanced member states is demonstrated or perceived in sophistication of production processes.

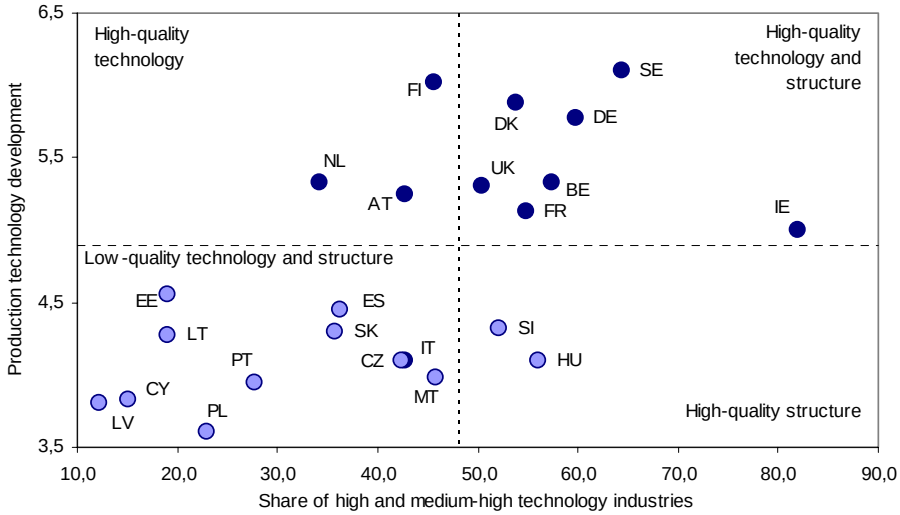
Figure 5: Indicators of the production technology component



Source: WEF (2004), own calculations.

In order to evaluate positions of EU members as to their **production technology** development, average values for this component were combined with the indicator of quality of economic structure (expressed as the share of industries with high and medium-high technology intensity). This comparison (figure 6) indicates a various country groups within the EU. The country group with a low quality of production technology and an unfavourable qualitative structure holds the worst position. At the same time, these countries demonstrate a small share of industries with high technology intensity. Another group (including the Czech Republic) demonstrates a more favourable qualitative structure of economic activities, while maintaining a low quality of production technology. In this case, supporting adoption of more sophisticated technology or development of domestic research activities in industries with higher technology intensity (i.e. especially technology transfer through foreign direct investment) would be appropriate. The remaining EU members demonstrate a higher or high quality of production technology in combination with medium to high quality of economic structure.

Figure 6: Quality of production technology and qualitative structure of economic activities



Note: Qualitative structure for 2002 expressed as a share of high and medium-high technology intensive industries in manufacturing value-added.
Source: WEF (2004), OECD – STAN Database, up to 1.11.2005, EUROSTAT – New Cronos, Industry, Trade, Services, up to 1. 5. 2005, own calculations.

3.2.2 Value chain

The (multinational) **value chain** component specifically takes into account positions of EU members with less developed knowledge base and a significant role of the FDI sector. In these cases, assessment of competitive advantage needs to take into consideration consequences of the multinational value chain fragmentation, where various (qualitatively different) segments are located in various countries. Less developed countries tend to attract especially segments that make use of the advantage of cheaper inputs. Placement in countries at a similar or higher level of (knowledge) development is motivated more by access to specific assets (for example new technology).[6] The quality of factor endowment (factor intensity) related to the level of technology capabilities influences the depth and focus of trade specialisation and motivation of foreign investment flows as a (potentially) significant source of technology transfer.

The first aspect of the value chain component includes the (1) intensity of exports to regional markets as a basic condition for asserting domestic production in foreign competition. Geographical proximity and intensity of economic and non-economic linkages facilitate penetration to markets in neighbouring countries. In the next stage of development assessment focuses on the (2) presence of non-production activities, i.e. to what extent companies develop activities of strategic importance besides manufacturing the input, such as product design, marketing, logistics or after-sales services. The more varied the value chain, the higher is the appreciation of production input. In assessment of the value chain completeness in the following stages the importance increases of qualitative intensity of the included segments. This is reflected first in the ability to export output (3) under own (renowned) brand. Assessment in the qualitatively highest stage turns to the (4) level of expenditure on research and development (compared to foreign competitors), which at the same time defines the corporate innovation typology (or is one of its major aspects).

International comparison of the Czech Republic position with groups of EU in individual indicators of the value chain component is shown in figure 7. Once again, the figure shows lagging of the less developed country group in individual stages of the value chain component. Intensity of regional trade as a basic condition for and result of competitiveness in foreign markets receives the most positive evaluation. The worst evaluation on average is achieved in intensity of expenditure on corporate research and development (which applies also to the EU-12). The most significant lagging of the EU-13 behind the EU-12 is shown in sales under an own renowned brand. Generally, the value chain in the group of less developed members lacks qualitatively more intensive segments. The Czech Republic position in all indicators is on average only slightly more favourable than the EU-13 average and displays identical qualitative characteristics of value chain (in)completeness.

When positions of EU members in the level of **value chain** quality (or completeness) are evaluated, average values for this component are combined with the transnationality index indicator, which describes the extent of internationalisation (figure 8). In this comparison, the less developed EU members are included in the group with a low value chain quality even if the levels of FDI

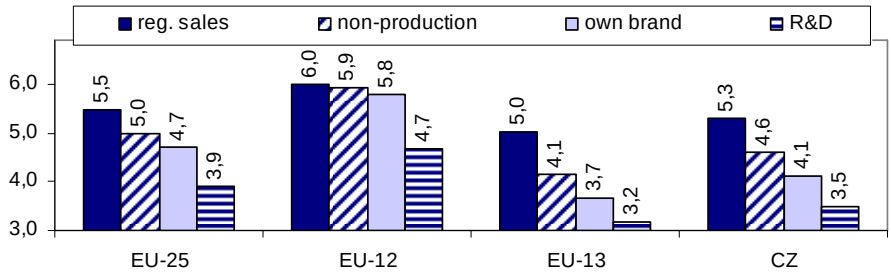
[4] Smaller firms may be in a specific position, having the advantage of greater flexibility for implementing new technology, while being potentially limited by insufficient material and knowledge resources and a more difficult access to information on the latest technology.

[5] This input may include for example skilled human resources (including specific qualifications such as scientists or technicians) or specialised research, education or ICT services. However, assessment of available skilled human resources in less developed countries must be interpreted with great caution. Positive assessment may indicate low demand or its low quality intensity rather than high quality of supply (see sophistication of demand in the environment component).

[6] Motivation of a company decision to expand activities abroad (i.e. questions how, where and when) is the subject of the international production theory. Reasons are divided according to the type of advantages pursued (in the so-called *OLI* paradigm) into the ownership of a unique asset (*ownership advantage*), opportunity to internalise benefits arising from undertaken transactions or making use of economies of scale (*internalisation advantage*) and making use of advantages of particular localisation (*localisation advantage*), see Dunning (1993).

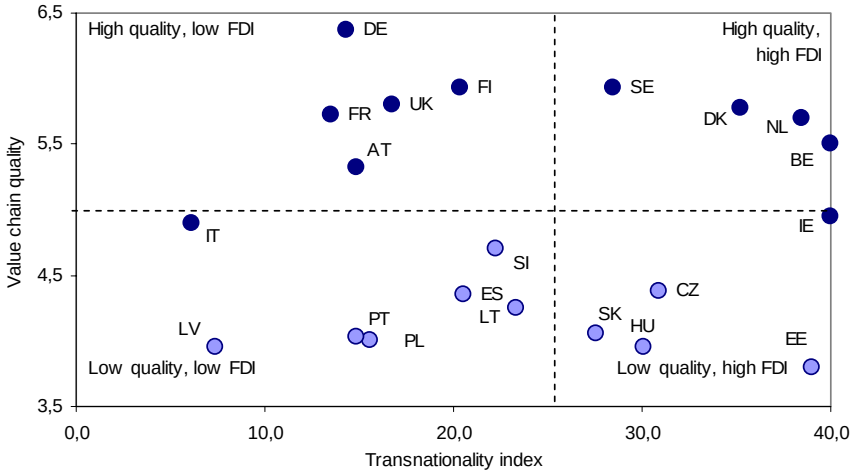
are comparable with some of the more developed members. The Czech Republic receives relatively positive evaluation in this group. However, the gap between the Czech Republic and more advanced members remains significant and indicates different motivation for investment decisions, i.e. cheaper input and medium skills of labour rather than specific assets (or importance of the domestic market).

Figure 7: Indicators of the value chain component



Source: WEF (2004), own calculations.

Figure 8: Quality of value chain and intensity of foreign direct investment



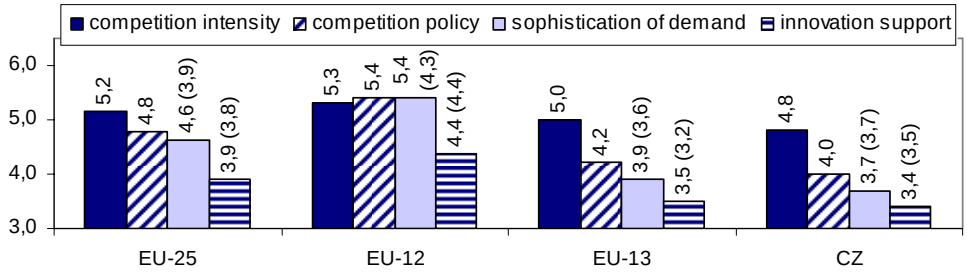
Note: Transnationality index for 2002, Belgium – 77.1, Ireland – 69.3. Data for Malta and Cyprus not available. Source: UNCTAD Database (2005), WEF (2004). Transnationality index (TNI) is expressed as the average of shares of the FDI inflow in gross fixed capital formation, the FDI inflow in GDP, number of employees in foreign affiliates in the total employment, value added in foreign affiliates in the total value added.

3.2.3 Environment (demand and policy)

The third component of the diamond model of competitive advantage – qualitative intensity of the **external environment** is evaluated according to competition intensity, sophistication of the domestic demand and support for innovation activities. Support in the narrow sense includes specific measures encouraging innovation and focused especially on various forms of financial (direct and indirect) instruments and instruments for (temporarily limited) protection of innovation results utilisation. Support eliminates or reduces the consequences of market failures, which under normal circumstances would weaken an incentive for investing in innovation and thus prevent companies from achieving a socially optimum outcome. In the broader sense, supporting innovation activities includes the quality of general conditions for economic decision-making. Innovation environment is influenced, for example, by quality of regulation and flexibility of product, labour and financial markets and within these by conditions for doing business and intensity of competition (including openness of the domestic market to foreign supply), labour mobility and determinants of supply and demand for specific financial instruments (like venture capital).

The first indicator in the environment component - (1) intensity of domestic competition depends mainly on openness of the domestic market (to imports and inflow of foreign investment). The importance of (2) effective protection of competition, especially protection that respects its dynamic benefits, increases with growing importance of technology intensive activities and the subsequent market concentration. Growing qualitative intensity of economic activities driven by intensity of domestic competition subsequently reflects in increasing (3) sophistication of the demand (i.e. preference of technology level and performance rather than price) from private, as well as public agents. In the last stage of development (4) sophisticated instruments for supporting innovation activities, specifically venture capital (by private agents) and government tax and subsidy allowances for companies are available.

Figure 9: Indicators of the environment component

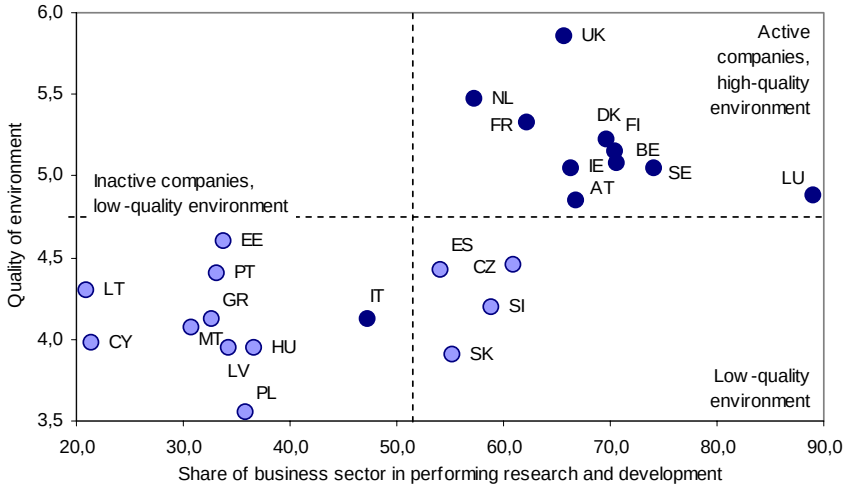


Note: Data in brackets represent indicator values for the public sector. Source: WEF (2004).

Comparison of the Czech Republic position with groups of EU-25, EU-12 and EU-13 is shown in figure 9 with differentiation between private and public agents in the case of demand sophistication and support to innovation. The Czech Republic scores best in intensity of competition. The Czech Republic lags behind the EU-12 the most in sophistication of the demand within the private sector and effectiveness of the competition policy. The relatively intensive competition with weaker effectiveness of its protection is typical for the EU-13. Sophistication of the domestic private and public demand is low and availability of specific supporting instruments limited. Low technology level of the demand is therefore matched by low qualitative intensity of supply, i.e. the support from the external environment.

Positions of EU members in the quality of **innovation environment** are evaluated in terms of average values for this component and values for the share of the business sector in performing research and development (figure 10). This comparison indicates countries (most of the EU-12) with high business activity, high-quality innovation environment and favourable conditions for doing business. The situation is quite the opposite in most countries of the EU-13. The research activity of businesses documented for the Czech Republic, Slovenia, Slovakia and Spain is above the EU-25 average, while the quality of their innovation environment is below the average. Improving the innovation environment can therefore be seen as an essential step for encouraging innovation activity in the business sector and can be potentially combined with more significant financial support. Although a relatively large part of public expenditure in the Czech Republic is dedicated to business R&D, the use of indirect financial support is only at its initial stages.

Figure 10: Quality of environment and the role of business sector in R&D performance



Note: Data on business R&D for last available year. Source: WEF (2004), EUROSTAT – New Cronos, Science and Technology, up to 1.11.2005.

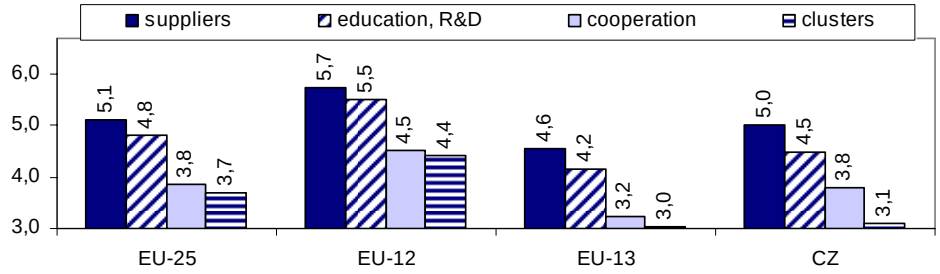
3.2.4 Linkages and interactions

Linkages and interactions evaluated according to the characteristics of national innovation systems and the level of cluster development make the fourth component of the competitive advantage diamond. Interactions between agents involved in innovation in the form of competition, transactions and networking take on two key forms, representing pillars of knowledge distribution in the national system. The most important type of interactions is that between key players in the innovation process, i.e. between companies and knowledge institutions. Innovation performance is conditional on their willingness and ability to cooperate, i.e. share and exchange knowledge. The second form of interactions includes market and non-market mechanisms supporting cooperation (partnership) in research and developments or creation of clusters of economic activities. Increasing importance of processes involved in creation, dissemination and use of knowledge reinforces linkages between the NIS approach and development of knowledge-based economy, in particular when examining determinants of complex mechanisms involved in distribution of knowl-

edge resources and benefits (institutional diversity, sector or industry innovation systems, economic and knowledge infrastructure, international linkages).

The first indicator in the linkages component is the (1) quality of domestic suppliers which defines availability and development of local supplier networks (of components, machinery and equipment) as opposed to dependence on their imports. Developed supplier networks interacting with customers positively influence innovation performance of producers. In the next stage of development, the intensity increases of knowledge activities in (2) availability of education and research services providing output adequate to specific user needs. This availability is especially important for agents facing insufficient level of internal knowledge resources. Increasing quality and flexibility of knowledge service supply (together with increasing qualitative intensity of the demand) gradually reflects in development of (3) cooperation between academic science and the businesses sector. This cooperation requires adequate institutional openness in both types of agents and developed mechanisms for mutual knowledge transfer. At the highest stage of development numerous and intense linkages among a wide range of agents (creators and users of knowledge) form (4) innovation-based clusters.

Figure 11: Indicators of the linkages and interactions component



Source: WEF (2004).

Comparison of the Czech Republic position within the EU according to indicators of the linkages and interactions component is shown in figure 11. The EU-13 members lag behind the more developed EU-12 members in all indicators. This disadvantage is at a similar, even if slightly higher level in the case of cluster development. The Czech Republic position is more favourable than the EU-13 average. The Czech Republic lags behind the EU-12 the most in the level of cluster development, which is also significantly worse compared to the intensity of cooperation between academic science and the business sector. Linkages and interactions among agents in the national innovation system, or condition for developing innovation-based clusters, are typically insufficiently developed in the EU-13 countries with less developed knowledge.

4. Conclusions

According to the matrix and diamond methodology used, the differences in **qualitative levels** of competitive advantage and its components among the EU-25 members are very significant. The comparison also showed major lagging of the less developed EU-13 group behind the more developed members. Competitive advantage structural characteristics applicable to the Czech Republic are similar to those of other EU-13 members, although the level of development is among the highest within the group. These national differences require adequate adaptation of concepts, instruments and supporting policy measures to reflect the country-specific maturity of competitive advantage. Inappropriate focus of these instruments resulting, for example, from mechanically adopting experiences of countries at a significantly higher level of development, increases the tendency towards inefficient exploitation of resources. Furthermore, it is necessary to distinguish between the countries with less developed competitive advantage quality and adjust the necessary support according to the sources and extent of weaknesses. Where weaknesses are more of an exception and include only some points of individual components, support should be specifically targeted. On the other hand, if the overall quality of competitive advantage is very low, attention must be paid to supporting system approaches with the widest achievable impact. According to the previous comparison, the Czech Republic is currently at a transitional stage. The average qualitative level is one of the highest within the EU-13, i.e. the fundamental conditions for its development have been created. However, there is a lack of sufficiently effective (system and at the same time strong) impulse for significant advancement.

The **competitive advantage matrix** places the Czech Republic (similarly to other EU-13 members) according to the competitive advantage sources in the efficiency-driven stage, however, still predominantly based on low costs (prices). The country therefore faces a great challenge as to the transition to efficiency-driven competitive advantage based more on quality. Furthermore, significant differences between economic performance of the domestic and foreign enterprises appears quite common in the EU-13. The question is whether differences in economic performance reflect in qualitative levels of competitive advantage. Regarding sources of technology knowledge, the Czech Republic ranks among countries with prevailing dependence on its external sources but also showing the ability to adapt this knowledge to local needs. The Czech Republic position in terms of innovation capacity is transitional, i.e. the dependence on external technology knowledge is combined with development of its internal sources, even though to a limited extent so far. The question is how to support the efficiency of technology transfer and gradual development of own innovation capacity from this qualitative level. Innovation strategies of foreign companies play a key role in this aspect.

The evaluation in the **competitive advantage diamond** and its results for production technology show lagging of the Czech Republic, as well as other less developed EU members. When integrated successfully in the multinational value chain, these countries display a positive tendency to catch up with the economic structure quality. The share of technology intensive industries can therefore be comparable or even higher than that in more developed countries. However, the persisting low level of production technology development reflecting qualitatively less intensive position in the value chain contributes to the insufficient use of knowledge potential in these industries. The results for the value chain confirm or even highlight the knowledge lagging of the EU-13. Despite extensive involvement of most of the countries in international production and trade activities (supported by their membership in the EU, among other factors), their positions in the multinational value chain compared to more developed members remain qualitatively less intensive. This limits the intensity of knowledge transfer from foreign investment as a potential source of technology and economic catch-up. In terms of environment quality, less developed EU members lag behind in sophistication of the demand and support for innovation, and also activity of business sector in research and development is low in most cases (the Czech Republic is one of the exceptions in this regard). This environment does not stimulate sufficiently development of qualitatively more intensive activities and this negative effect is further supported by the inadequate intensity and limited diversity of linkages and interactions among the innovation agents. Weak cooperation between the academic and the business sectors and especially low level of cluster development present a major problem.

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