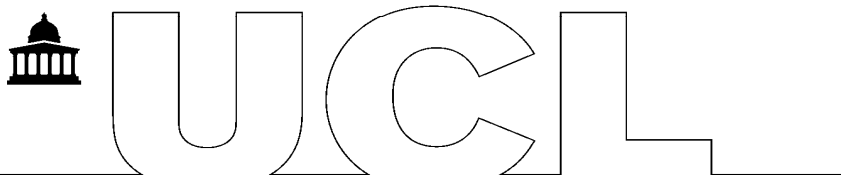
CENTRE FOR THE STUDY OF ECONOMIC AND
SOCIAL CHANGE IN EUROPE (CSESCE)



UCL SSEES
Centre for the Study of Economic and Social Change in Europe

KNOWLEDGE-BASED ENTREPRENEURSHIP IN CENTRAL AND EASTERN EUROPE: MYTH AND REALITY

Slavo Radosevic [a], Maja Savic [b] and Richard Woodward [c]

[a] University College London, School of Slavonic and East European Studies. Email: s.radosevic@ssees.ucl.ac.uk
[b] University College London, School of Slavonic and East European Studies.
[c] Centre for Social and Economic Research (CASE), University of Edinburgh.

Economics Working Paper No.93

November 2008

Centre for the Study of Economic and Social Change in Europe
UCL School of Slavonic and East European Studies
Gower Street, London, WC1E 6BT
Tel: +44 (0)20 7679 8519
Fax: +44 (0)20 7679 8777
Email: csesce@ssees.ucl.ac.uk

Knowledge-Based Entrepreneurship in Central and Eastern Europe: Myth and Reality

Slavo Radosevic and Maja Savic
School of Slavonic and East European Studies
University College London

Richard Wooodward
CASE – The Center for Social and Economic Research
and
University of Edinburgh

Acknowledgments

The authors would like to thank local experts that have collected or/and organised data collection: Andrea Szalavetz in Hungary, Anna Kaderabkova in the Czech Republic, Martina Hatlak in Croatia, Monika Kriaucioniene in Lithuania, Gheorgiu Radu in Romania, and the researchers at Biuro Badan Spolecznych in Poland. The usual disclaimers apply.

Abstract

This paper summarises results of a survey of 304 knowledge based firms in six central and east European (CEE) countries. Knowledge-based entrepreneurs in CEE are not 'gazelles' (i.e., fast growing new technology based firms which have the potential to reshape the industrial landscape). They consist of distinct types of companies, of which new technology based firms (NTBFs) are only one. The key factor in KBE firms' growth is most often firm specific capabilities which do not always involve R&D. Based on factor analysis we develop several taxonomies of KBEs which all point to a specific nature of knowledge based entrepreneurship in CEE. The networks of KBEs are broader and more frequently involve innovation system actors, including professional networks. For different types of KBEs different networks are important.

1. Introduction

A 2005 article in *Business Week* asked whether the countries of Central and Eastern Europe (CEE) could be considered a 'rising powerhouse' in high-tech industries[1]. It noted, among other things, that Poland's Warsaw University was ranked first in the world in top coder events, that software companies are springing up in Bulgaria, and that Romania has become an important center of engineering and R&D activities for a number of industries, including automobile manufacturing. It then concludes: 'As the race for top talent heats up globally, it turns out that Central Europe houses one of the planet's richest creative pools.'

This paper represents an attempt, based on evidence from a survey of 304 firms in six countries of the region, to separate myth from reality and identify both the strengths and weaknesses of Knowledge-Based Entrepreneurship (KBE) in the CEE countries in the light of the factors that affect the performance of firms. These factors

[1] *Business Week*, December 12, 2005, International Cover Story, Rise Of A Powerhouse: How the young knowledge workers of Central Europe are pushing the region to a new level

can be broadly divided into those referring to the entrepreneur, to the firm, and to the environment within which firms and entrepreneurs operate.

Our study of KBE was carried out in Hungary, Lithuania, the Czech Republic, Croatia, Poland and Romania. For the purposes of this paper we assume that knowledge-based entrepreneurship refers to the generation, utilisation and transmission of knowledge that has been generated within the fields of science, technology and innovation in anticipation of commercial application. In particular the emphasis is on the development of new technologies and the introduction of new products and processes (including new services) and the actors (new firms, universities and sources of external finance). We adopt Grant's (1996) definition of a knowledge-based venture, whereby knowledge is the firm's most valuable asset. Grant (1996) proposes that the ability of a firm to integrate knowledge held by individuals within the organisation creates its competitive advantage. When employees are mobile, the organisational capability depends more on the integration mechanisms than on the specialist knowledge that individuals posses (Grant, 1996). Apart from the importance of transmission of knowledge within the organisation we emphasise the importance of external environment and in particular the role of networks or innovation systems. We also acknowledge that some characteristics of entrepreneurs as individuals can significantly contribute to our understanding of the topic.

In the second section we will describe the sample of CEE KBE firms studied. In the third section we look more closely at the entrepreneurs behind those firms and identify the markets and customers they are serving. Section four analyses success factors and barriers in the firms' growth and describes categories of firms defined on the basis of those success factors and barriers. Section five explores the role of networks in firms' growth and again categorises the firms based on the types of networks in which they are involved. We conclude with a summary of our findings.

2. Description of the sample

During 2007 we administered an extensive questionnaire to the owners and/or chief executive officers in a sample of 304 firms in Hungary (50), Lithuania (52), Czech Republic (50), Croatia (50), Poland (62) and Romania (40). The two-page questionnaire consisted of 18 questions divided into four categories: (a) information about the firm, (b) information about the entrepreneur, (c) information about the demand and sources of knowledge and (d) information about growth, internationalisation and networks of the firm. The data refer to 2006, except the financial information, which relates to 2001 and 2005.

The firms were selected, first, on the basis of industrial classification, using a list, prepared by E. Wayne Clendenning and Associates (Clendenning and Associates, 2000), of industries considered to be knowledge-based. Since the exclusive use of industry classification as a selection criteria would likely result in some companies being inappropriately categorised as knowledge-based, we have additionally employed a set of auxiliary criteria for final selection of firms. These included, for example, whether the firm invests in R&D and whether it employs highly skilled personnel (MSc's, PhD's).[2]

[2] As our classification is product-based, we were unable to include in our sample firms that are innovative in terms of knowledge-based or high-tech production processes but produce traditional

The total number of employees in the firms in the sample is 52,883, which represents between 0.47% and 11.90% of overall industry employment (Table 1). In this respect, the sample can be considered on average fairly representative.

Table 1: Description of sample

	Number of firms		Number of persons employed		Representativeness	
Country	All firms	Sample	All firms	Sample	No of firms (% of total)	No of persons employed (% of total)
Hungary	45586	50	422111	5660	0.11	1.34
Czech R	59672	50	604435	10207	0.08	1.69
Lithuania	3413	52	74384	8852	1.41	11.90
Croatia	NA	50	NA	4111		
Poland	80195	62	948318	21553	0.08	2.27
Romania	22673	40	527017	2500	0.18	0.47
Total	211539	304	2576265	52883	0.14	2.05

Source: Eurostat, http://epp.eurostat.ec.europa.eu/, except for Croatia as data are not available on Eurostat web site.

Industry breakdown

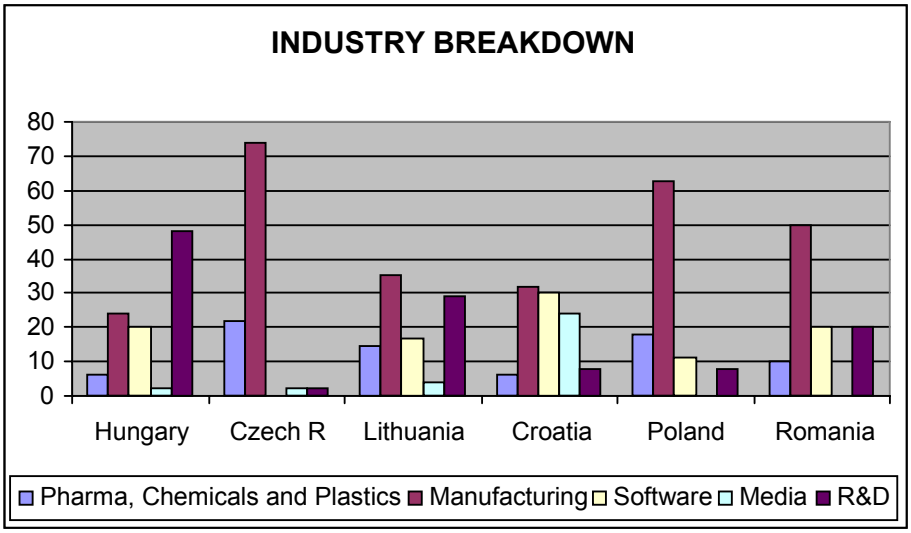
We have grouped our sample of firms into five broad sectors: Pharmaceuticals, Chemicals and Plastics; Manufacturing; Software; Media, and R&D (for the list of NACE industries included in each, see the annex).

The industry structure of our sample is as follows: Pharmaceuticals, Chemicals and Plastics (13%), Manufacturing (46%), Software (16%), Media (5%), R&D (18%). There are significant cross-country differences[3] with respect to the sectoral composition of the sample. In the Hungarian and Lithuanian samples, R&D enterprises are represented heavily, while in the Czech, Polish and Romanian samples, manufacturing enterprises are heavily represented. The Croatian sample has an unusually large group of media enterprises (Figure 1).

Figure 1

products. Hence it is likely that some types of knowledge-based firms are omitted from our sample. However, any other approach to identification would be prohibitively costly.

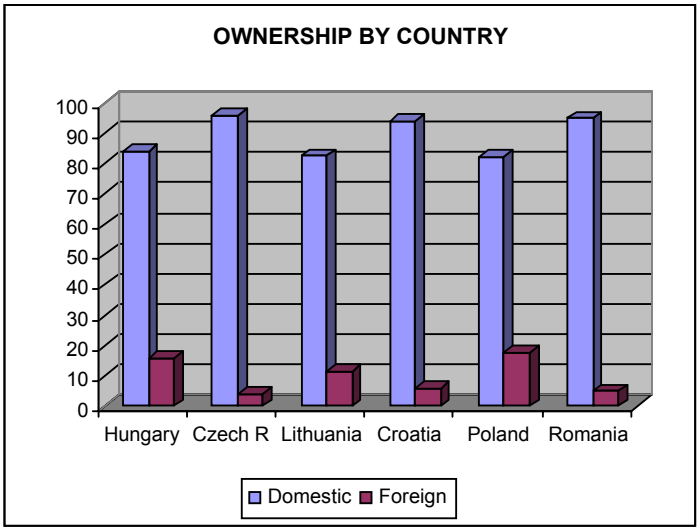
[3] On the basis of the Kruskal Wallis test, differences across countries with respect to sectoral structure are found to be significant (Chi-Square=60.502, Sig=0).



Ownership

The overwhelming majority of sampled companies are domestically owned. Percentage of domestic ownership ranges from 82% in Poland to 96% in Czech Republic. The highest percentage of foreign owned companies is found in Poland (18%) and Hungary (16%) (Figure 2). However, with respect to negligible differences across countries[4], we can conclude that KBE firms in CEECs are largely domestically owned. In other words, the process of internationalisation (globalisation) of KBE in these countries is still limited. (For a similar conclusion see UNCTAD 2005.) This is the same with respect to the industry breakdown, with the share of domestic ownership ranges from 98% in IT to 84% in the R&D sector.

Figure 2



[4] A Kruskal Wallis test reveals no significant differences between countries in our sample with respect to ownership structure (Chi-Square=9.696, Sig=0.084).

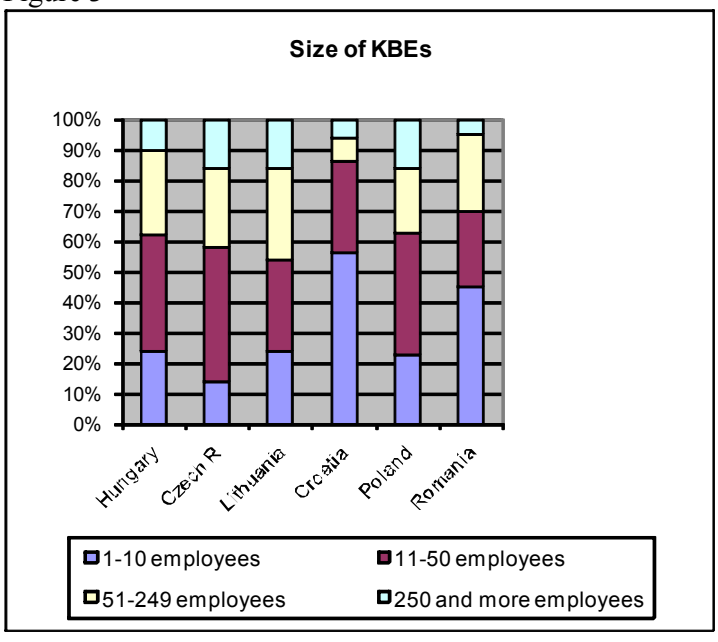
Size

The vast majority (88%) of the firms are small or medium sized enterprises (i.e. they have fewer than 250 employees), with 63% of them having under 50 employees. Cross-country differences are not strong[5]. However, the Croatian sample has an unusually high share of microentreprises (i.e. firms with 1-10 employees), with microentreprises representing 56% of the Croatian sample as opposed to 14%-45% in other countries[6]. The overall distribution for the sample as a whole is as follows: 30% of the enterprises are microentreprises with 1-10 employees, 35% are small, with 11-50 employees, 23% are medium-sized, with 51-249 employees, and 12% employ 250 or more employees. A detailed breakdown by country is shown in Figure 3. The Polish sample is biased towards a few very large companies (outliers), hence the mean distribution of the Polish sample is high compared to the other countries (Table 2).

Table 2 Size of KBEs by country

Country	Average number of employees	Median number of employees
Hungary	113	33
Czech R	204	43
Lithuania	188	45
Croatia	82	10
Poland	348	24
Romania	63	13
All countries	177	25

Figure 3



[5] An ANOVA test shows no significant differences between countries with respect to firms' size (Sig=0.142; F=1.668).

[6] The high share of micro enterprises in the Croatian sample is consistent with the high share of owners in Croatian sample for whom this is the first job. See below.

There are no statistically significant differences across industries with respect to the number of employees[7]. Nevertheless, we can report that high proportions of micro-enterprises are found in Software (40%), Media (56%) and R&D (38%), whereas the Pharma, Chemicals and Plastics industry is biased by a few large outliers, making the mean size of companies in this industry much higher compared to other industries (Table 3).

Table 3 Size of KBEs by industry

Industry	Average number of employees	Median number of employees
Pharma/ Chemicals and Plastics	359	55
Manufacturing	211	23
Software	46	15
Media	19	10
Research and Development	127	20
All industries	152	20

Year of establishment

Most (64%) of the firms were established during the initial transition period of the 1990s. 17% of companies were established during the planned economy period (before 1990), and 20% are very young companies established after 2000. Differences between countries are not statistically significant[8]. There are also no statistically significant differences between industries with respect to year of establishment[9].

3. Knowledge-based entrepreneurs: their characteristics, motivations and markets

Education

Obviously, in a treatment of knowledge-based entrepreneurship, we are interested in the educational attainment and other human capital of the entrepreneur (defined in our research as the CEO). We begin our discussion of human resources, therefore, by presenting the educational structure of core staff and CEOs in our sample of firms.

KBE enterprises are clearly a highly skilled segment of CEE firms. This is demonstrated by the fact that, in the sample as a whole, only 4% of the CEOs have completed only secondary education; 31% have a BA or the equivalent, 44% a master's degree and 19% a PhD. With 96% possessing at least some higher education, the entrepreneurs in this group are much better educated than the founders of companies studied in a European Commission study of companies founded in 10 CEE countries in the period 1995-2000. This study found rates ranging from 17.3% to 42.0% for the period as a whole (CEC, 2002). The highest percentage (44%) of PhDs

[7] An ANOVA test of significance shows non-significant differences between industries with respect to size of KBEs (ANOVA F=1.908, Sig=0.109).

[8] An ANOVA test of significance shows non-significant differences with respect to year of establishment across countries (ANOVA F=2.195, Sig=0.055).

[9] An ANOVA test of significance shows that differences between industries regarding year of establishment are statistically non-significant (ANOVA F=1.777, Sig=0.133).

was found in Hungary. Poland had relatively few PhDs (6%), but a very high (85%) percentage of master's degrees. Croatia had no PhDs and very few MAs; 90% of the Croatian entrepreneurs had BA-equivalent degrees.

Entrepreneurs: where do they come from?

Next, we consider the employment of entrepreneur prior to his or her founding of the firm. A common feature here is that a high percentage (68%) of entrepreneurs come from the business sector (either private or state); a quarter (25%) come from the science and technology (S&T) sector (in which we include educational, research and health care institutions). The private sector is the previous employer of 61% of the entrepreneurs in the sample (ranging from 57% in Hungary to 67% in Croatia and the Czech Republic); state-owned enterprises were the former employer of 7% of them (from 2% in the Czech Republic to 13% in Poland). Research and health care institutions were the former employers of 25% of our entrepreneurs (from 8% in Croatia to 28% in Hungary). The education sector employed 8% of the sampled entrepreneurs (from 4% in Poland to 19% in Hungary). Finally, for 14% of our entrepreneurs, work in the firm studied here was their first job (from 0% in Romania to 33% in Croatia).

Table 4: Previous employment of CEOs of KBEs

Sector	**Range**
Private sector (61%)	57% (H) - 67% (CR, CZ)
State owned enterprises (7%)	2% (CZ) – 13% (PL)
Research (25%)	8% (CR) – 28% (H)
Education (8%)	4% (PL) – 19% (H)
First job (13%)	0% (ROM) – 33% (CR)

We note two country-specific peculiarities. First, Hungary has a high share of entrepreneurs from the S&T sector (43%), corresponding to the high percentage of PhDs in this group and the high share of R&D companies in the Hungarian sample. Croatia had a remarkably high percentage of entrepreneurs for whom this was their first job, while Romania's knowledge-based entrepreneurs have all worked before[10].

How important is the knowledge acquired by entrepreneurs during their previous employment for the firms in which they are currently working? We see some answers in table 4, which shows the number of responses indicating high importance (6 or 7 points on a 7-point Likert scale) of this knowledge. As we see, the most important is knowledge of products and technology. There is varied, but much lower importance of knowledge on customers, competitors and suppliers. Thus, it seems that the creation of new firms involves the entrepreneurs' repositioning themselves on the market, but not with respect to technology. This pattern is observed across all the countries studied.

Table 5. High importance of knowledge acquired during previous employment (% of respondents previously employed elsewhere)

[10] A high share of KBE for whom this is the first job is consistent with the large share of micro enterprises in Croatian sample.

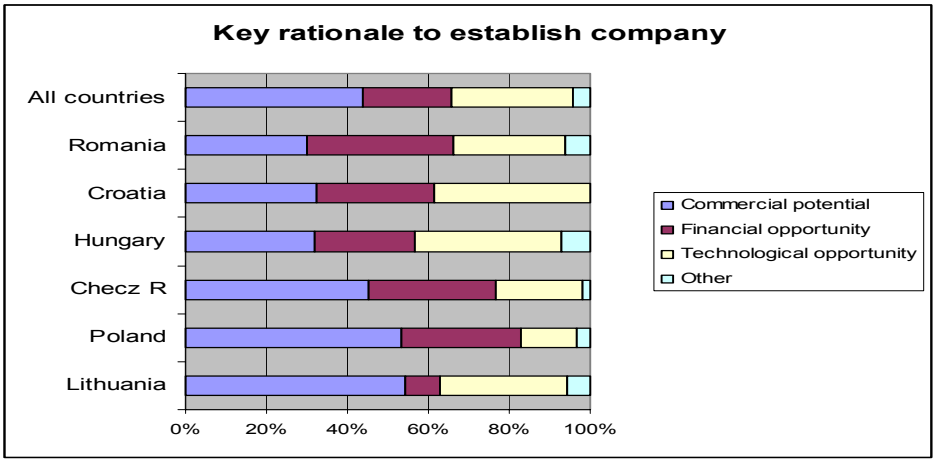
	Number of firms	Percent
Products/Technology	164	62
Customer base/demand	100	38
Competitors	83	32
Suppliers	68	26
Other	20	69

Key rationale to establish company: market opportunity

We see in Figure 4 that the major rationale for establishing the company was market opportunity (commercial potential and financial opportunity). Technological opportunity was relatively less important than market opportunity, but still quite an important rationale in all countries except the Czech Republic and Poland. In these two countries the share of firms where technology was the major rationale was 22% and 15% respectively, which can be explained by the large share of manufacturing firms in both these samples. The Hungarian sample has the largest share of firms where technological opportunity is a major motivation, which reflects their high R&D intensity and orientation towards the public R&D sector.

It is interesting that a certain percentage of firms cite other motivations. Most of these are institutional opportunities related to privatisation and their share is the highest in Hungary (10%), Romania and Lithuania (both 8%).

Figure 4 Key rationale to establish company



Market orientation: where are the customers and markets for CEE KBE firms?

The market orientation of sales of KBEs is quite different across countries. Table 6 shows the distribution of sales based on the share in total values (here, shares are highly influenced by the largest firms and do not reflect average values). Polish and Romanian firms are much more domestic market oriented than firms in smaller countries, which are mainly oriented towards export. The Czech sample is quite balanced in this respect.

Table 6: Regional distribution of sales: foreign and domestic market*

Country	Domestic	Foreign	Others
Hungary	26	74	0
Czech Rep.	49	51	0
Lithuania	24	76	0

Croatia	25	74	1
Poland	80	18	2
Romania	79	21	1
All countries	50	50	0

*Expressed as % of total values

In Table 7 we present sales to specific types of customers as percentages of total sales of all surveyed companies in the relevant country[11]. Table 7 shows that Lithuania and Croatia have the highest share of sales to foreign consumers, Hungary to foreign manufacturing firms, Romania to domestic manufacturing firms and Poland to domestic services companies. The Czech Republic again has a balanced orientation between sales to domestic and foreign manufacturers. However, we must note that the data in Table 7 may be strongly influenced by the largest firms.

Table 7: Distribution of sales by customer type (% of total sales in relevant country)

	Domes-tic manu-facturing	Domes-tic services	Foreign manu-facturing	Fo-reign servi-ces	Dome s-tic consu -mers	Foreig n consu-mers	Domes-tic scienti-fic/ researc h	Foreign scienti-fic/ researc h	Domes-tic public pro-cure-ments	Others
Country	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Hungary	8	8	**64**	7	4	1	1	2	5	0
Czech R	**48**	0	**51**	0	0	0	0	0	0	0
Lithuania	8	6	4	8	4	**61**	0	3	6	0
Croatia	2	3	10	9	19	**55**	0	0	0	1
Poland	12	**51**	8	5	11	3	2	1	5	2
Romania	**44**	7	1	5	18	15	9	0	1	1
All	**41**	6	**45**	1	2	3	0	0	1	0

Note: Sum of row values = 100

4. Sources of knowledge, networks, barriers and firms' typologies

Beyond value chains: sources of knowledge for innovation

In this research we are particularly interested in investigating the importance of various types of relationships and networks for the firms studied, and in particular, how important networks are for knowledge transfer. In Table 8 we see the major sources of knowledge used for innovation. In-house knowledge, customers and suppliers are major sources. In Community Innovation Survey data (see Eurostat) in-house and value chain partners (customers and suppliers) are also major sources of information for innovation. However, in the case of CEE KBEs the importance of other sources located outside the value chain is quite high. Fairs and exhibitions, patents, journals, and research organisations have a very high share, ranging from 68% to 71%. It is also interesting that other sources of innovation (most often the Internet) are very often a major source of knowledge for innovation. Amongst enterprises mentioning the Internet as an additional source of knowledge, 85% of them assign high to medium importance to this source.

[11] We were able to calculate this on the basis of total sales figures provided by each company in the survey; with this and the information on the share of various markets in sales, we could add the sales figures across countries and find the percentages of this figure for each market and each firm.

Table 8: Sources of knowledge as basis for innovation

High and medium importance of sources of knowledge as a basis for innovation							
	All countries	Hungary	Checz R	Lithuania	Croatia	Poland	Romania
In house	99	98	100	98	100	98	98
Customers	84	64	84	96	74	94	95
Suppliers	76	62	62	74	88	87	85
Fairs and exibitions	71	50	58	82	80	83	73
Patents, Journals	69	62	44	65	84	89	70
Research organizations	68	82	46	69	62	74	75
Other (internet etc)	85	100	100	100	100	100	10
Note: % as a percentage of all firms that answered the relevant question.							
Note: High and medium importance= answers 7 - 3 on a scale 1 - 7							

The share of KBEs where in-house and value chain partners are of high and medium importance is high in all six countries. Only in Hungary do value chain partners play a somewhat less important role, which is again expected given that Hungarian KBEs are mainly public-sector oriented and R&D-intensive firms. In the case of Hungary, research organisations are the second most frequently cited important source of knowledge for innovation (85%). The importance of other non-value chain partners (fairs and exhibitions, patents and journals) is important with varying degrees for specific sources in all six countries.

The key message from Table 8 is that the knowledge networks that underpin KBEs extend beyond value chains. In that respect, the KBEs in our sample do represent a distinctively different segment of firms in CEECs.

To learn more about the patterns affecting the use of various sources of the knowledge utilized in innovation, we have undertaken factor analysis on the sources of knowledge (Table 9). Table 9 shows that sources of knowledge are grouped into three underlying or latent factors. We can distinguish firms where value chain partners are the main source of knowledge, as both variables – suppliers and customers – load highly on one factor with the majority of others being unrelated. We can also distinguish firms where formalised R&D knowledge (as contained in patents, journals and research organisations) is the major source, and those firms in-house knowledge is the key knowledge resource in innovation. In both cases, factor loadings are very high and results quite robust. Fairs and exhibitions are the only source which loads relatively highly on two factors – value chains and formalised R&D knowledge. This may be expected given that knowledge for innovation very often resides in, and is easily accessible through, social and business networks. Fairs and exhibitions seem to be important for both meeting business partners and catching up with developments in the R&D area.

Table 9: Results of factor analysis of sources of knowledge for innovation

Rotated Component Matrix

	Value chain	Formalised R&D knowledge	In house
Suppliers	0.827	0.113	-0.067
Customers	0.813	-0.046	0.228

In summary, factor analysis has simplified the structure of the sources of knowledge for innovation and generated three factors which are robust proxies for three major sources of innovation: value chain partners, formalised R&D and in-house knowledge.

Success factors and typologies of KBEs

We asked firms about factors which lay behind their success. We have offered them a range of factors and asked them to assess their importance on a scale of 1 (completely unimportant) to 7 (crucial). Based on these results we have undertaken factor analysis in order to simplify the structure of success factors and explore whether factors of success belong to specific underlying factors. Table 10 presents the results of factor analysis, which gives a very robust grouping of firms into three groups based on latent factors or variables shared across different types of firms. Factor analysis shows that, on the basis of their success factors, we can observe three groups of KBEs in CEE:

a) *Networkers*, or firms highly dependent on links with other scientific organisations, on EU Framework programs, on government support and links with other firms;
b) *New Technology Based Firms*, or firms whose competitiveness is based on a unique technology, and on patents and licences, and
c) Firms whose competitiveness is based on *Customer-oriented organisational capabilities*. These firms are strong in knowledge of customer needs and in management, and are able to offer expected services/products at low cost.

The factor loadings on each of three factors are very high, and the three-factor solution is very neat and robust. The very interesting finding arising from this analysis is that CEE KBEs are not homogenous entities competing based on new technologies. In fact, new technology based firms are only one of three types of KBEs.

Table 10: Types of firms with respect to success factors (results of factor analysis)

	Networker	New technology based firms	Customer oriented organisational capabilities
Links with scientific organisations	**0.754**	**0.313**	-0.071
EU Framework programs and other EU support	**0.749**	0.086	0.095
Government support	**0.681**	0.239	0.172
Alliances/partnerships with other firms	**0.639**	-0.108	0.185
Links with previous employer	**0.489**	0.139	-0.179
Uniqueness of product/ technology/knowledge	0.062	**0.813**	0.076
Patents and licences	**0.400**	**0.716**	0.028
People and training	**0.345**	**0.410**	**0.303**

Barriers to growth

We asked KBEs about major barriers to their growth, on both domestic and foreign markets. Table 11 shows the frequencies with which identified various factors as barriers of medium to high importance (3-7 on the 7-point Likert scale). The major barrier seems to be a limited domestic market (78%), followed by lack of public support (75%) and high costs of labour (71%). Responses vary by country, but the limited market is among the top two answers everywhere except Croatia and Poland. For Croatia, Poland and Romania, the high costs of labour are also among the most frequent answers. Increased competition is among the major barriers in four of the six countries.

Table 11: Barriers of high and medium importance on domestic market (% of firms)

	All countries	Hungary	Czech Rep.	Lithuania	Croatia	Poland	Romania
Limited market	**78**	**78**	**70**	**74**	**80**	**79**	**88**
High cost of labour	**71**	68	68	60	**88**	**93**	**88**
Increased competition on market	54	59	**82**	59	**80**	**80**	**75**
Lack of access to finance	59	**78**	48	49	**84**	**81**	**75**
Lack of public support	**75**	52	50	43	**72**	**84**	**90**
Lack of skill and know how	65	42	40	44	**72**	52	**88**
Other	57	100	0	50	100	67	10

Note: % as a percentage of all firms that answered the relevant question.
Note: Medium to high importance = answers 3-7 on scale of 1-7

These answers suggest that KBEs are faced with limited domestic demand and face quite strong competition. In these market conditions, labour costs are of high concern.

Next, we explore whether barriers to firms' growth are systematically correlated and thus grouped into specific latent factors. The factor solution (Table 12) shows that high costs of labour, lack of skills and increased competition load on one factor. We interpret high labour costs and poor access to skills and knowledge as barriers that cause firms to feel weak with respect to their competitiveness. Hence, we take skills and labour as one important factor. Lack of access to finance and lack of

public support are quite closely connected factors which load on one underlying factor together with limited domestic demand. It seems logical that limited finance and limited domestic demand are closely correlated in the case of KBEs, as these are businesses which have relatively high fixed costs and low marginal costs and which are thus faced with frequent cash flow problems. Hence, we take lack of finance as a true firm-based barrier and limited domestic demand as an exogenous, structural constraint.

Table 12: Factor analysis results of barriers on domestic market

Rotated Component Matrix		
	Skills and labour	Finance
Increased competition on market	**0.835**	0.076
Lack of skill and know-how	**0.724**	0.098
High cost of labour	**0.722**	0.412
Lack of access to finance	0.036	**0.851**
Limited domestic market	0.145	**0.686**
Lack of public support	0.418	**0.597**

Extraction Method: Principal Component Analysis.

We have undertaken an identical analytical procedure for barriers on foreign markets. However, neither regression analysis nor factor analysis were able to provide either robust estimates or a factor solution.

5. Role of networks in knowledge-based entrepreneurship

A point of departure of the KEINS project is that networks are central to entrepreneurship. In this section we explore different network dimensions of KBEs in our sample.

Role of various types of relationships

Table 13 shows the percentage of firms indicating the medium to high importance of relationships with different types of partners. The most important links are with value chain partners (domestic and foreign buyers and sellers). This pattern of networking is similar to that of 'normal' firms. However, what distinguishes KBEs is the relatively high importance of universities, research institutes as well as alliances i.e. partnerships with other firms including licensing partners. This points to the importance of links that go beyond commodity / service flows as well as to the importance of institutions of national innovation systems (universities and research institutes) for KBEs. In this respect the pattern of networking is similar to that of important of sources of knowledge for innovation (Table 8), which also goes beyond value chain partners. The lowest importance of international joint ventures points to weak equity links between local KBEs and foreign firms in CEECs. This is consistent with the ownership structure of KBEs, which are dominantly domestically owned firms.

Table 13: Relationships of medium to high importance (% of firms)

	All	Hungary	Czech R	Lithuania	Croatia	Poland	Romania
Domestic firm (buyers)	**86**	**76**	**92**	**75**	**94**	**94**	**88**
Domestic firm (suppliers)	**77**	**64**	**86**	55	**84**	**84**	**88**
Foreign firms (buyers)	**70**	**76**	**88**	**76**	**63**	57	54
Foreign firms (suppliers)	**67**	52	**70**	**78**	**65**	**61**	**72**
Public authorities	59	54	54	**67**	58	59	**64**
Vocational/Higher education institute	56	**68**	36	53	**63**	**61**	54
Strategic alliances	57	**70**	48	44	46	**70**	**63**
Public/Private research institute	52	**68**	28	39	44	**64**	**69**
Licencing	49	51	26	34	56	**64**	**62**
Consultants	46	34	38	37	56	52	58
International joint ventures	38	26	26	40	32	49	56

Note: % as a percentage of all firms that answered the relevant question.
Note: High and medium importance = answers 3-7 on a scale 1-7

Types of firms based on intensity of links, country and industry patterns

We want to explore whether firms could be grouped in terms of different patterns of underlying network relationships. We undertake factor analysis using data on the intensity of network relationships. Table 14 shows the results of factor analysis for intensity of links.

Factor analysis shows that there are four types of firms based on the intensity of their links with external partners. This factor solution is quite robust with high loadings on underlying factors.

Foreign network dependent firms are those whose links with other firms, licensors, joint venture partners, consultants and public authorities are highly correlated. As Table 13 showed, the percentage of firms giving importance to these types of relationships is not very high in our sample when compared to value chain linkages. It seems that most of firms in this group are dependent on foreign partners other than buyers and suppliers (i.e. value chain partners). In addition, these firms are to some extent also dependent on public authorities but are not dependent on the public research system.

The second group of firms are those that are dependent on institutions of national innovation system like universities, research institutes and public authorities. Hence, it seems appropriate to define these firms as *public research system dependent* firms.

The third and fourth types of firms are those that are dependent on either foreign or domestic buyers or suppliers, i.e., *value chain dependent*.

Table 14 Types of firms based on intensity of their links

	(Foreign) Network dependent	Public research system dependent	Foreign value chain dependent	Domestic value chain dependent
Strategic alliances	**0.798**	0.166	0.183	0.046
Licensing	**0.757**	0.170	0.019	-0.006
International joint ventures	**0.665**	0.066	0.330	0.074
Consultants	**0.546**	0.223	-0.112	0.369
Public authorities	0.468	0.453	0.039	0.297
Vocational Higher education institute	0.096	**0.888**	0.091	0.032
Public/Private research institute	0.281	**0.805**	-0.039	-0.029
Foreign firm suppliers	0.069	0.071	**0.844**	0.195
Foreign firm buyers	0.189	-0.021	**0.782**	-0.168
Domestic firm suppliers	-0.062	0.140	0.221	**0.839**
Domestic firm buyers	0.324	-0.155	-0.223	**0.681**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

The factor analysis solution has demonstrated the different network orientations of KBEs in CEE. It shows that although on the aggregate, KBEs are dependent on both value chain links as well as on national innovation system links (universities, research institutes), this dependence is highly differentiated. Some firms are indeed dependent on the public research system, and some on foreign networks, while some KBEs are very similar to 'ordinary' firms by being dependent mainly on value chain partners, domestic or foreign.

6. Conclusions

Our findings allow us to make the following conclusions about KBE in CEE countries:

Knowledge-based entrepreneurs in this region usually start their careers in the business sector rather than the scientific sector, and start knowledge-based firms in order to take advantage of market (i.e., commercial and financial) opportunities. (Technological opportunities are frequently mentioned as a key rationale for establishing companies only in the Hungarian sample, where we see more entrepreneurs coming from the science sector.) These entrepreneurs bring knowledge about products and technology from their previous employment and then develop new markets with their new firms. In that respect, KBE in CEECs can be considered as primarily a market repositioning activity.

KBEs in CEE are not 'gazelles' (i.e., fast growing new technology based firms which have the potential to reshape the industrial landscape). They consist of distinct types of companies, of which NTBFs are only one. The key factor in KBE firms' growth is most often firm specific capabilities which do not always involve R&D. Based on what the firms have identified as their success factors, we have identified three groupings of companies: new technology based firms, 'networkers' and companies whose success is based on 'customer-oriented organisational capabilities'.

The most common developmental barrier in domestic markets is the low level of demand on those markets. This is followed by high labour costs, increased

competition, and lack of public support. Firms fell into two groups with respect to the kinds of barriers that were most important for them. The first group is one where the main barriers concern skills shortages and high labour costs. For the second group, the major barriers are related to finance (lack of access to finance and of public support).

Innovation survey data for CEECs show that in-house and value chain partners (buyers, suppliers) are key sources of knowledge for innovation. Unlike standard companies, which tend to limit their strategic interactions to value chain partners, the networks of KBEs are broader and more frequently involve innovation system actors (research institutes, universities), including professional networks (fairs and exhibitions). Indeed, here again we can identify a number of distinct types of firms (with respect to the sources of knowledge that are most important for their innovation processes): those where *value chain partners* are the key source of knowledge for innovation; those where *formalised R&D* like patents and journals and research organisations are the key source, and those where *in-house* or firm specific innovation activities are a key source of knowledge for innovation.

Another grouping of companies with respect to the intensity of their links with external organisations allows us to distinguish four types of firms: network dependent, public research system oriented, foreign and domestic value chain dependent firms. This shows that for different types of KBEs different networks are important. In general, these are either vertical (foreign and domestic value chains) or horizontal (links with the domestic public research system).

References

BC Stats (2001), Business Indicators July 2001 (http://www.bcstats.gov.bc.ca/pubs/bcbi/bcbi0107.pdf; last accessed 31 May, 2007).

Business Week, Rise Of A Powerhouse: How the young knowledge workers of Central Europe are pushing the region to a new level (International Cover Story), December 12, 2005.

Clendenning, E. Wayne, & Associates (2000), Comparison and Reconciliation of SIC and NAICS Industry Codes Used To Define Knowledge-Based Industries (KBIs). Prepared for Industry Canada, Small Business Policy Branch.

Commission of the European Communities (2002), *New enterprises and development of enterprises in Central European Countries: Data 1995-2001*, Luxembourg: Office for Official Publications of the European Communities.

Eurostat (2005), Patent classifications and technology areas, November (http://europa.eu.int/estatref/info/sdds/en/pat/pat_meth_hitech.pdf; last accessed 31 May, 2007).

Grant, Robert M. (1996), "Toward a knowledge-based theory of the firm", Strategic Management Journal, 17:109-22.

Radošević, S. (2006) 'Growth, Integration and Spillovers in the Central and East European Software Industry', UCL SSEES Working Paper, No. 69 (December) http://www.ssees.ac.uk/economic.htm

UNCTAD World Investment Report, 2005: Transnational Corporations and the Internationalisation of R&D

Annex. NACE classifications in industrial breakdown

Pharmaceuticals, Chemicals and Plastics
NACE Division 24 (Manufacture of chemicals and chemical products)
NACE Group 24.4 (Manufacture of pharmaceuticals, medicinal and chemicals and botanical products)
NACE Division 25 (Manufacture of rubber and plastic products)

Manufacturing
NACE Division 30 (Manufacture of office machinery and computers)
NACE Division 32 (Radio, TV and communication equipment)
NACE Division 33 (Instrument engineering)
NACE Group 35.3 (Manufacture of aircraft and spacecraft)
NACE Division 29 (Machinery and equipment)
NACE Division 31 (Electrical machinery)
NACE Division 35 (Other transport equipment)

Software
NACE Group 72.1 (Hardware consultancy)
NACE Group 72.2 (Software consultancy and supply)
NACE Group 72.21 (Publishing of software)
NACE Group 72.22 (Other software consultancy and supply)
NACE Group 72.3 (Data processing)
NACE Group 72.4 (Database activities)
NACE Group 72.5 (Maintenance and repair)
NACE Group 72.6 (Other computer related activities)

Media
NACE Group 92.1 (Motion picture and video activities)
NACE Group 92.2 (Radio and television activities)
NACE Group 92.3 (Other entertainment activities)
NACE Group 64.2 (Telecommunications)
NAICS 52.8 (Internet service providers; NACE code not available)

R&D
NACE Group 73.1 (Research and experimental development in natural sciences and engineering)
NACE Group 74.2 (Architectural and Engineering activities and related technical consultancy)
NACE Group 74.3 (Technical testing and analysis)

2008 CSESCE Working Papers

95 **Possible impact of corporate governance profile on a Russian bank valuation.** by Vassily Bokov and Andrei Vernikov

94 **Is there the rule of law in Russia? The case of Corporate Raiding: A note.** by Elena Zhuravskaya

93 **Knowledge-based Entrepreneurship in Central and Eastern Europe: Myth and Reality.** by Slavo Radosevic, Maja Savic and Richard Woodward.

92 **Brain Drain with FDI gain? Factor Mobility between Eastern and Western Europe.** by Gianfranco De Simoney and Miriam Manchin

91 **Party-System Institutionalization and Democracy: The Case of Russia.** by Kenneth Wilson

90 **Comparative Corporate Governance: Lessons from Eastern-Central Europe and Central Asia.** by Tomasz M Mickiewicz

89 **Macroeconomic stability, Governance and Growth: Empirical Lessons from the Post-Communist Transition** by Christopher J Gerry, Jong-Kyu Lee and Tomasz M Mickiewicz

88 **Entrepreneurship in Russia.** by Ruta Aidis, Julia Korosteleva and Tomasz Mickiewicz

87 **Utility Payments in Ukraine: affordability, subsidies and arrears.** by Samuel Fankhauser, Yulia Rodionova and Elisabetta Falcetti

86 **Voluntary Enrolment in the Peruvian Private Pension System.** by Carmen A Li and Javier Olivera

85 **Why are Optimistic Entrepreneurs Successful? An Application of the Regulatory Focus Theory** by Ruta Aidis, Tomasz Mickiewicz and Arnis Sauka

2007 CSESCE Working Papers

84 **The Sustainability of Russia's Energy Power: Implications for the Russian Economy** by Philip Hanson

83 **'Oligarchs', Business and Russian Foreign Policy: From El'tsin to Putin** by Peter J S Duncan

82 **Policies for promoting technological catching up: towards post-Washington approach** by Slavo Radosevic

81 **Entrepreneurship in Emerging Markets: Which Institutions Matter?** by Ruta Aidis, Saul Estrin and Tomasz Mickiewicz

80 **Oil and Gas: a Blessing for Few. Hydrocarbons and Within- Region Inequality in Russia** by Tullio Buccellato and Tomasz Mickiewicz

79 **Institutions and Entrepreneurship Development in Russia: A Comparative Perspective** by Ruta Aidis, Saul Estrin and Tomasz Mickiewicz

78 **Corporate Governance and Control in Russian Banks** by Andrei Vernikov

77 **Institutions, Infrastructure, and Trade** by Joseph Francois and Miriam Manchin

76 **The Great Divide: "Ruralisation" of Poverty in Russia** by Christopher J Gerry, Eugene Nivorozhkin and John A Rigg

75 **Research and Development and Competitiveness in South Eastern Europe: Asset or Liability for EU Integration?** by Slavo Radosevic

74 **Inequality, Democracy and Taxation: Lessons from the Post-Communist Transition** by Christopher J Gerry and Tomasz M Mickiewicz

73 **National Systems of Innovation and Entrepreneurship: In Search of a Missing Link** by Slavo Radosevic

72 **Convergence across Russian Regions: A Spatial Econometrics Approach** by Tullio Buccellato

2006 CSESCE Working Papers

71 **Knowledge Based Entrepreneurship in the Czech Republic and Hungary: Results from 4 case studies** by Kate Bishop

70 **Do Institutions Matter for Technological Change in Transition Economies? The Case of Russia's 89 regions and republics** by Brigitte Granville and Carol Leonard

69 **Growth, Integration and Spillovers in the Central and East European Software Industry** by Slavo Radošević

68 **Nature & determinants of productivity growth of Foreign subsidiaries in Central & East European countries** by Boris Majcen, Slavo Radošević & Matija Rojec

67 **Russia: Firm Entry and Survival.** by Ruta Aidis and Yuko Adachi

66 **Between Vision and Reality: Promoting Innovation through Technoparks in Kazahkstan.** by Slavo Radosevic and Marat Myrzakhmet

65 **Fiscal Policy and Policy Rules in Poland.** by Rafal Benecki, Jens Hölscher and Mariusz Jarmuzek

64 **Construction of Home by Polish and Lithuanian Migrants in the UK** by Violetta Parutis

63 **Ownership Structure and Development of Polish Life Insurance Companies: Evidence from 1991 to 2004** by Adam Sliwinski

62 **Corporate Governance, Managers' Independence, Exporting and Performance of Firms in Transition Economies** by Igor Filatotchev, Natalia Isachenkova and Tomasz Mickiewicz

2005 CSESCE Working Papers

61 **Entrepreneurship in Transition Economies: A Review** by Ruta Aidis

60 **New Estimates of the Risk and Duration of Registered Unemployment in Urban Russia** by Anton Nivorozhkin

59 **De-industrialisation and the Post-Communist Transition: Rowthorn and Well's Model Revisited** by Tomasz Mickiewicz and Anna Zalewska

58 **Upgrading Russian Enterprises from the Value Chain Perspective: the Case Study of Tube & Pipe, and Furniture Sectors**
Svetlana Avdasheva, Igor Budanov, Victoria Golikova and Andrei Yakovlev

57 **The Promotion of Innovation in Slovenia through Knowledge Transfer from Higher Education Institutions to SME's**
Will Bartlett and Vladimir Bukvič

56 **Reconstitution of Post-Soviet Ex-State Enterprises into Russian Business Firms under Institutional Weaknesses**
Yuko Adachi

55 **Post-Communist Recessions Re-examined**
Tomasz M. Mickiewicz

54 **Leadership and Corruption in Russia, 2000-2004**
Alena V. Ledeneva

53 **Foreign Direct Investment and Restructuring in the Automotive Industry in Central and East Europe**
Slavo Radosevic and Andrew Rozeik

52 **Financial Performance of Groups of Companies in Poland against the Background of Historical Determinants and Knowledge Management Procedures Applied**
Jan Chadam and Zbigniew Pastuszak

51 **Are the EU New Member States Fiscally Sustainable? An Empirical Analysis**
Mariusz Jarmuzek

50 **Growth Expectations of Business Owners: Impact of Human Capital, Firm Characteristics and Environmental Transition**
Ruta Aidis and Tomasz Mickiewicz