

Becoming Software Exporters? The Cases of Three Central European Nations— Romania, Poland, and the Czech Republic

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ABSTRACT. The global marketplace in software products and services is estimated at US\$ 200 billion. Thus far, this market has been dominated by a few advanced economies and the three “I’s”—India, Israel and Ireland. Rapidly growing demand for software raises the question if newcomers can establish themselves as exporting nations. In this paper, we study the three cases of Romania, Poland and the Czech Republic. Using the Software Export Success Model developed by Heeks and Nicholson, we provide an overview of the three countries’ software sectors. We then evaluate to what extent they meet the conditions for capturing a substantial market share. We find that these nations have some of the necessary assets: Their technical skill base is good, wage levels are competitive, and linkages with EU member states are emerging. However, they lack in important conditions for success: their national vision for the software sector is weak, so is industry collaboration. *[Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH.*

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INTRODUCTION

Since the 1990s dozens of nations have begun to export software. A niche that was once dominated by a handful of advanced economies, particularly the U.S., has broadened and is now accommodating close to 100 nations that export some software products or services. The cases of the first tier of the new software exporting nations—the so-called three “T’s”: India, Israel, and Ireland—are the best known and most extensively studied (Arora, Gambardella, and Torrisi 2001, De Fontenay and Carmel 2001).

The interest in software exports has been spurred by the tremendous growth of global demand. The global marketplace in software products and services is estimated at US\$ 200 billion (World Information Technology and Services Alliance 2002: 32). Government policy targeting the sector is driven by the hope that successful software exports will generate direct and indirect benefits to the nation as a whole—spurring broad economic growth, higher standards of living, and poverty reduction. While Kobrin (2000) cautions that for India backward linkages remain limited, current evidence suggests that in the cases of the first tier nations, broader economic effects have made themselves felt.

Such promises raise the question: can a group of newcomers succeed in this very competitive landscape? Does it provide opportunities for—say—the Central European economies, which are still in the process of transition and trying to position themselves in an international economy that frowns at closed national borders? Central Europe comprises 13 nations. With regard to their IT sectors, these economies have not been sufficiently analyzed. In cases where there has been analysis, it has usually focused on the digitization of the economy more generally (e.g., Center for Economic Growth 1999, Infovide 2002).

In an effort to shed more light on this understudied region, we chose three of the more prominent nations as interesting cases in terms of software exports: the Czech Republic, Poland, and Romania. All three are at relatively early stages of exporting software, though all have vibrant

software industries. However, they have yet to make a significant mark in the global software market. That said, there are some important differences between these three nations: while all three aspire to EU membership, the Czech Republic and Poland are further ahead in their accession negotiations. They have a stronger tradition of economic exchange while Romania has a stronger tradition of autarky.

In this paper we will analyze the three software sectors, holding up national data against the literature of national industry success. We will specifically draw on the model developed by Heeks and Nicholson (2002), which will be discussed below. Using their categories as signposts, we will give an overview first of Romania, then of Poland and the Czech Republic. We will then assess to what extent these nations meet the conditions for becoming successful software exporters.

RELEVANT RESEARCH

The examination of national industrial strengths has long been of interest to scholars. An important milestone in the field was the Porter model (1990) of competitive advantage of nations. Based on a broad scanning of successful national sectors, Porter noted factors that must be present to attain world-class stature of a national industry.

Recent empirical studies have found that open, small industrial economies tend to be more internationalized than large economies (Van Hoesel and Narula 1999). The following nations are cases in point: Canada, the Netherlands, Belgium, the four Nordic nations, Switzerland, Taiwan, Singapore, and Israel. This internationalization is especially evident in high-technology industries, such as software. The firms in small European countries, such as the Netherlands, Belgium, Switzerland and Sweden, have higher technological activity abroad, relative to larger advanced economies (Cantwell and Janne 1999).

Central European economies are medium-sized, and they have been open for a while, suggesting some internationalization. Has this openness enabled them to enter high-tech niches such as software? In 2001, we conducted a survey of Central European software exporters (Mroczkowski et al. forthcoming).¹ The goal was to understand how Central European software exporters viewed their prospects to establish national branding in this niche. The research yielded a dataset of 20 observations: nine from Bulgaria, four from the Czech Republic, one from Hungary, four from Poland, and two from Romania (Appendix A).

Our data suggested that Central European software companies were mostly new and young companies with a short export history. Among our respondents, the median number of years of selling outside the home country was 3.5 years, and the median years selling to the U.S. was a mere two years. In 2000, most companies derived \$250,000 or less from sales to the U.S. or Europe, respectively. The companies were small, too. Fifty-five percent of our sample had fifty employees or less. This suggested that the software export industries were small and—by implication—that competition among those firms was limited.

We also asked the respondents about their country's comparative advantages and disadvantages in establishing an IT service sector capable of exporting to the U.S. As advantages, 18 out of 19 respondents cited talented professionals, 14 selected "low cost/low wages." When discussing disadvantages, 13 out of 19 respondents pointed to weakness of government regulation and legal regime, 8 selected "poor reputation," 5 selected "inadequate project managers." We interpreted this as follows. To the extent that these countries have a national vision for the software sector, it has not left its mark on the regulatory framework in which these companies operate. That the reputation of Central European nations is poor suggests that their companies face difficulties in gaining the trust of potential customers from the West. Finally, even though these countries have technical expertise, they still lack in management skills.

Our study suggests that Central European exporters are few in number. They possess some of the assets for competitive success such as technical skill. Other assets, such as trust, are lacking. The results of our study are preliminary and based on the perspective of the producers. For a better understanding of Central European economies' prospects in software, an assessment of the conditions in which producers operate is needed. In this paper, we therefore examine three Central European cases in depth—Romania, Poland, and the Czech Republic. The Software Export Success (SES) Model by Heeks and Nicholson (2002), discussed in the next section, will guide our analysis.

THE SES MODEL

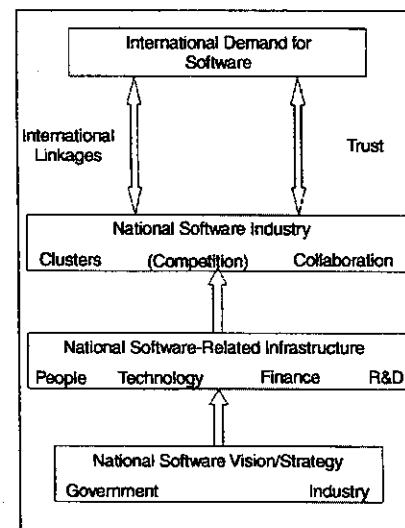
The Software Export Success (SES) Model by Heeks and Nicholson (2002), which is augmented in Carmel (forthcoming), is perhaps the most comprehensive model to date for evaluating national software industries specifically. An important distinction between it and the Porter

(1990) model is that its conditions are much less stringent. Fulfilling them may lead to export success, but not necessarily to world leadership. Heeks and Nicholson developed their model from factors associated with the success of the first tier of new software exporting nations: India, Ireland, and Israel. Then they applied the model to the three nations that form the second tier among software exporters: Russia, China, and the Philippines. The SES model is displayed in Figure 1. We will describe it here in detail since it will serve as our model for examining the three Central European nations.

The SES model is made up of five major factors, some of which comprise several subcategories. The five factors are: demand for software, national software vision and strategy, international linkages and trust, national software industry characteristics, and national software-related infrastructure. Heeks and Nicholson showed that for first- and second-tier software exporters, these factors have combined to determine national export success.

Demand for software. Healthy international demand for software is a necessary condition for successful software exports. This demand has

FIGURE 1. Software Export Success Model



Source: Adapted from Heeks and Nicholson (2002) <http://idpm.man.ac.uk/idpm/dj_wp12>

grown significantly for years and driven the software export sectors of quite a number of nations. The role of domestic demand is less clear, though. By stimulating software production, it may act as a facilitator for the export industry. By crowding out international demand, it may act as a hindrance in national software sector success.

National software vision and strategy. First-tier software exporters all had a national strategy to promote their software sectors in general and software exports in particular. This was a vision "shared by a relatively small but committed group of government officials and private entrepreneurs" (Heeks and Nicholson 2002). In India it was led by the national software industry via the National Association of Software and Service Companies (Nasscom), in Ireland by the quasi-governmental Industrial Development Authority, and in Israel by an agency of the Ministry of Industry and Trade. In order to be successful, national vision has to be more fine-grained than simply a general commitment to "software." It needs to focus on differentiation of the national software industry. The SES model also suggests that we need to distinguish between the *initial* strategy for kick-starting the sector and the *succeeding* or *sustaining* strategy for maintaining its drive. The sustaining strategy for India has been climbing the value chain. For Ireland, it has been diversification, and for Israel innovation and differentiation.

International linkages and trust is a multidimensional category. *International linkages* refers to making and sustaining linkages with markets and customers overseas. Many of these linkages have their roots in national diasporas. In the cases of the three "I's," brain drain helped forge ties between firms in the home country and the diaspora country. In addition, international linkages are built through the more conventional marketing operations set up by the exporting nation: sales offices, industry associations, etc. The other dimension of this factor is *trust*. "Without some degree of trust, no trade takes place" (Heeks and Nicholson 2002). Trust is facilitated by the diaspora linkages and by encouraging multi-national corporations (MNCs) to set up shop in a country. Realizing international software quality benchmarks is another means of establishing trust, because these standards signal to distant clients that companies can deliver high-quality output.² Finally, Heeks and Nicholson find that stricter enforcement of anti-piracy legislation also facilitates trust.³

National software industry characteristics. The many firms that make up a national software industry benefit from three characteristics: healthy competition between local firms; clustering in one or more locations, which provides locational economies and rapid interchange of

ideas and people; and collaboration, as manifested in partnerships between local firms and industry collaboration in associations.

National software-related infrastructure. This is another multidimensional factor. The first subcategory is *people*—also known as *human capital*. It captures the degree to which there is a strong scientific and engineering pool, supported by strong educational institutions. English language skills are important in business and software as is the knowledge about foreign markets. Finally, in some national software sectors low labor costs play a role. The second subcategory is *technology*. A strong technological infrastructure of telecom networks, terminal equipment such as computer hardware, and software, is important. In cases where this is absent on a national basis, "cluster-centered infrastructure," also known as technology parks, is a good alternative. The third subcategory is *finance*—the availability of working capital for growth. Through targeted policies of encouragement and liberalization, governments have fostered investment. In many instances, foreign direct investment (FDI) or venture capital has played an important role. The fourth subcategory is *Research and Development (R&D)*. Investment in either basic or applied R&D can come from governments, military, domestic, or foreign sources.

DATA ON ROMANIA, POLAND, AND THE CZECH REPUBLIC

In the following sections, we present current data pertaining to the SES model for the three Central European countries under study. Some comparative data for these three nations is presented in Table 1. As can be seen, all are small to medium-sized nations, with populations ranging between 23 million and 39 million. They vary considerably in GDP per capita. The Czechs earn more than twice as much (in current international \$) as the Romanians and 1.5 times as much as the Polish. In the following, we will take a closer look at Romania, then Poland, and last, the Czech Republic.

ROMANIA

Demand (for Software)

Before the 1989 revolution, the Romanian IT sector was isolated from the international market. As a consequence, Romanian IT special-

TABLE 1. Selected Indicators for Romania, Poland and the Czech Republic

Indicator	Source	Romania	Poland	Czech Republic
GDP per capita, PPP (current international \$), 2000	1	6,423	9,051	13,991
Population size, in thousand, 2000	1	22,435	38,650	10,273
GDP, PPP (current international \$), 2000	2	144 billion	350 billion	144 billion
Software industry contribution to GDP, 2000, USD million	3	45	387	279
Domestic spending on software in million US\$, 2001	4	46	511	364
Domestic spending on IT hardware in million US\$, 2001	4	209	1,661	822
Software/hardware spending in %, 2001	4	21.8	30.8	44.3
Information and communication technology expenditures (Million US\$, 2000)	1	858	9,570	4,649
ICT spending per GDP, 2001 in, %	1	2.2	5.9	9.5
ICT spending per capita, 2001	4	42.8	271.1	483.3
Personal computers (per 1,000, 2000)	1	32	69	122
Telephone mainlines (per 1,000 people), 2000	1	175	282	378
Telephone mainlines, waiting list, 2000	1	640,000	926,000	31,994
Share of the population aged 25-64 with at least an upper secondary education level, 1999	5	N/A	78	86
Share of the population aged 25-64 with a tertiary education level, 1999	5	N/A	11	11
Average annual software wage, 2000	3	2,484	9,923	10,380

Sources: (1) World Development Indicators Database; (2) Calculated from lines 1 and 2; (3) Datamonitor (2001); (4) World Information Technology and Services Alliance (2002); (5) OECD (2001).

ists supplied the domestic economy with their own custom-built operating systems and applications. After the revolution, this changed, as foreign software packages became available and were increasingly pirated. Grundey and Heeks (1998) report that by 1998, trading or supporting imported packages had become more profitable and more attractive than producing software packages locally. Thus, while there was some local demand, the domestic market for Romanian software products was small, not least due to piracy. Software piracy remains a serious problem in Romania, more so than in the other two nations discussed. The ratio of pirated software is estimated at 77% for the year

2000, although it has decreased since the mid-1990s (International Planning and Research Corporation 2001).

The U.S. Department of State estimated the Romanian computer software market at US\$ 32 million in 2000, with imports at US\$ 24 million. Of these imports, about 75 percent were American. Microsoft and Oracle held the lead, followed by SAP of Germany, Scala of Sweden, Informix of the U.S., and Baan of the Netherlands (U.S. Department of State 2000). The data for exports is somewhat encouraging, though inconsistent. According to InvestRomania (2002), Romanian software and IT services exports rose sharply, from US\$ 29.5 million in 1999 to US\$ 56.7 million in 2001. The State Department, though, estimates total software exports at US\$ 5 million in 2000 (U.S. Department of State 2000).

The destination markets are the U.S. and Europe, though the ratios are disputed. One source reports that in 2000, 36.5% of all Romanian software production was exported, with 53% of exports destined for the European Union and 27% for the U.S. (ARIES 2000).⁴ Another source reports that in 2000, over 50% of Romanian software exports went to the U.S. Of these, 75% came from companies with U.S. capital (U.S. Embassy in Romania. Press and Culture Section 2001).

National Software Vision and Strategy

In the end of 2000, the Romanian government established a Ministry for Communication and Information Technologies, whose mission it is to promote the transition to the information society as envisaged by the European Union. None of the ministry's departments specializes in promoting a strong software sector, even though software development has been recognized as one component of the strategy. In a most interesting move, as of July 1, 2001, the government suspended income taxes on salaries for software companies that employ certified Romanian programmers. In this way the government is trying to encourage Romanian youth to pursue a career in software (PriceWaterhouseCoopers 2001).

Two government agencies are responsible for facilitating FDI in the ICT sector: the Office of Investors of the Ministry of Communication and Information Technologies, and the Romanian Foreign Trade Center, a section in the Ministry of Foreign Affairs. The Office of Investors sees its role more as an information resource, not as an aggressive recruiter of foreign investors. The Romanian Foreign Trade Center's main tasks are export and investment promotion. Its export promotion

activities, though, do not include specialized efforts in the area of ICT (Romanian Foreign Trade Center 2002).

International Linkages and Trust

Romania has suffered from brain drain for many years. A substantial number of IT staff have emigrated, particularly to the U.S. (Grundey and Heeks 1998). However, it is not clear that the software industry has been able to capitalize significantly on this diaspora.

National Software Industry Characteristics

The number of Romanian IT companies is in the thousands, though the vast majority are quite small, often with one or two IT professionals (see Appendix B). According to one source the number rose from 3,408 in 1999 to 4,025 in the year 2000.⁵ Another source estimates the number of firms, however, at only half that amount—at 2,000 (George Mason University. Mason Enterprise Center 2001). To qualify as a substantial software firm, a company has to have at least 100 employees. According to Alexandru Mustea, Executive Director of ANIS, only about 10 firms exceed that threshold, with the largest firm employing 400 persons. Most of the large companies are subsidiaries of large foreign corporations and their activity is totally or partially focused on creating software for foreign markets. Of those companies that are not subsidiaries of foreign corporations, some are privately owned, the others are stated-owned institutes that date back to communist times.⁶ Approximately 100 firms fall into the category of medium-sized firms with 50-100 employees. Most of these companies are creating software primarily for the domestic market, but some have a revenue stream from software exported to Western Europe or the U.S.⁷

The most promising industry characteristics in any nation are well-defined niche markets recognized abroad. In the area of software services, Romanian firms are providing a broad spectrum of web development and other offshore services, though no niches are evident.

The employment size of the Romanian software industry is estimated at 6,000 (Datamonitor 2001), 10,000 (Grundey and Heeks 1998), or 25,000 (UNCTAD/WTO. International Trade Center, 2002). Such wide variations in employment are not unusual—even in the U.S. estimates vary by a factor of about 2.5 times. The software firms are concentrated in the areas of Bucharest, Cluj, Iasi and Timisoara (UNCTAD/WTO, International Trade Center, 2002).

With a relatively small software sector, there are three competing IT business associations—ANIS, ARIES, and AITC.⁸ ANIS has about 70 members, and ARIES 140. This raises the problem of fragmentation of efforts. In the worst case, these associations may even stymie the national success of the sector by engaging in turf wars. Perhaps in order to forestall such an outcome, the three associations, together with two other ICT associations, have joined forces in the "Tech 21 Coalition," which is a pillar of the USAID-sponsored Open Doors Campaign. The Coalition's mission is to work with the government in order to create a business-friendly economic environment. In 2001, it presented the government with five legislative proposals, two of which were adopted (Open Doors Campaign, 2002).

National Software-Related Infrastructure

The first element of software related infrastructure is human capital. After the post-revolution dip in technical training, the situation is improving. Romania has an estimated 25,000 university-educated IT specialists. By 2000, a survey of software firms indicated that "the professional preparation level obtained by the employees in the university" was rated "excellent" by 46% of the firms, while only 7% rated the universities "weak" (ARIES 2000). The State Department has good things to say as well: "Romania's density of software graduates per thousand inhabitants is significantly greater than the rate in the USA, five times that in Russia, and nearly seven times India's rate" (U.S. Department of State 2000).

Not surprisingly, wage levels are low in Romania. ARIES survey results suggest that in 2000, the average monthly net salary of a Romanian project manager was US\$ 494 and of a programmer US\$ 291. Field research by Grundey and Heeks in 1998 also reveals that real earnings in software are low. They found that the monthly wages of the former Electronic Calculus Regional Centers and Calculus Centers averaged from just over US\$ 100 to nearer US\$ 150. Wages in the IT departments of major companies were higher, with at least US\$ 240 on average. Wages in foreign-owned IT firms averaged over US\$ 300 per month.

The second element of software-related infrastructure is technology. Here, Romania is trailing behind the Czech Republic and Poland. In 2000, Romania had only 175 mainlines per 1,000 in 2000. Its waiting list during that year was correspondingly long: 640,000. In number of PCs per 1,000, Romania is also performing poorly, with only 32 per 1,000. This is only one-fourth of the Czech number. Although the coun-

try's ICT expenditures have tripled since 1996, they still constitute a low percentage of GDP: two percent (Table 1).

The third element of software-related infrastructure is finance. In the post-communist era, overall FDI in the Romanian economy increased from US\$ 40 million in 1991, to over US\$1 billion in 2000. Most of the funds come from the Netherlands with an investment stock of US\$ 789 million at the end of 2001. It is followed by Germany, with US\$ 550 million, then Cyprus, Italy, France and the U.S., their respective stock ranging between US\$ 380 million and US\$ 314 million (Hunya 2002).⁹

The fourth element of software-related infrastructure is R&D. In Romania, much of software R&D is carried out either by state-owned institutes or funded by government contracts, particularly through the Ministry for Research and Technology. An important government-funded organization is the Research Institute for Informatics.¹⁰ In 1998, it had some 360 employees. At the time it was the largest software R&D institution and the largest software-producing enterprise. Forty percent of its income was generated by government R&D contracts. However, the government's R&D policy created adverse incentives. Grundey and Heeks (1998) observed that where applications had been funded by the Ministry of Research, any sales income had to be used to pay back the state's investment. Consequently, firms tended to direct their efforts towards winning the next government contract rather than trying to commercialize the applications they had developed.

POLAND

Demand (for Software)

At 54 percent in 2000, software piracy in Poland is rather high (International Planning and Research Corporation 2001). Despite this piracy rate, domestic demand is robust, keeping Polish software producers focused on their home turf. In 2000, the IT market was estimated at US\$ 2.3 billion, with software representing about 25 percent of the amount. About 60 percent of software is supplied by domestic producers, who account for 80 percent of the software in the financial sector, 90 percent in administration, 84 percent in manufacturing, and 45 percent in CAD/CAM. While foreign companies dominate the business software segment for large companies, Polish companies have been strongest in the business software segment for small and medium size enterprises (SMEs). However, as the SME segment becomes more important, foreign suppliers are beginning to eye the market (U.S. Department of Commerce 2000).

National Software Vision and Strategy

Like Romania, Poland is working on implementing the European Union version of the information society. In November 2000, the Polish government adopted a program document entitled "Aims and Directions of Information Society in Poland" (European Union, Information Society Project Office 2001). This technology vision, however, focuses on expanding the possibilities for ICT consumption and establishing a regulatory framework for e-commerce. The development of a software sector is not part of this agenda. There is also no specialized ministry for information and communication technologies, which might champion the cause of software development. The existing Ministry for Infrastructure is focusing solely on matters of transportation and telecommunication.

PAIZ, the Polish Agency for Foreign Investment, is in charge of promoting Poland's investment opportunities and encouraging foreign companies to choose Poland as their preferred investment location.¹¹ However, its focus is on traditional manufacturing sectors such as chemical, construction, packaging, telecommunications and food. It does not single out software development as a strategic sector, but subsumes it under the broader heading of "electronics."

International Linkages and Trust

Within the Polish economy, principal linkages stem from the many foreign firms who have invested in its companies. Poland attracted US\$ 10 billion in FDI in 2000, and US\$ 7.1 billion in 2001. In terms of cumulative investment France dominates, with US\$ 10.2 billion, then comes the U.S. with US\$ 7.8 billion, Germany with US\$ 7.1 billion, the Netherlands with US\$ 4.5 billion, and Italy with US\$ 3.5 billion (Poland Ministry of Economy 2002). Among multinationals, Motorola, IBM and Intel have development centers in Poland.

National Software Industry Characteristics

There are approximately 500 Polish software companies; most are quite small (PAIZ 2001).¹² Poland has roughly 65 technology incubators—for small firms—scattered around the country. While several large firms such as ComArch compete in the international marketplace with products and services, there is no detectable niche in which the group of exporting firms specializes.

Among multinational technology corporations, both Motorola and Intel have software development centers in Poland. Motorola's center,

with an investment of US\$ 18 million, is located in Krakow. Intel has a software and hardware research center in Gdansk, which employs nearly 150 networking engineers and support personnel (Intel n.d.). U.S. software maker Informix (now part of IBM) created a training center in Warsaw for its partners from Central and Eastern Europe in January of 1997. In 2000, IBM opened a software development center in Poland (Financial Times Information 2000).¹³

The software industry is poor in industry collaboration. The Polish Software Market Association does not seem to have a voice and its website is only in Polish.¹⁴ The more established Polish Chamber of Information Technology and Telecommunications (PCITT) counts telecom operators among its members.¹⁵ While telecom providers are interested in maintaining high telephone access charges, providers of software services seek the opposite in order to facilitate business for the software industry. The question therefore arises to what extent PCITT suffers from conflicts of interest.

National Software-Related Infrastructure

The first element of software-related infrastructure is human capital. The country has several high quality institutes of higher education, such as the Polytechnics of Wroclaw, Poznań, Gdańsk, Gliwice, Warsaw and Cracow, the University of Warsaw and the Army Technical Academy in Wroclaw.¹⁶ More recently, private colleges have emerged such as the Polish-Japanese Higher School of Information Technology in Warsaw and the Higher School of Information Technology and Management in Bielsko-Biala.

As far as foreign language skills are concerned, Poland has performed poorly. The OECD Adult Literacy Survey showed that among Poles, only 9.5% claimed to speak at least one major European language (English, Spanish, French, or German). Eight percent of Poles between 16 and 35 claimed ability to hold a conversation in English.¹⁷

Polish wages in the software sector roughly compare to Czech wages. According to CzechInvest, Czech wages are considerably below Polish wages for general categories. A study by Datamonitor (2001), with data specific to the software wages, indicates that Polish wages are slightly lower than those in the Czech Republic (Table 2). However, if we compare these data with those for Romania, we find that Romanian wage costs are much lower than costs in both Poland and the Czech Republic (Table 1 and Romania section).

TABLE 2. Comparative Wages in Two Strongest Central European Economies

	Czech Republic	Poland
General manager average monthly US\$*	2,640	5,886
R&D engineer average monthly US\$*	1,013	2,092
The 2000 average annual software wage in US\$**	10,370	9,920

*Source: Adapted from Czechinvest n.d. (a).

**Source: Adapted from Datamonitor 2001.

The second element of software-related infrastructure is technology. While Poland is ahead of Romania, it is behind the Czech Republic. Teledensity is rather low, with 282 per 1,000 in the year 2000. Correspondingly, Poland had a 2000 waiting list of almost 1 million. In number of personal computers per 1,000, Poland also performs poorly, with only 69 in 2000. ICT expenditures in Poland tripled between 1996 and 2000. Overall ICT expenditures in Poland are highest, almost ten billion US\$ in 2000. However, if we standardize ICT expenditures on the basis of GDP, Poland does not look as impressive (Table 1).

The third element of software-related infrastructure is finance. Foreign investment in a variety of software-related ventures, as described above, has been the main catalyst for a sector largely neglected by government policy.

The fourth element of software-related infrastructure is R&D. All government support for separately budgeted research is channeled entirely through the State Committee for Scientific Research. Established in 1991, it is the supreme authority on policy in the area of science and technology (KBN n.d.). Other R&D is conducted by foreign multinationals and by some of the larger Polish software firms.

CZECH REPUBLIC

Demand (for Software)

In 2000, the Czech Republic spent nine percent of GDP on ICT, 1.5 times as much as Poland, and 4.5 times as much as Romania. On a per-capita basis this is 1.8 times as much as Poland and twelve times as much as Romania. This level of expenditures suggests a healthy demand that undoubtedly has spurred the development of software ser-

vices. It is not clear, however, if this healthy demand has, on balance, spurred or inhibited the software export sector.

Software piracy poses less of a problem in the Czech Republic than it does in Poland and Romania. The 2000 ratio of pirated software is estimated at 43 percent, the lowest in the region (International Planning and Research Corporation 2001).

National Software Vision and Strategy

As the Czech Republic is seeking EU membership, it has adopted the EU approach to the information society. However, as is the case in Poland, the vision focuses on expanding the possibilities for ICT consumption and establishing a regulatory framework for e-commerce. The development of a software sector is not part of this agenda.

Out of the 15 ministries that make up the Czech cabinet, two have responsibilities that touch on ICT and software: the Ministry of Transport and Communication and the Ministry of Industry and Trade.¹⁸ While the former is unlikely to set a software-related vision, such a task would fall within the purview the Ministry of Industry and Trade, which is in charge of promoting industry and external trade. However, the ministry's focus is on the traditional heavy industry. In its trade division, CzechInvest, a lower-level agency with promotion and image responsibility, has adopted the cause of the software sector. CzechInvest's website is highly professional, i.e., well-designed, written in four languages and featuring full-fledged search capabilities. The agency courts investors by presenting the Czech Republic as the only EU candidate country with patent protection at European levels (CzechInvest n.d. (b)).¹⁹ The agency promotes the Czech Republic as a location for software development and software R&D, and for this purpose it even opened an office in Silicon Valley in 2000. Software development tops its list of strategic service sectors (CzechInvest n.d. (d)).²⁰ Spurred by a June 2002 CzechInvest study, the Czech government introduced two framework programs, namely *Framework Program for Support of Strategic Services Projects* and *Framework Program for Support of Establishment and Expansion of Technology Centres* (CzechInvest 2000).²¹ These can be viewed as setting a national vision for the software industry. The new programs have extended the existing framework of investment incentives for the manufacturing industry, and are supposed to strengthen the Czech Republic's position of an IT hub in the Central European region.

International Linkages and Trust

The Czech Republic benefits from the geographic proximity to Western Europe. It shares borders with two German-speaking countries, Austria and Germany. This is augmented by cultural closeness between the nation and its German-speaking neighbors. Indeed, among foreign investors, Germany has been the most important origin country, with a capital stock of US\$ 5 billion by 1999. It is followed by the Netherlands with US\$ 4.6 billion, Austria with US\$ 2.2 billion, and the U.S. with US\$ 1.7 billion. Then comes Belgium with US\$ 1.4 billion, and the UK with US\$ 850 million (Embassy of the Czech Republic in Washington, DC n.d. (a)). The significant FDI has created a plethora of international linkages that will continue to benefit the Czech economy.

National Software Industry Characteristics

Czech software exports stem primarily from foreign technology firms that have established a presence in the Czech Republic. These firms have acquired or opened small software centers. Among them are IBM, Sun, and Logica. In 2001, Panasonic opened a software development center in Pilsen employing eight engineers. The plan was to increase the number to 45 by 2005 (Financial Times Information 2001 (a)). In addition, the following firms have R&D and design centers in the Czech Republic, though much of this list is not software: AVX (Kyocera), Boeing, Bosch, Ericsson, Honeywell, Matsushita Electric, Mercedes-Benz, Motorola, Philips, Rockwell Automation, Siemens, ThermoKing (Ingersoll-Rand), Viscofan, and Visteon (CzechInvest n.d. (b)). One case of a software developer is German Appliware Elektronik GmbH which has had a development center in Czech Republic since 1991 (SPACE Program n.d.).²²

In the area of home-grown software companies, there are some success stories. Several Czech companies are seeking offshore software development contracts. Among them are Qbizm and PC-Progress, to name only two. The Czech company Tiny Software sold US\$ 3.5 million in security software products in 2000 (Financial Times Information 2001 (b)). This figure does not include revenue from its contract with the U.S. Air Force for provision of security software. Seventy percent of the firm's sales are in the U.S.

Most software services and software firms cluster in metro Prague, in Brno and Pilsen. The industry has not been very successful in establishing a way of collaborating. The Czech Software Industry Association has little influence and its web site has no translations to English or German.²³

National Software-Related Infrastructure

The first factor is human capital. The country has a strong engineering tradition. The Czech Technical University in Prague claims to be the largest technical university in Europe, with 18,600 students. Per year, the country is producing 5,000 computer science related graduates (CzechInvest n.d. (f)).

The Czech Republic is competitive in wages relative to Western Europe, but among Central European nations, it is at the high end. As the data in Table 1 demonstrate, Czech wages in software may be somewhat higher than in Poland and are certainly higher than those of the software competition in Asia.

As far as foreign language skills are concerned, the Czech situation is acceptable though not strong. The OECD Adult Literacy Survey showed that among Czechs, 27 percent claimed to speak at least one major European language (English, Spanish, French, or German). Twenty-eight percent of Czechs between 16 and 35 claimed ability to hold a conversation in English.²⁴

The second factor is technology. Infrastructure in the Czech Republic is very good, approaching Western European levels. In 2000, teledensity in the Czech Republic was 350 to 370 per 1,000, which is much higher than the equivalent value for Poland (282 per 1,000) and Romania (175 per 1,000). In number of personal computers per 1,000, the Czech Republic leads as well, with 122 in 2000. Then comes Poland with 69. Romania has only 32 (Appendix).

The third factor is finance. The Czech economy has seen a significant increase in FDI inflows—from US\$ 600 million in 1991 to US\$ 4.5 billion in 2000 (World Development Indicators Database). On a per capita basis, it is thus performing better than Poland, which has four times the population size, but only twice the amount of FDI—US\$ 9.3 billion in 2000.²⁵ FDI in the IT sector increased significantly in the boom years, increasing from US\$ 1.3 billion in 1997 to US\$ 4.6 billion in 2000, mostly in the telecommunications sector. The specific flows into software are not available.

The fourth factor is R&D. Government support for R&D generally takes the form of institutional funding and project funding. R&D policy is overseen by the Research and Development Council, established in 1992 that also oversees the Czech Grant Agency. It in turn awards and administers scientific and R&D grants (Embassy of the Czech Republic in Washington, DC n.d. (b)). The government also promotes R&D cooperation between industry and academic institutions. The “Research

Centers” program of the Ministry of Education, Youth and Sports is specifically designed for this purpose (European Union, European Commission 2001).²⁶ An example of such cooperation is Ericsson’s R&D center, which is located at the Czech Technical University in Prague (CzechInvest n.d. (c)).

SUMMARY AND ANALYSIS

The findings of this comparative discussion add texture and depth to the preliminary results of our exploratory survey (Mroczkowski et al. forthcoming). They introduce dimensions that the previous study left untouched. A concise comparison of the results of the present study is provided in Table 3. In the following, we will discuss the factors of the SES model in turn.

Demand

As far as domestic demand is concerned, there are considerable differences among the three countries. In Romania, domestic demand is weak, not least due to piracy. Stronger demand might help kick-start the

TABLE 3. Strengths and Weaknesses of the Three Central European Nations

	Czech Republic	Poland	Romania
Demand (for software)	Moderate to strong domestic.	Strong domestic.	Weak domestic.
National software vision and strategy	Medium. Active trade promotion agency champions software development sector.	Weak. No government strategy at all.	Low until recently.
International linkages and trust	Weak diaspora links. Emerging EU links. MNC activity. Low trust.	Weak diaspora links. Emerging EU links. MNC activity. Low trust.	Weak diaspora links. Some foreign investment in local firms. Low trust.
National software industry characteristics	Weak competition and collaboration. Weak clusters.	Weak competition and collaboration. Weak clusters.	Weak competition and collaboration. Weak clusters.
National software-related infrastructure	Strong, moderate-cost, moderate-language human capital; good infrastructure and weak finance.	Strong, moderate-cost, weak-language human capital; weak infrastructure and weak finance.	Strong, low-cost, weak-language human capital; cluster-based infrastructure and weak finance.

sector. In Poland, the opposite is true, despite relatively high piracy. Here, software producers have largely been content serving the domestic market and not felt the necessity to look outward. The Czech Republic, the Central European "poster country" in terms of low piracy, lies in the middle.

National Vision

The absence of a national strategy is common to all three nations, and presents a major weakness. Until recently, none of the three nations had developed a serious national vision for the software industry. The vision came neither from the government nor from the weak (or non-existent) industry collaborative efforts. This is beginning to change, as we noted for the Czech Republic and Romania. However, even in those cases strategies are fairly unspecific and do not address what niches the industry should focus on and how it might differentiate itself from other nations.

A minor element in national strategy is the implementation of the EU Information Society initiative. Even though it does not focus on IT production, but expansion of consumption, it creates awareness among the population that IT is important. As a consequence, it may provide some boost for the nascent software industry in the three countries under study.

Linkages and Trust

Regarding the issue of trust, Heeks and Nicholson (2002) point to curbing piracy rates as an important trust-building measure. In this judgment, they are backed by investment and technology siting reports, which frequently note the endemic piracy problem of all post-communist nations. We find that high piracy rates may stifle the growth of software start-ups that produce for the domestic market. For this reason, we discussed piracy as one aspect of domestic demand. However, from our many discussions with technology managers over the years, we note that this factor plays a minor role—if that—in technology purchase and investment decisions by foreign companies. Rather, piracy is simply one data point in a landscape of corruption and crime from which Central European nations are struggling to extricate themselves.

Linkages present the most promising dimension for the three Central European nations. The prospect of EU membership matters: while all three seek and maintain relations with the U.S., they lean more heavily towards the European Union, and EU membership is at the top of the national agenda. As a result, software firms naturally seek collaboration

with EU firms. Integration into the EU also means participation in its "community building" programs. EU enlargement candidate countries have had the opportunity to participate in the 2001-2005 Multiannual Program for Enterprise and Entrepreneurship. This program facilitates access to finance for small and medium-size enterprises (SMEs) (European Union, European Commission, 2002 (a)). It has also established over 50 "Euro Info Centers" in the various candidate countries. Their purpose is to advise and assist SMEs in all Europe related areas (European Union, European Commission 2002 (b)).

Adoption of the *acquis communautaire*, the body of EU law, will result in procedural and legal standardization. This in turn will increase trust and lower transaction costs not only for West Europeans, but also for Americans and Japanese trying to do business in the East.

National Software Industry Characteristics

Competition and clustering are weak across the countries. We find that efforts at industry collaboration are still young. In Romania, there are three software business associations. This raises the specter of turf war, which may do more damage than good to the industry. The inclusion of the associations in the USAID-sponsored "Tech 21 Coalition" may help prevent such an outcome. The Polish Software Market Association does not seem to have a voice. The same is true for the Czech Software Industry Association.

National Software-Related Infrastructure

Spending on all aspects of ICT varies across the three nations in question. Overall ICT expenditures in Poland are highest, almost US\$ 10 billion. However, if we standardize ICT expenditures on the basis of GDP, Poland looks weaker: in 2000, the country spent a mere six percent of GDP on ICT. If we convert the data into per capita expenditures, we obtain similar results: in 2001, the Czech Republic spent US\$ 483 on ICT; Poland spent slightly more than half of the Czech amount, with US\$ 271. Romania trails far behind, with US\$ 42.

The issue of Internet and landline diffusion in Central European countries has received much attention (e.g., Franda 2001). We find that low overall Internet or landline penetration rates need not be an impediment to the development of a software sector. In bimodal countries like Romania and Poland, the software industry is concentrated in the well-educated, wealthy metro areas in which Internet penetration and

telephone penetration is high (though not in western European standards). The very low diffusion rates in the rural, agricultural areas of Poland and Romania are only relevant to the degree to which they hold down domestic demand. This is analogous to what has happened in the success case of India. In India, the disparity at all socio-economic and technology levels between the tech hub of Bangalore and the rural areas are immense—much larger than anything in central Europe.

One of the important components of national software infrastructure is human capital. Indeed, the macro-data we presented thus far indicates that the technical skill base in these countries is well-developed. The three nations, and particularly Romania, can boast a plentiful, low-cost, educated labor pool. This factor condition will continue to benefit these nations in software into the medium-term. All three nations benefit from a well-educated, literate, and technically trained workforce that most of the world's nations would be pleased to attain. Nevertheless, some key human capital dimensions are weak, namely business skills and language skills (English, German). Dozens of nations now export software services and most emphasize cost as a major competitive factor. Romania's significantly lower wages make the nation competitive with Asian destinations.

LOOKING INTO THE FUTURE

What do these findings mean for the Czech Republic, Poland and Romania? What prospects do these countries have in software? Together with most experts close to Central Europe and to Russia, we do not see these countries as competition for India, whose specialization is the provision of generic software services at low cost. With their highly skilled workforces and their strong engineering traditions, they are more likely to compete with similar-sized smaller companies in Western Europe. They may even snatch some contracts away from Israel, a high-cost country specializing in product R&D and R&D services (Ha'aretz, 2002).

Either way, these countries are far removed from being software exporters with global branding. In order to gain a reputation as competitive software exporters, these nations need to develop strategies that address how their software industries will compete in global markets. This puts demands both on Central European governments and on IT business associations. Several steps can be taken in that direction.

Governments could facilitate the development of their software sectors, by creating a suitable legal infrastructure and by addressing macro-economic shortcomings that deter investment. A specialized portfolio

for technology policy might act as liaison with industry representatives and ease their access to government.

Private sector business associations can create an effective national IT industry lobby and contribute to the formation of a national vision for software. In addition, these associations can provide valuable resources for their members. Examples are pertinent information on their country's legal framework and on EU resources their members might try to tap. To gain political clout, however, associations need to educate companies that paying membership dues is an investment in the future rather than a waste of money.

Finally, companies need to work together to strengthen their business associations. They also need to upgrade their management skills and learn more about the specific needs, requirements, and business practices of their Western customers. Here, the European Union might be a good resource, both in terms of funding and technical expertise. Its new Euro Info Centers, discussed in the previous section, can serve as a first point of inquiry.

NOTES

1. The authors wish to acknowledge the support of the German Marshall Fund of the United States, which made research for this survey possible through their grant for the project "Opportunities and Barriers to Integrating Central Europe into the Transatlantic Information Economy."

2. Examples of such standards are CMM, the Capability Maturity Model, or the ISO 9000 standard family, issued by the International Organization for Standardization. CMM and ISO are recognized software quality benchmarks that rely on outside audits. While imperfect, they do give outsiders some assurance of software professionalism.

3. However, we subsume piracy under "domestic demand," because it effectively reduces local demand for software products and thus impedes the emergence of a local industry.

4. The survey was conducted among companies that participated at the BINARY 2000 event, October 2000. BINARY 2000 is the National Exhibition of Evaluation for Software Production. There is no information about the number of the companies that completed the survey.

5. Interview with Alexandru Mustea, Executive Director of ANIS; October 17, 2001.

6. An example is the Research Institute for Informatics.

7. Interview with Alexandru Mustea, Executive Director of ANIS; October 17, 2001.

8. The website of ATIC, the Association for Information Technology and Communications of Romania, is located at: <http://www.atic.org.ro/>. The website of ANIS, the Romanian National Association of Software Enterprises, is at: <http://www.anis.ro/romana/index0.html>. The website of ARIES, the Romanian Association for Electronic and Software Industry, is at <http://www.aries.ro>.

9. Similar values can be found in Romania Factbook (2002).

10. The website of the institute is located at <http://www.ici.ro/ci/presentation.html>.
11. Its website is at <http://www.paiz.gov.pl>.
12. According to the U.S. Department of Commerce (2000), some of the largest Polish software companies are Prokom Software, Softlab Trade, Spin Katowice, Comp Rzeszow, Fast Systemy Komputerowe, Emak, Altkom Matrix, Hector, ZETO Katowice and Impaq Polska.
13. See also IBM 2000.
14. Its website is at <http://www.pro.org.pl/>.
15. PCITT's website is at <http://www.piit.org.pl/ang/index.xml>.
16. A listing of Polish technical universities can be found at <http://www.kbn.gov.pl/en/units/school.html#02>.
17. OECD; Adult Literacy Survey 1994-5 and SIALS-Second Adult Literacy Survey 1998, quoted in CzechInvest n.d. (a).
18. The Ministry of Transport has a website at <http://www.mdcz.cz/english/index.htm>. The Ministry of Industry has a website at <http://www.mpo.cz>.
19. For more information on R&D and Design Centers maintained by foreign investors, see CzechInvest n.d. (c).
20. See also CzechInvest n.d. (e).
21. See also CzechInvest n.d. (e). The Framework Program for Strategic Services can be downloaded at [http://www.czechinvest.org/ci/ci_an.nsf/aad3b09d92ef6a79c12568fb005d38ad/e248285ae951aabc1256b1d0065459e/\\$FILE/Framework%20Programme-Strat.Services.pdf](http://www.czechinvest.org/ci/ci_an.nsf/aad3b09d92ef6a79c12568fb005d38ad/e248285ae951aabc1256b1d0065459e/$FILE/Framework%20Programme-Strat.Services.pdf).
22. Appliware's website is at <http://www.appliware.com>.
23. Its website is located at <http://www.asocpor.cz/>.
24. OECD; Adult Literacy Survey 1994-5 and SIALS-Second Adult Literacy Survey 1998, quoted in CzechInvest n.d. (a).
25. Foreign direct investment, net inflows (BoP, current million US\$). Source: World Development Indicators Database.
26. The Czech Ministry of Education has a website at <http://www.msmt.cz/>.

REFERENCES

- ARIES. 2000. Survey Results of BINARY 2000 Participants. Downloadable (as zipped archive) from <http://www.aries.ro/statistics.html>. Accessed 09/09/02.
- Arora, Ashish, Alfonso Gambardella, and Salvatore Torrisi. 2001. *In the Footsteps of Silicon Valley? Indian and Irish Software in the International Division of Labour*. SIEPR Policy Paper Series, Paper No. 00-41. Stanford, CA: Stanford Institute for Economic Policy Research. Available online: http://siepr.stanford.edu/papers/papers_num.html. Accessed 09/09/02.
- Cantwell, John, and Odile Janne. 1999. The Internationalization of Technological Activity: The Dutch Case. In *Multinational Enterprises from the Netherlands*, eds. Roger van Hoesel and Rajneesh Narula. London, United Kingdom: Routledge.
- Carmel, Erran. Forthcoming. The Globalization of Software Outsourcing to Dozens of Nations: A Preliminary Analysis of the Emergence of 3rd and 4th Tier Software Exporting Nations. In *The Digital Challenge: Information Technology in the Development Context*, eds. S. Krishna and Shirin Madon. Aldershot, United Kingdom: Ashgate.

- Center for Economic Growth. 1999. Initiative on Internet for Economic Development: Initial Survey of Bulgaria, September 19-20, 1999. Study conducted for the United States Agency for International Development. Online: http://www.dec.org/pdf_docs/PNACH835.pdf
- CzechInvest. 2000. "News-CzechInvest: Surveying the Service Sector." July 24, 2000. Online: [http://www.czechinvest.org/ci/ci_an.nsf/\(DokumentyWS\)/4E136061C393CF24C125692900349C78?OpenDocument](http://www.czechinvest.org/ci/ci_an.nsf/(DokumentyWS)/4E136061C393CF24C125692900349C78?OpenDocument). Accessed 09/07/02.
- CzechInvest. N.d. (a). "Cost Driver Analysis." Online: [http://www.czechinvest.org/ci/ci_an.nsf/\(ReasonsToInvestWD\)/CostDriverAnalysis?OpenDocument](http://www.czechinvest.org/ci/ci_an.nsf/(ReasonsToInvestWD)/CostDriverAnalysis?OpenDocument). Accessed 09/07/02.
- CzechInvest. N.d. (b). "Research and Development." Online: [http://www.czechinvest.org/ci/ci_an.nsf/\(KeySectorsWD\)/ResDevelop?OpenDocument](http://www.czechinvest.org/ci/ci_an.nsf/(KeySectorsWD)/ResDevelop?OpenDocument). Accessed 08/16/02.
- CzechInvest. N.d. (c). "R&D and Design Centres." Online: [http://www.czechinvest.org/ci/ci_an.nsf/\(KeyServiceSectorWD\)/RDDesignCentres?OpenDocument](http://www.czechinvest.org/ci/ci_an.nsf/(KeyServiceSectorWD)/RDDesignCentres?OpenDocument). Accessed 09/13/02.
- CzechInvest. N.d. (d). "Key Service Sectors." Online: http://www.czechinvest.org/ci/ci_an.nsf/KeyServiceSector?OpenPage, accessed 09/07/02.
- CzechInvest. N.d. (e). "Investment Incentives for Strategic Services and Technological Centers." Online: [http://www.czechinvest.org/ci/ci_an.nsf/\(DokumentyWS\)/E248285AE951AABEC1256B1D0065459E?OpenDocument](http://www.czechinvest.org/ci/ci_an.nsf/(DokumentyWS)/E248285AE951AABEC1256B1D0065459E?OpenDocument). Accessed 09/07/02.
- CzechInvest. N.d. (f). "FAQ-Skills in the Czech Republic." Online: [http://www.czechinvest.org/ci/ci_an.nsf/\(FAQsW\)/D90792E41155C34AC1256ADB0031218B?OpenDocument](http://www.czechinvest.org/ci/ci_an.nsf/(FAQsW)/D90792E41155C34AC1256ADB0031218B?OpenDocument). Accessed 09/07/02.
- Datamonitor. 2001. *The Impact of the Software Sector on the Economies of Eastern Europe*. June. New York, NY: Datamonitor (URL: <http://www.datamonitor.com>).
- De Fontenay, Catherine, and Erran Carmel. 2001. *Israel's Silicon Wadi: The Forces Behind Cluster Formation*. SIEPR Policy Paper Series, Paper No. 00-40. Stanford, CA: Stanford Institute for Economic Policy Research. Available online: http://siepr.stanford.edu/papers/papers_num.html. Accessed 09/09/02.
- Embassy of the Czech Republic in Washington, DC. N.d. (a). "Czech Economic Recovery Hopes Grow—Results by Country of Origin." Online: http://www.mzv.cz/washington/ekon/ekon_us/recovery.htm. Accessed 09/07/02.
- Embassy of the Czech Republic in Washington, DC. N.d. (b). "Research and Development Council." Online: http://www.mzv.cz/washington/general/sc_1.htm. Accessed 09/08/02.
- European Union. European Commission. 2001. "Access to research and innovation; better use of patents by SMEs—Czech Republic." Online: http://europa.eu.int/comm/enterprise/enterprise_policy/enlargement/cc-best_directory/research/czech_republic.htm. Accessed 08/16/02.
- European Union. European Commission. 2002 (a). "EU Institutions Press Releases: EU enlargement candidate countries to take part in the EU enterprise policy programme." July 26, 2002. Online: http://europa.eu.int/rapid/start/cg/guesten.ksh?p_action.gettxt=gt&doc=IP/02/1160|0|RAPID&lg=EN. Accessed 09/08/02.
- European Union. European Commission. 2002 (b). "Euro Info Centres—Europe Closer to Businesses." August 19, 2002. Online: <http://europa.eu.int/comm/enterprise/networks/eic/eic.html>. Accessed 09/08/02.

- European Union. Information Society Project Office. 2001. "IS Promotional Activities: Poland Summary Report (1999-2000)." February 2001. Online: <http://www.eu-esis.org/esis2prom/PLprom7.htm>. Accessed 09/06/02.
- Financial Times Information. 2000. "IBM to set up 7 Linux development centers in Asia Pacific" September 8, 2000. Online: Lexis Nexis Academic Universe (Online database: <http://www.lexisnexis.com/academic/universe/academic/>).
- Financial Times Information. 2001 (a). "Panasonic opens new lab for software development in Plzen." November 15, 2001. Online: Lexis Nexis Academic Universe (Online database: <http://www.lexisnexis.com/academic/universe/academic/>).
- Financial Times Information. 2001 (b). "Release 3.0 Tiny Software's big numbers, and dashing a web of myths the latest in high-tech." March 19, 2001. Online: Lexis Nexis Academic Universe (Online database: <http://www.lexisnexis.com/academic/universe/academic/>).
- Franda, Marcus. 2001. *Launching into Cyberspace: Internet Development and Politics in Five World Regions*. Boulder, CO: Lynne Rienner.
- George Mason University. Mason Enterprise Center. 2001. *IT Outsourcing Romania*. Marketing brochure. Arlington, VA, 2001.
- Grundey, Mihaiela and Richard Heeks. 1998. *Romania's Hardware and Software Industry: Building IT Policy and Capabilities in a Transitional Economy*. Development Informatics Working Paper Series, Paper No. 2. Manchester, United Kingdom: University of Manchester, Institute for Development Policy and Management. Available online: <http://idpm.man.ac.uk/idpm/di2.pdf>. Accessed 09/05/02.
- Ha'aretz, Israel losing to Eastern Europe. June 2, 2002.
- Heeks, Richard, and Brian Nicholson. 2002. *Software Export Success Factors and Strategies in Developing and Transitional Economies*. Development Informatics Working Paper Series, Paper No. 12. Manchester, United Kingdom: University of Manchester, Institute for Development Policy and Management. Available online: http://idpm.man.ac.uk/idpm/di_wp12.htm.
- Hunya, Gabor. 2002. FDI in South-Eastern Europe in the Early 2000s: A Study Commissioned by the Austrian Ministry of Economy and Labour, Vienna, Austria: The Vienna Institute for International Economic Studies. Available online at <http://www.oecd.org/pdf/M00032000/M00032256.pdf>. Accessed 09/06/02.
- IBM. 2000. "IBM launches \$200 million Linux initiative in Europe, including major new European Linux development Centers." July 21, 2000. Online: <http://www-916.ibm.com/press/prnews.nsf/prinu/9FBDB7700322FB2E8525692A005EA980>. Accessed 09/09/02.
- Infovide. 2002. e-Readiness and e-Needs Poland. Online: <http://www.developmentgateway.org/node/137849/poland/erna.pdf>. Accessed 09/05/02.
- Intel. N.d. "Poland Intel locations." Online: <http://www.intel.com/jobs/poland/sites/>. Accessed 09/06/02.
- International Planning and Research Corporation. 2001. *Sixth Annual BSA Global Software Piracy Study*. Washington, DC: Business Software Alliance. Available online: <http://www.bsa.org/resources/2001-05-21.55.pdf>. Accessed 09/05/02.
- InvestRomania 2002. "Business Daily. Economy. IT&C Flurries." Online: http://www.investromania.ro/magazine/last_issue/24flurries.html. Posted May 21, 2002. Accessed 07/16/02.

- KBN (Polish State Committee for Scientific Research). N.d. "Financing of R&D." Online: <http://www.kbn.gov.pl/en/general/rd.html>. Accessed 09/07/02.
- Kobrin, Stephen J. 2000. Development After Industrialization: Poor Countries in an Electronically Integrated Global Economy. In *The Globalization of Multinational Enterprise Activity and Economic Development*, ed. Neil Hood and Stephen Young, 133-154. New York, NY: St. Martin's Press.
- Lexis-Nexis Academic Universe. Online database: <http://www.lexisnexis.com/academic/universe/academic/>
- Mroczkowski, Tomasz, Erran Carmel, and Nivien Saleh. Forthcoming. The Competitiveness of Central European IT Exporters: Can this Sector Attract Western Investment? *Journal of East European Management Studies*.
- OECD (Organization for Economic Cooperation and Development). 2001. OECD Science, Technology and Industry Scoreboard 2001: Towards a Knowledge-Based Economy. Paris, France: OECD. Available online: <http://www1.oecd.org/publications/e-book/92-2001-04-1-2987/>. Accessed 09/10/02.
- Open Doors Campaign. 2002. "The Tech 21 Coalition: Legislative Agenda/Draft Public Policy Advocacy Strategy, Information Technology and Communications Sector, July 2002." Online: http://www.opendoorscampaign.org/eng/tech21_1.html. Accessed 09/13/02.
- PAIZ (Polish Agency for Foreign Investment). 2001. Open Poland: A Huge Growth Potential of the Polish Electronics Sector. Online: <http://www.paiz.gov.pl/library/file/Electro.pdf>. Accessed 09/07/02.
- Poland Ministry of Economy. 2002. "Foreign direct investment in Poland 2001." Online: http://baltic.mg.gov.pl/invest/direct_inv.htm. Accessed 09/06/02.
- Porter, Michael E. 1990. *The Competitive Advantage of Nations*. New York, NY: Free Press.
- PriceWaterhouseCoopers. 2001. "Romania, Flash Report No. 35, 03 July 2001: 'Individual income tax exemption for employees working in the software development industry.'" Available online: http://www.pwcglobal.com/ro/eng/ins-sol/survey-rep/flashrep/pwc_flash2001_35.pdf. Accessed 09/05/02.
- Romania Factbook. 2002. "Foreign Investments by Country of Origin." Online: <http://www.factbook.net/forinvcountry.php>. Accessed 09/13/02.
- Romanian Foreign Trade Center. 2002. "Program of the Romanian companies participation, under national flag, in international fairs and exhibition, during the year 2002." Online: <http://www.traderom.ro/en/Export%20Promotion/PROGRAM-TarguriENG2002.htm>. Accessed 09/05/02.
- SPACE Program. N.d. "Consultants-Customer Design Services at the Half Price-Appliware Elektronik." Online: <http://www.spacetools.com/tools4/space/385.htm>. Accessed 09/07/02.
- UNCTAD/WTO. International Trade Center. 2002. International Market Prospects for Information and Communications Technology Industries from Romania: Country Export Potential Profile. Background paper for the National Business Roundtable in Bucharest, Romania, 8-9 March 2002. Downloadable from <http://www.aries.ro/statistics.html>. Accessed 09/05/02.
- U.S. Department of Commerce. 2000. "CEEBICnet Market Research-Poland: Application Software." May 23, 2000. Available online: <http://www.mac.doc.gov/eebic/countryr/poland/market/plsoftware.htm>. Accessed 09/06/02.

U.S. Department of State. 2000. *FY2001 Country Commercial Guide: Romania*. Washington, DC: U.S. Department of State. Available online: http://www.state.gov/www/about_state/business/com_guides/2001/europe/romania_ccg2001.pdf. Accessed 09/09/02.

U.S. Embassy in Romania. Press and Culture Section. 2001. "Press release, February 23, 2001: 'Ambassador Rosapepe: Silicon Valley 'invades' Romania; number of new U.S. software companies here doubled last year; highlights spectacular growth of the U.S. investments in the Romanian information technology market at press conference.'" Available online: <http://www.usembassy.ro/Documents/prelITEn.htm>. Accessed 09/05/02.

Van Hoesel, Roger, and Rajneesh Narula. 1999. "Outward Investment from the Netherlands." In *Multinational Enterprises from the Netherlands*, eds. Roger van Hoesel and Rajneesh Narula. London, United Kingdom: Routledge.

World Development Indicators Database. Online database: <http://devdata.worldbank.org/query/>.

World Information Technology and Services Alliance. 2002. *Digital Planet 2002: The Global Information Economy*. Arlington, VA: World Information Technology and Services Alliance.

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APPENDIX A

The Central European Software Export Study

In this study, we conducted structured interviews with representatives of export-oriented IT companies from five central European countries. Our research approach—locating respondents through incremental research—yielded firms with particularly high international visibility. We can therefore assume that our respondents are at the forefront of the industry. The dataset exceeds the focus of the current study, as it includes observations from Hungary and Bulgaria. However, we found no country-specific variance among respondents, and the questions we asked were general and addressed characteristics that are common to the region. We therefore conjecture that the study provides valuable cues with respect to the Czech Republic, Poland, and Romania.

APPENDIX B

Romanian Software Exporters

Quite a number of Romanian companies are attempting to acquire offshore software development contracts. The following is a selection of companies that advertise their offshore development abilities in English over the Internet.

Company	URL
Algoritma	http://www.algoritma.ro/eng/d_msie.htm
Profiware	http://www.profiware.com/services.html
eSoftdev	http://www.esoftdev.net/outb2.jsp
IPACRI Romania	http://www.ipacri.ro/
Deuromedia	http://www.deuromedia.ro/english/firma/profil.asp
Softwin	http://www.softwin.ro/en/index.php
Infopulse	http://www.infopulse.ro/eng/
Genesys	http://www.genesys.ro/
Dante	http://www.dante.ro/index.html
Infotim	http://www.infotim.ro/en/infohome.htm
Comet	http://www.comettech.com/SoftwareDevelopment.asp

Top Romanian software exporters (year 2000)—million USD

IBM Romania	3.43
Microsoft Romania	2.8
Softwin	2.4
Kepler Prodimpex	2.01
UBI Soft	1.88
Finisel Romania	1.83
Deuromedia	1.56
Printec Group Romania	1.3
Romanian Data Soft	1.3
IPACRI Romania	1.26

Source: Adapted from InvestRomania (2002)