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Does Internet Connectivity Affect Export Performance?

Evidence from the Transition Economies

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Abstract

Over the past few years, many commentators have suggested that the Internet is one of the forces driving globalization. This paper tries to assess one aspect of these claims, looking at whether Internet access appears to affect the export performance of enterprises in low- and middle-income economies in Eastern Europe and Central Asia. The papers finds that even after controlling for self-selectivity bias and for factors that might affect both exports and Internet connectivity, enterprises with Internet access appear to export more than similar enterprises without access. Further, Internet access appears to affect industrial and service enterprises to similar degrees.

Keywords: exports, information technology, FDI

JEL classification: F15, O14, O30

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1 Introduction

Two of the most dramatic changes over the past ten years have been 'globalization', reflected in a massive increase in foreign capital flows and international trade, and the revolution in information technology (IT). In real terms (US$ 1995), total world exports increased from US$4.8 trillion (19.3 per cent of gross world product) in 1990 to US$8.2 trillion dollars (26.9 per cent of gross world product) between 1990 and 1999 (World Bank 2001). Over the same period, inward foreign direct investment increased from 1.0 per cent of gross world product to 2.9 per cent of gross world product.[1] The revolution in Information Technology has been even more dramatic. Despite the ubiquity of the Internet by the start of the new millennium, it is important to recall that the first e-mail was sent over the predecessor to the Internet as recently as 1972 and that Netscape released the first commercially successful web browser, the *Netscape Navigator*, only in 1994 (Friedman 1999: 62-4). Even in the United States, where more than 110 million people had Internet access by 1999, only 3 million had access in 1990 (ITU 2000).

Because the Internet has dramatically lowered communication costs, many observers have suggested that it is one of the primary reasons for the increase in globalization. For example, Friedman (1999: xviii) suggests:

> The new information technologies are able to weave the world together even tighter. These technologies mean that developing countries don't have just have to trade their raw materials to the West and get finished products in return: they mean that developing countries can become big-time producers as well. These technologies also allow companies to locate different parts of their production, research and marketing in different countries, but still tie them together through computers and teleconferencing as though they were in one place.

Although Internet access might have the most significant impact on goods and services that can be delivered electronically, it might also increase exports of other goods.[2] For example, even when their goods need to be delivered physically, enterprises might use the Internet to sell their products directly to consumers, to discover potential customers, to bid online for procurement contracts, or to take part in business-to-business (B2B) Internet exchanges. Further, enterprises can use the Internet to communicate with potential customers or distributors, since it provides a cheap and easy way to transmit and receive technical specifications, quality requirements, and other information. Finally, enterprises might be able to communicate with research institutes, universities, or government agencies over the Internet, allowing them easier access to information on

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1 The increase for developing countries was just as dramatic with exports increasing from 20.7 per cent of GDP to 28.1 per cent of GDP and incoming FDI increasing from 0.5 per cent of GDP to 3.0 per cent of GDP.

2 For example, some goods can be delivered electronically (e.g., books, computer software, music, or pictures), while many services, including back-office services to other enterprises, can be delivered over the Internet. Panagariya (2000: 959) lists the following examples of services: 'electronic publishing, website design and management, customer call centers, medical records management, hotel reservations, credit card authorizations, remote secretarial services, mailing list distribution technical on-line support, indexing and abstracting services, research and technical writing, and technical transcription'.

exporting requirements and on ways of upgrading their production facilities to international standards.

There is considerable anecdotal evidence that the Internet increases export opportunities for enterprises in developing countries. For example, Dasgupta *et al.* (2000) note that women in villages in Lethem, Guyana were able to use an Internet connection to sell handcrafted hammocks for as much as US$1000 a piece. Similarly, Friedman (1999) notes that in 1999 America Online (AOL) employed 600 college-educated customer service representatives in the Philippines to answer e-mails containing technical and billing inquiries from their customers mainly located in the United States. Finally, the most cited example of an industry in a developing country that has thrived due to the Internet is the software industry in India, centred in Bangalore, which was estimated to have exports of about US$6.2 billion in 2000/01.[3]

This paper looks at whether Internet access has affected the export performance of industrial and service enterprises in low- and middle-income countries in Eastern Europe and Central Asia. The focus on low- and middle-income countries is appropriate because, unlike in the United States or Western Europe where Internet coverage is extremely high, there are large numbers of enterprises without Internet access in these economies. This variation makes it easier to assess the impact of Internet access on enterprise performance and behaviour in these economies.

The paper finds that enterprises that are connected to the Internet export more than similar enterprises that are not connected, even after controlling for other factors that might affect Internet access and export performance and for self-selectivity bias. Further, despite the possibility that the Internet might impact service enterprises more than industrial enterprises, since some services might be able to be delivered directly over the Internet, there is little evidence that this is the case.

2 Data and descriptive analysis

The main source of data used in this paper is the World Business Environment Survey (WBES), a cross-sectional survey of industrial and service enterprises conducted in mid-1999 by the World Bank and several other agencies.[4] The main purpose of the WBES is to identify perceived constraints on enterprise performance and growth in developing and transition economies. The survey, therefore, has a large number of questions on how taxation, regulation, the performance of the financial sector, the institutional environment and corruption affect business operations. In contrast, the survey includes little information on enterprise characteristics or performance. In particular, although some information on assets, sales, broad sector of operations, ownership, employees, and enterprise growth was collected, detailed balance sheet information and profit and loss statements were not collected from participating enterprises. Although the WBES asked similar questions in the 80 countries, there were

3 Data are from India's National Association of Software and Services Companies (see http://www.nasscom.org/).

4 The survey of the transition economies was conducted in collaboration with the European Bank for Reconstruction and Development. Hellman *et al.* (2000) and EBRD (1999) provide more complete descriptions of the survey.

some differences between regions. For the purpose of this study, the most important difference was that questions on Internet access were asked only in the transition economies.[5] Throughout the analysis, data for industrial and service enterprises are analysed separately since, notwithstanding changes due to the expansion of the Internet, many service enterprises have only limited export opportunities.[6]

2.1 Internet access and exports

Of the nearly 1500 industrial enterprises in manufacturing, farming and mining, 38 per cent exported some part of their production (see Table 1). Service enterprises were less likely to export than industrial enterprises; only 19 per cent of service enterprises had any sales outside of their home country. Service enterprises that were involved in exporting also exported less than industrial enterprises; only 25 per cent of sales were outside of their home country for service enterprises involved in exporting, compared to 40 per cent of sales for industrial enterprises (see Table 1). Within these broad sectors, manufacturing enterprises were most likely to export and exported the greatest share of their production when they did, while retail trade enterprises were least likely to export and exported the smallest share when they did (see Table 1).

About 34 per cent of industrial enterprises and 35 per cent of service enterprises in the transition economies had access to the Internet in 1999 (see Table 2). Consistent with the hypothesis that Internet access makes exporting easier, service and industrial enterprises with Internet access exported more than similar enterprises without Internet access. For example, whereas the average industrial enterprise with Internet access exported 29 per cent of production (including enterprises with no exports), the average industrial enterprise without Internet access exported only 8 per cent of production (see Figure 1).

Since no other data on investment in information technology (IT) were available in the WBES, it seems likely that Internet connectivity serves as a more general proxy for IT investment. On average, enterprises that are connected to the Internet might have also invested more in other information technologies than enterprises that are not connected. Consequently, the coefficient on Internet access might partially reflect the effect of more general investment in IT, rather than purely the effect of access to the Internet.

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5 The countries in the sample were: Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, the Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, the Kyrgyz Republic, Lithuania, Moldova, Poland, Romania, Russia, Slovenia, the Slovak Republic, Ukraine, and Uzbekistan. Questions on Internet access were also asked in Cambodia, Thailand, Turkey, and the West Bank. However, since these additional countries are less comparable with the transition economies of Eastern Europe and Central Asia than the transition economies are with each other, and because other control variables were not available for the additional countries, they are omitted from the analysis.

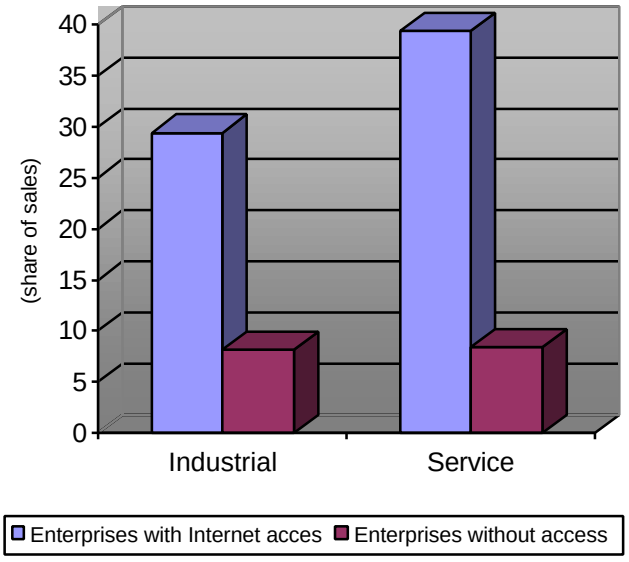
6 Enterprises in the power sector and construction are also omitted from the sample of industrial enterprises since these enterprises' exporting activities are probably more constrained than mining, farming, and manufacturing enterprises.

Table 1
Industrial and services enterprises involved in exporting by sub-sector

Sector	No. of enterprises	% of enterprises in sub-sector	% of enterprises in sub-sector that export	Exports (as share of sales) for enterprises that export
Industrial	1,439	100	38	40
Manufacturing	979	68	49	42
Farming, fishing or forestry	431	30	15	26
Mining or quarrying	29	2	45	32
Services	1,469	100	19	25
Wholesale trade	410	28	26	20
Retail trade	466	32	4	9
Transportation	196	13	35	40
Financial Services	52	4	25	10
Personal Services	183	12	17	32
Business Services	161	11	26	19

Data source: WBES ©2000 The World Bank.

Figure 1
Enterprises in transition economies with Internet access exported more than enterprises without Internet access in 1999



Note: Averages includes enterprises with no exports.
Data source: WBES ©2000 The World Bank Group.

Table 2
Distribution of industrial and service enterprises in sample

	Industrial	Services
Internet access		
Does enterprise have access to the Internet?(1-yes,0-no)	34.2	35.3
Does company have any foreign shareholders? (omitted category is no foreign shareholder)		
Foreign shareholder from Europe [a]	4.4	2.9
Foreign shareholder from other high income OECD country [b]	1.3	0.8
Foreign shareholder from Russia	0.3	0.2
Foreign shareholder from 'other' or 'unknown' [c]	4.1	2.3
What is biggest competitive threat to enterprises? (omitted category is domestic enterprises)		
Foreign firms producing in domestic markets (not imports)	6.9	8.4
Legal and illegal imports	14.9	1.6
Who is the largest shareholder in enterprise? (omitted category is government)		
A foreign company	4.3	3.1
Enterprise's managers	3.4	1.9
Enterprise's employees	15.6	6.3
Other private (individuals, families, domestic companies, banks or investment funds)	54.9	76.2
How was enterprise established? (state-owned, including subsidiaries and privatized state-owned, are omitted)		
Private from time of start up (no state-owned predecessor)	37.2	68.3
Joint venture with foreign and domestic partners	1.0	1.2
How many competitors does enterprise's major product line face in domestic markets? (more than three are omitted)		
Between one and three	12.3	7.8
No competitors	15.0	10.4
How many full-time employees and casual staff in total work for this company? (omitted category is over 500)		
Less than nine	12.9	40.9
Between 10 and 49?	15.2	24.3
Between 50 and 99?	16.6	14.1
Between 100 and 199?	17.9	8.5
Between 200 and 499?	24.1	8.2

Notes: [a] Austria, Belgium, Denmark, France, Germany, Greece, UK;
[b] US, Japan and Canada;
[c] Includes other European and high income OECD, except for those listed above.

Data source: WBES ©2000 The World Bank Group.

2.2 Effect of enterprise characteristics on Internet access and exports

Although the difference between exporters and non-exporters with respect to Internet access appears dramatic (see Figure 1), the difference might be due to enterprise characteristics that affect both Internet connectivity and export behaviour. For example, if there are large fixed costs associated with setting up an international distribution or service networks, large enterprises might be more likely to export than small enterprises are.[7] Furthermore, large enterprises might also be more likely to have access to the Internet if there are fixed costs associated with setting up and operating computer networks. To control for factors that might affect both export behaviour and Internet access, the empirical analysis includes control variables for enterprise size, sector of operations, foreign ownership, largest shareholder, how the enterprise was established, and the level and kind of competition that the enterprise faces in domestic markets.[8] The share of industrial and services enterprises in each category is shown in Table 2.

Since foreign ownership might affect both Internet connectivity and export behaviour, it is important to control for this in the empirical analysis to avoid finding a spurious correlation between Internet access and exports. Even after controlling for other factors that might affect Internet access, foreign-owned enterprises in the transition economies are more likely to have Internet access than fully domestically owned enterprises (Clarke 2001). This could be because foreign-owned enterprises have greater experience using information technology or because they have greater resources for investment. Further, since foreign-owned enterprises might have easier access to international marketing and distribution networks, they might also be more likely to export, especially when the foreign owner is affiliated with a multinational corporation (Blomström and Kokko 1998: 7). The effect of foreign ownership on export behaviour might be especially important in developing or transition economies, since domestic enterprises in these countries might be more likely to lack the skills and resources needed to set up marketing, distribution and service networks. Since the impact of foreign ownership might depend upon the nationality of the main foreign owner or the extent of foreign ownership, the analysis includes dummies indicating nationality and whether the foreign investor holds the largest stake in the enterprise (see Table 2).

Another factor that might affect both Internet access and exports, resulting in a spurious correlation between the two variables, is that better performing enterprises might be both more likely to be involved in exporting and more likely to have Internet access. There are several reasons why enterprise performance might be correlated with Internet access. First, the underdeveloped state of financial markets in many transition economies means that enterprises often rely heavily upon retained earnings to finance investment. Consequently, better performing enterprises might have greater resources to invest in information technology. Second, although e-commerce and Internet access are unlikely to have had a major impact on enterprise performance in the transition economies, broader investment in IT, which as noted above is probably correlated with Internet connectivity, might have been important.[9] However, although this is possible,

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7 See, for example, results from Clerides *et al.* (1998: 929).

8 A series of dummy variables indicating number of enterprise employees are used to proxy for enterprise size (see Table 2). The actual number of employees was not available.

9 Although several studies have found that investment in IT has improved productivity in the US, the direct impact of e-commerce is thought to be small even in the United States. For example, Oliner and

the impact of IT investment on enterprise productivity in the transition economies is probably quite small.[10] Even in the United States, where IT investment is thought to have had the largest impact on productivity, it appears to have affected productivity only modestly before the early to mid-1990s.[11] Since enterprises in the transition economies almost certainly lagged behind US enterprises with respect to IT investment, the impact in the transition economies is likely to have been modest even by the end of the decade.

In addition to being correlated with IT investment and Internet access, enterprise performance might also directly affect exports. Several studies of exporting and non-exporting enterprises in developing and developed markets have found that enterprises that export are more efficient than those enterprises that do not.[12] The higher efficiency of exporters could be either because enterprises that are more efficient self-selecting into exporting (i.e., the *self-selectivity hypothesis*) or because the discipline of exporting directly improves efficiency (i.e., the *learning-by-exporting hypothesis*).[13]

If the stronger performance of exporters is primarily due to self-selectivity, then including performance indicators in the analysis will reduce the likelihood of a spurious

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Sichel (2000) estimate that e-commerce has increased multifactor productivity growth in the US by considerably less than 0.1 per cent per year. Since e-commerce has almost certainly had a greater impact in the US than it has had in the transition economies, the impact in the transition economies is likely to be very small.

10 In addition to the observation that IT investment is probably lower in the transition economies than in the US, the impact of IT investment might be less significant due to the lower levels of human capital in many of these countries. Brynjolfsson and Hitt (2000: 35-6) note that IT investment has greater impact in enterprises with higher human capital.

11 The minor impact of IT investment on productivity before 1990 is most famously captured in Robert Solow's (1987) remark in 1987 that: 'You can see the computer age everywhere except in the productivity statistics'. For example, Oliner and Sichel (1994) found that IT investment had little impact on productivity by the mid-1990s. However, Brynjolfsson and Hitt (2000: 31) note that although studies using sectoral and economy level data found little evidence of productivity improvements before the mid-1990s, enterprise level studies (e.g., Brynjolfsson and Hitt 1995, 1996; Lichtenberg 1995) found evidence of productivity improvements in the early 1990s. Even in the mid to late 1990s in the United States, there is considerable debate about whether IT investment has had a large economy wide impact, with some recent studies finding that productivity improvements are heavily concentrated in certain sub-sectors of the economy. For example, Gordon (2000) finds little evidence of productivity improvements outside of durable manufacturing and computer sector by the late 1990s. Other studies (e.g., Oliner and Sichel 2000) have found more widespread gains.

12 For example, Chen and Tang (1987), using data from the electronics industry in Taiwan, China, find that export-oriented firms were between 6 and 11 per cent closer to the production frontier than import-substituting firms. Using similar data from 1986, Aw and Hwang (1995) find that exporters are between 3 and 20 per cent more efficient than non-exporters. Using US data from the mid-1980s through the early-1990s, Bernard and Jensen (1999) find that manufacturing enterprises are between 12 and 19 per cent more productive than non-exporters.

13 Under the *self-selectivity hypothesis*, efficient enterprises are more likely to export either because their margins are higher or because the fixed costs associated with entering export markets make it difficult for inefficient enterprises to do so. In contrast, under the *learning-by-exporting* hypothesis, the discipline of competing on international markets forces the enterprise to improve technical efficiency after entering export markets. One possible way that this might occur is that enterprises might be able to improve efficiency by observing how their competitors in international markets operate (see, for example, Lall 1997: 37) or by buyers passing on technical expertise and advice to the enterprise on how to meet international standards (see, e.g., Egan and Mody 1992).

correlation between Internet access and export behaviour. However, if the stronger performance were due to exporting improving performance, including performance indicators might introduce endogeneity into the analysis. Although some case-study evidence supports the learning-by-exporting hypothesis (see, e.g., Egan and Mody 1992), recent econometric studies, which look at efficiency changes before and after entering or exiting export markets, tend to find strong support for the self-selectivity hypothesis but little support for the learning-by-exporting hypothesis.[14] Consequently, performance indicators are included in some parts of the analysis, although the main results are similar whether they are included or not.

2.3 Effect of country characteristics on Internet access and export performance

In addition to controlling for enterprise characteristics that might affect export performance and Internet connectivity, the empirical analysis also controls for country-level characteristics. The country-level controls include participation in international trade organizations, the overall level of exports and foreign direct investment, location, progress with privatization, telecommunications infrastructure, income, size and urban population (see Table 3). In some parts of the analysis, these controls are replaced with country dummies.[15]

Among the country-level controls, variables reflecting the quality of the country's telecommunications infrastructure and the possibility of 'market access' spillovers are of particular interest. The quality of a country's telecommunications infrastructure is correlated with Internet connectivity, but might also affect exports directly.[16] Progress with privatization, the level of exports and the level of foreign direct investment might affect exports if 'market access' spillovers are important.[17] For example, if exporting enterprises provide information on foreign technologies and market conditions to non-exporting enterprises, it might encourage those enterprises to enter export markets. If 'market access' spillovers are important, and privatized or foreign-owned enterprises are more likely to export than state-owned enterprises, privatization and foreign investment might therefore increase exports throughout the rest of the economy. Further, if technological spillovers or network externalities are important, and if foreign and private enterprises are more likely to have Internet access than domestic or state-

14 Using data from Columbia and Mexico from the 1980s and early 1990s, Clerides *et al.* (1998) conclude that the evidence supports the self-selection hypothesis, while providing little support for the learning by exporting hypothesis. Similarly, using data from the United States for the mid-1980s through the early 1990s, Bernard and Jensen (1999) find similar results. Using data from Taiwan, China for the electrical machinery and electronics industry, Liu *et al*. (1999) reach similar conclusions. Finally, Aw *et al*. (2000), using data from the 1980s and early 1990s, find some evidence to support the learning-by-exporting hypothesis for some industries in Taiwan, China but no evidence to support it for Korea. Further, they find other evidence that is not consistent with the learning by exporting hypothesis in Taiwan, China and conclude (p. 83): 'The lack of strong evidence of learning by exporting is consistent with Clerides *et al*. (1998) and Bernard and Jensen (1999)'.

15 The country controls are omitted when country dummies are included since they are collinear with the dummies.

16 For example, telecommunications infrastructure might affect communication with downstream enterprises in other countries. Dasgupta *et al.* (2000) and Clarke (2001) show that the Internet connectivity is lower in countries in poor telecommunications infrastructure.

17 See Blomström and Kokko (1998: 7-10) for a discussion of market spillovers.

owned enterprises, the level of privatization and foreign investment in the country might also affect the probability that other enterprise have access to the Internet.[18]

Table 3
Means and standard deviations of country-level control variables for industrial enterprises.

Variable	Source	Mean	Standard deviation
Member of the WTO in early 1999 (1 indicates 'yes')	EBRD	0.40	0.49
EU Association Agreement in early 1999 (1 indicates 'yes')	EBRD	0.41	0.49
Net incoming foreign direct investment in 1998 (share of GDP)	WDI	4.10	4.82
Exports of goods and services in 1998 (share of GDP)	WDI	38.35	15.67
Distance from Vienna (in km)	Murrell (1996)	938	831
EBRD index for large-scale privatization in 1999 (4-point scale)	EBRD	2.76	0.69
Main telephone lines per 100 inhabitants in 1999	ITU	21.77	10.42
Urban Population (share of total) in 1998	WDI	61.12	12.98
Per capita GDP in 1998 (PPP, international dollars, 000s).	WDI	5.70	3.09
Population in 1998 (natural log)	WDI	16.50	1.41

Notes: For source variables, WBES implies that data are from the World Business Environment Survey (WBES) ©2000 The World Bank Group;

WDI implies that data are from World Bank (2001);

ITU implies that data are from International Telecommunication Union (ITU 2000). EBRD is EBRD (2000). EBRD ranks progress with privatization on a 4-point scale with 4 being most progress.

3 Empirical Estimation

3.1 Econometric model

Exports for enterprise i in country j is assumed to be a function of enterprise characteristics (X_{ij}), including a dummy variable indicating whether the enterprise has access to the Internet (I_{ij}), and country characteristics (Z_j):

$$\text{Exports}_{ij} = \alpha + \gamma I_{ij} + \beta X_{ij} + \delta Z_j + \varepsilon_{ij}$$

where (α,β,γ and δ) is the vector of coefficients.

In addition to the concern that the higher level of exports observed in enterprises with Internet access might be due to omitted variable bias (e.g., large enterprises might be more likely to export and to have Internet access), self-selection bias is also a concern. For example, enterprises with a high propensity to export might be especially likely to gain access to the Internet to allow them to communicate with foreign customers more cheaply. Consequently, a simple regression of exports on Internet access might

[18] Clarke (2001) shows that foreign direct investment appears to have spillover effects on Internet connectivity in the transition economies.

overestimate the effect of Internet access on export performance. To control for the possibility of sample selection bias, we estimate a standard treatment effects model in the empirical analysis.[19]

3.2 Results for industrial enterprises

Since industrial enterprises are considerably more likely to export than service enterprises, this section primarily focuses on industrial enterprises. The next section presents results for service enterprises. In addition to the variables listed in Table 4, the analysis includes a set of dummy variables indicating size and broad sector of operations.

3.2.1 Internet access

Even after controlling for enterprise and country characteristics, exports accounted for 6 per cent more of sales in 1999 for industrial enterprises with Internet access than for enterprises without access (see Table 4, columns 1 and 3). Results are similar whether country control variables or country dummies are included in the analysis.[20] The results also appear similar when we attempt to control for self-selection bias and, in general, we are unable to reject the null hypothesis of no self-selection bias (see Table 4, columns 2 and 4). This suggests that Internet access improves export performance, even after controlling for the possibility that enterprises with a high propensity to export might be more likely to become connected to the Internet.

3.2.2 Foreign shareholding

In general, industrial enterprises that are at least partly foreign-owned export more as share of production than fully domestically owned enterprises (see Table 4). This is consistent with the hypothesis that foreign ownership improves export performance, perhaps by providing access to international marketing and distribution networks. However, it is also consistent with the hypothesis that foreign owners are attracted to enterprises that are already exporting or that have exporting potential. Although foreign owners from all regions appear to be associated with greater exports, foreign owners from high-income OECD countries outside of Europe appear to affect exports most significantly, while foreign owners from 'other' (i.e., non-OECD) countries appear to affect them least. Industrial enterprises with European owners appear to export less than enterprises with owners from either Russia or other high-income OECD countries. In all regressions, the null hypothesis that the dummies for different types of foreign owners are equal is rejected at a one-per cent level or higher.[21]

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19 The error terms in the equations for export growth and Internet access are assumed to have a joint normal distribution. See Vella (1998) and Maddala (1983) for literature surveys on sample selection bias.

20 In general, we fail to reject the null hypothesis that the country dummies, rather than the country control variables, are appropriate. In the OLS regression for share of exports, the chi-squared statistics with 10 degrees of freedom is 28.6, whereas in the treatment effects model, the Chi-squared statistic with 20 degrees of freedom is 36.6. Note that the treatment effects regression includes two sets of dummies—one in the equation for export share and one in the equation for predicting Internet access.

21 This is true only for industrial enterprises. For service enterprises, we are unable to reject the null hypothesis that the dummies are equal.

3.2.3 Largest shareholder

After controlling for whether the enterprise has any foreign ownership, industrial enterprises where foreign owners are the largest shareholders appear to have higher exports than enterprises where the main foreign owner is only a minority shareholder (see Table 4). Other than for foreign-owned enterprises, other forms of ownership appear to have little impact on exports; state-owned, employee-owned and manager-owned enterprises appear similar in terms of total exports. Although the coefficient on private ownership is statistically significant and positive in the regression that includes country control variables (see columns 1 and 2), this result is not robust to the inclusion of country dummies (see columns 3 and 4).

3.2.4 Other enterprise characteristics

De novo private enterprises (i.e., enterprises established as private enterprises rather than enterprises that have been privatized) appear to export similar amounts to enterprises established as state-owned enterprises (see Table 4). Given that *de novo* enterprises are, in general, younger than privatized enterprises, this might be because it takes more time for new entrants to build international distribution and marketing networks than to build local networks. In contrast to the previous results, which suggest that enterprises that are partly foreign-owned have higher exports than fully domestically owned enterprises, enterprises that were established as joint ventures tend to export less than other (partly foreign-owned) enterprises.[22] This suggests that when foreign enterprises form joint ventures with domestic partners to establish new enterprises, they do so to gain access to domestic markets rather than to export to their home market. Finally, enterprises facing little competition in domestic markets tend to have higher exports than enterprises in markets that are more competitive. One plausible explanation for this is enterprises in less competitive industries might be able to gain higher domestic market share and to bear the fixed costs of expanding into foreign markets more easily.

3.2.5 Country-level controls

The only country-level controls that were statistically significant at conventional levels were per capita GDP and population. Enterprises in large countries were less likely to export than enterprises in smaller countries, while enterprises in richer countries were more likely to export. Although enterprises were more likely to export in countries with better telecommunications infrastructure, this result became marginally statistically insignificant in the regression controlling for self-selectivity (significant at only an 11 per cent level). There was little evidence of export spillovers—after controlling for enterprise characteristics, other country characteristics and self-selectivity, the coefficient on exports for the country was statistically insignificant at conventional significance levels. As noted previously, the null hypothesis that country dummies, rather than country controls, should be included in the analysis cannot be rejected at conventional levels.

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22 The negative coefficients on joint ventures are similar in size, but have the opposite sign to, the coefficients indicating some foreign ownership.

Table 4
Effect of Internet access on exports (as share of sales) in 1999 for industrial enterprises

Estimation method	*OLS*	*Treatment effects*	*OLS*	*Treatment effects*
Dependent variable	Export share	Export share	Export share	Export share
Number of observations	1291	1291	1291	1291
Sector and size dummies	Yes	Yes	Yes	Yes
Country dummies	No	No	Yes	Yes
Internet access:				
Does enterprise have Internet access?	6.08 ***	10.13 ***	5.76 ***	8.96 **
	(3.60)	(2.70)	(3.40)	(2.37)
Foreign shareholding:				
Foreign owner from Europe [a]	10.65 ***	9.85 ***	10.96 ***	10.34 ***
	(2.80)	(2.58)	(2.88)	(2.72)
Foreign owner from other high income OECD [b]	23.99 ***	23.17 ***	25.02 ***	24.39 ***
	(3.93)	(3.81)	(4.07)	(4.01)
Foreign owner from Russia	20.29 ***	19.79 *	21.20 *	20.88 *
	(1.75)	(1.72)	(1.83)	(1.83)
Foreign owner from other [c]	3.11	2.32	3.17	2.56
	(0.83)	(0.62)	(0.84)	(0.68)
Largest shareholder:				
Largest shareholder—foreign	11.87 ***	12.03 ***	11.51 **	11.58 **
	(2.66)	(2.72)	(2.58)	(2.64)
Largest shareholder—other private	3.66 **	3.55 *	2.31	2.26
	(1.85)	(1.81)	(1.13)	(1.12)
Largest shareholder—managers	4.45	4.94	4.24	4.62
	(1.16)	(1.29)	(1.09)	(1.20)
Largest shareholder—employees	2.79	2.99	1.46	1.64
	(1.22)	(1.32)	(0.63)	(0.71)
Enterprise-level controls:				
Main competition—imports	1.68	1.46	0.52	0.33
	(0.87)	(0.76)	(0.26)	(0.17)
Main competition—foreign-owned domestic enterprises	1.93	1.88	1.54	1.55
	(0.75)	(0.74)	(0.60)	(0.61)
Firm established as private enterprise	1.59	1.33	1.85	1.64
	(0.89)	(0.75)	(1.04)	(0.92)
Firm established as joint venture with foreign and domestic partners	-13.83 **	-14.05 **	-12.25 **	-12.40 *
	(-2.06)	(-2.11)	(-1.82)	(-1.87)
No competitors in domestic markets	5.27 ***	5.17 ***	5.74 **	5.64 ***
	(2.86)	(2.83)	(3.11)	(3.10)
Between one and three competitors	9.48 ***	9.40 ***	9.90 ***	9.82 ***
	(4.45)	(4.45)	(4.56)	(4.59)
Country-level controls:				
Member of WTO	-0.50	-0.33		
	(-0.19)	(-0.13)		
EU Association Agreement	2.55	2.35		
	(0.83)	(0.77)		
Foreign direct investment (% of GDP)	-0.24	-0.24		
	(-1.39)	(-1.43)		
Exports (% of GDP)	-0.12 *	-0.09		
	(-1.82)	(-1.39)		
Distance from Vienna	0.00	0.00		
	(-0.79)	(-0.75)		

(Table 4 continues)

Table 4 (con't)
Effect of Internet access on exports
(as share of sales) in 1999 for industrial enterprises

Estimation method	*OLS*	*Treatment effects*	*OLS*	*Treatment effects*
Country-level controls (con't)				
Progress with privatization (EBRD index for large-scale privatization)	-0.69 (-0.65)	-0.93 (-0.87)		
Number of telephone lines (per 100 inhabitants)	0.32 * (1.93)	0.27 (1.61)		
Urban population (% of population)	-0.17 (-1.55)	-0.16 (-1.53)		
Per capita GDP (000s of US$)	1.05 *** (2.89)	0.96 ** (2.59)		
Population (natural log)	-3.70 *** (-3.96)	-3.55 *** (-3.81)		
Log-likelihood or R-squared	0.33	-6381.68	0.35	-6363.38
P-value for test for sample selection bias (ρ=0)	—	0.22	—	0.34

Notes: t-statistics in parentheses: *** Significant at 1 % level; ** significant at 5 % level; * significant at 10 % level;

Omitted categories are state-owned enterprises (as largest shareholders) and enterprises established as state-owned enterprises (origin). Variables predicting Internet connectivity are the same as in main regression, except that WTO membership and EU association agreements are omitted and internet users (over population) is included in regression without country dummies;

(a Austria, Belgium, Denmark, France, Germany, Greece, UK;

(b US, Japan and Canada;

(c Includes other European and high income OECD, except for those listed above.

Data source: WBES ©2000 The World Bank Group.

3.2.6 Results controlling for enterprise performance

Although the WBES data provide little information on enterprise performance, two measures of performance are included in the analysis—margin for main product line (sales price less operating costs as per cent of costs) and a dummy variable indicating that the enterprise had a serious arrears problem.[23] These variables are chosen to reflect the enterprise's profitability and cash flow, since both might affect the enterprise's ability to invest in information technology and might be correlated with export performance.

Consistent with the hypothesis that better performing enterprises are more likely to export, the coefficient on margin for the enterprise's main product line is positive and statistically significant at a 5 per cent level (see Table 5). The inclusion of the performance variables does not appear to have a large effect on the other main results.[24] In particular, the coefficients on Internet access and foreign shareholdings remain similar to the previous results in terms of size and statistical significance.

23 The dummy variable is equal to one if the enterprise managers reported serious levels of overdue payments to the national government, workers, supplier, utilities, or local government.

24 The only differences between the results in Table 5 and Table 6 are that some country controls become statistically significant when the performance variables are included and the coefficient on the dummy variable indicating that the largest shareholder is 'other private' becomes statistically insignificant.

Table 5
Effect of Internet access on exports (as share of sales) for industrial enterprises with performance controls

Estimation method	*OLS*	*Treatment effects*	*OLS*	*Treatment effects*
Dependent variable	Export share	Export share	Export share	Export share
Number of observations	1051	1051	1051	1051
Sector and size dummies	Yes	Yes	Yes	Yes
Country dummies	No	No	Yes	Yes
Internet access:				
Does enterprise have Internet access?	6.19 ***	9.03 **	5.78 ***	8.12 **
	(3.35)	(2.22)	(3.15)	(2.04)
Foreign shareholding:				
Foreign owner from Europe (a	9.08 **	8.64 **	9.37 **	9.01 **
	(2.23)	(2.13)	(2.32)	(2.25)
Foreign owner from other high-income OECD (b	22.60 ***	21.97 ***	23.45 ***	22.90 ***
	(3.47)	(3.40)	(3.60)	(3.56)
Foreign owner from Russia	20.03 *	19.55 *	21.16 *	20.79 *
	(1.73)	(1.71)	(1.84)	(1.84)
Foreign owner from other (c	5.84	5.30	6.04	5.60
	(1.42)	(1.29)	(1.48)	(1.38)
Largest shareholder:				
Largest shareholder—foreign	11.21 **	11.24 **	10.48 **	10.49 **
	(2.29)	(2.33)	(2.16)	(2.21)
Largest shareholder—other private	2.77	2.69	1.02	0.98
	(1.27)	(1.26)	(0.46)	(0.45)
Largest shareholder—managers	3.23	3.45	3.38	3.57
	(0.79)	(0.86)	(0.82)	(0.88)
Largest shareholder—employees	0.97	1.14	-0.45	-0.29
	(0.39)	(0.46)	(-0.18)	(-0.12)
Enterprise-level controls:				
Main competition—imports	0.54	0.43	-0.80	-0.89
	(0.26)	(0.21)	(-0.38)	(-0.44)
Main competition—foreign-owned domestic enterprises	1.40	1.43	0.51	0.56
	(0.49)	(0.51)	(0.18)	(0.20)
Firm established as private enterprise	-0.42	-0.55	0.01	-0.10
	(-0.21)	(-0.28)	(0.00)	(-0.05)
Firm established as joint venture with foreign and domestic partners	-17.22 **	-17.04 **	-16.88 **	-16.72 **
	(-2.24)	(-2.25)	(-2.21)	(-2.23)
No competitors in domestic markets	5.61 ***	5.49 ***	6.34 ***	6.24 ***
	(2.77)	(2.75)	(3.15)	(3.16)
Between one and three competitors	11.65 ***	11.55 ***	12.57 ***	12.52 ***
	(4.79)	(4.82)	(5.10)	(5.19)
Enterprise performance:				
Margin for main product (sales less operating cost as % of costs)	0.11 **	0.11 **	0.11 **	0.11 ***
	(2.29)	(2.28)	(2.36)	(2.36)
Enterprise has serious arrears problem	-0.42	-0.18	-0.61	-0.40
	(-0.25)	(-0.10)	(-0.36)	(-0.23)

(Table 5 continues)

Table 5 (con't)
Effect of Internet access on exports (as share of sales)
for industrial enterprises with performance controls

Estimation method	*OLS*	*Treatment effects*	*OLS*	*Treatment effects*
Country-level controls:				
Member of WTO	-2.41 (-0.82)	-2.34 (-0.81)		
EU Association Agreement	5.12 (1.52)	5.06 (1.53)		
Foreign direct investment (% of GDP)	-0.33 * (-1.77)	-0.33 * (-1.83)		
Exports (% of GDP)	-0.14 ** (-2.02)	-0.13 * (-1.72)		
Distance from Vienna	0.00 (-0.25)	0.00 (-0.22)		
Progress with privatization (EBRD index for large-scale privatization)	-2.29 ** (-1.89)	-2.49 ** (-2.04)		
Number of telephone lines (per 100 inhabitants)	0.35 ** (1.98)	0.32 * (1.75)		
Urban population (% of population)	-0.11 (-0.97)	-0.11 (-0.98)		
Per capita GDP (000s of US$)	0.88 ** (2.25)	0.82 ** (2.06)		
Population (natural log)	-4.46 *** (-4.40)	-4.38 *** (-4.38)		
Log-likelihood or R-squared	0.37	-5190.95	0.39	-5167.62
P-value for test for sample selection bias (ρ=0)	—	0.43	—	0.51

Notes: See Table 4 for footnotes.
Data source: WBES ©2000 The World Bank Group.

3.3 Results for service enterprises

Internet access appears to have as significant effect on service enterprises as it does on industrial enterprises (see Table 6). Before controlling for self-selectivity, service enterprises with Internet access appear to export about 5 to 6 per cent more output than service enterprises without access. After controlling for self-selectivity, the point estimate of the parameter increases, indicating that service enterprises with Internet access export about 7.5 to 10 per cent more of their than enterprises without Internet access. These results are similar to the results for industrial enterprises.

For most of the other variables included in the analysis, the results for service enterprises are weaker than for industrial enterprises (compare Table 4 with Table 6). Except for the variables indicating that the enterprise has access to the Internet and that it has a foreign owner from Europe, the enterprise-level controls are statistically insignificant in the regressions for service enterprises. In part, this probably reflects that services enterprises were far less likely to export than industrial enterprises (see Table 1), possibly because the export of many services remains difficult despite the technological changes of the past decade. For the country-level control variables, the

results for industrial and service enterprises appear similar for most variables. In particular, enterprises in countries with good telecommunications infrastructure appear more likely to export than other enterprises and there is little evidence of spillovers from exporting. The main differences between the two sets of results are that the coefficients on per capita income and population are statistically insignificant for service enterprises, while the coefficients on progress with privatization and urban population are statistically significant.

Table 6
Effect of Internet access on exports (as share of sales) in 1999 for service enterprises

Estimation method	OLS	Treatment effects	OLS	Treatment effects
Dependent variable	Export share	Export share	Export share	Export share
Number of observations	1328	1328	1328	1328
Sector and size dummies	Yes	Yes	Yes	Yes
Country dummies	No	No	Yes	Yes
Internet access:				
Does enterprise have Internet access?	5.72 *** (5.88)	7.57 *** (3.42)	5.45 *** (5.53)	9.35 *** (3.94)
Foreign shareholding:				
Foreign owner from Europe (a	7.34 *** (2.60)	6.95 ** (2.46)	8.07 *** (2.84)	7.17 ** (2.51)
Foreign owner from other high income OECD (b	4.29 (1.02)	3.60 (0.85)	5.26 (1.24)	3.49 (0.81)
Foreign owner from Russia	3.34 (0.40)	3.46 (0.42)	4.14 (0.50)	4.24 (0.52)
Foreign owner from other (c	4.99 (1.61)	4.90 (1.60)	6.24 ** (2.00)	6.05 ** (1.96)
Largest shareholder:				
Largest shareholder—foreign	-2.71 (-0.75)	-2.75 (-0.77)	-3.88 (-1.07)	-3.93 (-1.09)
Largest shareholder—other private	2.15 (1.26)	2.05 (1.21)	2.10 (1.23)	2.01 (1.19)
Largest shareholder—managers	-0.69 (-0.23)	-0.63 (-0.21)	-1.18 (-0.38)	-0.95 (-0.31)
Largest shareholder—employees	-1.60 (-0.77)	-1.48 (-0.72)	-1.58 (-0.75)	-1.13 (-0.54)
Enterprise-level controls:				
Main competition—imports	-1.42 (-1.03)	-1.61 (-1.17)	-0.72 (-0.51)	-1.22 (-0.85)
Main competition—foreign-owned domestic enterprises	0.89 (0.58)	0.63 (0.41)	1.35 (0.86)	0.72 (0.46)
Firm established as private enterprise	-1.34 (-1.16)	-1.53 (-1.33)	-1.13 (-0.97)	-1.56 (-1.33)
Firm established as joint venture with foreign and domestic partners	4.28 (1.14)	3.96 (1.07)	4.44 (1.19)	3.98 (1.07)
No competitors in domestic markets	0.57 (0.44)	0.49 (0.38)	0.60 (0.46)	0.50 (0.38)
Between one and three competitors	-1.47 (-0.92)	-1.34 (-0.84)	-1.58 (-0.97)	-1.34 (-0.83)

(Table 6 continues)

Table 6 (con't)
Effect of Internet access on exports (as share of sales)
in 1999 for service enterprises

Estimation method	*OLS*	*Treatment effects*	*OLS*	*Treatment effects*
Country-level controls:				
Member of WTO	-0.96 (-0.61)	-1.02 (-0.66)		
EU Association Agreement	-0.60 (-0.34)	-0.64 (-0.36)		
Foreign direct investment (% of GDP)	-0.13 (-1.28)	-0.12 (-1.16)		
Exports (% of GDP)	-0.03 (-0.75)	-0.02 (-0.58)		
Distance from Vienna	0.00 (-0.24)	0.00 (-0.32)		
Progress with privatization (EBRD index for large-scale privatization)	-2.18 *** (-2.91)	-2.25 *** (-3.01)		
Number of telephone lines (per 100 inhabitants)	0.46 *** (4.22)	0.44 *** (4.07)		
Urban population (% of population)	-0.14 ** (-2.04)	-0.14 ** (-2.19)		
Per capita GDP (000s of US$)	-0.25 (-1.03)	-0.27 (-1.12)		
Population (natural log)	-0.31 (-0.59)	-0.14 (-0.27)		
Log-likelihood or R-squared	0.19	-5994.8	0.20	-5969.9
P-value for test for sample selection bias (ρ=0)	—	0.42	—	0.08

Notes: See Table 4 for footnotes.

Data source: WBES ©2000 The World Bank Group.

4 Conclusions

In general, the results from this study are consistent with the assertion than the Internet has increased 'globalization', at least in the transition economies of Eastern Europe and Central Asia. In these countries, enterprises that were connected to the Internet tended to export more in 1999 than enterprises that were not connected even after controlling for various enterprise and country characteristics that might affect both Internet access and exports and for self-selection bias. Internet access might increase export performance by making it easier for enterprises to communicate with foreign buyers, by improving access and information on markets, consumers and standards in developed countries, by linking the enterprise directly to consumers in developed countries, or by allowing enterprises to bid for contracts over the Internet or to participate in business-to-business exchanges.

As discussed previously, one of the most noted characteristics of the Internet is that it allows services that do not require face-to-face transactions to be sold across international boundaries. For example, enterprises in developed countries could purchase many services (e.g., remote secretarial services, web publishing, or accounting

services) from enterprises in developing countries over the Internet. Despite these possibilities, the evidence from this study suggests that by 1999 Internet access had had a similar impact on exports by industrial and service enterprises.

There are several plausible reasons for this finding. First, notwithstanding recent technological changes, it is impossible to deliver many services over the Internet (e.g., haircuts, restaurant service or hotel services) and it is difficult for legal or practical reasons to deliver other services (e.g., doctor visits). Second, although some back office services can be provided over the Internet, many developing or transition economies might not have a comparative advantage in providing these services. For example, India, which is one of the main providers of these services in the developing world, has several advantages that the transition economies lack. Most notably, it has a large population of highly trained, English speaking workers[25]—something the transition economies of Eastern Europe and Central Asia lack. Finally, as noted by Panagariya (2000), Internet provision of services between countries often depends upon countries recognizing educational qualifications and occupational licenses.

After controlling for the effect of Internet access on export performance, which is more common among foreign-owned enterprises in the transition economies (Clarke 2001), it appears that foreign ownership also improves export performance. In addition, enterprises where foreign shareholders are their largest shareholder appear to export more than enterprises where foreign shareholders have smaller ownership shares. Finally, enterprises with owners from Russia and owners from non-European OECD countries appear to export more than enterprises with owners from non-OECD and European countries.

[25] Panagariya (2000: 970) notes that India has the world's second largest pool of English speaking scientific workers and that as many as 115,000 engineers graduate from Indian universities each year.

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