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Infrastructure, competition and innovation: new survey evidence from transition*

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ABSTRACT

This paper uses a new cross-section survey data-set of 6,000 firms in 26 transition economies conducted in 2002 to investigate how market infrastructure and product market competition affect innovative activity and growth. Questions were asked about organizational change, innovative activity, the state of competition faced by the firm and the firm's evaluation of its external environment. The external environment or market infrastructure refers to the state of transport and communications, the framework of laws and regulations, and the effectiveness of the financial system in matching investment resources with entrepreneurial opportunities. Our aim is to see whether there is evidence that the market infrastructure directly affects innovation and performance and / or whether it works in conjunction with competitive pressure. We find some indication that factors internal to the firm, the firm's relationships with its competitors, and the market infrastructure play distinctive roles in innovation decisions and in firm growth.

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1. Introduction

This paper investigates the role played by competition and the external environment in which firms operate for their innovative activity and growth. Transition economies provide a valuable opportunity for trying to identify the importance of these factors since a large number of countries switched from a planned to a market economy regime early in the 1990s and present a wide variety of experience in the successful establishment of the different components of the market infrastructure.

We distinguish between three aspects of the market infrastructure: physical, legal and financial. Schumpeter placed particular emphasis on the importance of financial institutions for the process of creative destruction; Adam Smith linked both physical infrastructure and the structure of laws to the effective operation of the competitive process. The following quote from *The Wealth of Nations* captures the direct role of infrastructure for growth as well as its importance for the operation of competition that we seek to explore:

> Good roads, canals and navigable rivers, by diminishing the expense of carriage, put the remote parts of the country more nearly upon a level with those in the neighbourhood of the town. They are upon that account the greatest of all improvements. They encourage the cultivation of the remote, which must always be the most extensive circle of the country. They are advantageous to the town, by breaking down the monopoly of the country in its neighbourhood. They are advantageous even to that part of the country. Though they introduce some rival commodities into the old market, they open many new markets to its product. Monopoly, besides, is a great enemy to good management, which can never be universally established but in consequence of that free and universal competition which forces everybody to have recourse to it for the sake of self-defence. (*The Wealth of Nations* 1776, Pelican edition 1970, p. 251)

There is a disparate empirical literature that attempts to characterize the role played by infrastructure in economic performance. At one extreme is the cross-country growth regression tradition where physical, legal or financial infrastructure variables are added to standard (augmented) Solow-type regressions. At the other are micro-data based studies, usually of individual countries. The empirical literature is plagued by the problems of how to measure these variables and how to deal with reverse causation and omitted variables. Most of the literature focuses on the direct effect on performance of infrastructure at the national level so as to capture external, network and threshold effects.

Probably the most successful attempt to test for the direct effect of physical infrastructure on growth using country level data is Roeller & Waverman (2001). They identify the problems with previous work: for example, Aschauer (1989) reported very high growth returns from investment in physical infrastructure but did not deal adequately either with the fact that growth drives up the demand for infrastructure (reverse causality) or with the omission from the analysis of other policies or institutions that are potentially correlated with infrastructure provision. Roeller and Waverman focus on telecommunications infrastructure in a sample of OECD countries and address the first problem by estimating

a production function for GDP simultaneously with equations for the demand for (the stock) of infrastructure and the supply (flow) of infrastructure investment. The second problem is handled by estimating the equations with country fixed effects. They find a positive effect of telecommunications infrastructure investment (the size of which is much reduced (by over one-third) when controlling for country fixed effects). Even so, their estimates suggest that about one-third of the growth of the OECD economies over the period from 1970 to 1990 is attributable to the extension of telecommunications infrastructure.

Esfahani and Ramirez (2003) use cross country data on 78 developing and OECD countries over the period 1965-95 to examine the importance of telecom and power infrastructure to growth. The approach has some similarity with that of Roeller and Waverman in the sense that they estimate a system in which they also have an equation for investment in infrastructure (i.e. supply). The specific question they address is whether the contribution of physical infrastructure to growth depends on other institutional characteristics of the economy. They use measures of institutional quality such as democracy, contract enforcement and interactions with measures of ethnic and income heterogeneity. They find that institutional quality affects both the steady state level of investment in infrastructure as well as the speed of adjustment. The paper represents an attempt to pin down the circumstances under which infrastructure investment occurs as well as how it affects growth from the 'supply of infrastructure' side. They do not investigate how institutional quality may mediate the impact of the infrastructure stock on growth.

A quite different literature is that of 'firm ecology', which examines the determinants of the size distribution of firms. A key finding of this literature is the phenomenon of the 'missing middle' in the size distribution of firms in developing countries – i.e. the failure of small firms to grow. In a wide-ranging survey of the literature, Tybout (2000) concludes that high transactions and information costs associated with weak institutions prevent the size distribution from evolving toward that of developed economies. A recent paper that seeks to test for the mechanisms at work is Sleuwaegen and Goedhuys (2002), who use firm-level data from the Ivory Coast. They find that the obstacles to firm growth due to failings in physical infrastructure, financial infrastructure and business regulation as reported in surveys of managers vary systematically with size (with both micro (<5 employees) and large (>250) least constrained). They interpret this as supportive of the hypothesis that inadequate physical and financial infrastructure impair the growth of small firms.

Evidence on the impact of legal infrastructure on performance is more limited. A striking characteristic of the transition has been the extent to which the law on the books has been reformed to embody high levels of protection for creditors and shareholders – often higher than found in many advanced economies. Early cross-country work by La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998) (using a sample of developed and developing but not transition countries) suggested that the nature of the law on the books was more important for financial development than was the rule of law. The experience of the transition economies points the opposite way. Pistor, Raiser and Gelfer (2000)

have shown that across transition countries, financial development measured either by the size of the stock market or of private credit relative to GDP is better correlated with the rule of law than with features of the law of the books (such as the extent of creditor or minority shareholder protection). Berkowitz, Pistor and Richard (2003) develop this argument further, showing that transplantation of legal codes from abroad produces weaker legal institutions than does the internal development or adaptation of legal codes to local conditions.

Levine (2003) surveys the empirical literature testing for the role of financial development in growth and argues that there is now causal evidence from country, industry and firm-level studies. The literature on transition has documented the existence of weak financial infrastructure in the form of credit constraints on new firms combined with the availability of finance to poorly performing old firms (e.g., Lizal and Svejnar 2002).

Brown and Earle (2001) provide empirical evidence on the role of competition and infrastructure in the performance of Russian firms. They refer to Aghion and Schankerman (1998, 2003) as providing the theoretical starting point. Aghion and Schankerman develop a model of infrastructure and competition in which a reduction in transport costs enhances product market competition by increasing the elasticity of substitution between differentiated goods. The enhanced competition then affects productivity through both selection and incentive effects for incumbents. Brown and Earle test for the interaction between infrastructure and competition amongst incumbent firms using firm-level data for medium to large firms (>100 employees) in Russian manufacturing industry over the period 1992-99 to explore the interaction between competition and infrastructure. They estimate a production function augmented by market structure (an inverse measure of market concentration calculated at industry level pre-reform), infrastructure (telecommunications and transport) and market structure interacted with infrastructure. They include two policy/political variables (measuring the extent of price regulation in the region and the proportion of communist votes in the regional elections) and interact them with the competition measure. Although the choice of a market structure variable from the pre-reform period avoids a potential endogeneity problem, it is unclear how well it represents the competitive conditions faced by firms in the sample. They find some evidence for the presence of a positive interaction effect between better physical infrastructure and product market competition as a determinant of static efficiency.

The present study offers a contribution by making use of data that combines a broad variety of country experience across transition with firm-level information on performance and actions taken by the firm as well as on a mix of quantitative and qualitative indicators of each dimension of the market infrastructure. This allows us to test whether infrastructure has a direct impact on firm performance and/or an indirect one via its interaction with the extent of product market competition or innovation. We also follow up in a systematic way an observation that emerged from an analysis of a previous large-scale firm-level survey (BEEPS99) (Carlin, Haskel, Seabright 2001). Major organizational change was reported by 9.5% of firms in that sample and such

organizational change appeared to be differentially associated with sales and productivity growth in the non-CIS as compared with the CIS countries. This was interpreted as suggesting that the quality of the market infrastructure is important in translating restructuring effort (as measured by organizational change) into performance improvements.

In section 2, we explain the nature of the data and the variables that we use. In section 3, we present descriptive results on performance and then explore the determinants of sales growth and innovation. Section 4 provides an interpretation of our results and suggests the direction to be taken by further research.

2. Data description and definition of variables

The data used in this paper comes from the EBRD-World Bank Business Environment and Enterprise Performance Survey (referred to from here as BEEPS02) conducted in the summer of 2002. The survey was conducted through face-to-face interviews in 26 transition countries (plus Turkey) and covered 6,667 firms. An earlier large-scale firm-level survey was conducted in 1999 (BEEPS99). The results of the earlier survey have been presented in several papers (e.g. Hellman and Schankerman, 2000, Carlin, Fries, Schaffer and Seabright, 2001).

A detailed description of the survey and overview of results is provided in Fries and Polanec (2003) and in a report by the company that conducted the survey (MEMRB 2002). The sample was designed to be representative of the non-farm business sector of the economy (excluding sectors subject to government price regulation and prudential supervision: railways, water supply, electricity generation and banking). The target shares of firms from industry and services in each country were dictated by the sectoral shares of GDP. Within each broad sector, the aim was to achieve a representative sample of firms subject to fulfilling a set of quotas to ensure the presence of firms with specific characteristics. Minimum quotas were imposed as follows: by size group (10% small (2-49 employees), 10% medium (50-249), 10% large (250-9,999)), by ownership (10% foreign-owned and10% state-owned), a minimum of 10% of exporting firms, and by location (10% of firms to be located in a town with a population of less than 50,000 or in a rural area). Only enterprises in existence from 1999 were included since performance data requested was for the three years up to 2002.

Populations of firms eligible were obtained from the Statistical Office (supplemented by other sources) and firms were classified according to the specified characteristics. The characteristics of the self-weighted samples were then compared with the minimum quota requirements. To the extent the quotas were not met, re-weighting was required. Judgemental considerations entered only at the final stage in relation to the selection of sample firms in the service sector. It was frequently the case that 60-80% of enterprises in the service sector were in ‘retail, wholesale and repairs’ and that this population of firms was close to the universe of small private firms. In order to ensure that other parts of the service sector (transportation, hotels, real estate etc.) were included in the survey, and to increase the chances of meeting the size and ownership criteria, the share of firms from these sectors was increased.

More firms were sampled than the target in order to fulfil the quotas for ownership and exporting firms. One country was dropped (Turkmenistan) because of intervention by the secret police. In all, 18,052 firms were contacted and 6,667 interviews completed (37%). Approximately the same number of firms refused to participate, with the remainder accounted for by firms contacted in order to fulfil the quotas but which turned out to be ineligible.

Table 1 summarizes the size and ownership characteristics of the sample. Around a third of firms are very small (fewer than 10 employees), and another third have less than 50 employees. In terms of ownership, 63% are new firms with no state-owned predecessor and among old firms, the privatized and state-owned categories comprise 23% and 14% respectively. As compared with BEEPS99, the share of small firms is higher (up from 50%) and so is the share of new firms (up from 54%). These differences reflect the rapidly changing structure of the economies, as does a somewhat greater representation of service sector firms (which here comprise some 62% of the sample).

[Table 1 here]

In this paper we use as measures of firm performance their (self-reported) growth of sales and of labour productivity during the three years prior to the survey. In addition, we have sought to uncover the steps undertaken by firms to improve their performance. Firms were asked questions about whether they had developed a new product line or upgraded an existing one, whether they had opened a new plant, whether they had obtained ISO9000 quality accreditation in the previous three years, and whether they had introduced new technology that had substantially changed the way that the main product is produced.

The innovation variable used in our estimations is constructed using the method of principal components from responses to the questions described above.[1] The index is normalized so that the minimum value is zero and the maximum value is the number of possible restructuring measures. This is done to facilitate interpretation of the regression results – a unit increase in the index corresponds, roughly speaking, to the introduction of another restructuring measure.

A separate question was asked about the extent to which firms had engaged in reorganization since 1998: responses were coded according to four possible degrees of reorganization from “My firm is organized in much the same way as it was in 1998” to “My firm has had a completely new organizational structure”. Across the sample 12% of firms reported undertaking a complete organizational change.

[1] The use of a summary measures is more conservative than the alternative of including all the individual components as explanatory variables in the regressions. With so many regressors, a likely outcome of this alternative procedure is a finding that some regressors are significant and with the expected sign, some are insignificant, and some are significant but with the opposite of the expected sign, making it difficult to reach an overall interpretation of the results.

The survey instrument was expressly designed to discover the extent to which firms believed themselves to be facing significant competitive challenge. It began by asking firms three questions designed to elicit different indicators of the extent of competition in the market for the firm's main product:

- The first question elicited information about the number of competitors the firm believed itself to face in this market, distinguishing in the replies between no competitors, one to three competitors, and more than three competitors. Note that although this looks like a simple market concentration measure, it measures concentration in what the firm believes to be its main market, rather than the administrative category of products the firm is placed in by the national statistical agency.
- The second question concerned what firms believed to be the likely reaction of customers to a real 10% rise in the price of its main product, its competitors' prices remaining unchanged in real terms. This represented an attempt to ascertain directly the firm's perceived own-price elasticity of demand. Four categories of response were allowed, representing progressively less elastic responses of overall demand.
- The third question asked for an estimate of the mark-up of prices over variable costs (a method of ascertaining directly the Lerner index of market power).

In fact the responses to these three questions complement one another. Carlin & Seabright (2001) show, using the equivalent data from BEEPS99, that firms in concentrated markets report lower own-price elasticities, and profit from these elasticities to raise their margins, which is an entirely intuitive relationship.

Table 2 confirms this finding with the data from BEEPS02. It shows that firms reporting no competitors in the market for their main product report on average a lower impact on sales of a hypothetical price rise, and that firms reporting such a lower impact report higher average price-cost margins. This indicates a degree of consistency across the complementary measures of competition in this sample of firms.

[Table 2 here]

The survey also sought to investigate the impact of perceived competitive pressure on decisions by managers to undertake restructuring measures. The responses on sources of pressure to innovate are important since they enable us to explore more closely how performance improvements come about. Specifically, firms were asked about the importance of certain factors, including pressure from various kinds of competitors and from customers, in influencing their decision to undertake restructuring.

Finally, BEEPS02 asked a range of questions about the availability and quality of infrastructure, classified under three main headings: physical infrastructure (power, water and telecommunications), legal infrastructure (the reliability and accessibility of the courts; barriers to business activity due to poor law enforcement) and financial infrastructure (availability of credit). We used principal components analysis to obtain an

aggregate measure of infrastructure quality in each of these three domains. We began by defining the infrastructure variables using as much information as was available in the survey – i.e. based on the full range of questions asked. This produced infrastructure measures reflecting both quantitative and qualitative components (e.g. 'days without power supply' and 'judgement of how serious was electricity as an obstacle for the operation and growth of the business'). However, we faced a trade-off between the use of very broadly based measures and a diminution in the size of the sample. Firms were especially reluctant to answer questions about 'unofficial payments' that had to be made for example in order to get connected to services or to deal with the courts, and to answer questions about financing (MEMRB 2002). In the end, we decided to use measures based on less than the maximum number of components: by dropping the components with the smallest eigenvectors in the construction of the principal components, the sample size was increased. Our experiments suggest that the qualitative results are not affected by this choice. The components of each infrastructure variable are shown in the appendix.

To summarize, the physical infrastructure variable reflects interruptions to supply, delays in obtaining connection and problems with electricity as a barrier to business. The legal infrastructure measure reflects the evaluation of the operation of the judiciary, the presence of corruption, crime and the mafia as a barrier to business. The financial infrastructure measure reflects the significance of access to finance and its cost as a barrier to business. The 'barriers to operating and expanding your business' question allows us to establish how firms rank the three elements of the market infrastructure that we are interested in. The physical infrastructure factors (telecommunications, electricity, transport) are ranked as least problematic (mean scores from 3.4 to 3.5 on a scale of 1 'Major obstacle' to 4 'No obstacle'); followed by legal infrastructure (2.8 to 3.2) and as most problematic, financial infrastructure (2.5, 2.7).

The country means for the infrastructure measures used in the analysis below are presented in Table 3 and produce some surprising results. The rankings for physical infrastructure accord with perceptions of progress in transition and GDP per capita: four accession countries (Lithuania, Poland, the Czech Republic and Slovenia) and Croatia make up the top five whilst Tajikistan, Albania, Georgia, the Kyrgyz Republic and Uzbekistan are at the bottom. On legal infrastructure, however, the top five include Hungary and Slovenia but also Azerbaijan, Armenia and Uzbekistan. The three Baltic states plus Slovenia top the rankings for financial infrastructure – but Kazakhstan is at number five. Poland is in the bottom five in both legal and financial infrastructure. Other survey results including those from BEEPS99 have produced apparently anomalous results, especially in relation to the countries at very early stages of transition. This can perhaps be explained by the fact that in a very underdeveloped market environment, 'market infrastructure' is judged to be of limited importance to the operation of the firm. More worrying from the perspective of using these indicators is the apparent influence of the poor cyclical conditions in Poland (and to some extent in Bulgaria) on the measures of market infrastructure.

3. Results

Tables 4 and 5 give some descriptive results. Table 4 shows growth rates of sales, labour productivity and employment over the three years prior to the survey. Particularly noteworthy are the findings that countries with poor performances in the early survey BEEPS99 (notably Russia, Ukraine and countries in the CIS) have strong growth rates of sales in the present survey, while some former star performers (notably in central Europe) here perform much less well. Countries are grouped in Table 4 into the 8 early accession countries, the countries of South Eastern Europe (7) and the eleven CIS countries. Amongst the accession countries, firm performance in Poland stands out: on average, firms report falling sales over the past three years. This is also true of Bulgaria in SEE, with Macedonian firms on average reporting flat sales. Amongst the CIS countries, countries divide into two groups: those with growth of more than 20% and those with declining or stagnant sales (Armenia, Georgia, Kyrgyz Republic and Tajikistan.) Of note also is the strong employment growth virtually everywhere (with the exception of Poland, Kyrgyz Republic and Uzbekistan), which makes the average figures for labour productivity growth much less impressive. However, nothing is implied about the welfare implications of these figures – low productivity growth may simply indicate that firm growth has been employment-intensive, which may well be a good thing in a region with high rates of both official and disguised unemployment.

[Table 4 here]

Table 5 indicates that labour productivity growth has been exactly zero on average for the firms in the sample as a whole, with positive productivity growth in privatized and state firms but negative productivity growth (again interpreted as employment-intensive output growth) in new firms, which make up well over half the sample. This last feature was also strongly characteristic of firms in the earlier survey. In terms of overall sales growth, privatized firms have behaved more like new firms than like state-owned firms, in contrast to the earlier survey. Across the entire sample, average sales growth is much higher than recorded in the BEEPS99 survey (11.5% as compared with 2.6%). As in 1999 growth is much higher amongst new than old firms but in the 2002 survey, strong sales growth is also reported by privatized firms). Table 3 also reports a measure of capital investment (the self-reported answer to the question of the percentage increase in fixed assets over the previous three years), which again indicates a broad similarity between privatized and new firms.

[Table 5 here]

We now turn to an examination of the main determinants of firm performance. Our approach is Schumpeterian in spirit: we focus on the role of the competitive environment and market infrastructure in explaining innovation behaviour by firms – both product and process innovations. We also explore the extent to which these factors can account for TFP growth, controlling for innovation. Innovation will typically entail the adjustment of factors of production, and the external environment of the firm may influence how reliably these actions are translated into success in terms of the growth of the firm.

More specifically, we make use of the empirical strategy developed to analyze the BEEPS99 data and described in CSS (2003). The objective is to estimate two equations – one for the firm's innovation behaviour and the second for performance (controlling for innovation). The latter is measured by an augmented TFP-type growth equation in which we include the growth of employment and capital stock and measures of competition and infrastructure. We follow Nickell (1996) in using the cross-section to attempt to identify the role of the level of competition (and infrastructure) in TFP growth; unlike Nickell, we do not have a time series for our measures of competition and infrastructure and cannot therefore examine the effect of competition and infrastructure on the level of TFP (by including a term in the change in competition in the TFP growth equation).

To ensure identification of the two equations, we exclude from the growth equation firm size and measures of the pressure to innovate. Firm size is a standard determinant of innovation (e.g. in R&D expenditure equations) whereas there is no strong prior that it has an independent direct effect on growth. Sales growth is excluded from the innovation equation; instead we make use of a more specific measure of the pressure of demand by using the responses of managers to a question asking them to rate the importance of pressure from customers as a factor behind their decision to undertake innovation.

The variables of interest in this paper are those related to competition and infrastructure described above. Reverse causality is a worry in relation to both. It is indeed possible that firms recording high growth in the recent past (or having undertaken innovation) tend to perceive a systematically different elasticity of product demand or a different number of competitors than do poorly performing firms. Similarly, such firms may have a rosier outlook, which leads them to express more confidence in the infrastructure. Conversely, successful firms may be more sensitive to their external environment and therefore more critical about it than mediocre firms. Unfortunately our data does not provide a means for controlling for reverse causality. We therefore stress that data of the kind we report can make a contribution by helping to identify channels through which competition and infrastructure may be having their effect: it should be seen as complementary to evidence that is more informative about causality but less informative about channels.

Table 6 reports the result of an OLS regression of sales growth. The key findings are as follows: our measure of physical infrastructure is insignificant but our measures of financial and legal infrastructure are strongly (and positively) associated with sales growth. New product restructuring is highly significant. Our competition variables matter only to the extent that firms reporting the highest own-price demand elasticities have grown more slowly than others, indicating that some degree of market power is important in growth. However (and in striking contrast to the findings of the earlier survey), the number of reported competitors is insignificant[2]. The differences between new and old

[2] This may be an indication that market structure has become more endogenous than it was in the earlier survey, in that opportunities for growth (previously characteristic of markets with somewhat restricted competition) may have attracted increased entry and therefore intensified competition. It may also reflect the coarseness of the grid used to sort firms by perceived rivalry: in BEEPS99, firms were distributed

firms, and among old firms between state-owned and privatized firms, are insignificant and remain so in all specifications of the sales regressions we have tried, including those reported below. Finally, both the employment growth and capital investment variables are highly significant as one would expect given the production function specification. However, in interpreting these elasticities we should note that the short time period of observation implies that their magnitude would be likely to deviate substantially from those estimated for a long-run production function observed in equilibrium.

[Table 6 here]

As in CSS (2003) we take seriously the endogeneity of innovation, which may well be the consequence as well as the cause of sales growth (and for which we cannot control through panel data techniques since this is a cross-section).[3] Moves by the firm to develop or modify products or to introduce new technology may be the result of poor past performance or they may be spurred by good performance. Table 7 reports an OLS equation in which our measure of innovation is regressed on the measures of competition and on firms' reports of "pressure to innovate" from domestic competitors, foreign competitors and customers, as well as on a range of controls. Although the number of competitors is again insignificant, the results confirm that competition matters importantly, and in a similar manner to that reported in CFSS(2001) and CSS (2003) for the earlier survey. That is, market power (as determined by the 10% test) is an important determinant (positively) of innovation. However, firms' perceptions of the need to innovate because of competitive pressure is also important. The overall message is highly Schumpeterian in spirit. Size is also a significant positive determinant of innovation, new firms innovate more and state firms less than privatized ones, and innovation is higher in industry as compared with services.

[Table 7 here]

Drawing on these insights we use instrumental variables to estimate the sales growth equation and report the results in Table 8[4]. The key finding is that innovation as a determinant of sales growth becomes much more important; its already highly significant coefficient quadrupling in size. This is consistent with the hypothesis that poor performance is a spur to innovation, leading to a downward bias on the innovation variable in the absence of instrumenting. The market power variables lose all significance, indicating that they work entirely through their impact on innovation. The coefficients on the two significant infrastructure variables somewhat increase.

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across the three categories of zero, 1-3, >3 competitors as follows: 9.0; 13.1; 77.8. In BEEPS02, the distribution is 1.3; 16.8; 81.9.

[3] It is important to note that even if we had been able to collect a second round of data from the set of firms surveyed in BEEPS99, it is unlikely that panel data techniques would be admissable. Given the nature of the sample selection and the extent of structural change in these economies over this period, attrition bias would be a serious concern.

[4] We exclude pressure from domestic competitors as an instrument because of its likely endogeneity, and indeed a C-test rejects its exogeneity at 10%; without it, the remaining instrument set comfortably passes the Hansen test.

[Table 8 here]

It therefore seems reasonable to conclude that both financial and legal infrastructure have a significant positive impact on firm performance, though (perhaps surprisingly) physical infrastructure does not. To draw a firm conclusion about the role of physical infrastructure from this data would probably be unwise. In the documentation provided by the survey company, it is very clear that poor telecommunications infrastructure was a major hindrance in conducting the survey. The survey design required firms to be identified from statistical office registers (supplemented by commercial directories) and contacted *by telephone* to conduct the screener questionnaire and arrange the full interview. The free-form country reports for Albania, Armenia, Georgia and Uzbekistan all mention that the low penetration and poor telephone lines in rural and sometimes urban areas made identification of firms difficult. Firms in the sample are biased toward those with access to telecommunications infrastructure and this makes it less likely that a variable measuring infrastructure at the level of the firm will show up as a significant determinant of performance.

Can we say more about how precisely infrastructure affects firm performance? One striking finding of the earlier survey (reported in Carlin, Haskel and Seabright, 2001) was that organizational change was a much more hazardous activity in countries of the CIS than elsewhere. CIS firms reporting high levels of reorganization were not more likely to have performed better than those adopting a more cautious strategy, whereas outside the CIS, major organizational change was a highly significant predictor of good performance. This led us to conjecture that perhaps the better infrastructure of non-CIS countries might be interacting with organizational change to increase its effectiveness. Table 9 shows this comparison for both sales and productivity growth for each of the two surveys. The disparity between the two regions is absent in the more recent survey. In fact only a couple of countries (Kyrgyz Republic and Tajikistan) display the pattern characteristic of the CIS in the BEEPS99 survey. The extent of organizational change is indeed strongly associated with sales growth (though not with productivity growth, which tends to reinforce the impression that the current phase of transition is more about 'disequilibrium' labour-intensive growth than about labour-shedding). However, the strength of the association is if anything *stronger* in the CIS than elsewhere. This suggests that if the state of infrastructure is indeed responsible for the greater effectiveness of organizational change, the disadvantage of the CIS in this respect has disappeared (or perhaps been offset by other factors).

[Table 9 here]

So how does organizational change affect innovation and sales growth, and does it interact with infrastructure? In the absence of clear guidance from economic theory, we proceed in an empirical fashion. We have estimated, but do not report, an OLS sales growth equation with the extent of organizational change as a regressor, both alone and interacted with the infrastructure variables. In the former specification it is highly significant (though multi-collinearity problems make both it and the interaction terms

insignificant in the latter); however, its significance disappears once the endogeneity of innovation is taken into account in the IV estimation. This suggests that it is worth investigating directly the relationship of organizational change to innovation. Table 10 does just that. It reports an extended specification of the innovation equation, with both the extent of organizational change and the infrastructure variables included as regressors. Organizational change is massively significant and positive, and the two infrastructure variables that were significant in the sales regressions are insignificant here. This means that the effect of legal and financial infrastructure on productivity does not come via inducing innovation. Somewhat surprisingly, physical infrastructure enters significantly but with a negative sign, a result for which we have no convincing explanation.

[Table 10 here]

Table 11 reports the new instrumental variables estimation of sales growth with organizational change included as a first-stage regressor only. Compared to the results reported in Table 8, the main effect is to lower somewhat the coefficient on innovation, but importantly to lower its standard error by about one third. The instruments (including organizational change) pass the conventional tests for instrumental validity, though as these are not particularly powerful tests this does not amount to a positive endorsement of their quality as instruments. However, this does raise the question of how to interpret the findings.

[Table 11 here]

There would seem to be two main alternative interpretations. One is that organizational change is just a form of innovation that our innovation variable fails to capture adequately but which, when present, is strongly associated with improved firm performance. If so our first-stage regression in the IV sales growth estimation would be mis-specified, since organizational change would be correlated with the error term in the first stage (innovation) equation (rather than in the second stage, which is what the tests measure). While we cannot rule this possibility out, if it were valid we would expect organizational change to show up as independently significant in the second stage equation, which it does not (Table 11 does not report this but the addition of organizational change to the regressors produces an insignificant parameter estimate).

A second interpretation, which we are inclined to favour, is that willingness to undertake major organizational change is a product of a formative change in the culture, management and (in a general sense) the politics of the firm – an internal managerial revolution. This change is the result of human factors internal to the firm and need not be associated particularly with the presence of market opportunities (in this sense it is exogenous to both innovation and to sales growth). However, when it occurs it both tends to encourage innovation and to ensure that, when innovation occurs, it is translated more reliably into improved performance. By itself it is not the solution to the firm's difficulties (change for change's sake may be merely turbulent), but when it leads to innovation it may be a powerful factor in improved performance. This would explain why

our results show organizational change to be very significant in explaining innovation but to be of insignificant weight as an independent factor in sales growth.

These results suggest that in economies in which the operation of market forces is of recent origin, radical organizational change and innovation are widespread phenomena and are positively associated with labour-intensive growth of the firm. This data provides the opportunity of taking a first step toward disentangling the factors behind this phenomenon. What role is played by the components of the market infrastructure (physical, legal, financial) and by the extent of product market competition? We divide the underlying determinants into factors internal to the firm (characteristics of managers (and workers)); the competitive environment in which the firm operates (the firm and its rivals) and the market infrastructure (external to the firm). Our investigation using this data-set suggests that it may be internal factors that determine which firms undertake radical organizational change. Willingness to embark on major organizational change in turn feeds into the innovation decision, at which stage the competitive environment both in terms of the pressure from competitors and the expected rents from innovation/ rents to finance innovation come into play. Finally, over and above the role played by innovation in growth, a favourable legal and financial infrastructure boosts growth further.

Our speculations about the role of an internal managerial revolution remain very obviously speculations since it is hard to find measurable empirical correlates of such a phenomenon. It might be, for instance, that such a revolution comes about only when a firm's general manager is replaced (this would be an extreme version of the theory that differences between good and bad managers are more important than the incentives facing any particular manager). Table 12 examines whether the replacement of a general manager is related to innovation – but finds this variable to be significantly negative. However, there are some likely alternative explanations for this, such as that a general manager might be replaced precisely because the firm has been resistant to innovation and has been performing poorly.

For the time being therefore we merely note these issues as providing an ambitious agenda for future work. We conclude with an overview of the findings as a whole.

5. Conclusions

One of the clearest messages to come out of this survey is that firms in Russia and the CIS have performed very much better than in the earlier survey, both in absolute terms and in comparison to firms in Central and Eastern Europe and the Baltic states. This is true not only in that their levels of sales growth are better (something that should come as no surprise given the improved macroeconomic performance of the region, at least compared to its dismal performance in the late 1990s). More significantly perhaps, the current survey appears to indicate that CIS firms are behaving more like "normal" firms, or at least like their counterparts elsewhere in the transition. For those counterparts elsewhere, successful change was not just about labour-shedding but about finding new

markets and new opportunities. For those counterparts elsewhere, innovation and organizational change might be hazardous but they had a clear tendency to be associated with improved performance. In the CIS, in contrast, conditions appeared so turbulent that firms engaging in innovation and organizational change had little hope of doing much better than firms that merely drew in their horns and waited for the storm to pass. The storm did pass for significant numbers of them, but without particular rewards for those who had been bold compared to those who had been timid. That has now changed, and in the CIS as elsewhere fortune favours the brave – at least in expectation. Willingness to innovate remains the most reliable single indicator of improved performance throughout the region.

What has caused this change? We previously speculated that the presence of satisfactory physical, legal and financial infrastructure might be the key factor making the difference between firms that successfully innovate and those that do not, and that this might explain why organizational change had seemed so much more turbulent in the CIS than elsewhere. Two things make us sceptical about this now. The first is the disappearance of the disadvantage apparently faced by CIS firms: three years seems too short a time for a radical catch-up by the region of prior infrastructural shortcomings. The second is that our infrastructural variables show up in our performance equations either as insignificant or wrongly signed (physical infrastructure) or as significant only directly and not in interaction with organizational change, innovation or competition. Our tests for interaction are, of course, only weak ones, and our legal and financial infrastructure variables are based on subjective responses to a survey, but we can at least say that we have not found positive evidence for the "infrastructure as a condition for successful innovation" hypothesis.

However, we have found very clear evidence that organizational change is both a statistical predictor of innovation and is associated with more reliable outcomes of innovation. This suggests a more "cultural" and less infrastructural explanation of why CIS firms have found innovation more reliably rewarded by results in the more recent period. For reasons that may have to do with political factors at the country level, it may be that firms in the CIS have taken much longer to accept the inevitability of radical organizational reform, and longer to accept that they must look after themselves rather than depend on a client relationship with the state. It may also be that such acceptance has some aspects of a coordination problem – if only some groups within a firm, or only some firms within a network of suppliers and customers, accept the necessity of organizational change, then those that do may be less sure of success (which may in turn discourage the others). If so the evidence suggests that CIS firms are starting to overcome the coordination problem. Blanchard and Kremer (1997) argued that in the initial stage of transition, increased competition would impair performance because of its effect in triggering the disintegration of supply chains. In a comparison between Bulgaria and Estonia, Konings (1998) demonstrated the role of disorganization in early as compared with late transition.

The solution of coordination problems is also easier in a growing than in a contracting economy and the macroeconomic improvement in the region following the Russian crisis

may have played a part. Evidence from market economies suggests that the 'creative destruction' process works differently in booms and recessions (Carlin, Haskel and Seabright 2001). It seems that the adversity faced by firms in recessions does not have the same beneficial effect on incentives to restructure as does the threat from innovative rivals. This is consistent with the poor performance observed for Polish firms in this period. Needless to say this interpretation remains highly speculative, but we hope to pursue it further in later work.

Finally, it is encouraging to note that high sales growth among the surveyed firms has been associated with strong employment growth, especially in a region where both open and hidden unemployment has remained very high. Nevertheless caution is required in interpreting the strong growth performance of firms in the CIS: growth spurts for countries lasting up to a decade are much more common than is success in sustained convergence (Rodrik 2003 Table 9). Growth has been sparked in a broad range of transition countries but translating this into convergence may well depend on improvement in the market infrastructure.

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Table 1
Ownership and Size of Firms in Sample

	Number of Employees				
Ownership	**2-9**	**10-49**	**50-199**	**200+**	**Total**
Privatized	247	418	367	396	1428
Row %	17.30	29.27	25.70	27.73	100.00
Column %	11.86	20.30	35.63	41.64	23.33
State	65	245	214	337	861
Row %	7.55	28.46	24.85	39.14	100.00
Column %	3.12	11.90	20.78	35.44	14.06
New Firm	1770	1396	449	218	3833
Row %	46.18	36.42	11.71	5.69	100.00
Column %	85.01	67.80	43.59	22.92	62.61
Total	2082	2059	1030	951	6122
Row %	34.01	33.63	16.82	15.53	100.00
Column %	100.00	100.00	100.00	100.00	100.00

Table 2
Relation between three measures of perceived competition

	Number of competitors in market for main product				
	No competitors	1-3 competitors	>3 competitors	**Total firms**	**Price-cost margin**
Market power (10% test):					
1= Most sales would be lost	7	216	1663	1886	16.7%
2= Sales would fall a lot	9	143	934	1086	18.3%
3=Sales would fall slightly	17	370	1456	1843	20.0%
4=No change in sales	43	278	857	1178	20.9%
Total	76	1007	4910	5993	
Average market power score	3.3	2.7	2.3	2.4	

Table 3

Country Means of Infrastructure Variables

Country	Physical	Legal	Financial
Albania	1.181	0.925	0.786
Armenia	1.847	1.666	0.745
Azerbaijan	1.632	1.726	0.855
Belarus	1.831	1.384	0.653
Bosnia-Herz	1.779	1.083	0.629
Bulgaria	1.875	1.136	0.552
Croatia	2.030	1.322	0.837
Czech Rep	2.049	1.435	0.710
Estonia	1.856	1.520	0.946
FYR Macedonia	1.681	1.136	0.832
Georgia	1.424	1.052	0.772
Hungary	1.894	1.639	0.819
Kazakhstan	1.700	1.510	0.923
Kyrgyz Rep	1.532	1.254	0.803
Latvia	1.960	1.564	0.984
Lithuania	2.067	1.321	1.035
Moldova	1.658	1.058	0.606
Poland	2.045	1.097	0.515
Romania	1.776	1.160	0.627
Russia	1.691	1.426	0.819
Slovakia	1.989	1.194	0.691
Slovenia	1.995	1.626	0.943
Tajikistan	0.774	1.389	0.635
Ukraine	1.610	1.191	0.700
Uzbekistan	1.619	1.606	0.747
Yugoslavia	1.660	1.379	0.661

Table 4 Mean log of growth over three years of:			
Country	**Sales**	**Labour Productivity**	**Employment**
Accession:			
Czech Rep	9.9%	2.4%	7.5%
Estonia	22.3%	16.4%	6.6%
Hungary	17.1%	12.6%	5.2%
Latvia	9.6%	-1.2%	11.5%
Lithuania	6.7%	-3.4%	9.6%
Poland	-4.8%	-3.9%	-0.7%
Slovakia	15.6%	6.3%	10.8%
Slovenia	14.7%	-3.0%	16.5%
South-East Europe:			
Albania	19.7%	-25.7%	45.4%
Bosnia-Herz	3.7%	-7.8%	13.4%
Bulgaria	-6.7%	-14.1%	7.4%
Croatia	20.8%	5.1%	15.8%
FYRMacedonia	-0.2%	-9.5%	10.0%
Romania	20.4%	2.8%	16.8%
Yugoslavia	8.1%	-8.0%	18.1%
CIS:			
Armenia	-6.7%	-19.1%	11.7%
Azerbaijan	0.1%	-10.8%	10.7%
Belarus	18.3%	3.2%	14.6%
Georgia	-0.7%	-11.6%	9.0%
Kazakhstan	20.5%	2.2%	17.7%
Kyrgyz Rep	-1.8%	0.4%	0.5%
Moldova	17.7%	0.1%	17.2%
Russia	27.2%	7.2%	21.4%
Tajikistan	2.0%	-11.8%	15.5%
Ukraine	20.0%	6.8%	13.3%
Uzbekistan	20.9%	25.6%	-5.0%

Table 5

Mean log of growth over three years of:

Ownership Category	Sales	Labour Productivity	Employment	Fixed Capital
Privatized	12.3%	10.8%	1.8%	10.0%
State	5.9%	10.3%	-4.4%	4.7%
New Firm	12.5%	-6.4%	19.1%	14.6%
Total	11.5%	0.0%	11.8%	12.1%

Table 6

Determinants of Sales Growth

OLS	Coefficient (**bold**=sig. @ 5%)	Robust Standard Error	P-value
Log employment growth	**0.148**	0.020	0.000
Capital investment	**0.531**	0.032	0.000
Number of competitors			
1-3 competitors	-0.010	0.053	0.853
More than 3 competitors	-0.056	0.052	0.283
Market power (10% test)			
Sales would fall a lot	**0.040**	0.019	0.033
Sales would fall slightly	**0.037**	0.016	0.025
No change in sales	**0.044**	0.018	0.014
Innovation (principal component)	**0.024**	0.004	0.000
Physical Infrastructure (principal component)	-0.007	0.012	0.591
Legal Infrastructure (principal component)	**0.031**	0.012	0.011
Financial Infrastructure (principal component)	**0.033**	0.014	0.023
State-Owned Firm	-0.005	0.021	0.799
New Firm	-0.019	0.016	0.224
Industry	0.014	0.013	0.298
Big City	0.021	0.014	0.132
Country dummies	YES		
N=3835, r2 (centered) =0.30			

Table 7 Determinants of Innovation			
OLS	Coefficient (**bold**=sig. @ 5%)	Standard Error	P-value
Log employment	**0.208**	0.015	0.000
Number of competitors			
1-3 competitors	-0.098	0.210	0.641
More than 3 competitors	-0.353	0.207	0.089
Market power (10% test)			
Sales would fall a lot	**0.117**	0.059	0.046
Sales would fall slightly	**0.389**	0.053	0.000
No change in sales	**0.424**	0.062	0.000
Pressure from Domestic Competitors	**0.084**	0.024	0.000
Pressure from Foreign Competitors	**0.164**	0.021	0.000
Pressure from Customers	**0.115**	0.024	0.000
State-Owned Firm	**-0.243**	0.073	0.001
New firm	**0.200**	0.056	0.000
Industry	**0.564**	0.045	0.000
Big City	0.055	0.045	0.223
Country dummies	YES		
N=5377, r2 (centered) =0.17			

Table 8
Determinants of Sales Growth

GMM estimation	Coefficient (**bold**=sig. @ 5%)	Robust Standard Error	P-value
Log employment growth	**0.131**	0.019	0.000
Capital investment	**0.479**	0.036	0.000
Number of competitors			
1-3 competitors	-0.017	0.055	0.753
More than 3 competitors	-0.035	0.054	0.521
Market power (10% test)			
Sales would fall a lot	0.028	0.020	0.163
Sales would fall slightly	0.012	0.018	0.489
No change in sales	0.030	0.019	0.122
Innovation (principal component)	**0.098**	0.018	0.000
Physical Infrastructure (principal component)	0.011	0.013	0.419
Legal Infrastructure (principal component)	**0.043**	0.013	0.001
Financial Infrastructure (principal component)	**0.037**	0.015	0.016
New Firm	-0.002	0.015	0.880
Industry	**-0.039**	0.019	0.039
Big City	0.012	0.015	0.435
Country dummies	YES		

Hansen test of overidentifying restrictions J-statistic = 2.5, p-value 0.28

N=3731, r2 (centered) =0.25

Table 9
Sales and Productivity Growth by Firm Reorganization, 2 surveys

	Extent of Reorganization:			
	None	**Some**	**Major**	**Complete**
Sales Growth				
Non-CIS				
BEEPS99	0.6%	11.2%	24.1%	27.0%
BEEPS02	2.3%	12.7%	18.8%	18.3%
CIS				
BEEPS99	-7.9%	-1.1%	-2.8%	-0.6%
BEEPS02	2.5%	17.5%	26.1%	19.4%
Productivity Growth				
Non-CIS				
BEEPS99	0.0%	7.9%	12.2%	16.3%
BEEPS02	-4.1%	-0.8%	8.3%	-6.7%
CIS				
BEEPS99	-1.0%	0.7%	9.2%	1.4%
BEEPS02	-2.8%	6.3%	4.3%	1.1%

Table 10 Determinants of Innovation			
OLS	Coefficient (**bold**=sig. @ 5%)	Standard Error	P-value
Log employment	**0.170**	0.018	0.000
Number of competitors			
1-3 competitors	0.036	0.225	0.872
More than 3 competitors	-0.167	0.221	0.451
Market power (10% test)			
Sales would fall a lot	**0.130**	0.065	0.047
Sales would fall slightly	**0.353**	0.060	0.000
No change in sales	**0.360**	0.069	0.000
Organizational change	**0.333**	0.024	0.000
Pressure from Foreign Competitors	**0.172**	0.024	0.000
Pressure from Customers	**0.114**	0.026	0.000
Physical Infrastructure (principal component)	**-0.153**	0.045	0.001
Legal Infrastructure (principal component)	-0.020	0.046	0.662
Financial Infrastructure (principal component)	0.017	0.054	0.753
State-Owned Firm	-0.121	0.084	0.152
New firm	**0.236**	0.064	0.000
Industry	**0.581**	0.052	0.000
Big City	0.056	0.052	0.283
Country dummies	YES		
N=3990, r2 (centered) =0.22			

Table 11
Determinants of Sales Growth

GMM estimation	Coefficient (**bold**=sig. @ 5%)	Robust Standard Error	P-value
Log employment growth	**0.139**	0.020	0.000
Capital investment	**0.503**	0.036	0.000
Number of competitors			
1-3 competitors	-0.022	0.054	0.680
More than 3 competitors	-0.052	0.053	0.333
Market power (10% test)			
Sales would fall a lot	0.029	0.019	0.126
Sales would fall slightly	0.022	0.017	0.204
No change in sales	0.037	0.019	0.052
Innovation (principal component)	**0.068**	0.015	0.000
Physical Infrastructure (principal component)	0.004	0.013	0.738
Legal Infrastructure (principal component)	**0.039**	0.013	0.002
Financial Infrastructure (principal component)	**0.033**	0.015	0.026
State-Owned Firm	-0.002	0.022	0.925
New Firm	-0.009	0.016	0.587
Industry	-0.016	0.017	0.327
Big City	0.020	0.014	0.164
Country dummies	YES		
Hansen test of overidentifying restrictions J-statistic = 0.748, p-value 0.69			
C-test for exogeneity of organizational change as instrument: 0.012, p-value 0.91			
N=3708, r2 (centered) =0.29			

Table 12
Determinants of Innovation

OLS	Coefficient (**bold**=sig. @ 5%)	Standard Error	P-value
Log employment	**0.177**	0.018	0.000
Number of competitors			
1-3 competitors	0.050	0.228	0.827
More than 3 competitors	-0.165	0.224	0.461
Market power (10% test)			
Sales would fall a lot	**0.139**	0.065	0.033
Sales would fall slightly	**0.362**	0.060	0.000
No change in sales	**0.370**	0.069	0.000
Change in General Manager	**-0.164**	0.056	0.003
Organizational change	**0.341**	0.024	0.000
Pressure from Foreign Competitors	**0.176**	0.024	0.000
Pressure from Customers	**0.116**	0.026	0.000
Physical Infrastructure (principal component)	**-0.153**	0.045	0.001
Legal Infrastructure (principal component)	-0.023	0.047	0.618
Financial Infrastructure (principal component)	0.017	0.054	0.758
State-Owned Firm	-0.097	0.084	0.251
New firm	**0.222**	0.064	0.001
Industry	**0.568**	0.052	0.000
Big City	0.046	0.052	0.379
Country dummies	YES		
N=3968, r2 (centered) =0.23			

Appendix

Tables the showing construction of the principal components measures of innovation and infrastructure

Table A1. Construction of innovation measure

Component	Eigenvalue	Difference	Proportion	Cumulative Proportion
1	0.43911		0.4683	0.4683
2	0.14394	0.29516	0.1535	0.6219
3	0.13512	0.00882	0.1441	0.7660
4	0.11574	0.01938	0.1234	0.8894
5	0.10368	0.01206	0.1106	1.0000

Survey question: Has your company undertaken any of the following initiatives in the last three years?	Eigenvector of 1st component (weighting)
Upgrading of existing product line	0.60601
Successful development of major new product line	0.58474
Introduction of new technology that substantially affected way main product produced	0.47905
Opening of new plant	0.18138
Quality accreditation (ISO 9000)	0.16863

Table A2. Construction of measure of physical infrastructure

Component	Eigenvalue	Difference	Proportion	Cumulative Proportion
1	0.35610		0.3850	0.3850
2	0.20088	0.15522	0.2172	0.6022
3	0.11253	0.08835	0.1217	0.7238
4	0.10100	0.01153	0.1092	0.8330
5	0.08660	0.01440	0.0936	0.9266
6	0.06787	0.01873	0.0734	1.0000

Survey questions (all coded so poor quality, low access, problematic infrastructure is low):	Eigenvector of 1st component (weighting)
More than 3 days in 2001 with power outages / surges	0.65115
More than 3 days in 2001 with water shortage	0.41626
More than 3 days in 2001 with mainline telephone services unavailable	0.39580
In period since 1998, more than 3 days delay (after application) in getting a main-line telephone connection	0.36071
In period since 1998, more than 3 days delay (after application) in getting an electrical connection	0.27677
How problematic is electricity for the operation and growth of your business (1 no obstacle; 4 major)	0.19838

Table A3 Construction of measure of legal infrastructure

Component	Eigenvalue	Difference	Proportion	Cumulative Proportion
1	0.35996		0.6759	0.6759
2	0.08397	0.27599	0.1577	0.8336
3	0.05174	0.03223	0.0972	0.9307
4	0.03688	0.01486	0.0693	1.0000

Survey questions:	Eigenvector of 1st component (weighting)
How problematic is corruption for the operation and growth of your business (1 no obstacle; 4 major)	0.55478
How problematic is organized crime / mafia for the operation and growth of your business (1 no obstacle; 4 major)	0.50560
How problematic is street crime /theft / disorder for the operation and growth of your business (1 no obstacle; 4 major)_Q80Cri |	0.48428
How problematic is the functioning of the judiciary for the operation and growth of your business (1 no obstacle; 4 major)	0.44952

Table A4 Construction of measure of financial infrastructure

Component	Eigenvalue	Difference	Proportion	Cumulative Proportion
1	0.23718		0.8151	0.8151
2	0.05379	0.18339	0.1849	1.0000

Survey question:	Eigenvector of 1st component (weighting)
How problematic is access to finance (e.g. collateral required)or financing not available from banks for the operation and growth of your business (1 no obstacle; 4 major)	0.72415
How problematic is cost of financing (e.g. interest rates and charges) for the operation and growth of your business (1 no obstacle; 4 major)	0.68964