Contributions to Economic Analysis & Policy

Volume 3, *Issue* 1 2004 *Article* 17

A Minimum of Rivalry: Evidence from Transition Economies on the Importance of Competition for Innovation and Growth

Wendy Carlin* Mark Schaffer†

Paul Seabright‡

*University College London, w.carlin@ucl.ac.uk

†Heriot-Watt University, m.e.schaffer@hw.ac.uk

‡IDEI, University of Toulouse-1, seabrigh@cict.fr

A Minimum of Rivalry: Evidence from Transition Economies on the Importance of Competition for Innovation and Growth*

Wendy Carlin, Mark Schaffer, and Paul Seabright

Abstract

This paper examines the importance of competition in innovation and the growth of firms. We make use of the large-scale natural experiment of the shift from an economic system without competition to a market economy to shed light on the factors that influence innovation by firms and their subsequent growth, thereby alleviating problems due to non-random clustering of innovation opportunities in mature market economies. We find evidence that monopolies innovate less and have weaker growth than firms facing a minimum of rivalry. The presence of competitors has both a direct effect on performance, and an indirect effect, through improving the efficiency with which the rents from market power in product markets are utilised to undertake innovation. There is also some less clear-cut evidence of an 'inverted-U', namely that the presence of a few rivals is more conducive to performance than the presence of many competitors.

KEYWORDS: competition, productivity growth, innovation, rivalry, transition

---

*We have received advice and help from Philippe Aghion, Richard Blundell, Ronald Braeutigam, Saul Estrin, Rachel Griffith, Mark Schankerman and Jan Svejnar, from seminar and conference audiences, and from the referees and the editor of this journal, Judith Chevalier. We are grateful to the EBRD and World Bank, who financed the survey, and especially to Steven Fries, with whom we have co-authored related papers using these data. The usual caveat applies. Department of Economics, University College London, Gower St, London WC1E 6BT

1. INTRODUCTION

How much does competition matter for innovation and the growth of firms, and if it is significant, through what channels does it work? These are important and long-standing questions in economics, but ones to which convincing answers have been frustratingly difficult to find. Theories of the influence of competition on firm behaviour and performance suggest that this influence can work through many different channels, some of them mutually offsetting, so the question of their relative importance can only be settled empirically. However, there are many obstacles in the way of finding convincing empirical answers.

The greatest such obstacle concerns the nature of the phenomenon to be explained. Broadly speaking, the literature on the determinants of firms' performance has conceptualized performance in two main ways.[1] The first is the productivity measure of performance, which assumes that there is a common technology available to all firms in an industry, and that this technology can be estimated empirically by inferring 'best achievable practice' from data on actual productivities of firms.[2] Firms' performance is then assessed in terms of their closeness to best achievable practice, which is a 'level' measure of productivity. Studies using this approach have achieved the clearest results in industries such as electricity and air transport where there is a single world market for the technology (so that the common technology hypothesis seems reasonable) but the market for the product or service itself is national or regional, so that there is enough variation in the degree of competition across markets to make econometric analysis possible.[3] In addition it is easier to interpret performance measures where the product concerned is reasonably homogeneous, so that aggregate output measures are not contaminated by the endogeneity of prices (firms with market power may appear more productive because their output prices are higher).

The second concept of performance is one in which different firms face different opportunities which manifest themselves over time, and to which they respond to a greater or lesser degree. This is a measure of performance as a 'change' rather than a 'level' variable, but the significance of a given change can only be evaluated by comparing it to the opportunities faced by the firm concerned. We can think of such a measure of performance as an 'innovation'

[1] We exclude from this classification measures of performance which take firms' productivities (and thus their costs) as given, and seek to explain their price-cost margins in terms of a number of variables including competition variables. Schmalensee (1989) provides a comprehensive survey of this literature; although its main focus is quite different from our concerns in this paper (which are to explain variations in costs, not in price-cost margins), some of the methodological issues raised by Schmalensee are pertinent to our own approach, as we discuss in section 4 below.

[2] Two main techniques used in productivity studies are data envelopment analysis and stochastic production frontier analysis (see Ng and Seabright, 2001, for a discussion of their relative merits).

[3] See Kwoka (1996) for electricity and Ng and Seabright (2001) for air transport.

rather than a productivity measure, provided we use the term in a sufficiently broad sense. Innovation refers to the development of new products or processes. But in principle the products or processes need not be completely new to the industry concerned – a restaurant that succeeds in identifying a hitherto-unsatisfied demand for pizza in a neighbourhood is responding to an opportunity no less than a pharmaceutical company that identifies a therapeutic use for a newly-synthesized molecule. What matters is that the firm should respond to the opportunities that appear, when and where they appear. We are interested in whether competition makes them better or worse at doing so.

Unfortunately, in a market economy at any one time, we typically do not directly observe the opportunities for innovation faced by firms, though we do know that they vary greatly across firms and across industries. It is therefore difficult to know to what extent variations in actual innovative activity are due to variations in responsiveness to opportunity, and to what extent they are due to variations in the opportunities themselves. For instance, firms that innovate relatively little in any one period may be relatively unresponsive to opportunity, or they may have undertaken innovation in earlier periods and already be occupying an optimal market niche. Conversely, firms that innovate more in any one period may be those that are responding rapidly to current opportunities, or those that are responding slowly to past opportunities. Of course, if the distribution of innovation opportunities were completely random, such differences would just add noise to the data without biasing the estimation. But there is a great deal of evidence that actual innovations cluster, and this is probably due to a clustering of innovation opportunities: in any period they are likely to be more concentrated among firms of certain categories (of size and market position, for instance) than others. As the survey by Cohen and Levin (1989) pointed out, studies of the determinants of innovation have often been unsatisfactory because they have been unable to control for differences in demand, in technological opportunity and in the appropriability of innovations that faced firms in different industries.[4]

Moreover, studying performance as a change rather than a level variable would be interesting even if there were no shortcomings in the literature measuring the determinants of productivity levels. The most significant factors influencing growth and living standards in the long run are surely those that determine innovation, rather than those that simply improve productivity with

[4] As Cohen and Levin also point out, these same factors that determine innovation opportunities may also exercise an influence on market structure, leading to endogeneity bias in any statistical association between market structure and measured innovation. Indeed, Levin et al. (1985) include variables that seek explicitly to model such determinants in equations explaining innovation, and once they do so the independent effect of market structure disappears. We discuss this endogeneity question in detail in section 4 below.

respect to a static concept of technology. This suggests the importance of finding solutions to the problem of our inability directly to observe the clustering of innovation opportunities across firms. One possible solution is to take a measure of productivity growth over a sufficiently long time period for inter-industry differences in opportunities to be more nearly random; however, nobody has more than an educated guess as to how long a time period is long enough. Another is to use panel data that control via fixed effects for at least some of the unobserved inter-firm differences; however, opportunities that arise during the life of the panel will by definition not be captured through firm fixed effects. Knott and Posen (2003), who use a 20-year panel of almost 3000 firms from 34 industries, combine these two approaches.[5] A third solution is to confine the study to certain sectors (IT or pharmaceuticals, for instance) where there is reason to think that many firms faced innovation opportunities, if not always to the same degree. A firm that did not innovate during the period in question is therefore much more likely to be a poorly performing firm.

In this paper we propose a more radical version of this third solution: the use of data from transition countries, where the end of central planning offers a historically unique opportunity to observe large numbers of firms simultaneously facing opportunities for and the urgent need to escape from the products and processes inherited from the command economy. Indeed, in the modest sense of innovation that refers not to shifting the technological frontier but to improving the firm's own products and processes, the early years of the transition provide as close to a laboratory for responsiveness to innovation as we may ever come. Virtually every firm that emerged from central planning was maladapted to the new environment, and virtually every firm needed to innovate at least modestly in order to survive.[6]

This observation applies, of course, to firms that existed under central planning and continued into the new era of the market economy, whether or not they remained state-owned. However, the firms operating in transition economies today include not only these old firms, but also new firms – those founded since the end of central planning. Though these firms also needed to innovate, their need was not a consequence of a prior maladaptation but simply of the need to enter the market in the first place. To put it another way, the behaviour of new firms tells us more about the response of entrepreneurs to new opportunities than about the response of pre-existing firms. For this reason, we pay particular attention in what follows to differences in the behaviour of new and old firms, and we consider hypotheses about the effect of competition on innovation to be more easily testable on the sub-sample of old firms.

[5] However, their concern is more to deal with the endogeneity of market structure than with the non-observability of innovation opportunities as such.
[6] Johnson et al. (2002) refer to evidence of the pervasiveness of lucrative unfilled niches.

One consequence of our use of transition data to alleviate the problem of the non-observability of innovation opportunities is that, although we make every effort to address concerns about reverse causality (an issue we discuss at length in section 4 below), we do not develop a model that is structural in the sense of deriving testable predictions from an equilibrium model of firm behaviour. In the normal sense of the word 'equilibrium', every firm in our sample is engaging in out-of-equilibrium behaviour, and the phenomenon we are studying is an out-of-equilibrium phenomenon. This does not mean, though, that the once-only historical experiment represented by transition, and on which our estimations are based, has no relevance for future policy. On the contrary, policy frequently seeks to subject firms (usually on an industry-by-industry basis) to similar shocks, by dismantling regulations and lowering barriers to entry in an attempt to improve performance. The results we present here constitute a large-scale version (important for the degree of statistical precision it makes possible) of similar experiments that are continually being carried out in a more sporadic way.

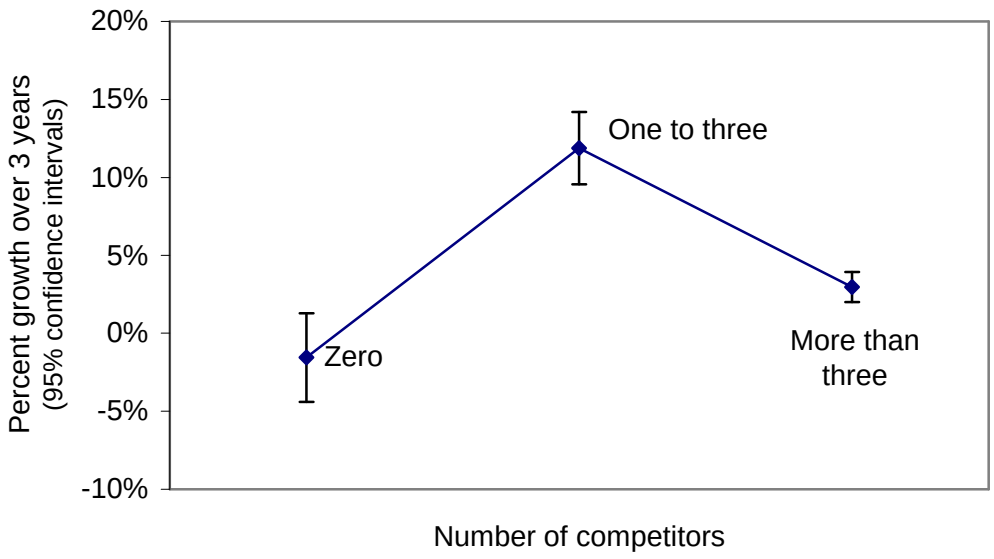
In the paper we also propose a solution to another difficulty that has faced many previous studies of the relationship between competition and innovation. It is hard to find suitable measures of the competitive pressure faced by firms. Proxies such as shares of administratively defined product markets identified by SIC codes may be a long way from identifying the true nature of economic competition. Our survey contains a number of questions that elicit from firms a much more intuitive and economically-grounded view of their competitive circumstances than has previously been possibly in surveys on this scale. There are two main advantages to doing so. First, our market structure measures correspond more closely to the situation faced by managers than do statistical measures based on SIC codes. Secondly, we can distinguish (as we discuss below) between pure market structure measures and measures of the residual elasticity of demand faced by firms. The latter is theoretically distinct from the former (and can vary separately from the former) but is often ignored in empirical work because of the difficulty of finding suitable measures.

The survey also contains detailed questions about the innovative activities undertaken by managers. These provide us with the opportunity of investigating the impact of competition on innovation as the first step and then in the second step, looking at how competitive conditions influence output growth as distinct from their effect on innovation.

In a nutshell, what do we find? In the raw data presented in Fig. 1, there is a clear inverted-U relationship between firm growth and the number of competitors faced by the firm. Firms facing between one and three competitors had average sales growth of nearly 11% over the three years to 1999, while monopolists saw real sales decline by over 1% and firms facing more than three

competitors had sales growth of under 2%.[7] To investigate whether this bivariate correlation stands up to more rigorous econometric estimation is the task of this paper. We also explore in some detail the channels through which competition works, distinguishing between the effects of competition on managerial and workforce motivation, and its effects on the resources available to firms to put into practice their strategies of investment and innovation. We do so in two ways. First of all, we use two measures of competitive pressure, one being the number of rival firms perceived by the firm in its main market, and the other being the elasticity of demand the firm perceives for its products; these turn out to have distinct and largely independent influences on firm behaviour. In turn we look at this behaviour in two ways – through measures of the innovation activity undertaken by the firm, and through a measure of its growth in sales. These respond in distinct ways to the two kinds of competitive pressure just described.

Figure 1: Average real sales growth by number of competitors
(3,288 firms)



The principal objective of the paper should therefore be seen as proposing a solution to the problem identified by Cohen and Levin (1989) for studies of the impact of competition on innovation – namely the problem of the many omitted

[7] The vertical lines are 95% confidence intervals from a simple least squares regression of log sales growth on three category dummies (monopolist, 1-3 competitors, >3 competitors) and no constant.

determinants of innovative opportunities. The structure of the paper is as follows. In section 2 we review briefly the theoretical and empirical literature on the link between competition and growth – do we have any reason to expect there to be a link at all? In section 3 we describe our data, and in section 4 we discuss empirical specifications, bearing in mind particularly concerns about the possible endogeneity of some explanatory variables, and setting out the strengths and weaknesses of our methods for meeting these concerns. Sections 5 and 6 present our results and section 7 concludes.

2. WHY SHOULD COMPETITION MATTER FOR INNOVATION AND FOR THE GROWTH OF FIRMS?

There is a clear consensus in theoretical and empirical work that stronger competition is associated with improved allocative efficiency in most types of industries, though as Schmalensee (1989) points out, the direction of causality between competition and other market characteristics may be very difficult to determine: competition and allocative efficiency may both be effects of deeper underlying causes, notably of the nature of industry technology. There is also a reasonable empirical consensus that stronger competition is associated with improved levels of *productive* efficiency in industries characterized by a common technology (see Ng and Seabright, 2001; Friebel et. al., 2004 and references therein). However, since (as explained in section 1) neither of these strands of literature is directly relevant to our concern with innovation, we do not survey them further here.

The connection between competition and both innovation and growth is much more contentious than either of these previous empirical associations. Schumpeter identified the countervailing pressures at work in 1943. Not till more than a half century later has theoretical work been able to formalize the mechanisms he described and best-practice empirical analysis to find ways of separating out the effects in the data.

Schumpeter's vision of the capitalist economy was of a system in which incumbents with market power are constantly being threatened both by existing competitors and by new entrants (Schumpeter 1943, Carlin et al., 2001a). Innovation is spurred by the potential rents that would come from success in a necessarily risky activity and by the need to innovate to maintain existing rents in the face of competitive threat. He also emphasized that innovation is costly, that financial markets are imperfect and that internal funds are often necessary in order for a firm to innovate. Schumpeter's vision draws therefore on an analysis of both the *costs* of innovation, and the *benefits* it yields to the entrepreneurs undertaking it. The costs are likely to be lower when market power creates rents that can be used to fund the investments upon which innovation depends. The benefits, however, may be higher or lower under market power: market power allows

entrepreneurs to keep a greater share of the resulting profits, but it also protects entrepreneurs who fail to innovate, whereas under competition, incumbents who fail to innovate will be pushed out by innovating incumbents or entrants. In his vision of how the competitive process works, these counteracting forces are simultaneously present. The subtlety of Schumpeter's analysis does not therefore lend itself to a simple hypothesis such as 'more competition raises/lowers innovation' that can be taken to the data. His analysis distinguishes between actual rents (resources), perceived rents (post-innovation), actual competition and potential competition.

Considerable progress has been made in recent years in building formal models in both industrial organization and in growth theory that capture several aspects of the Schumpeterian competitive process. A survey of models from both traditions is provided in Aghion and Griffith (2004). In addition to the classic Schumpeterian effect of greater ex post competition depressing the incentive to innovate (as in Aghion and Howitt, 1998), other models have shown how the adverse effects of knowledge spillovers to competitors on the incentive to invest may offset the direct productivity-enhancing impact of the spillovers themselves (e.g. Dutta and Seabright, 2002). The opposite relationship with greater competition inducing productivity growth is captured in some models. For example, the emergence of new competitors threatens the temporary monopoly profits from innovation and the survival of incumbents, which prompts satisficing managers to exert effort and shorten the innovation cycle (Aghion et al., 1999). More recently, the basic Schumpeterian model has been extended by allowing incumbent firms to innovate (Aghion et al., 2001). In a further step, Aghion et al. (2004) simplify the modelling of the technology gap between firms and are able to show formally the existence of an inverted-U relationship between competition and innovation. At low levels of competition, the incentive to innovate is sharpened as more competition raises the incremental profits from innovation. When competition becomes intense, further competition may inhibit innovation as the standard Schumpeterian effect offsets the pressure to innovate so as to escape competition.

Empirical support for the role of competition as a spur to performance comes from recent econometric research using a variety of performance measures. For instance, Blundell et al. (1999) use numbers of innovations as a measure and are able to reconcile the fact that large firms are more likely to innovate with the positive role of competition in innovation. They show both that firms with larger market shares have more to gain by innovating in a pre-emptive fashion (potential competitive threat) and that in industries where competition is less intense, rates of innovation are lower. The results are consistent with those of a quite different methodology (bench-marking using case studies) in which Baily and Gersbach (1995) find that 'head-to-head' competition in the same market results in faster innovation in several manufacturing industries. Nickell (1996) controls for

industry level concentration and import concentration and finds that a firm-level measure of competition is correlated with TFP growth. A robust inverse U-relationship between product market competition and the patenting activity of UK firms consistent with the counteracting Schumpeterian mechanisms is reported in Aghion et al. (2004).

Evidence that the presence of only a few competitors is sufficient to sharpen incentives is provided in an empirical study of entry thresholds. Bresnahan and Reiss (1991) find that most of the competitive impact from entry comes from the first two entrants to challenge a monopolist, with the effect levelling out once market participants number around five.

Nickell motivates his 1996 paper by observing that the most convincing evidence for the role of competition in innovation and growth comes from a 'broad brush' comparison between the lack of dynamism of centrally planned as compared with market economies. Studies are beginning to emerge that examine the role of competition in the transition from central planning to the market economy. Grosfeld and Tressel (2002) apply Nickell's methodology to a panel of Polish firms listed on the stock market. They find that a reduction of 10 percentage points in the firm's market share is associated with faster total factor productivity growth of 1.4 percentage points. Using a measure of competition at industry level, Konings (1998) found in a study of Bulgaria and Estonia that more competitive pressure in the industry enhanced firm TFP growth in Bulgaria but not in Estonia. A recent attempt has been made to use the statistical technique of meta-analysis to synthesize the empirical results of studies of transition economies (Djankov and Murrell, 2002). Although there are important questions about the reliability of meta-analysis techniques, especially where there is reason to suspect that empirical biases may be correlated across studies,[8] their findings are nevertheless illuminating. Djankov and Murrell pool 23 studies (that use mainly *level* rather than *growth rate* measures) and report a positive impact of competition on performance (see Table 7 in Djankov and Murrell for the estimated size of the effects). Finally, a study of Georgian firms (Djankov and Kreacic, 1998) that collected information on actions taken by managers found that competition from foreign producers tended to be associated with employment cuts and changes in suppliers (but tended to reduce the likelihood of the disposal of assets, renovations and computerization). By contrast, firms with a larger market share were more likely to engage in computerization, introduce renovations, establish a new marketing department and dispose of assets. This last study, though based on data from only one country, is the most similar to ours in design

[8] For a survey of the methodological problems associated with 'narrative' and meta-analysis reviews, see Chalmers and Altman (1995).

and spirit, both in its conceptualisation of innovation and in its focus on the role of competition.[9]

Naturally, as was emphasized by Cohen and Levin (1989), all studies of the impact of competition need to control for other factors, and studies vary in the extent and manner in which they do so. One such factor is ownership. Since privately-owned firms also tend to operate in a different competitive environment, failure to control for ownership might lead to significant bias. Pooling 37 studies and placing more weight on studies that controlled for selection bias in the privatization process, Djankov and Murrell (2002) found that privatization improved performance significantly (the majority of studies used levels rather than growth rate measures, see Djankov and Murrell, Table 2). For the Commonwealth of Independent States (CIS) countries (former Soviet Union excluding the Baltics), however, there was no robust significant difference between the performance of state-owned and privatized firms.

To summarize, theory provides good reasons to expect that monopolists will be less dynamic and innovative than rivalrous oligopolists, with a small number of exceptions in naturally monopolistic industries. Empirical evidence tends to confirm this view. Both theory and evidence are less clear, however, as to whether competition has a monotonically beneficial effect on performance or whether many competitors are actually less good for performance than just a few. Theory and evidence also suggest that any attempt to test for such a relationship needs to control for firm and industry characteristics, as well as for relevant features of the external environment.

It is evident that the theories we have outlined above do not provide sufficiently precise empirical predictions for us to be able to distinguish one theory from another; instead they provide a guide as to certain empirical tendencies for which one can test (such as whether the effect of competition is monotonic). Nevertheless, we can tentatively draw a distinction between theories that appeal to the effect of competition on managerial incentives (on how keenly managers will wish to ensure the efficient use of the firm's resources), and those that appeal to the effect of competition on the resources over which managers enjoy discretionary control. This corresponds to the distinction between the benefits and the costs of innovation that we noted above in the work of Schumpeter. As we noted above, the effect of competition on incentives could well be non-monotonic: for firms in which monetary rewards for managers are weak, lack of rivalry may make managers lazy, while too much rivalry may make them resigned to their fate. Equally in profit-maximizing firms, the incentive to escape competition by innovating may be strong at low levels of competition but

[9] An early study using survey data from three transition countries examined the impact of the number of competitors along with other variables on the price-cost margin, but not on innovation or growth (Hersch et al., 1994).

be offset by the standard Schumpeterian effect when competition is high, again producing an inverted-U pattern. However, the effect of managerial resources is more likely to be monotonic, but to depend qualitatively on how well aligned are the incentives of the managers and the shareholders. Managers acting efficiently will tend to do more for the firm the more resources they have to play with, while those acting inefficiently will tend to do worse, the more resources they have to play with. We explore this suggestion further in the regressions we report in section 6 below.

3. DATA AND VARIABLES

Our objective is to make use of a large multi-country cross-sectional firm-level dataset to examine the determinants of innovation and growth at the level of the firm. Although there are serious shortcomings with the data that limit the analysis that can be undertaken, these are balanced by the opportunities afforded by bespoke data-collection on this scale. The key disadvantages stem from the fact that there is no panel structure and that the data are self-reported rather than of an accounting or administrative nature. On the other hand, information collected from firms of all sizes across all sectors in a large number of economies following a major shock to the competitive environment is a potentially rich source of evidence to complement the insights from more conventional datasets. We discuss the nature of the survey and the data collected and then in turn the issues raised by the measurement of growth, innovation and competition.

THE BEEPS ENTERPRISE SURVEY

A major effort at the collection of firm-level data on enterprise performance and the external environment of firms in transition economies was undertaken in 1999 by the EBRD and World Bank. Face-to-face interviews at enterprises in twenty transition countries were conducted in the early summer of 1999. Surveys of five more transition countries were completed later in 1999. The aim was to investigate how enterprise restructuring behaviour and performance were related to competitive pressure, the quality of the business environment, and the relationship between enterprises and the state.

The survey sample was designed to be broadly representative of the population of the firms according to their economic significance, sector, size and geographical location within each country. The sectoral composition of the total sample in each country in terms of agriculture, industry and services was determined by their relative contribution to GDP after allowing certain excluded sectors. Firms that operated in sectors subject to government price regulation and prudential supervision were excluded from the sample. Within each sector, the sample was designed to be as representative as possible of the population of firms subject to various minimum quotas for the total sample in each country. This

approach sought to achieve a representative cross-section of firms while ensuring sufficient weight in the tails of the distribution of firms for key control parameters (size, geographical location, exports, and ownership).

The survey was implemented on behalf of the EBRD and World Bank by AC Nielsen through face-to-face interviews with each of the respondents in their local language (see Appendix 1). They were informed that the EBRD and World Bank had commissioned the survey and that the identity of the survey respondents was to be kept strictly confidential by the survey firm. The interviewers assured respondents that their identity would not be disclosed either to the two sponsoring institutions or to the government. In order to collect evidence on the role of competition in growth and restructuring, we designed a block of questions to be included in the BEEPS survey.

The full sample size was 3,954 firms. The survey included approximately 125 firms from each of the 24 countries, with larger samples in Poland and Ukraine (over 200 firms) and in Russia (over 500 firms). We omit from the analysis firms missing any of the indicators used in the econometric analysis in the next section, reducing the sample to 3,341.

Just over half the firms in the sample were newly-established private firms, 33% were privatized and 16% remained in state ownership at the time of the survey. Table 1 provides some basic information on the distribution by size, sector and region of the sample of firms. The sample is dominated by small and medium-sized enterprises; one-half the sampled firms employed fewer than 50 persons, and just over one-fifth employed more than 200. Nearly one half of firms are from the service sector and 12% are from agriculture. 30% of firms are from the manufacturing sector. Just under one-third of the sample is from the Central and Eastern European region (including the Baltics) and nearly 10% of firms are Russian. Most firms were located in either large cities or national capitals (37%) or in medium-sized cities (31%), with the remaining third in towns and rural areas.

THE MEASUREMENT OF PERFORMANCE: GROWTH AND INNOVATION

Table 2 presents data on the average performance by firms using the performance measures that we concentrate on in this paper: the growth of real sales, of real sales per worker and the engagement of firms in innovation activities. The growth measures were calculated from self-reported figures for the real growth of sales and of employment over the previous three years. It is important to note that there is no true time-series dimension. We have only self-reported information on the change in real sales as well as on the kinds of restructuring activities carried out by the firms over the preceding three years. We need to keep these limitations in mind when analyzing the results.

TABLE 1. NUMBER OF FIRMS BY SIZE, SECTOR AND REGION
(In proportion of firm type, %)

		Agriculture	Manufact-uring	Other industry	Retail & wholesale trade	Other services	Total
Full sample	All firms	374 (11.5)	1046 (30.2)	323 (9.9)	928 (28.4)	670 (20.0)	3341 (100)
	Micro	31	151	59	430	195	866 (25.9)
	Small	40	194	78	265	155	732 (21.9)
	Medium	135	355	121	171	187	969 (29.0)
	Large	168	346	65	62	133	774 (23.2)
CEB		50 (4.6)	302 (28.0)	82 (7.6)	330 (30.6)	314 (29.1)	1078 (100)
SEE		19 (2.8)	304 (44.7)	56 (8.2)	178 (26.2)	123 (18.1)	680 (100)
Russia		102 (21.8)	123 (26.3)	54 (11.5)	139 (29.7)	50 (10.7)	468 (100)
Western CIS		50 (15.1)	111 (33.5)	45 (13.6)	86 (26.0)	39 (11.8)	331 (100)
Southern CIS		64 (14.3)	111 (24.7)	46 (10.2)	148 (33.0)	80 (17.8)	449 (100)
Central Asia		89 (26.6)	95 (28.4)	40 (11.9)	47 (14.0)	64 (19.1)	335 (100)

Notes: Micro firms (employment < 10); small firms (employment 10-49); medium firms (50-199), large (>200). 'Other industry' comprises mining, construction and electricity; 'other services' comprises transport, financial, personal, business and miscellaneous services. CEB=Central Europe & Baltics, SEE= South-Eastern Europe.

In the sample as a whole, 31% of firms reported a contraction in sales (in real terms) over the previous three years; just under one-quarter reported flat sales and 47% reported growing sales. The Central and East European region including the Baltic States (CEB) and the South East European region (SEE) were the only regions in which a majority of firms reported growing sales. In line with the macroeconomic performance across different regions, the proportion of firms with shrinking sales in a region ranged from just over one-fifth in CEB to one-third in Russia and over 40% in the Western and Southern CIS.

For old firms (state-owned and privatized), average growth of sales was negative; it was positive for new firms. The opposite was true of productivity growth: average growth of sales per worker was negative in new firms and positive in old ones. For both privatized and new private firms, average growth increased with the size of the firm. This was not the case for state firms. In old firms, where between 55 and 60% of firms had stagnant or declining sales, the more rapid shedding of labour than reduction of output lies behind the positive productivity growth recorded. In new firms, average productivity growth was negative but there is a clear size effect: as we move to higher size classes, productivity growth becomes less negative. In the largest size class, positive productivity growth was recorded for new firms. A possible explanation for this size effect is the endogeneity of size. Larger firms may be larger at the time of survey because they grew faster (or shrank less rapidly); we return to this issue in the next section when we discuss our econometric estimations.

TABLE 2. REAL SALES AND PRODUCTIVITY GROWTH AND RESTRUCTURING/ INNOVATION BY OWNERSHIP OF FIRM
Mean of log 3-year real sales and productivity growth

		Old firms		New firms	All firms
		SOE	Privatized		
Number of firms (in proportion of firm type, %)		535 (16.1)	1098 (32.9)	1708 (51.1)	3341 (100)
Sales growth (%)		-0.4	-1.8	8.7	3.8
Number of firms, in proportion of firm type (%)	Increase in sales	40.6	45.0	50.4	47.1
	Zero growth	27.5	19.3	22.4	22.2
	Decline in sales	32.0	35.7	27.7	30.7
		100	100	100	100
Productivity growth (%)		8.6	9.3	-1.7	3.6
Firms undertaking various types of restructuring activity:					
Opening of new plant		16.4	23.7	20.6	20.9
New product line		28.0	34.1	30.0	31.0
Upgrade		42.8	39.4	38.8	39.7
ISO		17.6	22.2	10.8	15.6

Notes: The question asked was, 'By what percentage have your sales changed in real terms over the last three years?' 'Productivity' growth is calculated from the change in sales and in employment reported over the last three years. All restructuring indicators refer to changes in the previous three years. 'New product line' refers to the successful development of a major new product line. 'Upgrade' refers to the upgrading of an existing product line. 'ISO' refers to the receipt of an ISO9000 accreditation.

In addition to measures of performance based on sales growth, we sought to uncover the steps undertaken by firms to improve their performance through innovation.[10] To capture the extent of their innovative activities, 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, and whether they had obtained ISO9000 quality accreditation in the previous three years. Table 2 shows that 40% of all firms upgraded at least one product, 31% introduced a new product, 21% opened a new plant and 16% obtained ISO9000 quality accreditation. Engagement in these activities was common across all firm types, including state-owned firms. The measures most clearly interpretable in terms of our definition of innovation are the introduction of a new product line or the upgrading of an existing one, and a simple principal components analysis corroborates this choice: these two measures receive the highest weights (eigenvectors).[11] Because the weights assigned to the two measures are similar, and for ease of interpretation, we define our innovation variable as simply the number of these innovation activities

[10] Patterns of cost-oriented or defensive restructuring are explored in Carlin et al. (2001b).

[11] When the principal components are calculated on the covariance matrix, the first principal component explains 42% of the variation. The eigenvectors assigned to a new product, upgrading, new plant and ISO9000 are, respectively, 0.62, 0.70, 0.28 and 0.22. The pattern is similar if the correlation matrix is used instead.

undertaken: 0, 1 or 2. In the sample, about one-half undertook none of these measures, just under one-third implemented one measure, and just under one-fifth both developed a new product and upgraded an existing one. The shares are almost identical for new and old firms alike.

While there is no way in our data to weight these innovation measures according to their economic significance (distinguishing, for example, between cosmetic changes in existing products and more radical improvements), such difficulties exist for all measures of innovation of which we are aware in this literature (such as patent counts). However, as will be seen below, our estimation strategy involves an important 'reality check' – we not only look at the determinants of innovation, but we also include this same measure, suitably instrumented, in an equation explaining productivity growth. The fact that the innovation regressor is strongly positive and significant is a welcome corroboration that, on average, our measures are indeed capturing innovation that is of economic significance in the sense of making an important contribution to the productivity of the firms that undertake it.

THE MEASUREMENT OF COMPETITION

One common and intuitive starting point for measuring competition is the extent to which production is concentrated in the hands of a few firms. The crudest measure of this concentration is simply the number of firms that are operating in the same or a recognisably similar market. To be useful this measure depends on there being some practical method of defining the relevant market (see Neven et.al., 1993, chapter 2), which essentially means finding goods and services that are reasonably close substitutes for each other while being distant substitutes for all other goods or services. But while this may be a useful first indicator, it may be seriously misleading when there are important differences in size, strength and productivity between firms. For example, the exit of one large firm and entry of many small ones may reduce conventionally measured concentration but lower the vigour of the rivalry faced by the remaining large firms. This problem has been observed in transition countries where the exit of one or two large enterprises from an industry along with the simultaneous entry of many new small firms has resulted in a reduction in effective competition (see Kattuman and Domanski, 1998, on Poland). One way of dealing with this is by calculating measures of market power at the firm rather than the market level, in particular by looking directly at the market share of each individual firm or by asking managers to provide a judgement as to the number of competitors they believe the firm faces in its main market.

A second way of measuring competition is to look at some of the consequences of market structure rather than market structure itself, and specifically at the freedom firms have to choose prices (and other business

strategies) independently of any concern about losing business to other firms. A natural way to do this is to estimate the so-called residual elasticity of demand for the firm's own products, namely the extent to which a price rise by the firm would lead customers to substitute away, either to rival firms or away from the product altogether. When sophisticated data are available, this elasticity can sometimes be estimated econometrically (see Hausman et al., 1994, for an application to the case of beer), and it is particularly useful to do so when products are differentiated so that the notion of a single product market may make little sense.

Naturally, the firm's residual elasticity of demand will depend in important ways on the market structure in which it is operating – the more competitors, the higher its residual elasticity. However, it is also determined by fundamental features of the market demand for the good concerned (see e.g. the Dasgupta and Stiglitz (1980) model of innovation and market structure, in which the residual elasticity of demand is a function of the number of competitors and the market elasticity of demand). Ideally, empirical studies of the effect of competition on innovation and growth would follow theory and try to capture both of these measures, but usually data limitations have obliged them to settle for market structure measures alone.

A third and altogether different approach to measuring competition is to look directly at the behaviour of firms and to infer from this the extent of the rivalry they believe themselves to face. In particular, the price-cost margin charged by a profit-maximising firm facing constant marginal costs (given by the technology and not capable of being influenced by the firm itself) will be inversely proportional to the own-price elasticity of demand for its products. If price-cost margins can be reliably measured, therefore, they may themselves be an inverse indicator of the vigour of competition in the market.

The survey instrument was expressly designed to discover the extent to which firms believed themselves to be facing significant competitive challenge using each of these kinds of measures.

- As a measure of market structure we use the number of competitors reported by the respondent in the market for its main product, dividing firms into those reporting respectively no competitors, between one and 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. In particular, in a survey with coverage of the entire economy, this is likely to provide an economically meaningful measure of competition whether the firm is a pizza parlour or a components supplier for a multinational company.

- As a measure of firms' freedom to raise prices we use their response to a question asking them what would be the consequence of a 10% rise in the real price of their product relative to that of their competitors, scoring from one (for firms reporting that most customers would switch to rival suppliers) to four (for firms reporting that most customers would continue to buy in similar quantities as previously).
- As a measure of firms' behaviour we use their (self-reported) price-cost margin.

We can ask two questions about these different ways of measuring competition. First, are they empirically consistent with one another, in the sense that they identify the same firms as possessing market power? And secondly, are they just alternative empirical proxies for the same phenomenon, or do they measure distinct aspects of market power? To answer the first question, we report in Table 3 mean values of the second and third measure for firms categorized by the first measure, and sub-categorized by ownership status (state firm, privatized firm and other) in order to control for different degrees of commitment to profit-maximising behaviour. The answers clearly indicate that in markets with no competitors firms report lower own-price elasticities of demand and higher price-cost margins than in markets with 1-3 competitors. The exception is for state firms, where the price-cost margin is lower for firms facing 1-3 competitors than for either of the other categories (as one might expect given their weaker incentives for profit-maximisation). It appears that the responses to these three questions complement one another, which is reassuring in terms of the economic content of the data. The questions asked about the number of competitors appear to have focused the attention of managers on an economically relevant concept of the 'market' in which they are competing. Nevertheless, the somewhat counter-intuitive behaviour of the price-cost margin for state firms leads us to prefer not to use this as an indicator of market power in the regressions below.[12]

To answer the second question (about whether these measure distinct aspects of market power) we shall investigate in detail the ways in which they interact with our measures of performance; we do so in section 6 below. However, we can make some general empirical predictions at this stage. First, if these measures were just imperfect proxies for the same basic phenomenon ('market power') we would expect that each of them would have a stronger impact when entered singly in a performance regression than when entered in the presence of the other (that is, entering a second measure would reduce the explanatory power of the first). In fact, as we shall see, the explanatory power of the measures

[12] However, the price-cost margin and the residual elasticity of demand are correlated at very high levels of significance: a t-ratio of 4.73.

appears to be more or less unchanged whether entered singly or together, which suggests that they may be identifying distinct aspects of market power.

TABLE 3. COMPETITION AND CONCENTRATION
Market power (10% test, answer from 1 - *all customers switch* - to 4 - *customers continue to buy as before*) and price-cost margin, by ownership and number of competitors

	Number of competitors			
	None	1 to 3	>3	Total
State-owned Enterprises				
Number of firms	129	103	303	535
(in proportion of firm type, %)	(24.1)	(19.6)	(56.6)	
% price-cost margin	15.1	12.1	16.1	15.1
10% test (answer from 1 to 4)	3.07	2.50	2.27	2.51
Privatized firms				
Number of firms	86	147	865	1098
(in proportion of firm type, %)	(7.8)	(13.4)	(78.8)	
% price-cost margin	18.3	15.6	15.5	15.7
10% test (answer from 1 to 4)	2.60	2.35	2.15	2.21
New firms				
Number of firms	84	202	1422	1708
(in proportion of firm type, %)	(4.9)	(11.8)	(83.3)	
% price-cost margin	23.2	20.1	17.3	17.9
10% test (answer from 1 to 4)	2.48	2.36	2.02	2.09
All firms				
Number of firms	299	452	2590	3341
(in proportion of all firms, %)	(9.0)	(13.5)	(77.5)	
% price-cost margin	18.3	16.7	16.6	16.7
10% test (answer from 1 to 4)	2.77	2.39	2.09	2.20

So what might these distinct aspects of market power be? We distinguished above (following the original approach in Schumpeter) between theories that appeal to the effect of competition on managerial incentives, and those that appeal to the effect of competition on the resources over which managers enjoy discretionary control. We suggested moreover that the two might interact: control over resources would be associated more reliably with innovation when managerial incentives are strong.

How could we investigate this conjecture empirically? It seems reasonable to suggest that the perceived number of competitors is likely to capture the motivation of managers, while the freedom to raise prices will capture their control over resources (the rents available to them). This prompts a second empirical prediction: if motivation is strongest when there are 1-3 competitors and

weakest when there are none, then more resources should be associated with better performance when there are 1-3 competitors and not associated (or negatively associated) when there are none.

Finally, the survey also sought to investigate the impact of perceived competitive pressure on decisions by managers to undertake innovation measures (rated in each case on a scale of 1=not important to 4=very important). The questions about pressure to innovate are important since they enable us to explore more closely how performance improvements come about. A smaller proportion of state firms as compared with other firms reported pressure from domestic competitors as playing a significant role in their decision to enter new markets or introduce new products. Amongst private firms, one in five reported pressures from foreign competitors as significant in stimulating the introduction of new products. New entrants reported less pressure from foreign competition, which may reflect their small average size.

4. ECONOMETRIC ESTIMATION AND MODELLING STRATEGY

Our procedure is to estimate two equations, one for innovation and the second for sales growth. The equations are estimated separately for old and for new firms. We include in the sales growth equation our measure of innovation together with the growth of employment and a dummy variable indicating whether the firm had opened a new plant, along with other regressors. This may therefore be interpreted as one version of an augmented total factor productivity growth equation, in which our dummy variable for capacity expansion proxies for the growth of fixed capital.

Using innovation both as a dependent variable and as an endogenous regressor in a productivity equation enables us, first, to verify that our measures of innovation are indeed capturing developments of economic significance, and secondly, to examine the effects of competition on productivity through other channels than via innovation as captured by our measures.

We first describe the specification and list the variables in each equation, and then discuss our identification strategy. We write the innovation equation as follows (all variables are firm-level variables):

$$innov = a_0 + a_1 comp + a_2 mpower + a_3 pressureD + a_4 pressureF + a_5 pressureC + a_6 size + \mathbf{X}\mathbf{a}_7 + u_1 \quad (1)$$

where

innov is the number of innovative activities undertaken (introducing a new product or upgrading an existing one);

comp is the number of competitors in the firm's main product market;

mpower is market power as measured by the 10% price test;

pressureD, pressure F and *pressure C* are measures of the importance attached by managers respectively to pressure from domestic competitors, from foreign competitors and from customers in their decision to innovate;
size is log total employment in the firm;
X is a vector of controls for sector, country and urban/rural location.

We write the sales growth equation as follows:

$$y = b_0 + b_1 comp + b_2 mpower + b_3 l + b_4 k + b_5 innov + \mathbf{Xb_6} + u_2 \qquad (2)$$

where
y is the growth of output;
l is employment growth;
k is a dummy variable for capacity expansion.

We now address issues of identification. There is a set of variables that theoretical considerations suggest should be in the innovation equation but not in the growth equation and vice versa. Variables that on a priori grounds should be excluded from the growth equation are the so-called pressure variables that reflect the view of managers as to the importance of different sources of pressure for their decision to innovate. Sources of competitive pressure were 'domestic' or 'foreign' competitors. In addition, managers were asked about the role of pressure from customers, which we use as a proxy for the growth of the market. The availability of a direct measure of the 'demand pull' force behind innovation allows us to exclude sales growth from the innovation equation. The 'pressure' variables are instruments for innovation in the growth equation, the validity of which we test. The size of firm is a standard determinant of innovation (reflecting, for example, economies of scale in R&D and marketing) but it is less clear that it has a place in a TFP growth equation. We test whether size is a valid instrument in the growth equation. Conversely, on a priori grounds, employment growth should be in the growth equation but not in the innovation equation.

Capacity expansion clearly belongs in the growth equation, but how to treat it in the innovation equation is not clear. On the one hand, prior literature suggests that fixed investment is a potential determinant of innovation, either because innovations may be embodied or because innovation opportunities may vary with technological maturity (see e.g. Levin et al., 1985). On the other hand, innovation and fixed investment may be jointly determined: introducing a new product line may be more likely in a new plant, but the decision to introduce the product may be the reason why the plant is built. In the results reported below we omit capacity expansion from the innovation equation. We can report, however, that when it is included it attracts, as expected, a positive and significant

coefficient,[13] and that the values of the other coefficients (and hence our conclusions) are not affected.

Size is potentially endogenous, and we are able to deal with this in a straightforward way. There may be a spurious correlation between performance as measured over the preceding three years and size as measured at the time of survey, because *ceteris paribus* firms that grew during the period will tend to be larger at the end of the period. We therefore use employment at the start of the period as our size measure, calculated using observed end-period employment[14] and employment growth during the period.

Since inputs and output may be chosen simultaneously, the possible endogeneity of employment growth and capacity expansion in the growth equation must also be addressed. Suitable instruments for employment growth are difficult to find in the survey data. Our strategy is to recognize that the estimated labour elasticity is not of particular interest for the purposes of this paper, and to impose a range of coefficients on employment growth. We then examine the sensitivity of the other coefficients to this variation, reporting as robust those coefficient values that are qualitatively unaffected by the coefficient value imposed.[15] Using a coefficient of one is equivalent to estimating a labour productivity growth equation. Capacity expansion is more likely to be pre-determined than employment growth, but endogeneity is still a concern. We can and do test for its exogeneity, but the power of these tests may be limited. An alternative strategy would be to use the same procedure as we do for the labour elasticity and to impose a range of coefficients on capacity expansion as well. Below we summarize the results using this alternative procedure but do not report them in detail.

An important issue is the extent to which the competition variables may be considered exogenous. In the long run, successful performance brings with it an increase in market share and more market power. Reverse causality of this kind will put an upward bias on measures of market power, and a downward bias on measures of competition (such as the number of competitors), in a performance regression. The causality may operate through other channels as well: as Knott

[13] The value of the coefficient is about 0.25-0.30, depending on specification, with a standard error of about 0.05.

[14] Firms report employment by choosing 1 of 6 size categories; our end-period 'log employment' is the log of the midpoint of the reported category.

[15] An alternative strategy we adopted was to experiment with an instrument for employment constructed by interacting the country dummies with an exogenous determinant of performance at the level of firm (we used one of the competition measures). The logic of the choice of the country-competition interaction variable is that there is country variation in policies that protect firms from shocks that would force them to downsize. Diagnostic tests revealed these instruments to be rather weak, however, so we do not report the results, though we can report that they cast no doubt on the robustness of the results discussed in the text.

and Posen (2003) note, the same factors that lead to increased innovation and growth given competition also attract entry, and hence with free entry there may be a reduced or even no residual effect of competition. However, there are some reasons to think that such concerns may be less serious in the transition context than they would be in mature market economies. Transition economies were subjected to a comprehensive economy-wide shock to competition. Broadly speaking, the old firms in the sample are likely to operate in markets, the structure of which at the time of the survey is still strongly influenced by the pre-transition arrangements in which competitive success was not a determinant of market structure. The new firms making up the bulk of the sample are mainly small and more plausibly characterized as responding to market conditions than establishing them. As we have seen when inspecting the data (Table 3), market power is much more characteristic of state-owned firms than of others: such firms had privileged access to resources in the old regime. At the time of the survey, transition economies were distant from an equilibrium in which market structure was the outcome of the playing out of competitive forces. Thus, not only were many aspects of market structure and the competitive pressure faced by firms inherited from the command economy – but many of the subsequent changes were the outcome of random events during the liberalisation process early in the transition. Such random events were unobserved (by the econometrician) and firm-specific, and therefore not easily capable of being instrumented.

Our approach can therefore be considered complementary to that of Knott and Posen. Their panel allows them to first-difference and then to instrument their market structure measures; they then find that innovation increases with the number of firms. So while they use a long time series to tease out the effect of small changes in aggregately-measured market structure, we use a cross-section of many firms facing individually-measured market structures that are still well out of equilibrium and at least partly exogenous.

Such considerations do not entirely remove concerns about endogeneity of our competition measures; indeed, in the absence of panel data and given that we are not able to measure competition prior to innovation it is likely to be impossible to remove such concerns altogether. However, the considerations about the inherited character of market structure suggest that for old firms, any endogeneity bias should be smaller than for new firms. For this reason we examine the sub-samples of old and new firms separately, and bear this differential vulnerability to bias in mind in interpreting the results.

The cross-country nature of the dataset allows for another check on endogeneity bias. The process of reform and transition to a market economy has, by all accounts, proceeded more rapidly in Central Europe and the Baltics than elsewhere in the region, and in the case of Central Europe, started two years earlier (1989 vs. 1991). This suggests that the endogeneity of market structure

should be lower in the non-CEB countries of the CIS and South-Eastern Europe – more of the 'natural experiment' of transition is still intact. As an additional robustness check of our growth regressions, we therefore report the results of splitting the sample between CEB countries and the remainder.

Finally, in our data it is impossible to take into account the endogeneity of the privatisation decision by correcting for selection bias. We therefore do not distinguish separately between privatized firms and ones that were state-owned at the time of the survey. We can report, however, that this distinction proved insignificant in our preliminary work: any positive bias on the effect of privatization due to selection effects was not strong enough to produce a significant difference in performance between state-owned and privatized firms once competition, size and sector were controlled for. The relevant distinction in the data appears to be between *old* and *new* firms rather than between state-owned and private (i.e., privatized plus new) ones. This distinction also raises fewer econometric problems since the difference between old and new firms is given by history.

ESTIMATION METHODS AND DIAGNOSTIC TESTS

For the instrumental variables estimations we employ several diagnostic tests. Our benchmark regression is a two-step efficient GMM estimation, chosen because it is efficient in the presence of arbitrary heteroskedasticity, which tests suggest is present.[16] We report an F-test of the excluded instruments in the first-stage regression as a test of the rank condition for identification.

We also present a test of overidentifying restrictions, namely the Hansen J statistic. This is a test of the joint hypothesis that the instruments are valid (i.e., uncorrelated with the error term) *and* that none of the instruments should have been included in the set of regressors and were not. Tests of the exogeneity/validity of selected instruments use the C or 'difference-in-Sargan' test, a GMM-type test of orthogonality conditions.[17] All estimations were done using the Stata statistical package.[18]

[16] We also estimated the modification of limited-information maximum likelihood (LIML) proposed by Fuller (1977); we set the Fuller parameter $\alpha=1$, giving us the mean-unbiased version of his estimator. The main motivation for the use of LIML is that recent research suggests it performs relatively well when instruments are weak, which is occasionally the case (e.g., Table 6, column 2). We do not report these results since they were qualitatively identical to the GMM results.

[17] See Hayashi (2000), pp. 218-220, for a description of the test, and Baum et al. (2003) for the Stata implementation.

[18] For further details of the estimation routines used, see Baum et al..

5. RESULTS

INNOVATION

We begin by reporting in Table 4 the results of the innovation equation (equation 1), separately for the sub-samples of old and new firms. Columns (2) and (4) are identical to columns (1) and (3) except that a single indicator has been used for each of the pressure variables. This does not affect the results. Pressure from both foreign competitors and from customers is a strong and highly significant determinant of innovation. Pressure from domestic customers was not significant and has been dropped – suggesting that domestic and foreign competitors are far from being close substitutes in terms of their effects on firm behaviour.[19]

Both new and old firms show strong evidence of Schumpeterian effects, though their manifestation is somewhat different. For both groups, innovation is positively related to market power as measured by the 10% test, suggesting that firms face resource constraints which make rents important in financing innovation. However, the relation is monotonic for old firms, while there is some evidence of an inverted U-shape for new firms – those with the most market power do less innovation than those with somewhat less. As far as the number of competitors is concerned, old firms facing oligopolistic rivalry do more innovation (though the coefficient is not significant at conventional levels) than old monopolists, while new firms facing rivalry do more innovation than new firms facing competition.

Larger old firms and those in big cities are more likely to have engaged in innovation, which is in line with other empirical evidence and suggests that economies of scale in innovation and agglomeration effects are at work in the transition economies. Predictable industry effects are also confirmed: firms in the service and agricultural sectors are much less likely to have innovated.

SALES GROWTH

Before presenting the instrumental variables equations, we report a reduced form equation for sales growth with only the exogenous variables present, as shown in equation (3). The inclusion of employment growth and capacity expansion as regressors mean the equation can be interpreted as a reduced form augmented TFP equation in which input growth rates are treated as exogenous. The results constitute our initial check of the bivariate correlation of growth with intense rivalry in the product market illustrated in Fig. 1.

$$y = \beta_0 + \beta_1 comp + \beta_2 mpower + \beta_3 pressureF + \beta_4 pressureC + \beta_5 size + \mathbf{X}\boldsymbol{\beta_6} + \beta_7 l + \beta_8 k + u_3 \quad (3)$$

[19] We tested whether pressure from domestic competitors was a valid instrument for innovation in the growth equation but it failed the instrument validity test and was dropped from the equation.

TABLE 4. DETERMINANTS OF INNOVATION

	(1)	(2)	(3)	(4)
Dependent variable	Innovation (old firms)	Innovation (old firms)	Innovation (new firms)	Innovation (new firms)
Number of competitors				
No competitors	-0.094	-0.106	0.017	0.023
	(0.068)	(0.068)	(0.092)	(0.092)
>3 competitors	-0.074	-0.073	-0.169**	-0.165**
	(0.052)	(0.052)	(0.055)	(0.055)
Market power (10% test)				
Sales would fall a lot	0.099*	0.105*	0.077+	0.077+
	(0.046)	(0.046)	(0.044)	(0.044)
Sales would fall slightly	0.111*	0.119**	0.250**	0.251**
	(0.048)	(0.048)	(0.048)	(0.048)
No change in sales	0.176**	0.173**	0.177**	0.180**
	(0.057)	(0.057)	(0.065)	(0.065)
Pressure from foreign competitors				
Categorical				
Slightly important	0.201**		0.134**	
	(0.056)		(0.050)	
Fairly important	0.215**		0.052	
	(0.051)		(0.048)	
Very important	0.224**		0.210**	
	(0.056)		(0.058)	
Coded 1 to 4 (cardinal)		0.079**		0.056**
		(0.018)		(0.017)
Pressure from customers				
Categorical				
Slightly important	0.039		0.054	
	(0.055)		(0.057)	
Fairly important	0.070		0.067	
	(0.053)		(0.058)	
Very important	0.125*		0.142*	
	(0.062)		(0.061)	
Coded 1 to 4 (cardinal)		0.042*		0.045*
		(0.020)		(0.019)
Size (lagged log employment)	0.023+	0.024+	0.008	0.008
	(0.013)	(0.013)	(0.015)	(0.015)
Services	-0.226**	-0.234**	-0.305**	-0.308**
	(0.042)	(0.042)	(0.039)	(0.039)
Agriculture	-0.316**	-0.318**	-0.045	-0.044
	(0.054)	(0.054)	(0.081)	(0.082)
Big city	0.120**	0.125**	0.056	0.055
	(0.042)	(0.042)	(0.038)	(0.038)
Country dummies	Yes			
Number of observations	1633	1633	1708	1708
R^2	0.179	0.175	0.167	0.164

Notes: $^{+}$ = sig. at 10%, * = sig. at 5%; ** = sig. at 1%; heteroskedastic-robust standard errors in ().
Test of (1) vs. (2): $\chi^2(4)=6.40$, p-value=0.17; Test of (3) vs. (4): $\chi^2(4)=7.28$, p-value=0.12.

The results are shown in Table 5. When interpreting the results, it is important to recall that the average growth of sales and of productivity of firms was close to zero and only just over 40% of firms reported positive sales growth over the preceding three years. The findings are striking. The nature of competition in the product market has a statistically significant and economically important inverted-U effect on the performance of both old and new firms. Sales and productivity growth are lower in both monopolies and firms facing more than 3 competitors than in the control group of rivalrous oligopolists. More precisely, old firms facing between one and three competitors reported growth in sales and productivity about 8% higher than monopolists and 6% higher than competitive firms. The corresponding figures for new oligopolists were 14% and 7% respectively. As we shall see, this inverse-U relation is not always statistically significant in the equations capturing the separate component effects of innovation, but such an inverse-U is certainly a robust descriptive property of the total impact of product market competition.

The second indication that competition effects are important comes from the positive sign on the variable for firms reporting that sales would fall only slightly or not at all in response to a 10% price rise. These firms saw productivity growth between 5% and 10% higher than others.

Appendix Table A1 reports the results of addressing the potential problem of endogeneity of labour growth by imposing a range of labour elasticities. The estimated labour elasticities in Table 5 are about 0.5 for old firms and about 0.7 for new firms, so Table A1 reports estimations assuming elasticities of 0.25 and 0.75 for old firms and 0.5 and 1.0 for new firms (the latter is equivalent to estimating a labour productivity equation). Our prior is that the endogeneity bias in the employment coefficients is positive,[20] and so we should probably place more weight on the estimations assuming the lower elasticities. Table A1 shows that the key results are relatively insensitive to the specification chosen and hence to the labour endogeneity issue: the inverse-U and the impact of market power remain significant, particularly with the lower elasticities.

Although the capacity expansion variable passes an exogeneity test in our instrumental variables specification (see below), we also tested the robustness of the results in Table 5 by allowing for the possibility that the coefficients on both inputs are subject to endogeneity bias. The procedure was calibrated as follows. In Table 5, column (1), the estimated coefficients on employment growth and capacity expansion are about 0.5 and 0.1 respectively.[21] If returns to scale were

[20] The standard argument is that the manager takes into account a component of the error term unobservable to the researcher when choosing the employment level; see, e.g., Hayashi (2000), pp. 196-7.

[21] We use the results for old firms because the coefficient on capacity utilization is significant and because our prior is that endogeneity is less of a concern for this group of firms.

constant, this would imply that when capacity is expanded by the average firm, fixed capital increases by (log) 20%, which is plausible. We simplify our robustness tests by assuming constant returns and imposing pairs of coefficients on employment growth and capacity expansion of (0.25, 0.15), (0.50, 0.10), and (0.75, 0.05). The detailed results are not reported here; we simply note that, again, the key results for the impacts of the number of competitors and of market power are unaffected by allowing for the endogeneity of inputs in this way.

TABLE 5. REDUCED FORM GROWTH REGRESSIONS

	(1)	(2)
Dependent variable	Real sales growth Old firms	Real sales growth New firms
Estimation method	OLS	OLS
Employment growth	0.547**	0.697**
	(0.028)	(0.025)
Capacity expansion	0.102**	0.018
	(0.024)	(0.026)
Number of competitors		
No competitors	-0.081*	-0.141**
	(0.036)	(0.053)
>3 competitors	-0.061*	-0.073*
	(0.027)	(0.031)
Market power (10% test)		
Sales would fall a lot	0.017	0.033
	(0.026)	(0.026)
Sales would fall slightly	0.089**	0.099**
	(0.026)	(0.026)
No change in sales	0.103**	0.052
	(0.030)	(0.036)
Pressure from foreign competitors	0.022*	0.005
	(0.009)	(0.010)
Pressure from customers	0.008	0.006
	(0.010)	(0.011)
Services	0.034	-0.035
	(0.023)	(0.022)
Agriculture	(0.016)	0.063
	(0.030)	(0.046)
Big city	0.007	0.028
	(0.022)	(0.022)
Size (lagged log employment)	0.025**	0.013+
	(0.008)	(0.008)
Country dummies	Yes	
Number of observations	1615	1673
R^2	0.295	0.410

Notes: * = sig. at 5%; ** = sig. at 1%; heteroskedastic-robust standard errors in ().

We look now at the instrumental variables estimates in Table 6. The excluded instruments for innovation are the 'pressure to innovate' variables and size.

TABLE 6. DETERMINANTS OF SALES GROWTH, EMPLOYMENT GROWTH TREATED AS EXOGENOUS

	(1)	(2)
Dependent variable	Sales growth Old firms	Sales growth New firms
Estimation method	GMM	GMM
Employment growth	0.424** (0.049)	0.618** (0.068)
Capacity expansion	0.033 (0.035)	-0.038 (0.051)
Innovation (endogenous)	0.361** (0.098)	0.225 (0.163)
Number of competitors No competitors >3 competitors	 -0.045 (0.039) -0.046 (0.030)	 -0.143** (0.057) -0.044 (0.042)
Market power (10% test) Sales would fall a lot Sales would fall slightly No change in sales	 -0.015 (0.030) 0.056* (0.028) 0.054 (0.033)	 0.017 (0.030) 0.052 (0.044) 0.019 (0.039)
Services	0.115** (0.037)	0.021 (0.052)
Agriculture	0.137** (0.047)	0.066 (0.040)
Big city	-0.028 (0.027)	0.018 (0.024)
Country dummies	Yes	
Excluded instruments	Pressure from foreign competitors, pressure from customers, size	Pressure from foreign competitors, pressure from customers, size
First-stage F-test of excluded instruments	F(3,1577)=13.6	F(3,1635)=4.78
Test of overidentifying restrictions (Hansen J)	$\chi^2(2)$=1.64 p-value=0.44	$\chi^2(2)$=1.58 p-value=0.45
C test of endogeneity of capacity expansion	$\chi^2(1)$=1.37 p-value=0.24	$\chi^2(1)$=1.58 p-value=0.21
Number of observations	1615	1673

Notes: * = sig. at 5%; ** = sig. at 1%. Standard errors and test statistics are heteroskedastic-robust.

In the growth equation for old firms, employment growth and innovation are highly significant determinants, which suggests that it be interpreted as a form of augmented TFP growth equation. Column (2) indicates that innovation in new firms is less reliably associated with growth than is the case in old firms: the coefficient is large but estimated imprecisely. This is likely to be because of the presence amongst new firms of a proportion of experiments with entrepreneurship that will fail. Extensive evidence from both advanced and developing economies shows that turnover rates of firms are especially high for young firms.[22]

The really important feature to emerge from this table is that, for *new* firms, having between one and three competitors contributes positively and significantly to productivity growth in a *direct* way, even when the role of innovation is taken into account. Conditional on innovation, the presence of rivalry seems to matter for these firms. For *old* firms, by contrast, rivalry matters through its impact on innovation. Market power as measured by the own-price elasticity of demand appears to work mainly *indirectly*, via promoting innovation.[23]

Although agriculture and services attract significant negative coefficients in the innovation equation, both are positive in the growth regression for old firms, indicating that residual productivity growth in firms outside industry is relatively high. The other control variables are important for innovation – and therefore indirectly for growth – but play no role in explaining residual productivity growth.

The diagnostic tests of the instruments for innovation are satisfactory, although more so for the equation for old firms. The overidentification tests are also comfortably passed in each specification, which provides support for excluding the 'pressure' and size variables from the growth equation. The C-test of the endogeneity of capacity expansion suggests that it is acceptable to treat this variable as exogenous.

As with our reduced form results, since we cannot be fully confident that our estimation of the productivity growth equation has dealt satisfactorily with the endogeneity of employment growth, we experiment with a range of values of the employment growth elasticity and explore the implications for how the growth equation behaves. The results for coefficients ranging from 0.25 to 0.75 are shown in Table 7. The key competition results discussed in connection with Table 6 remain in place, which is reassuring.

[22] Baldwin (1995), for example, reports that about half of new entrants in Canadian manufacturing die within the first decade. Tybout (2000) surveys the evidence for developing and developed economies and concludes that firm turnover rates are relatively rapid in developing countries.

[23] Concern about the bias on TFP level estimates in the context of imperfect competition in the product market (Hall 1988) is mitigated by the fact that we are looking at the impact of a given *level* of competition on productivity *growth*.

TABLE 7. DETERMINANTS OF SALES GROWTH, IMPOSED LABOUR ELASTICITY

	(1) Elasticity=0.25	(2) Elasticity=0.75	(3) Elasticity=0.25	(4) Elasticity=0.75
Dependent variable	Sales growth Old firms	Sales growth Old firms	Sales growth New firms	Sales growth New firms
Estimation method	GMM	GMM	GMM	GMM
Capacity expansion	0.062+	0.031	-0.031	-0.015
	(0.036)	(0.037)	(0.061)	(0.052)
Innovation (endogenous)	0.305**	0.271**	0.382*	0.105
	(0.103)	(0.104)	(0.163)	(0.140)
Number of competitors				
No competitors	-0.055	-0.053	-0.128*	-0.146**
	(0.038)	(0.039)	(0.061)	(0.058)
>3 competitors	-0.054+	-0.043	-0.022	-0.059
	(0.030)	(0.030)	(0.047)	(0.040)
Market power (10% test)				
Sales would fall a lot	-0.003	-0.012	0.006	0.025
	(0.030)	(0.029)	(0.033)	(0.029)
Sales would fall slightly	0.075**	0.050+	0.022	0.075+
	(0.027)	(0.026)	(0.048)	(0.040)
No change in sales	0.081*	0.042	0.025	0.030
	(0.033)	(0.034)	(0.047)	(0.038)
Services	0.105**	0.068+	0.069	-0.014
	(0.037)	(0.037)	(0.053)	(0.045)
Agriculture	0.117**	0.098*	0.077	0.069+
	(0.047)	(0.049)	(0.045)	(0.039)
Big city	-0.014	-0.036	0.034	0.018
	(0.027)	(0.027)	(0.028)	(0.024)
Country dummies	Yes			
Excluded instruments	Pressure (2x), size	Pressure (2x)	Pressure (2x), size	Pressure (2x)
First-stage F-test of excluded instruments	F(3,1578)=11.2	F(2,1579)=15.4	F(3,1636)=5.85	F(2,1637)=8.66
Test of overidentifying restrictions (Hansen J)	$\chi^2(2)$=0.14 p-value=0.93	$\chi^2(1)$=0.10 p-value=0.75	$\chi^2(2)$=3.04 p-value=0.219	$\chi^2(1)$=0.01 p-value=0.94
C test of endogeneity of capacity expansion	$\chi^2(1)$=0.12 p-value=0.73	n.a.	$\chi^2(1)$=2.99 p-value=0.084	n.a.
Number of observations	1615		1673	

Notes: * = significant at 5%; ** = significant at 1%; heteroskedastic-robust standard errors in (); number of observations=3288.
Size fails the endogeneity test for specification (2) ($\chi^2(1)$=12.6, p-value=0.00) and is dropped from the set of instruments in the estimation reported.
Size fails the endogeneity test for specification (4) ($\chi^2(1)$=5.0, p-value=0.03) and is dropped from the set of instruments in the estimation reported.

Lastly, we look for evidence of endogeneity in the competition measures by exploiting the cross-country dimension of the dataset and estimating the equations reported in Tables 5-7 separately for the 1000+ firms from Central Europe and the Baltics (CEB) and the remaining 2200+ firms from the CIS and South-Eastern Europe (SEE). Because the latter group of firms are operating in market environments that are still far from equilibrium, we expect the coefficients on the competition measures to be less subject to endogeneity bias. The results are shown in Appendix Table A2; for brevity, only the coefficients on the competition measures are reported. The effect of splitting the sample along these lines is very clear. The estimated effects of competition on growth in the CIS and SEE countries are broadly similar to those reported above for the sample as a whole, in part, of course, because they account for two-thirds of the total sample. The estimates for the CEB countries are quite different: the estimated coefficients are often much smaller and never significant. The standard errors of the estimates are not much larger for the CEB sub-sample compared to those for the CIS-SEE sub-sample, and so the differences in the estimation results cannot be entirely attributed to the smaller sample size for the CEB countries. The results are suggestive of an endogeneity bias that is operating via free entry, reducing the observed impact of competition and market structure in countries that have progressed longer and further in the transition to a mature market economy. This suggests in turn that our estimates of the impacts of competition are more likely to be biased downwards than upwards, implying that our conclusions are likely to be on the conservative side.

6. INTERACTION BETWEEN MANAGERIAL MOTIVATION AND RESOURCES

In this section we explore the interaction between the number of competitors faced by a firm and its market power as measured by the freedom to raise prices. We suggested above that the former might work primarily through influencing the motivation of managers, and the latter through influencing the resources over which they have discretionary control. Before exploring how the interaction between the number of competitors and the extent of market power affects innovation, we check how the equation behaves when each measure is included separately. As Table A3 in the Appendix shows, the inclusion of both competition measures appears justified. Although the size of the coefficient on 'more than 3 competitors' is reduced slightly when the market power measure is added to the equation, little else changes. This strengthens our belief that these measures may be capturing distinct aspects of market power rather than being alternative imperfect measures of the same phenomenon. The same finding holds true in the growth equation, although we do not report this result explicitly.

TABLE 8. DETERMINANTS OF INNOVATION: COMPETITION AND MARKET POWER INTERACTED

	(1)	(2)
Dependent variable	Innovation Old firms	Innovation New firms
Number of competitors		
No competitors	0.009	0.050
	(0.178)	(0.237)
>3 competitors	0.003	-0.211
	(0.121)	(0.135)
Market power (10% test) *Coded 1-4 (cardinal)*		
With no competitors	0.039	0.061
	(0.046)	(0.072)
With 1-3 competitors	0.085*	0.071
	(0.044)	(0.051)
With > 3 competitors	0.052**	0.094**
	(0.021)	(0.020)
Foreign competitors *Coded 1-4 (cardinal)*	0.079** (0.018)	0.057** (0.017)
Customers *Coded 1-4 (cardinal)*	0.041* (0.020)	0.047** (0.019)
Size (lagged log employment)	0.024+	0.010
	(0.013)	(0.015)
Services	-0.233**	-0.302**
	(0.043)	(0.039)
Agriculture	-0.318**	-0.047
	(0.054)	(0.082)
Big city	0.124**	0.056
	(0.042)	(0.038)
Country dummies	Yes	
Number of observations	1633	1708
R^2	0.175	0.160

Notes: + = sig. at 10%, * = sig. at 5%; ** = sig. at 1%; heteroskedastic-robust standard errors in ().

In Table 8, the result of interacting the number of competitors with the market power (10% test) variable is shown. The results are striking. Looking first at old firms, we see that firms facing no competitors do no more innovation when they have market power than when they do not. Firms with 1-3 competitors, on the other hand, do more innovation when they have market power than when they do not. So do firms with more than three competitors. Both the latter two coefficients are significantly different from the first coefficient at the 5% level, though they are not significantly different from each other. Since old firms in particular are likely to be characterized by managers with objectives other than solely maximizing profits, this result suggests that resources are more likely to be directed toward innovation in the presence of rivalry in the product market. This

result is consistent with that of Aghion et al. (1999) in which for firms with satisficing managers, competition acts as a substitute device for sharpening managerial incentives to innovate.

Turning to the new firms, we recall the large and significant negative coefficient on the variable 'more than three competitors' in the innovation equation. For these firms there was also a strong positive association between market power and innovation, although firms claiming demand was inelastic innovated less than those with somewhat more elastic demand. Whilst this is consistent with the Schumpeterian hypothesis, as we noted earlier, the result may be contaminated by reverse causality, which is more worrisome for new than for old firms. The strong negative sign on 'more than three competitors' may partly reflect the tendency for firms that have innovated successfully to perceive an absence of competitors in their niche. This is also consistent with such firms reporting a low perceived elasticity of demand. Such reverse causality could potentially bias the coefficients on both of the competition measures. Can the experiment in Table 8 throw light on this issue? We see that firms with more than 3 competitors do more innovation when they have market power than when they do not and that this partially offsets the tendency for such firms to innovate less. This pattern suggests that greater market power releases the financing constraint for innovation in more competitive markets. It is much more difficult to interpret the result in Table 8 as the outcome of reverse causality from innovation to the interaction between number of competitors and market power since in this case the competition measures should, if anything, be reinforcing rather than offsetting each other.

In the growth equations, by contrast, there is no significant interaction between the number of competitors and the freedom to raise prices, though once again we do not report these results explicitly.

These results provide suggestive, though not conclusive, evidence that our measures of numbers of competitors and of the freedom to raise prices are indeed measuring distinct facets of a firm's market power, rather than being imperfect proxies for one single phenomenon. It seems plausible to suggest that the former represents the motivation of managers while the latter captures the resources over which they have discretionary control. Pursuing this hypothesis further seems to us a fruitful subject for further research.

7. CONCLUDING REMARKS

The chief finding of this study is the power of competition in influencing innovation and growth. In the innovation equation, the presence of some market power together with competitive pressure from foreign suppliers, strongly and robustly enhances performance, though in ways that differ interestingly and intuitively between old and new firms. Furthermore, it appears that the presence

of at least some rivalry in the market is important not just in its own right but because it ensures that the resources available to a firm from any market power it enjoys are efficiently used. In the productivity growth equation (where we control for innovation as well as for employment growth), innovation matters strongly for growth but there is an additional effect of competition, indicating that intense rivalry in the product market raises residual productivity growth. The effect is stronger for new firms than for old ones, for whom the competition impact works more strongly through innovation. There is also some evidence that the effect is stronger for limited rivalry (one to three competitors) than for more than three competitors – the inverse-U relation. The difference is not consistently significant at conventional levels in the separate innovation and growth equations, though it is significant in the reduced-form specifications. This means that we can be more confident that an inverse-U relation of some sort characterizes the link between competition and growth than about the channels through which such a relation might operate.

Although we have made a start in examining the channels through which these competitive pressures work, notably by distinguishing between factors influencing managerial incentives and those influencing the resources under managers' discretionary control, it is not possible on the evidence we have to distinguish more precisely between alternative hypotheses about the mechanisms at work. However, these findings are certainly consistent with the presence of a Schumpeterian-type competitive process, albeit one accompanied by considerable disruption and turbulence (see Carlin et al., 2001a). Consistently also with the findings of Bresnahan and Reiss (1991), this evidence suggests that it is the presence of a minimum number of seriously competing firms that generates competitive conduct. And retained profits – in the presence of competitive pressure – appear also to be important for financing the restructuring that helps firms to succeed.

Finally, our results support the value of using measures of market power that correspond to the perceptions of individual firms as to the competitive pressures they face. These are an important supplement to more conventional measures, such as shares of markets based on standard industrial classifications. These can help not just in illuminating the overall pressures faced by firms but also the way in which different constraints on managerial decision-making interact.

8. APPENDICES

APPENDIX 1: SURVEY METHOD

The survey instrument was developed by the staff of the EBRD and World Bank and the authors of this paper. The 1996 survey by Aymo Brunetti and collaborators on behalf of the World Bank provided a basis for this instrument. The sampling frame was designed to be broadly representative of the population of the firms according to their economic significance, sector, size and geographical location within each country. The sectoral composition of the total sample in each country in terms of industry versus services was determined by their relative contribution to GDP after allowing for certain excluded sectors. Firms that operated in sectors subject to government price regulation and prudential supervisions, such as banking, electric power, rail transport, water and wastewater were excluded from the sample.

Enterprises eligible for the 1999 BEEPS were therefore in the following sectors:

Industry

1. Agriculture, hunting and forestry (ISIC Sections A: 1 – 2, B: 5)
2. Mining and quarrying (ISIC Section C: 10 – 14)
3. Construction (ISIC Section F: 45)
4. Manufacturing (ISIC Section D: 15 – 37)

Services

5. Transportation (ISIC Section I: 60 – 62)
6. Wholesale and retail trade and repairs (ISIC Section G: 50 – 52)
7. Real estate and business services (ISIC Section K: 70 – 74)
8. Financial services (ISIC Section J: 67)
9. Hotels, restaurants and other personal services (ISIC Sections H: 55, I:63)
10. Other community, social and personal services (ISIC Section M:80, N: 85, O: 91 – 93 and 93)

The International Standard Industrial Classification (ISIC) codes for each sector are reported parenthetically.

Within sectors, the sample was designed to be as representative as possible of the population of firms subject to various minimum quotas for the total sample in each country. This approach sought to achieve a representative cross-section of firms while ensuring sufficient weight in the tails of the distribution of firms for key control parameters (size, geographical location, exports, and ownership). The minimum quotas of the samples for each country were:

1. At least 15 per cent of the total sample should be small in size (2 to 49 employees) and 15 per cent large (200 to 9,999 employees) Firms with only one employee and 10,000 or more employees were excluded from the sample.
2. At least 15 per cent of the firms should have foreign control and 15 per cent state control, where control is defined as an ownership share of more than 50 per cent.
3. At least 15 per cent of the firms should be exporters, meaning that at least 20 per cent of their total sales are from exports
4. At least 15 per cent of the firms should be located in a small city (population under 50,000) or countryside.

The BEEPS was implemented in 24 of the 27 countries of Central and Eastern Europe and the former Soviet Union. For analytical purposes, the Federation of Bosnia and Herzegovina and Republika Srpska are treated separately. The survey was not implemented in FR Yugoslavia, Tajikistan and Turkmenistan because AC Nielsen did not have the capacity to implement the survey in these countries, in some cases due to the security situation.

AC Nielsen implemented the survey on behalf of the EBRD and World Bank and was selected through a competitive tendering process. AC Nielsen follows the ICC/ESOMAR International Code of Marketing and Social Research Practice (www.esomar.org, click on codes and guidelines), including those pertaining to the rights of respondents. These rights provide for the confidentiality and anonymity of the respondents. The interviewers working on behalf of AC Nielsen assured the survey respondents that their identities would not be disclosed to either the sponsoring institutions or government authorities and that their anonymity would be protected.

APPENDIX 2

TABLE A1. REDUCED FORM GROWTH REGRESSIONS, IMPOSED LABOUR ELASTICITY

	(1) Elasticity=0.25	(2) Elasticity=0.75	(3) Elasticity=0.50	(4) Elasticity=1.00
Dependent variable	Sales growth Old firms	Sales growth Old firms	Sales growth New firms	Sales growth New firms
Estimation method	OLS	OLS	OLS	OLS
Capacity expansion	0.131**	0.080**	0.050+	-0.030
	(0.025)	(0.037)	(0.026)	(0.027)
Number of competitors				
No competitors	-0.081*	-0.080*	-0.138**	-0.147**
	(0.037)	(0.037)	(0.054)	(0.056)
>3 competitors	-0.077**	-0.049+	-0.081**	-0.060+
	(0.028)	(0.028)	(0.032)	(0.033)
Market power (10% test)				
Sales would fall a lot	0.025	0.012	0.036	0.028
	(0.027)	(0.026)	(0.026)	(0.027)
Sales would fall slightly	0.108**	0.077**	0.108**	0.085**
	(0.026)	(0.026)	(0.027)	(0.027)
No change in sales	0.132**	0.083**	0.068+	0.027
	(0.031)	(0.031)	(0.036)	(0.037)
Pressure from foreign competitors	0.025*	0.020*	0.012	-0.006
	(0.010)	(0.009)	(0.010)	(0.010)
Pressure from customers	0.009	0.007	0.008	0.004
	(0.011)	(0.011)	(0.011)	(0.011)
Services	0.037	0.032	-0.041+	-0.026
	(0.023)	(0.023)	(0.023)	(0.023)
Agriculture	(0.030)	(0.007)	0.068	0.056
	(0.031)	(0.030)	(0.047)	(0.048)
Big city	0.022	-0.003	0.041+	0.008
	(0.023)	(0.022)	(0.022)	(0.023)
Size (log employment)	0.003	0.040	-0.001	0.036**
	(0.008)	(0.008)	(0.008)	(0.008)
Country dummies	Yes			
Number of observations	1615	1615	1673	1673
R^2	0.128	0.116	0.106	0.084

Notes: + = sig. at 10%; * = sig. at 5%; ** = sig. at 1%; heteroskedastic-robust standard errors in ().

TABLE A2. GROWTH REGRESSIONS:
CENTRAL EUROPE AND THE BALTICS (CEB) AND CIS AND SOUTH-EASTERN EUROPE (CIS-SEE) SAMPLES ESTIMATED SEPARATELY

	(1)	(2)	(3)
	Number of competitors		Residual elasticity of demand
	None	>3	
Table 5 (Growth, reduced form)			
Old firms, CEB, estimated labour elasticity	-0.011 (0.055)	-0.013 (0.042)	0.006 (0.015)
Old firms, CEB, labour elasticity=0.25	-0.011 (0.058)	-0.022 (0.045)	0.016 (0.016)
Old firms, CEB, labour elasticity=0.75	-0.011 (0.055)	-0.011 (0.043)	0.003 (0.015)
Old firms, CIS-SEE, estimated labour elasticity	-0.112** (0.045)	-0.078* (0.034)	0.052** (0.012)
Old firms, CIS-SEE, labour elasticity=0.25	-0.111* (0.046)	-0.097** (0.035)	0.061** (0.012)
Old firms, CIS-SEE, labour elasticity=0.75	-0.113** (0.046)	-0.062+ (0.034)	0.045** (0.012)
New firms, CEB, estimated labour elasticity	0.006 (0.106)	-0.067 (0.051)	0.014 (0.015)
New firms, CEB, labour elasticity=0.50	-0.006 (0.107)	-0.078 (0.052)	0.015 (0.016)
New firms, CEB, labour elasticity=1.00	0.039 (0.114)	-0.036 (0.055)	0.011 (0.017)
New firms, CIS-SEE, estimated labour elasticity	-0.187** (0.063)	-0.076+ (0.040)	0.041** (0.013)
New firms, CIS-SEE, labour elasticity=0.50	-0.172** (0.064)	-0.080* (0.041)	0.051** (0.014)
New firms, CIS-SEE, labour elasticity=1.00	-0.203** (0.065)	-0.071+ (0.041)	0.031* (0.014)

Continued overleaf.

TABLE A2. GROWTH REGRESSIONS (CONT.):

	(1)	(2)	(3)
	Number of competitors		Residual elasticity of demand
	None	>3	
Tables 6-7 (Growth, innovation instrumented)			
Old firms, CEB, estimated labour elasticity	0.027 (0.055)	0.027 (0.045)	0.000 (0.013)
Old firms, CEB, labour elasticity=0.25	0.008 (0.053)	0.017 (0.044)	0.008 (0.014)
Old firms, CEB, labour elasticity=0.75	0.016 (0.059)	0.025 (0.047)	-0.003 (0.014)
Old firms, CIS-SEE, estimated labour elasticity	-0.058 (0.054)	-0.074+ (0.039)	0.029+ (0.015)
Old firms, CIS-SEE, labour elasticity=0.25	-0.068 (0.053)	-0.081* (0.038)	0.038* (0.016)
Old firms, CIS-SEE, labour elasticity=0.75	0.074 (0.053)	-0.066+ (0.036)	0.026+ (0.016)
New firms, CEB, estimated labour elasticity	0.001 (0.080)	0.017 (0.078)	-0.017 (0.019)
New firms, CEB, labour elasticity=0.25	-0.008 (0.093)	-0.024 (0.080)	-0.021 (0.020)
New firms, CEB, labour elasticity=0.75	0.017 (0.078)	-0.036 (0.078)	0.008 (0.019)
New firms, CIS-SEE, estimated labour elasticity	-0.188** (0.072)	-0.017 (0.046)	0.037 (0.023)
New firms, CIS-SEE, labour elasticity=0.25	-0.159* (0.075)	-0.053 (0.050)	0.038 (0.028)
New firms, CIS-SEE, labour elasticity=0.75	-0.190** (0.075)	-0.074+ (0.045)	0.038 (0.023)

Notes: + = sig. at 10%; * = sig. at 5%; ** = sig. at 1%; heteroskedastic-robust standard errors in ().

TABLE A3: DETERMINANTS OF INNOVATION, VARIOUS SPECIFICATIONS

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Innovation Old firms	Innovation Old firms	Innovation Old firms	Innovation New firms	Innovation New firms	Innovation New firms
Number of competitors	-0.109	-0.084		0.025	0.042	
No competitors	0.068	0.068		0.092	0.092	
	-0.074	-0.090+		-0.158**	-0.182**	
>3 competitors	0.052	0.052		0.055	0.055	
Market power (10% test)	0.055**		0.054**	0.089**		0.097**
Coded 1-4 (cardinal)	0.018		0.017	0.019		0.018
Foreign competitors	0.079**	0.075**	0.080**	0.057**	0.051**	0.055**
Coded 1-4 (cardinal)	0.018	0.018	0.018	0.017	0.017	0.017
Customers	0.042*	0.038+	0.043*	0.047**	0.045*	0.043*
Coded 1-4 (cardinal)	0.020	0.020	0.020	0.019	0.019	0.019
Size (lagged log	0.024+	0.025+	0.025+	0.010	0.014	0.013
employment)	0.013	0.013	0.013	0.015	0.015	0.015
Services	-0.234**	-0.228**	-0.237**	-0.303**	-0.315**	-0.307**
	0.042	0.043	0.042	0.039	0.040	0.040
Agriculture	-0.320**	-0.304**	-0.324**	-0.048	-0.068	-0.061
	0.054	0.053	0.054	0.082	0.082	0.082
Big city	0.124**	0.129**	0.123**	0.056	0.064+	0.053
	0.042	0.042	0.042	0.038	0.038	0.039
Country dummies	Yes					
Number of observations	1633	1633	1633	1708	1708	1708
R^2	0.174	0.169	0.173	0.160	148	154

Notes: + = sig. at 10%; * = sig. at 5%; ** = sig. at 1%; heteroskedastic-robust standard errors in ().

9. REFERENCES

Aghion, P. and Howitt, P. (1998) *Endogenous Growth Theory*, MIT Press, Cambridge, MA.

— — , Bloom, N., Blundell, R., Griffith, R. and Howitt, P. (2004) "Competition and Innovation: An Inverted-U Relationship", *IFS* June 2004.

— — , Dewatripont, M. and Rey, P. (1999) "Competition, Financial Discipline, and Growth," *Review of Economic Studies*, Vol. 66, pp. 825-852.

— — , Harris, C., Howitt, P. and Vickers, J. (2001) "Competition, Imitation and Growth with Step-by-Step Innovation", *Review of Economic Studies*, Vol. 68, No. 3, pp. 467-492.

— — and Griffith, R. (2004 forthcoming) *Competition and Growth*, MIT Press, Cambridge, MA

Angrist, J. and Krueger, A. (1991) "Does Compulsory School Attendance Affect Schooling and Earnings?", *Quarterly Journal of Economics*, Vol. 106, pp. 979-1014.

Baily, M. N. and Gersbach, H. (1995) "Efficiency in Manufacturing and the Need for Global Competition," *Brookings Papers on Economic Activity: Microeconomics*, pp. 307-347.

Baldwin, J.R. (1995) *The Dynamics of Industrial Competition: A North American Perspective*, New York: Cambridge University Press

Baum, C.J., Stillman, S. and Schaffer, M. (2003) "Instrumental Variables and GMM: Estimation and Testing", *The Stata Journal*, Vol. 3, No. 1, pp. 1-31.

Blundell, R., Griffith, R. and Van Reenen, J. (1999) "Market Share, Market Value and Innovation in a Panel of British Manufacturing Firms", *Review of Economic Studies*, Vol. 66, pp. 529-554.

Bresnahan, T. and Reiss, P. (1991) "Entry and Competition in Concentrated Markets", *Journal of Political Economy*, Vol. 99, No. 5, pp. 977-1009.

Carlin, W., Haskel, J. and Seabright, P. (2001a) "Understanding 'the Essential Fact about Capitalism': Markets, Competition and Creative Destruction", *National Institute Economic Review*, January.

— — , Fries, S., Schaffer, M. and Seabright, P. (2001b) "Competition and Enterprise Performance in Transition Economies: Evidence from a Cross-country Survey", CEPR Discussion Paper No. 2840.

Chalmers, I. and Altman, D.G. (eds.) (1995) *Systematic Reviews,* London: BMJ Publishing Group.

Cohen, W. M. and Levin, R.C. (1989) "Empirical Studies of Innovation and Market Structure" in R. Schmalensee and R.D. Willig (ed.) *Handbook of Industrial Organization Volume II*, Elsevier.

Dasgupta, P. and Stiglitz, J. (1980) "Industrial Structure and the Nature of Innovative Activity", *Economic Journal*, Vol. 90, June, pp. 266-293.

Djankov, S. and Kreacic, V.-G. (1998) "Restructuring of manufacturing firms in Georgia: four case studies and a survey", World Bank, Working Paper.

— — and Murrell, P. (2002) "Enterprise Restructuring in Transition: a Quantitative Survey", *Journal of Economic Literature*, Vol. 40, No. 3, pp. 739-792.

Dutta, J. and Seabright, P. (2002) "Competition and Economic Growth", University of Birmingham, mimeo.

Fingleton, J., Fox, E., Neven, D. and Seabright, P. (1996) *Competition Policy and the Transformation of Central Europe*, London: Centre for Economic Policy Research.

Friebel, G., Ivaldi, M. and Vibes, C. (2004) "Railway (De-)Regulation: A European Efficiency Comparison", Discussion Paper no. 4319, Centre for Economic Policy Research.

Fuller, W.A. (1977) "Some Properties of a Modification of the Limited Information Estimator", *Econometrica*, Vol. 45, pp. 939-954.

Grosfeld, I. and Tressel, T. (2002) "Competition, Corporate Governance: Substitutes or Complements? Evidence from the Warsaw Stock Exchange", *Economics of Transition*, Vol. 10, No. 3.

Hall, R. E. (1988) "The Relation between Price and Marginal cost in U.S. Industry", *Journal of Political Economy*, Vol. 96, No. 5, pp. 921-947.

Hayashi, F. (2000), *Econometrics*, Princeton University Press.

Hausman, J., Leonard, G. and Zona, J.D (1994) "Competitive Analysis with Differentiated Products", *Annales d'Economie et de Statistique*, Vol. 34, pp. 159-180.

Hersch, P. L. Kemme, D.M. and Bhandari, S. (1994). "Competition in Transition Economies: Determinants of Price-Cost Margins in Private Sector Manufacturing in Eastern Europe", *Southern Economic Journal*, October, pp. 356-366.

Johnson, S., McMillan, J. and Woodruff, C. (2002) "Property Rights and Finance" *American Economic Review*, 92 (5), pp. 1335-1356.

Kattuman, P. and Domanski, R. (1997) "Industrial concentration under shock therapy: Poland in early transition years", *ESRC Centre for Business Research*, Cambridge University, Working Paper No. 76.

Knott, A.M. and Posen, H.E. (2003) "Does competition increase innovation? New evidence from old industries", Wharton School, University of Pennsylvania, Author's web site: http://www-management.wharton.upenn.edu/knott/ .

Konings, J. (1998) "Firm performance in Bulgaria and Estonia: the effects of competitive pressure, financial pressure and disorganization", *The Davidson Institute Working Paper Series*, No. 185.

Kwoka, J. (1996) *Power Structure: Ownership, Integration and Competition in the US Electricity Industry*, Kluwer.

Levin, R.C., Cohen W.M. and Mowery, D.C. (1985) "R&D Appropriability, Opportunity, and Market Structure: New Evidence on Some Schumpeterian Hypotheses", *American Economic Review Papers and Proceedings*, Vol. 75, No. 2, May, pp. 20-24.

Neven, D., Nuttall, R. and Seabright, P. (1993) *Merger in Daylight: the Economics and Politics of European Merger Control*, London: Centre for Economic Policy Research.

Ng, C. and Seabright, P. (2001) "Competition, Privatisation and Productive Efficiency: Evidence from the Airline Industry", *Economic Journal* (111), pp.591-619.

Nickell, S. (1996) "Competition and Corporate Performance", *Journal of Political Economy*, Vol. 104, August, pp. 724-46.

Schmalensee, R. (1989) "Inter-industry Studies of Structure and Performance" in R. Schmalensee and R.D. Willig (eds.) *Handbook of Industrial Organization*, Vol. II., Elsevier.

Schumpeter, J. A. (1943) *Capitalism, Socialism and Democracy*, London: Allen and Unwin, reprinted 1976.

Tybout, J.R. (2000) "Manufacturing Firms in Developing Countries: How Well Do They Do, and Why?" *Journal of Economic Literature*, XXXVIII March, pp. 11-44.