GLOBALIZATION AND INNOVATION IN EMERGING MARKETS

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Abstract

Globalization brings opportunities and pressures for domestic firms in emerging markets to innovate and improve their competitive position. Using data on firms in 27 transition economies, we test for the effects of globalization through the impact of increased competition and foreign direct investment on domestic firms' efforts to raise their capability (innovate) by upgrading their technology or the quality of their product/service, taking into account firm heterogeneity. We find competition has a negative effect on innovation, especially for firms further from the frontier, and that the supply chain of multinational enterprises and international trade are important channels for domestic firm innovation. We do not find support for the inverted U effect of competition on innovation. There is weak evidence that firms in a more pro-business environment invest more in innovation and are more likely to display the inverted U relationship between competition and innovation.

Key Words: competition, innovation, emerging markets, spillovers

JEL: F23, M16, O16, P23

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1. Introduction

With the opening of borders to trade and foreign investment, globalization brings opportunities and pressures for domestic firms in emerging market economies to innovate and improve their competitive position. Many of these pressures and opportunities operate through increased competition from and linkages with foreign firms. In this paper, we use the conceptual frameworks of a recent theoretical model by Sutton (2007) and a series of models by Aghion et al. (2005a, 2005b and 2006), to examine the determinants of innovation by domestic firms in emerging market economies. Our focus is on the effect of competition and transfer of capabilities stemming from globalization, which may be brought about through various channels, including the entry of foreign firms (foreign direct investment – FDI), trade, and increased competitive responses by domestic firms through both entry and upgrading of the quality of their products. Our work also relates to the large literatures on innovation[1] and FDI spillovers;[2] while we focus on testing the theoretical proposition of the specific models above, we also relate our findings to these broader literatures.

Sutton (2007) develops an industrial organization model capturing the effect of globalization on the behavior of firms in the emerging market economies. The model assumes that a firm's competitiveness depends not only on its productivity but also on the quality of its product, with productivity and quality jointly determining a firm's "capability." In particular, Sutton's (2007) model has the property that consumers choose to buy on the basis of price-quality combinations and if a firm has a product whose quality is superior to that of its rivals, the firm will retain some level of market share even when the number of low quality rivals becomes arbitrarily large. Moreover, there is a lower bound on quality that any firm has to maintain in order to survive, thus creating a range ("window") of quality levels in which firms can operate. What matters is relative quality at both the firm and country levels, and with globalization the lower bound on the

[1] See e.g., Becheikh, Landry and Amara, 2006 and Cohen, 2005 for reviews of literature on innovation.
[2] See e.g., Gorg and Greenaway, 2004 for a review of the FDI literature.

window of opportunity rises for local firms that were previously shielded from the competition by higher quality firms in advanced economies.

An important prediction of the Sutton (2007) model is that after an initial shakeout, firms in emerging markets will strive to adjust by raising their capabilities. Sutton (2007) suggests that the process will vary widely across industries and stresses that it will be influenced by the vertical transfer of capabilities to the emerging market economies through the supply chain of multinational enterprises (MNEs). In fact, he argues that "…the 'middle group' countries of Eastern Europe… are best placed to be the most dramatic beneficiaries of the present globalisation, not – or not primarily – because of trade liberalization per se, but because of the virtuous dynamic that follows as part of the general package of liberalization of foreign direct investment and capability transfer." (Sutton, 2007, p. 28) Given these predictions, we examine the factors that determine whether or not different types of firms raise their capabilities. In line with Sutton's conceptual framework, we look at factors that may influence capability at the level of the firm, industry and country or region.

A related theoretical framework has been advanced in a series of recent papers by Aghion et al. (2005a , 2005b, 2006). In these Schumpeterian models, firms or industries operate within a range (window) of efficiency and increased competition associated with liberalization and globalization has different effects on firms/industries depending on their level of technology. In particular, firms/industries close to the frontier (maximum efficiency) are expected to be spurred by competition to innovate and increase their efficiency, while those far from the frontier (near the lower bound) are expected to be discouraged from innovating and fall further behind. In Aghion et al.'s (2005a) model, competition discourages laggard firms from innovating ("Schumpeterian effect") but encourages "neck-and-neck" firms to innovate (the "escape-competition effect"). Aghion et al. (2005a) develop the hypothesis, proposed earlier by Kamien and Schwartz (1972) that the effect of the intensity of product market competition on the extent of innovation is in the form of an inverted U. The inverted U relationship is derived from the balance

between the opposing effects of competition on the two types of firms (the neck-and-neck and the laggard firms).[3] Finally, in an extension to this model Aghion et al., (2005b) predict that firms located in regions with more pro-business institutions are more likely to respond to the threat of entry (competition) by investing in new technologies and production processes.

Whereas the predictions of the Sutton model have yet to be tested empirically, the predictions of the Aghion et al. (2005a, 2005b, 2006) models have been tested in a few studies and the tests have yielded mostly but not completely supporting evidence. We briefly review these tests and existing evidence in order to place our results in a comparative perspective.

Using an unbalanced panel of 311 firms listed on the London Stock Exchange between 1973 and 1994, Aghion et al. (2005a) construct a two-digit SIC industry panel of 354 industry-year observations. Using the price cost margin (markup) as the competition indicator and citation-weighted patents as a measure of innovation, the authors find an inverted U effect of competition on innovation. Aghion et al. (2006) combine a variety of US and UK data sources to create a 1987-93 annual panel data set of over 23,000 establishments in 180 4-digit manufacturing industries and a data set of patents in over 1,000 incumbent UK firms. They find that technologically advanced entry by foreign firms has a positive effect on innovation in sectors initially close to the frontier and that the effect of entry on total factor productivity growth interacts negatively with the distance to the frontier.

Carlin, Schaeffer and Seabright (2004) also test the inverted U hypothesis using data on transition economies (the 1999 Business Environment and Enterprise Performance Survey, BEEPs). They examine the effect of product competition (defined as the number of competitors in the firm's main product line) on innovation (defined as the number of innovative activities undertaken in introducing a new product or upgrading

[3] Although their theory does not directly predict an inverted U relationship, it does exclude the possibility of a U shaped relationship.

an existing one) and growth. Using different variables in a related data they reached the same basic conclusion we did in that innovation is higher in monopolistic industries. We build on these findings by using additional (2002 and 2005) BEEPS data and examining the effect of competition in greater depth.

Studies have also examined the heterogeneity in firms' responses to product competition in terms of changes in their productivity (the other part of "capability"). Aghion et al. (2005b) hypothesized that within industry variation in firm performance should increase with competition, as those firms further from the frontier and in regions with poorer business institutions invest less while those close to the frontier will invest more in new technologies and production processes. They analyze a three-digit-industry data available for all the states in India for the period 1980-97 and find that entry liberalization (de-licensing) led to an increase in within-industry inequality in output, labor productivity and total factor productivity. Sabirianova, Svejnar and Terrell (2005a, 2005b) also find support for heterogeneous effects of firm entry on firm performance in Russian and Czech industrial firms. They find that entry by foreign firms in a given industry has a positive effect on the productivity of foreign firms (which are at or close to the frontier) but a negative effect on the productivity of domestic firms (which are laggards compared with foreign firms).

In this paper, we extend the literature by testing the following predictions derived from Aghion et al., (2005a, 2005b, 2006) and Sutton (2007), using 2002 and 2005 data on firms in 27 transition economies:

i. Globalization stimulates innovation by domestic firms in less developed countries through the supply chain of MNEs (transfer of capabilities);

ii. Globalization increases competition (through entry of foreign firms, increased capabilities of domestic firms, etc.), whose effect on innovation depends on firms' technological capabilities:

    a. Firms close to the frontier at similar technological levels (neck-and-neck) are spurred to innovate,

    b. Firms further away from the frontier (laggard firms) are discouraged from innovating,

c. In general, the effect of competition on innovation is hypothesized to have an inverted U shape.

d. The inverted U relationship between competition and innovation is steeper among firms that are closer to the frontier.

iii. Firms that are located in regions with different business environments (institutions) will respond to globalization's competitive pressure in a heterogeneous manner. Firms in regions with more-business friendly policies are more likely to respond to competition with more innovation than those in less-business friendly environments.

2. Data and Econometric Specification

To test these predictions, we use data from the 2002 and 2005 Business Environment and Enterprise Performance Survey (BEEPS), a joint initiative of the European Bank for Reconstruction and Development (EBRD) and the World Bank Group. These are large surveys of enterprises (6,500 in 2002 and 7,900 in 2005) in 27 transition countries (including Turkey)[4] which relied on very similar sampling frames and identical questionnaires. In each country, the sectoral composition of the sample in terms of manufacturing[5] versus services[6] was to be determined by their relative contribution to GDP. Firms that operate in sectors subject to government price regulation and prudential supervision, such as banking, electric power, rail transport, and water and waste water, were excluded from the sample. The sample includes very small firms with as few as two employees and firms with up to 10,000 employees. Moreover, the data include firms in the rural areas as well as large cities. Hence these data enable us to analyze quite heterogeneous firms in these countries, and perhaps the most important of the data coverage is the inclusion of firms in the service sector, which is the new dynamic sector in these economies.

[4] Both were to be administered to 28 transition economies: 16 from CEEE (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Former Yugoslavia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia and Turkey) and 12 from the CIS (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan). In neither year could the survey be administered in Turkmenistan.

[5] Manufacturing includes mining and quarrying, construction, manufacturing and agro-processing.

[6] Services includes: Transportation, storage and communications; wholesale, retail, repairs; real estate, business services; hotels and restaurants; other community, social and personal activities; and commerce.

In addition, the data set contains a panel component, where 1,443 firms that were surveyed in 2002 were surveyed again in 2005.[7] We use this panel data set for an important robustness check. However, our analysis relies primarily on the pooled 2002 and 2005 data since many variables of interest have a retrospective component and because it is hard to detect robust relationships with a small panel of relatively volatile firms, especially when we use many control variables.

An important advantage of our data is that firms self-report various types of innovation activity. Most studies on innovation use patent data or R&D expenditures, which are problematic. Patents are generally viewed as having several weaknesses: 1) patents measure inventions rather than innovations; 2) the tendency to patent varies across countries, industries and processes; and 3) firms often use methods other than patents to protect their innovations (such as technological complexity, industrial secrecy, and maintaining lead time over competitors). Using R&D expenditures may also be problematic because not all innovations are generated by R&D expenditures, R&D does not necessarily lead to innovation, and formal R&D measures are biased against small firms (Michie, 1998; Archibugi and Sirilli, 2001). Perhaps most important for the purposes of this paper is that in emerging market economies these types of innovations are less likely to be observed as firms are expected to engage more in imitation and adaptation of already created and tested innovations, rather than in generating new inventions and are less likely to expend resources on R&D.

In this study, we define innovation broadly as the development and upgrading of new products, adoption of new technologies or obtaining quality certifications. Specifically, we use binary variables based on answers to the question in the BEEPS survey, about whether or not firms have undertaken any of the following initiatives in the last three years:

[7] The relatively small size of the panel should not be associated with intensive exit of firms in these countries. The exit rate was about 8% (average across countries). The size of the panel is mainly due to refusal of firms to participate in the new way of the survey (42%) and due to inability to reach eligible responders within firms (25%).

- Developed successfully a major new product line or upgraded an existing product line – hereafter *New Product*;
- Acquired new production technology -- hereafter *New Technology*;
- Obtained a new quality accreditation (such as ISO 9000, 9002 or 14000, AGCCP, etc.) -- hereafter *New Accreditation*.

We are concerned with "product innovation" rather than "process innovation," although the new technology and the quality accreditation can reflect changes in the process with which the product/service is made. Given the determination as to whether a new product was developed or upgraded is a subjective answer (in the variable "New Product," which also includes a new service), we include the variable "New Accreditation," which is a formal affirmation that the quality of the product has been upgraded according to some internationally established standards. For example, ISO 9000 is a family of standards for quality management systems, maintained by the International Organization for Standardization and administered by accreditation and certification bodies.[8] However, in order to ensure the quality of a product, the standards monitor the process by which a product is produced.[9] The new technology that is used in the firm can be developed by the firm although very few (17%) who answered that they acquired a new technology gave this as the way it was acquired; or it can be embodied in new machinery or equipment which might be purchased or licensed from other sources (75%) or it can be acquired by hiring new personnel (5%) or it can be transferred from elsewhere (universities, business associations, etc., 3%).

The BEEPS data also permit us to capture the degree of competition faced by each firm in various ways. A key variable that is comparable with that used by Aghion et al. (2005a), as well as Nickell (1996), is the price-cost margin or markup (*Markup*).[10]

[8] Although the standards originated in manufacturing, during WWII when there were quality problems in many British high-tech industries, they are now employed across a wide range of sectors. A "product", in ISO vocabulary, can mean a physical object, or services.

[9] Some of the requirements in ISO 9001 (which is one of the standards in the ISO 9000 family) would include: a) a set of procedures that cover all key processes in the business; b) monitoring processes to ensure they are effective; c) keeping adequate records; d) checking output for defects, with appropriate corrective action where necessary; e) regularly reviewing individual processes and the quality system itself for effectiveness; and f) facilitating continual improvement.

[10] Note that we do not compute markup using price and cost information provided by firms. If there are measurement errors in prices, costs and quantities, the constructed markup may be correlated with

Firms that are able to charge a larger markup are deemed to have less competition. The advantage of this indicator over a market share or Herfindahl index is that it does not require precise definition of geographic and product markets, which is difficult to obtain in emerging market economies that vary considerably by size and geographic reach of firms. We are also able to capture the effects *Pressure from Foreign Competition* with three dummy variables for "low" (slightly important) and "medium-high" (fairly and very important), with "not important" as the base response. (See the description of variables in Table A1.)

Foreign firms can spur innovation among domestic firms through competition but they can also directly transfer capabilities. BEEPS also permits us to capture the extent of vertical linkages between domestic and foreign firms, which allow for transfer of capabilities or "spillovers." The FDI literature has found that vertical linkages with foreign firms in the country through trade can improve a domestic firm's productivity (see e.g., Gorg and Greenaway, 2004; Gorodnichenko, Svejnar and Terrell, 2007).[11] We use three variables: *SMNE*, the share of a firm's sales to MNEs;[12] *Exports*, share of sales exported; and *Imports*, share of inputs imported.

To test whether firms that are further away from the efficiency frontier innovate less than firms that are closer to the frontier, we define the frontier as the best (the most efficient one-third of) foreign firms and then calculate each domestically-owned firm's distance from the frontier. We draw on the literature on matching (e.g., Rosembaum, 2002) and measure the distance between a domestically-owned firm and the leading foreign-owned firms in an industry and country with the Mahalanobis distance, which assumes that firms that are similar in a set of observed characteristics are likely to have similar efficiency. Conversely, if the observed characteristics of domestic firms are

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measured productivity which is not desirable. Fortunately, the markup is self-reported by firms in the survey and therefore it is less likely that we have spurious correlation between markup and productivity.

[11] In the most recent literature, work is being done to test the channels through which these spillovers are occurring. For example, Javorcik and Spartareanau (2007) ask whether it is through direct training or loans from MNEs.

[12] An MNE is defined as a firm with 50% or more foreign ownership.

different from those of the best foreign-owned firms, the domestic firms are likely to be less efficient than the best foreign-owned firms. One may hence interpret this difference as the distance from the best business practice of foreign-owned firms. The Mahalanobis distance of domestic firm *i* to a foreign firm is equal to:

$$distance_i = \min_{j \in F} \{(x_i^D - x_j^F)' S_x^{-1} (x_i^D - x_j^F)\}^{1/2}$$

Where superscripts F and D denote the best foreign-owned firms and domestic companies, respectively, and S_x is the covariance matrix of the vector of observed characteristics x. This amounts to computing the distance of a given domestic firm to all foreign firms that embody the frontier and taking the minimum distance. In other words, we take the distance to the nearest relevant foreign firm. The vector of observed characteristics contains the size of the firm in terms of the logarithm of number of employees and number of establishments; the structure of employment (educational attainment, share with, vocational school, secondary school, college; skill level: share of managers, share of professional workers; share of permanent workers), capacity utilization in terms of machinery and labor, markup, share owned by largest shareholder(s); growth rates (of sales and capital); a dummy for paying for security. We match firms exactly by industry, country and year, i.e., domestic firms are matched only to foreign-owned firms in the same industry, country and year. Since the distance is skewed, we take $\log(1 + distance)$ as the distance from the frontier in our specification. The larger the Mahalanobis distance, the further the domestic firm is from the best foreign firms in its industry/country.

We estimate the following baseline specification with the pooled data in the 2002 and 2005 BEEPS for domestically owned firms (i.e., with no foreign ownership):

$$\begin{aligned} I_{isct} = \Phi \{ & \alpha_0 Markup_{isct} + \alpha_1 ForComp_{isct} + \\ & \beta_0 SMNE_{isct} + \beta_1 Export_{isct} + \beta_2 Import_{isct} + \delta_1 \ln(1 + distance_{isct}) + \\ & \gamma_0 \ln L_{isc,t-3} + \gamma_1 (\ln L_{isc,t-3})^2 + \gamma_2 \ln CU_{isc,t-3} + \gamma_3 EDU_{isc,t-3} + \gamma_4 SKILL_{isc,t-3} + \\ & \gamma_5 Age_{isct} + \gamma_6 CNM + \gamma_7 R\&D_{isct} + \gamma_8 SOE_{isct} + \omega_{sct} + error \} \end{aligned} \quad (1)$$

where I is the dummy variable equal to one if firm reported an innovation and zero otherwise; Φ denotes c.d.f. of a standard normal random variable; *i, s, c* and *t* index firms, sector, country and time. Variables dated with period $t-3$ are taken from retrospective questions about the firm's performance three years prior to the current date. The first two variables capture our measures of competition: *Markup,* and *ForComp* (pressure from foreign competition). The next three explanatory variables capture vertical linkages or transfer of capabilities: *SMNE* -- the share of sales to multinational enterprises, *Export* -- the share of export in sales and *Import* -- the share of imported imports.[13] The variable *distance* is the Mahalanobis distance and ω is a set of industry, country, location[14] and time fixed effects. The last set of variables control for a number of firm-specific factors deemed to be important in the literature:

L (the number of employees) and L^2 measure the size of firm, which has been found to be positively correlated with innovation. The argument for including size is that large companies have more resources to innovate and can benefit from economies of scale in R&D production and marketing;[15]

CU (Capacity Utilization) is the percentage of a firm's output relative to maximum possible output. Although capacity utilization has been found to be a strong predictor of innovations (e.g. Becheikh et al., 2006), the effect of *CU* on innovation is *a priori* indeterminate. If firms are too busy filling demand, they may be more interested in extending their current capacity than finding new ways of producing goods and services. At the same time, if firms are at capacity they may need to innovate;

EDU (the share of workers with a university education) and *SKILL* (the share of skilled workers) capture human capital in the firm. These variables might be expected to be positively correlated with innovation if *EDU* reflects the involvement of workers in

[13] Note that in contrast to previous literature we have *firm-level* variables describing linkages instead of industry-level variables (e.g., Bertschek 1995).
[14] Location types (LOC) refer to ….., further described in appendix Table A1.
[15] This variable is probably one of the most studied firm characteristics determining innovation.

R&D and more skilled workers (*SKILL*) are able to give feedback to the firm on how to improve a product;

Age of the firm is the log of the number of years since the firm began operations in the country. Two hypotheses are plausible: one suggesting that older firms developed routines that are resistant to innovation and another suggesting that older firms will accumulate the knowledge necessary to innovate. There is evidence for both hypotheses;

CNM is a dummy equal to one if the firm competes in the national markets and zero otherwise. We expect *CNM* to have a positive effect on innovation, given that the firm operates in a larger market.

R&D is a dummy variable equal to one if the firm has positive expenditures on research and development and zero otherwise. We have noted that much of the research proxies innovation with R&D expenditures. However because not all innovations are due to R&D expenditures, R&D does not necessarily lead to innovation, and R&D biases against small firms, we do not use this as a dependent variable, but rather include it as a control variable that captures the extent to which R&D investment leads to innovation.

SOE (State Owned Enterprise) is a dummy variable equal to one if the government owns 50% or more of the firm and zero otherwise. This variable is expected to be negatively correlated with innovation for a variety of reasons, including a poor system of rewards for innovative activities in state-owned enterprises (SOEs);

We report in Table A1 a detailed description of the variables and in Table A2 – their means and standard deviations for the whole sample of domestically owned firms, as well as for some stratifications of the sample that we use in our analysis. Domestically owned firms are defined as firms with zero share of foreign ownership.

3. Findings

We begin by describing estimates of our baseline specification which tests for two of the five hypotheses described at the end of Section 1. In Section 3.2 we confront issues

of endogeneity and undertake some robustness checks. Once these issues are resolved, we proceed with testing for the other three hypotheses in Sections 3.3 - 3.5.

3.1 Baseline Specification

Our baseline specification for each of the three types of innovation, estimated with over 11,500 firm-level observations in the 27 countries, is reported in Table 1.

We find that product market competition, as proxied by *markup*, has a negative effect on innovation. In particular, the larger the markup (implying less competition), the greater the probability that a firm develops a new product or acquires new technology. On the other hand, product market competition does not have an effect on the third dimension of innovation, namely obtaining a new accreditation. We have also tested for the inverted U hypothesis by estimating a specification with *markup* and $markup^2$ and we have found that neither coefficient was significant (results not reported here). Hence, we do not find the inverted U shaped relationship between competition and innovation proposed by Kamien and Schwartz (1972) and developed more recently by Aghion et al. (2005a). Our baseline specification supports the basic Schumpeterian view that monopolistic market structures boost innovative activity.

Greater pressure from foreign firms has a positive effect on innovation, holding constant vertical linkages with foreign firms. Firms that feel pressure from foreign competition is "fairly or very important" in reducing their production costs are more likely to upgrade their product/service or acquire a new technology than firms that feel this pressure is "not at all important." Firms that feel that the pressure is slightly important in turn have coefficient estimates that are about half the size, but only significant for "new technology." On the other hand foreign competition is not a determinant of new accreditation. We conclude that the process of obtaining a new accreditation does not seem to be influenced by the forces of product market or foreign competition, whereas developing or upgrading a new product (or service) and acquiring a new technology are. The latter tend to be carried out by monopolies that feel moderate to

high pressure from foreign competition, which is consistent with the Aghion et al. (2005a) "escape competition" effect.

Vertical transfer of capability from foreign to domestic firms, stressed by Sutton (2007) and the FDI spillover literature, are significant. As may be seen in Table 1, firms that have stronger vertical relationships with multinationals, either domestically (by supplying them) or out of the country (by exporting or importing), innovate more than firms that have weaker relationships. A one percentage point increase in a domestic firm's share of sales to MNEs or to exports has a very similar impact on all the first types of innovations and a much larger positive impact on acquiring a new accreditation. On the other hand, a firm's share of inputs imported is less influential in obtaining a new accreditation than it is in upgrading a product or acquiring a new technology. Nevertheless, we conclude that vertical transfers of capability appear to be strong for all types of innovation.

Using Mahalanobis distance we find support for the hypothesis that firms that are further away from the frontier are less likely to innovate in terms of developing a new product or acquiring new technology. As with markup, *distance* is not significantly related to obtaining a new quality accreditation, although the sign and point estimate of the coefficient is similar to those for the other two types of innovation.

There are a number of interesting findings with respect to the control variables in reported in Table 1. First, larger firms tend to innovate more than smaller firms, which is consistent with the finding in the vast majority of the studies on innovation (see e.g., Becheikh, Landry, and Amara, 2006). The size effect is linear (and with very similar coefficients) for new product and new technology, but for new accreditation it is increasing at a decreasing rate. Second, firms with higher capacity utilization are less likely to innovate than firms that have more unutilized capacity. This may imply that firms that are selling everything they produce feel less need or have less time to innovate than firms that have more down time because of low demand. The negative effect is highly significant across the first two types of innovation and it is the strongest for

developing a new product. Third, and not surprisingly, firms with positive expenditures on R&D are more likely to innovate than firms that spend nothing on R&D. The coefficients are highly significant for all three types of innovation and a bit higher for developing a new product and obtaining new accreditation than for acquiring new technology. This suggests that the acquisition of new technology contains a somewhat greater element of purchase than own development through R&D in comparison to the other two innovations. Fourth, the effect of human capital varies across the three types of innovation. Having a higher share of skilled workers does not affect the probability of developing a new product, acquiring new technology, or obtaining a new accreditation. On the other hand, as the share of workers with a university education rises, innovation is boosted across all three types. This result, of having a higher share of labor force with university education is more conducive to innovation than having a higher share of skilled labor, stresses the need for a highly educated labor force to improve the capabilities of the product or service. Fifth, older firms are not as likely to innovate with respect to product and technology but have the same probability of obtaining a new accreditation as new firms. Sixth, state-owned (50% or more) firms are less likely to innovate than privately owned firms in terms of product or technology but are not different with respect to acquiring a new accreditation. Finally, firms that compete/operate in national markets are more likely to innovate in any of the three areas than firms that only compete/operate in a local or regional market. This may reflect both the capability of the firms operating at the national level as well as the characteristics of the national as opposed to local environment.

We note that the coefficients for these determinants of obtaining a new accreditation are not likely to be significant as often as the coefficients for the determinants of upgrading a product or acquiring a new technology. The results indicate that something else must be driving this process; the fact that the coefficients on downstream linkages with MNEs are relatively large compared to those for the other two types of innovation, leads us to believe that accreditation is being obtained as a necessary

condition for selling to MNEs and exporting and is not being influenced by product market competition.

3.2 Econometric Issues and Robustness Checks

The baseline specification potentially has issues of endogeneity of our firm-level measures of competition, transfer of capabilities and distance to the frontier. We first resolve these issues and then carry out a robustness checks for our Mahalanobis measure of the distance to the frontier.

3.2.1 *Endogeneity of Markup*. Is the innovative activity being spurred by the market structure or is the market structure the result of the innovative activity? If, for example, firms successfully innovate they may be able to gain higher share of the market and prevent entry of new firms into the market (as noted by Aghion et al., 2005a, and others). In order to control for this potential endogeneity, it is necessary to find an instrumental variable (IV) that is correlated with markup (relevance condition) and does not affect innovation directly (orthogonality condition). Variables that capture the regulation of an industry might be considered good instruments since they control for entry of new firms but not necessarily innovative activity. BEEPS provides several questions about regulations of which we selected the following two:

> Q1. Thinking now of unofficial payments/gifts that a firm like yours would make in a given year, could you please tell me how often would they make payments/gifts for the following purposes [score on 1 (Never) to 6 (Always) scale]:
> - To obtain business licenses and permits;
> - To deal with occupational health and safety inspections;
> - To deal with fire and building inspections;
> - To deal with environmental inspections;
> - To influence the content of new legislation, rules, decrees etc.
>
> Q2. Can you tell me how problematic are these different factors for the operation and growth of your business [score on 1 (No obstacle) to 4 (Major obstacle) scale]:
> - Access to land;
> - Title or leasing of land;
> - Customs and trade regulations;
> - Business licensing and permits;
> - Labour regulations.

The advantage of these questions is that they provide a measure of entry barriers at the firm level. In contrast, previous literature used aggregate variables such as movements in exchange rates and changes in tariffs. This difference is important because variability at the firm level dwarfs variability at the macroeconomic level and thus our instruments are much more informative. At the same time, our instruments preserve the spirit of the instrumental variables used in previous literature. Since these questions provide many potential instruments (a firm's response to each sub-question in Q1 and Q2 is a potential instrument that varies on scale from one to four or one to six), we select instruments using Andrews (1999) and Hall and Peixe (2003). In short, our selection procedure maximizes the informativeness of the instruments (measured by canonical correlations) in the first stage and penalizes potential instruments for correlation with error term in the second stage regression. This procedure ensures that we do not include redundant (uninformative) moments or moments that violate the orthogonality condition.

Results using the IV are presented in Appendix Table A4. We find that the optimally selected instruments have a strong first stage fit. The first-stage F-statistic and partial R2 suggest that excluded variables have strong predictive power for the markup. Likewise Anderson's canonical correlation test rejects the null that instruments are irrelevant. We also reject the null that the instruments are incorrectly excluded from the second stage regression.

Although the point estimates in the IV specification are greater than the point estimates in the standard probit, both sets of estimates convey the same message, i.e., greater market power spurs innovation in introducing new products and adopting new technologies and has no effect on acquisition of new accreditation.[16] These results are similar to those of Aghion et al. (2005a) who also find that corrections for endogeneity of the markup do not change qualitative results. Because the IV estimates have relatively

[16] Similar to our standard probit estimates, we also find that squared markup is not statistically significant in the IV specifications.

large confidence intervals and we can't reject equality of IV and standard probit estimates, we proceed with the standard probit estimates in the rest of the paper.

3.2.2 *Reverse Causality (Endogeneity) due to timing of measurement of variables.* Because our variables for competition, vertical transfer of capabilities and distance are reported in the years of the survey (2002 and 2005), while innovation is measured over the preceding three-year periods (1999-2002 and 2002-2005, respectively), there is a potential problem that the causality runs from the dependent variable to the explanatory variables (i.e., that the regressors are endogenous). For example, while it may be that firms selling more to MNEs tend to innovate, it is also possible that firms that have innovated are more able to sell more to MNEs than firms that have not innovated. We address this potential problem in two ways.

First, the reverse causality is less of a problem if the values of the explanatory variables in question (the firm's competition, sales to MNEs, export, import, competition, and markup) do not vary much over a given three-year period. Within the subsample of about 1,000 BEEPs firms for which we could link the 2002 and 2005 survey data and hence create a panel, the correlation coefficients between the 2002 and 2005 values of *Exports*, *Imports* and *SalesMNEs*, respectively, are relatively high -- 0.95, 0.93 and 0.42. The competition variables are dummy variables and the probability of reporting the same value (staying in the same group) is around 50%. The only variable that has a relatively low correlation between 2002 and 2005 values is markup (0.2). All but one of these coefficients hence show considerable persistence, especially when one considers that a number of the variables are expressed as shares.

Second, we replicate our estimates on the panel subsample of BEEPs firms, which allows us to regress innovation measured for the period 2002-2005 on the 2002 values of competition, vertical transfers, and distance from the frontier. By construction, these "initial value" regressions eliminate the possibility that the relationship between a firm's innovation and competition, vertical transfers, and distance from the frontier is brought about by contemporaneous shocks to these variables, or to reverse causality. However,

because the panel subsample is much smaller than the entire sample, we must use a more parsimonious specification. Therefore, we must check whether and how our findings are affected by the change in specification and in the end, the smaller sample size. In particular, we include only the country and industry fixed effects as control variables and exclude the nine control variables in equation (1). Moreover, we include the competition variables one at a time. Finally, because of the small sample size and the fact that the majority of the non-zero values in the share of sales to MNEs, share of exports and share of imports variables are close to unity (greater than 90%), we convert these variables from shares into dummy variables, where 0 = no share of sales to MNEs, exports, etc..

In order to check what drives the difference, if any, between the estimates from the full sample and panel data, we estimate the more parsimonious specification for various samples:

(a) the full sample, using pooled 2002 and 2005 data on all firms and current (contemporaneous) values of the explanatory variables, as in the base specification;

(b) the pooled 2002 and 2005 data on the panel of firms, using current values of the explanatory variables;

(c) the 2005 data on the panel of firms, using current values of the explanatory variables; and

(d) the 2005 data on the panel of firms, using three year lagged values of the explanatory variables.

The model in (a) reveals whether the more parsimonious specification applied to the full sample yields similar results to those in the base specification reported in Table 1. It also provides a benchmark against which to compare the estimates from the panel subsample. The estimation in (b) is identical to that in (a) except that it uses the panel subsample of firms. Comparing the estimates in (b) to those in (a) hence permits us to assess whether for the purposes of our study the panel is a representative subsample of the full sample. The estimation in (c) is identical to (b) but uses only the 2005 part (i.e., the more recent half) of the panel. Comparing the estimates in (c) to those from (b)

permits us to infer how much significance, if any, we lose by using just the more recent half of the panel data observations. Finally, the results in (d) represent the ideal specification, which explains innovation over the 2002-05 period with the lagged (2002) values of the explanatory variables.[17] Comparing the results in (c) and (d) enables us to assess the difference in the estimated coefficients between the specification using the current v. the lagged values of the explanatory variables.

The coefficients from each of these four specifications are presented in appendix Table A5 for the competition, transfer of capability and distance variables. First a comparison of the coefficients in columns (a) of each panel in Table A5 to the coefficients in Table 1 indicates that applying the more parsimonious model to the full sample yields similar coefficient signs, estimates and significance on all the variables with the only notable difference being that the coefficients on *pressure from foreign competition* are somewhat larger in the parsimonious specification.

A comparison of the results in columns (a) with columns (b) in each of the three panels of Table A5 indicates that going from over 11,500 observations in the full pooled sample to about 2,000 observations in the pooled panel data, holding constant the specification, maintains the signs and in most instances also the significance of the key coefficients. The only significant change in signs occurs for the coefficients on *markup* for new technology.

Comparing columns (b) and (c) in each of the three panels of Table A5 demonstrates that going from the 2,000 pooled panel observations for 2002 and 2005 to just 1,000 observations for 2005 (but estimating the same equation which still has contemporaneous values of the independent variables) maintains all signs and reduces the significance of just two coefficients. Finally, moving from columns (c) to (d), means using the lagged (2002) rather than the current (2005) values of the explanatory variables with the 2005 panel observations, reduces the significance on three and increases the

[17] This uses data from the 2005 part of the panel for the dependent variable and data from the 2002 part of the panel for the independent variable.

significance on another three of the 24 coefficients. Interestingly, in the three cases where the coefficient becomes significant (*markup* for new technology and *Sales to MNES* for New Good and New Technology) it also becomes similar to the corresponding coefficient in the full sample estimates in column (a) of Table A5 and the corresponding coefficient in the base model in Table 1.

Overall, the results in Table A5 suggest that using the large pooled sample of 2002 and 2005 data with the current values of the competition, transfer of capability and distance variables is a reasonable empirical strategy that does not generate major biases in the estimated coefficients.[18]

3.2.3 *Distance*. To test the robustness of the Mahalanobis distance measure, we re-estimate the baseline equation with a measure that captures differences in efficiency using the Solow residual or total factor productivity (TFP). We compute the Solow residual with the cost share for labor and capital (computed for each firm and aggregated for a given industry in each country and year) and adjust it for capacity utilization:

$$Solow_{ijt} = TFP_{ijt} = \ln Y_{ijt} - \overline{s}_j^L \ln L_{ijt} - (1 - \overline{s}_j^L) \ln K_{ijt} - \ln CU_{ijt},$$

where i, j, c, and t index firms, industries, countries and time. We then estimate the Solow distance measure as the log of the ratio of the TFP of the most efficient foreign firm in a given industry and country to the TFP of each domestic firm in the same industry and country.

Using the Solow measure is problematic in our data since only about one-half of the firms report sales revenue. With only 5,548 firm observations, we find in appendix Table A7 that the coefficients on Solow distance measure are similar to those of the Mahalanobis distance in suggesting that there is a negative and significant relationship

[18] For the export share we can construct *t* - 3 values using retrospective questions about growth rates of export (including the first year of export status) and sales as well as the current year information on the export share in total sales and the level of sales. We report results for this measure in appendix Table A6. The estimated coefficients are nearly identical to the results reported in the baseline specification. However, we do not use this measure in our analysis because many firms are reluctant to report the level of sales and hence the sample size for the regressions based on export share dated at t-3 shrinks to about 6,000 observations.

between distance and innovation. Hence, our results are robust to alternative measures of the distance from the frontier. Because we lose so many observations with the Solow distance measure, we continue to use the Mahalanobis distance in the rest of the paper.

3.3 Distance to the Frontier and the Effect of Competition and Transfer of Capability

In this section we test whether the effect of competition and vertical transfer of capabilities on innovation differs by firm heterogeneity in technology. In order to do so, we estimate the baseline specification separately for three groups of firms, according to where they lie in the distribution of the Mahalanobis distance to the frontier. The key hypotheses in the Aghion et al. (2005a, 2006) models are that (a) firms closer to the frontier are spurred by competition to innovate, while those far from the frontier are discouraged from innovating, (b) the inverted U relationship between competition and innovation is more likely to be found and be steeper among firms that are closer to the frontier.

Examining the coefficients on *markup* and on *pressure from foreign competition* in the columns titled "close" (to the frontier), "middle" and "far" (from the frontier) in Table 2, we find no support for these hypotheses. Monopolists tend to innovate more in areas of product and technology whether they are close to or far from the frontier. We also estimated this model with *markup* and $markup^2$ (results not shown here) and find again that both coefficients are not significant. Greater pressure from foreign competition spurs type 1 and type 2 innovation among firms across the entire distribution of technology.

A key hypothesis with respect to the relationship between vertical transfer of capabilities and innovation found in the FDI literature is that firms closer to the frontier are in a better position than firms farther from the frontier to imitate (absorb) the technology of foreign firms. As may be seen from Table 2, we do not find support for this hypothesis in any of our three vertical transfer variables. Virtually all the coefficients are highly significant and for most cases one cannot reject the hypothesis that the effects are the same for firms that are close and far from the efficiency frontier. Hence,

Sutton's (2007) prediction that the vertical transfer of capability is an important phenomenon is strongly supported, and the effect seems to be strong across the board irrespective of the relative efficiency of domestic firms.

3.4 Heterogeneity by Sector and Age of Firm

One of the key predictions advanced by Sutton (2007), which is also implicit in the other models, is that the effects of globalization may vary across different sectors of the economy. We therefore test whether the effects of competition and vertical linkages with foreign firms on innovation are different for firms that are in manufacturing than those in services and for firms that were established during communism (old) vs. firms created during the transition to a market economy (new). This manufacturing-service sector distinction is useful because the service sector is rapidly gaining in importance in many emerging market economies and existing studies of FDI and innovation have invariably used data on manufacturing rather than services.

The estimates in Table 3 indicate that there is not much heterogeneity in the innovation effect of competition, vertical transfer of capabilities and distance to the frontier between firms in manufacturing and services. The coefficients are for the most part similar. The results hence indicate that the effect of globalization, as captured by our three sets of variables, is broad based and relatively similar in manufacturing and services.

Similarly, it is of interest to assess possible heterogeneity in terms of the vintage of firms, defined as firms created since a country shifted from a socialist to a market-oriented strategy of development as compared to firms established under communism. In particular, we check whether the two types of firms innovate differently in response to competition, linkages with foreign firms and distance to frontier. The literature provides some (although limited) guidance here, with new firms typically innovating more than old firms. The results from estimating the baseline equation separately for firms that started operating before 1991 (*Old*) and since 1991 (*New*) are presented in Table 4. The results suggest there is not a statistically significant difference in the reaction of the two types of firms, except that the new firms are less responsive than the old ones to pressure

from foreign competition. Moreover, greater distance to the frontier negatively affects the amount of innovation (all three types) among old firms, but has no effect among new firms.

3.5 Testing for Business Environment

We carry out two tests of the effects of differences in business environment. First, we check whether general differences in levels of development of markets and institutions, captured by stratifying the sample by historically different regions, affect innovation and the effect of our three sets of variables. Second we test whether differences in the level of bribery (corruption) matter.

In Table 5, we present the coefficients from separate estimates of equation (1) for countries in the Commonwealth of Independent States (CIS), Central Europe and the Baltic (CEB) and South Eastern Europe, including Turkey (SEE). Since markets and market oriented institutions are viewed as functioning better in the CEB region than in the CIS and SEE regions, one may expect that the dispersion of firms in terms of efficiency would be smaller and firms in CEB would operate more at a neck-and-neck level and closer to the frontier than firms in CIS and SEE. The Aghion et al. (2005b) model would predict a positive relationship between competition and innovation in the CEB region and a negative relationship in the two other regions.

Our estimates do not support this prediction. Whereas the CEB coefficients on *markup* are positive and significant for the first two types of innovation, so are the coefficients for the CIS and SEE. We also tested for an inverted U relationship and did not find support for it.[19] However, firms in the CEB region do tend to respond more positively to foreign competition in their innovative behavior, especially *vis a vis* the SEE region (again for only the first two types of innovation). The CEB firms also display a more consistent positive effect on innovation from selling to MNEs. Hence, we conclude

[19] We estimated a regression with *markup* and *markup squared*, however including higher terms for *markup* makes coefficients on *markup* and higher order terms insignificant.

that firms in the CEB region are more sensitive to foreign presence in their innovative activity.

In Table 6 we present tests of whether more pro-business environment in terms of lower level of bribery (corruption) induces firms to respond to competition by investing more in innovations (Aghion et al., 2005a, 2005b). To carry out this test we allocate firms into low, medium and high corruption environment category on the basis of the percentage of annual sales that the firms ("a firm like yours") pay in unofficial payments to public officials and estimate equation (1) separately for firms in each category. The three categories have highly statistically different mean values of 0.005, 0.011 and 0.021, respectively. Overall, there do not appear to be many systematic differences between the estimated coefficients of firms in the low and high categories of corruption. The clearest difference is observed in the fact that firms in the low bribery category have a significant negative relationship between the distance to the frontier and all three types of innovation, while firms in the middle and high bribery categories register only insignificant coefficients. In developing a new product, the low bribery firms are also less responsive to sales to MNEs, but more responsive to exporting. In acquiring a new technology and license, the low bribery firms generate similar patterns of coefficients as high bribery firms.

4. Conclusion

In view of the theoretical literature on globalization and innovation, we use rich firm-level data from the 27 emerging market economies of the post-socialist republics to test predictions about the effects of product market competition and linkages with foreign firms on domestic firms' innovative activities. Our focus on innovation is motivated by the fact that innovation is widely regarded as a channel through which local firms try to stay competitive in the new global economy.

Economists tend to champion the positive effects of globalization and competition. For example, according to Sutton (2007), the 'middle group' countries of Eastern Europe should be the most dramatic beneficiaries of globalization, especially from the transfer of

capabilities of foreign direct investment. Others have stressed that the competitive effect of entry of foreign firms will strengthen the performance of domestic firms in emerging market economies. However, economic theory has been unclear about the effect of competition on innovation. The Schumpeterian view is that market power promotes innovation by providing a stable platform to fund these investments and by making it easier for the firm to capture its benefits. Moreover, innovation is spurred in order to maintain existing rents in the face of competitive threat. This is contrasted by the view that market power reduces innovation by protecting entrepreneurs who fail to innovate. Empirical work has found both effects. Aghion et al. (2005a, 2005b, 2006) have developed a theory that has reconciled these opposing views by showing that the Schumpeterian effect dominates in industries with laggard firms whereas the competition spurs investment among high performing firms.

Our basic finding is that firms with market power are the innovators in terms of their product and technology (but not necessarily with accreditation). We do not find a strong differential effect of product market competition on the laggard v. the high performance firms and hence, the inverted U relationship generated by the balance of these two. However, we find support for the hypothesis that firms further away from the frontier (laggard firms) are less likely to innovate. Importantly, we find that greater pressure from foreign competition stimulates innovation. Combining this result with our basic finding, suggests that firms with market power are innovating to escape competition.

Vertical transfer of capability from foreign to domestic firms, stressed by Sutton (2007), appears to be substantial for all three types of innovation that we study. This result suggests that the supply chain of multinational enterprises and international trade are important means for domestic firms to raise their capability.

Finally, we test whether the effects of globalization vary across industries, firm age, and more or less pro-business environments. The results indicate that the effects of competition, vertical linkages with foreign firms and distance to the frontier are broad-based and relatively similar in manufacturing and services as well as between firms

established under communism and those created after a country shifted to a market-oriented strategy of development. However, innovation in the old firms tends to be more sensitive to pressure from foreign competition. We test the Aghion et al. (2005b) prediction that firms in a more pro-business environment invest more in innovation and are more likely to display the inverted U relationship between competition and innovation. Stratifying firms across regions with different business environments provides little support for this prediction. Moreover, when we proxy the quality of business environment by the extent of bribery (corruption), we do not find many systematic differences between firms in the low and high categories of corruption.

Our results are both encouraging and sobering. Whereas the advocates of globalization and market oriented institutions might be disappointed that product market competition does not foster innovation, they will be cheered by the finding that foreign direct investment does promote innovation among domestic firms and that there is some weak evidence that firms in more market oriented economies tend to innovate more. Our data set has numerous strengths but also some limitations. We hope that this paper will help to design future surveys to address the issues we raise in the paper.

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Table 1: Baseline Specification for All Firms.

	New Product	New Technology	New Accreditation
Competition			
Markup	0.562***	0.613***	-0.061
	(0.110)	(0.111)	(0.149)
Pressure from foreign competition			
Low	0.051	0.071*	0.044
	(0.035)	(0.037)	(0.048)
Medium & High	0.101***	0.133***	0.065
	(0.032)	(0.033)	(0.042)
Vertical Transfer of Capability			
Share of sales to MNEs	0.224***	0.203***	0.392***
	(0.067)	(0.066)	(0.074)
Export share	0.277***	0.229***	0.450***
	(0.079)	(0.074)	(0.081)
Import share	0.363***	0.271***	0.201***
	(0.038)	(0.039)	(0.050)
Ability			
Distance (Mahalanobis)	-0.051**	-0.049**	-0.032
	(0.022)	(0.022)	(0.028)
Controls			
lnL, t-3	0.120***	0.123***	0.261***
	(0.031)	(0.033)	(0.047)
$(lnL)^2$, t-3	-0.006	-0.005	-0.012**
	(0.004)	(0.004)	(0.006)
Capacity utilization, t-3	-0.523***	-0.301***	-0.109
	(0.063)	(0.064)	(0.082)
Positive R&D dummy	0.399***	0.286***	0.359***
	(0.039)	(0.037)	(0.043)
Share of skilled workers, t-3	0.059	0.008	-0.076
	(0.045)	(0.047)	(0.062)
Share of workers with Univ. Ed. t-3	0.207***	0.169***	0.195***
	(0.051)	(0.053)	(0.070)
Firm's age	-0.058***	-0.042**	0.023
	(0.019)	(0.020)	(0.024)
State owned dummy	-0.235***	-0.112**	0.012
	(0.046)	(0.047)	(0.055)
Compete in national markets	0.220***	0.208***	0.238***
	(0.033)	(0.034)	(0.045)
No. of Observations	11,665	11,562	11,643

Note: The table reports estimates of equation (1). Definitions of the variables are in Appendix Table A1. Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2: Testing for Interaction Between Distance and Competition.

	New Good Distance to the Frontier			**New Technology** Distance to the Frontier			**New Accreditation** Distance to the Frontier		
	Close	Middle	Far	Close	Middle	Far	Close	Middle	Far
Competition									
Markup	0.341	0.326*	0.910***	0.990***	0.309	0.682***	-0.160	-0.282	0.134
	(0.231)	(0.189)	(0.172)	(0.236)	(0.199)	(0.167)	(0.302)	(0.264)	(0.229)
Pressure from foreign competition									
Low	0.134**	-0.054	0.074	0.032	0.117*	0.065	-0.044	0.099	0.100
	(0.061)	(0.062)	(0.063)	(0.064)	(0.065)	(0.064)	(0.080)	(0.086)	(0.085)
Medium & High	0.161***	0.016	0.123**	0.137**	0.139**	0.123**	0.078	-0.049	0.151**
	(0.054)	(0.055)	(0.057)	(0.056)	(0.058)	(0.058)	(0.069)	(0.076)	(0.074)
Vertical Transfer of Capability									
Share of sales to MNEs	0.180	0.247**	0.215*	0.257**	0.168	0.178*	0.362***	0.551***	0.291**
	(0.116)	(0.124)	(0.113)	(0.117)	(0.122)	(0.108)	(0.126)	(0.140)	(0.121)
Export share	0.260*	0.134	0.369***	0.273**	0.094	0.315**	0.329**	0.482***	0.612***
	(0.137)	(0.141)	(0.137)	(0.128)	(0.133)	(0.127)	(0.140)	(0.148)	(0.146)
Import share	0.418***	0.261***	0.409***	0.231***	0.311***	0.270***	0.243***	0.159*	0.199**
	(0.069)	(0.067)	(0.067)	(0.069)	(0.070)	(0.065)	(0.087)	(0.094)	(0.088)
No. of observations	3,945	3,890	3,830	3,904	3,859	3,799	3,933	3,882	3,820

Note: The table reports estimates of equation (1). Definitions of the variables are in Appendix Table A1. Close denotes the lowest third of firms in terms of distance to foreign firms; Far denotes the greatest third of firms in terms of distance to foreign firms. Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3: Testing for Heterogeneity in Response by Manufacturing v. Services

	New Product		New Technology		New Accreditation	
	MNFR	SERV	MNFR	SERV	MNFR	SERV
Competition						
Markup	0.543***	0.578***	0.611***	0.573***	0.034	0.053
	(0.202)	(0.155)	(0.186)	(0.168)	(0.231)	(0.240)
Pressure from foreign competition						
Low	0.083	0.024	-0.004	0.125**	-0.091	0.088
	(0.065)	(0.051)	(0.062)	(0.057)	(0.080)	(0.076)
Medium & High	0.116**	0.124***	0.076	0.161***	0.005	0.083
	(0.055)	(0.045)	(0.053)	(0.051)	(0.065)	(0.067)
Vertical Transfer of Capability						
Share of sales to MNEs	0.226**	0.178*	0.252**	0.219**	0.411***	0.462***
	(0.113)	(0.102)	(0.104)	(0.105)	(0.112)	(0.127)
Export share	0.270**	0.218*	0.270***	0.197	0.378***	0.711***
	(0.119)	(0.121)	(0.103)	(0.126)	(0.113)	(0.140)
Import share	0.442***	0.277***	0.238***	0.255***	0.250***	0.111
	(0.071)	(0.053)	(0.065)	(0.058)	(0.079)	(0.080)
Ability						
Distance (Mahalanobis)	-0.071*	-0.074**	-0.041	-0.070*	-0.058	-0.079
	(0.039)	(0.035)	(0.036)	(0.038)	(0.043)	(0.053)
No. of Observations	3,892	5,624	3,855	5,580	3,884	5,615

Note: The table reports estimates of equation (1). Definitions of the variables are in Appendix Table A1. MNFR is Manufacturing, SERV is services. Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4: Testing for Heterogeneity in Response by Old v. New Firms

	New Product		New Technology		New Accreditation	
	Old	New	Old	New	Old	New
Competition						
Markup	0.499**	0.573***	0.640***	0.587***	-0.411	0.052
	(0.217)	(0.128)	(0.217)	(0.130)	(0.300)	(0.173)
Pressure from foreign competition						
Low	0.176**	0.010	0.130*	0.041	0.135	0.012
	(0.071)	(0.041)	(0.072)	(0.044)	(0.087)	(0.057)
Medium & High	0.129**	0.095**	0.127**	0.138***	0.215***	-0.013
	(0.062)	(0.037)	(0.063)	(0.039)	(0.075)	(0.051)
Vertical Transfer of Capability						
Share of sales to MNEs	0.187	0.224***	0.517***	0.061	0.433***	0.389***
	(0.119)	(0.081)	(0.118)	(0.081)	(0.130)	(0.091)
Export share	0.352**	0.248**	0.277**	0.266***	0.629***	0.344***
	(0.137)	(0.098)	(0.127)	(0.092)	(0.143)	(0.104)
Import share	0.412***	0.352***	0.241***	0.279***	0.108	0.224***
	(0.081)	(0.044)	(0.078)	(0.045)	(0.095)	(0.060)
Ability						
Distance (Mahalanobis)	-0.101**	-0.031	-0.108**	-0.022	-0.094*	0.006
	(0.043)	(0.026)	(0.043)	(0.027)	(0.051)	(0.034)
Observations	3,176	8,489	3,158	8,404	3,174	8,469

Note: The table reports estimates of equation (1). Definitions of the variables are in Appendix Table A1. Old firms are those established before 1991. Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: Regional Differences

	New Product			New Technology			New Accreditation		
	CIS	CEB	SEE	CIS	CEB	SEE	CIS	CEB	SEE
Competition									
Markup	0.649***	0.527**	0.506**	0.736***	0.732***	0.416**	0.186	-0.348	-0.079
	(0.170)	(0.211)	(0.204)	(0.168)	(0.227)	(0.199)	(0.225)	(0.311)	(0.273)
Pressure from foreign competition									
Low	0.100*	0.152**	-0.137**	0.047	0.229***	0.003	0.006	0.033	0.079
	(0.054)	(0.068)	(0.067)	(0.055)	(0.075)	(0.070)	(0.073)	(0.095)	(0.089)
Medium & High	0.122**	0.247***	-0.057	0.115**	0.226***	0.131**	0.070	0.080	0.021
	(0.052)	(0.060)	(0.057)	(0.052)	(0.067)	(0.058)	(0.068)	(0.084)	(0.073)
Vertical Transfer of Capability									
Share of sales to MNEs	0.252**	0.235*	0.147	0.150	0.356***	0.181*	0.279**	0.688***	0.281**
	(0.116)	(0.131)	(0.107)	(0.113)	(0.132)	(0.105)	(0.130)	(0.139)	(0.128)
Export share	0.362**	0.085	0.434***	0.385***	0.029	0.279**	0.613***	0.144	0.580***
	(0.150)	(0.145)	(0.132)	(0.129)	(0.145)	(0.123)	(0.142)	(0.171)	(0.137)
Import share	0.415***	0.348***	0.297***	0.332***	0.161**	0.249***	0.197**	0.118	0.322***
	(0.059)	(0.074)	(0.071)	(0.058)	(0.080)	(0.071)	(0.077)	(0.105)	(0.091)
Ability									
Distance (Mahalanobis)	-0.006	-0.180***	-0.063	-0.050	-0.063	-0.082*	0.076*	-0.080	-0.128**
	(0.034)	(0.045)	(0.043)	(0.034)	(0.049)	(0.042)	(0.046)	(0.059)	(0.053)
Observations	5,010	3,154	3,500	4,964	3,133	3,464	5,006	3,146	3,490

Note: The table reports estimates of equation (1). Definitions of the variables are in Appendix Table A1. CIS stands for Commonwealth Independent States; CEB stands for Central Europe and Baltic; SEE stands for South East Europe. Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: Testing for Business Environment: Bribery

	New Good			New Technology			New Accreditation		
	Bribery			Bribery			Bribery		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Competition									
Markup	0.490**	0.239	0.875***	0.820***	0.436**	0.542***	-0.139	-0.027	-0.106
	(0.200)	(0.189)	(0.190)	(0.203)	(0.195)	(0.189)	(0.271)	(0.262)	(0.254)
Pressure from foreign competition									
Low	0.001	0.078	0.055	0.146**	0.005	0.086	0.055	0.079	0.023
	(0.064)	(0.062)	(0.060)	(0.067)	(0.066)	(0.061)	(0.088)	(0.084)	(0.082)
Medium & High	0.072	0.135**	0.081	0.208***	0.080	0.133**	0.132*	0.032	0.066
	(0.056)	(0.055)	(0.056)	(0.059)	(0.057)	(0.057)	(0.075)	(0.072)	(0.073)
Vertical Transfer of Capability									
Share of sales to MNEs	0.108	0.339**	0.278**	0.296***	0.147	0.183	0.656***	0.123	0.305**
	(0.103)	(0.133)	(0.120)	(0.102)	(0.128)	(0.119)	(0.113)	(0.142)	(0.142)
Export share	0.435***	0.040	0.206	0.198*	0.276*	0.156	0.314**	0.567***	0.489***
	(0.127)	(0.144)	(0.152)	(0.117)	(0.142)	(0.137)	(0.129)	(0.158)	(0.156)
Import share	0.319***	0.398***	0.377***	0.197***	0.307***	0.346***	0.255***	0.102	0.314***
	(0.066)	(0.068)	(0.068)	(0.068)	(0.068)	(0.068)	(0.087)	(0.093)	(0.090)
Ability									
Distance (Mahalanobis)	-0.116***	-0.061	-0.002	-0.054	-0.064	-0.019	-0.082*	-0.071	0.061
	(0.041)	(0.040)	(0.039)	(0.041)	(0.042)	(0.039)	(0.049)	(0.053)	(0.053)
Observations	3,753	3,974	3,930	3,722	3,938	3,900	3,739	3,966	3924

Note: The table reports estimates of equation (1). Definitions of the variables are in Appendix Table A1. Low denotes the lowest third quantity in terms of bribery made. Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix Table A1: Definition of Variable

Variable Name	Variable Definition	BEEPS question
Newgood	New good or upgrade existing good	Dummy variable. Has your company undertaken any of the following initiatives over the last 36 months? Dummy variable is equal to one if 'yes' to any of the two questions: - Developed successfully a major new product line - Upgraded an existing product line
Newtech	New technology is implemented	Dummy variable = 1 if answer is affirmative to question: Has your firm acquired new production technology over the last 36 months?
Newaccred	New accreditation is received	Dummy variable = 1 if answer is affirmative to question: Has your company Obtained a new quality accreditation (ISO 9000, 9002 or 14,000, AGCCP, etc) over the last 36 months? Dummy variable is equal to one if 'yes' to any of the two questions
Markup	Markup	Considering your main product line or main line of services in the domestic market, by what margin does your sales price exceed your operating costs (i.e., the cost material inputs plus wage costs but not overheads and depreciation)?
ForComp	Pressure from foreign competition None Low Medium High	How would you rate the importance of pressure from foreign competition on key decisions about your business with respect to "Reducing the production costs of existing products or services": Not important Slightly important Fairly important Very important
SMNE	Share of sales to MNEs	Share of sales to multinationals located in your country (not including your parent company, if applicable)
EXPORT	Export share	Share of sales exported directly or indirectly through a distributor
IMPORT	Import share	Share of your firm's material inputs and supplies that are imported directly or indirectly through a distributor
L	Labor	Number of permanent and temporary employees 36 month ago
CU	Capacity utilization	In your judgment, what is your firm's output in comparison with the maximum output possible using its facilities/man power at the time 36 months ago? If you are using the facilities/man power to the full, answer 100%; if output was 60% of capacity, answer 60%.
R&D	R&D dummy	= 1 if positive expenditures on research and development (including wages and salaries of R&D personnel, materials, R&D related education and training costs) in previous year; =0 otherwise
SKILL	Share of skilled workers, 3 yrs ago	What share of your current permanent, full-time workers are skilled workers 36 months ago?
EDU	Share of workers with higher education, 3yrs ago	What share of the workforce at your firm has some university education in 36 months ago?
Age	Log (Firm's age)	Year of survey minus the year when the firm was established. For the year established: In what year did your firm begin operations in this country?
SOE	State owned	Government is the major shareholder (50%+)
CNM	Compete in national markets	Does your firm compete in the national market (i.e. whole country) for its main product line or service or does it serve primarily the local market (i.e. region, city, or neighborhood)? 1= yes.
LOC	Location	Type of location: Capital; Other city over 1 million; Other 250,000-1,000,000; Other 50,000-250,000; Under 50,000
BR	Bribes	On average, what percent of total annual sales do firm's like yours typically pay in unofficial payments/gifts to public officials?

Appendix Table A2: Summary Statistics.

	Mean	St.Dev.
Innovation Variables		
New Good	0.562	0.496
New Technology	0.302	0.459
New Accreditation	0.129	0.335
Competition		
Markup	0.209	0.118
Elasticity of demand		
Low	0.303	0.459
Medium&High	0.477	0.499
Pressure from foreign competition		
Low	0.173	0.378
Medium&High	0.297	0.457
Vertical Transfer of Capability		
Share of sales to MNEs	0.066	0.196
Export share	0.069	0.187
Import share	0.258	0.359
Ability		
Distance (Mahalanobis)	3.034	0.706
Distance(Solow)	0.364	0.377
Controls		
lnL, 3yrs ago	3.000	1.604
$(lnL)^2$, 3yrs ago	11.577	11.530
Capacity utilization, 3yrs ago	0.794	0.206
Positive R&D dummy	0.163	0.369
Share of skilled workers, 3yrs ago	0.487	0.309
Share of workers with higher education, 3yr ago	0.272	0.290
Firm's age	2.367	0.777
State owned	0.118	0.322
Compete in national markets	0.667	0.471

Appendix Table A3: Summary statistics for innovation variables by country.

Country	New Good			New Technology			New Accreditation			New Good	New Technology	New Accreditation
	N	Mean	St.Dev.	N	Mean	St.Dev.	N	Mean	St.Dev.	Divide each by total mean		
Yugoslavia	375	0.685	0.465	374	0.385	0.487	374	0.110	0.313	1.219	1.273	0.948
Macedonia	268	0.552	0.498	263	0.312	0.464	267	0.079	0.270	0.982	1.031	0.680
Albania	257	0.607	0.489	256	0.352	0.478	253	0.150	0.358	1.079	1.162	1.299
Croatia	213	0.840	0.367	209	0.483	0.501	212	0.146	0.354	1.494	1.598	1.265
Turkey	796	0.352	0.478	779	0.202	0.401	796	0.113	0.317	0.625	0.666	0.978
Bosnia	225	0.653	0.477	220	0.427	0.496	223	0.130	0.337	1.162	1.413	1.125
Slovenia	323	0.368	0.483	323	0.310	0.463	323	0.238	0.427	0.655	1.024	2.062
Poland	1162	0.584	0.493	1159	0.319	0.466	1160	0.109	0.311	1.039	1.055	0.940
Ukraine	791	0.671	0.470	789	0.330	0.470	791	0.090	0.286	1.194	1.090	0.776
Belarus	409	0.729	0.445	408	0.304	0.461	409	0.086	0.280	1.296	1.005	0.740
Hungary	615	0.426	0.495	615	0.140	0.347	615	0.228	0.420	0.758	0.462	1.969
Czech Republic	354	0.429	0.496	352	0.213	0.410	354	0.102	0.303	0.764	0.704	0.880
Slovakia	269	0.736	0.442	267	0.247	0.432	269	0.115	0.320	1.309	0.817	0.997
Romania	646	0.670	0.470	643	0.387	0.488	646	0.176	0.382	1.192	1.280	1.526
Bulgaria	397	0.569	0.496	397	0.262	0.440	396	0.081	0.273	1.012	0.866	0.699
Moldova	352	0.636	0.482	349	0.321	0.467	352	0.060	0.237	1.132	1.061	0.516
Latvia	242	0.591	0.493	241	0.286	0.453	242	0.066	0.249	1.051	0.947	0.572
Lithuania	292	0.610	0.489	284	0.285	0.452	286	0.122	0.328	1.084	0.943	1.059
Estonia	221	0.579	0.495	216	0.208	0.407	221	0.109	0.312	1.030	0.689	0.939
Georgia	242	0.463	0.500	242	0.269	0.444	242	0.116	0.321	0.823	0.888	1.001
Armenia	413	0.596	0.491	413	0.436	0.496	413	0.061	0.239	1.059	1.441	0.524
Kazakhstan	680	0.490	0.500	677	0.263	0.441	680	0.104	0.306	0.871	0.869	0.903
Azerbaijan	398	0.555	0.498	375	0.381	0.486	398	0.090	0.287	0.987	1.261	0.782
Uzbekistan	404	0.361	0.481	403	0.226	0.419	403	0.072	0.259	0.643	0.747	0.622
Russia	779	0.569	0.496	766	0.300	0.459	777	0.115	0.319	1.011	0.993	0.991
Tajikistan	304	0.576	0.495	304	0.349	0.477	303	0.102	0.304	1.024	1.153	0.885
Kyrgyzstan	238	0.613	0.488	238	0.399	0.491	238	0.122	0.328	1.091	1.320	1.054
Total	11665	0.562	0.496	11562	0.302	0.459	11643	0.116	0.320	1.000	1.000	1.000

Table A4: Probit vs IV Probit Estimates on Markup

	New Product	New Technology	New Accreditation
Probit			
Markup	0.562***	0.613***	-0.061
	(0.110)	(0.111)	(0.149)
Instrumental Variables (IV) Probit			
Markup	1.915*	2.055*	0.301
	(1.111)	(1.205)	(2.801)
First stage:			
F-test	28.98	26.93	20.53
Anderson canon. corr. LR test	116.05***	107.91***	41.24***
p-value(Overidentifying restrictions test)	0.398	0.772	0.927
p-value(Exogeneity test)	0.316	0.271	0.157
No. of Observations	11,665	11,562	11,643

Notes: The table reports estimates of equation (1). IV probit is implemented as in Newey (1987). Selection of instruments is based on Andrews (1999) and Hall and Peixe (2003). Robust standard errors are in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A5: Testing for Endogeneity due to the Timing of the Variables

	New Good				New Technology				New License			
	Full Sample (current)	2002 & 2005 Panel (current)	2005 Panel (current)	2005 Panel (lagged)	Full Sample (current)	2002 & 2005 Panel (current)	2005 Panel (current)	2005 Panel (lagged)	Full Sample (current)	2002 & 2005 Panel (current)	2005 Panel (current)	2005 Panel (lagged)
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
Competition												
Markup	0.593***	0.557**	0.497*	0.310	0.460***	-0.050	-0.524	0.654*	-0.006	0.031	0.011	-0.170
	(0.098)	(0.237)	(0.300)	(0.367)	(0.100)	(0.243)	(0.328)	(0.375)	(0.105)	(0.250)	(0.346)	(0.394)
Pressure from foreign competition												
Low	0.159***	0.297***	0.331***	0.250**	0.154***	0.186**	0.395***	0.342***	0.153***	0.244***	0.227*	0.097
	(0.032)	(0.078)	(0.112)	(0.101)	(0.033)	(0.079)	(0.112)	(0.109)	(0.035)	(0.082)	(0.117)	(0.116)
Medium&High	0.276***	0.123*	0.084	0.263 **	0.261***	0.176**	0.351***	0.168*	0.286***	0.189***	0.158	0.065
	(0.027)	(0.069)	(0.098)	(0.087)	(0.028)	(0.070)	(0.102)	(0.097)	(0.030)	(0.072)	(0.106)	(0.097)
Vertical Transfer												
Sales to MNEs	0.308***	0.356***	0.191	0.305***	0.213***	0.158**	0.065	0.264**	0.344***	0.374***	0.294**	0.366***
	(0.033)	(0.083)	(0.120)	(0.108)	(0.032)	(0.079)	(0.119)	(0.108)	(0.033)	(0.079)	(0.122)	(0.109)
Export share	0.296***	0.463***	0.444***	0.371***	0.213***	0.204***	0.315***	0.189*	0.423***	0.494***	0.466***	0.442***
	(0.032)	(0.084)	(0.115)	(0.116)	(0.031)	(0.076)	(0.109)	(0.110)	(0.033)	(0.079)	(0.112)	(0.114)
Import share	0.368***	0.338***	0.319***	0.182**	0.307***	0.255***	0.283***	0.146	0.212***	0.190***	0.298***	0.125
	(0.025)	(0.061)	(0.088)	(0.086)	(0.026)	(0.064)	(0.092)	(0.091)	(0.028)	(0.067)	(0.098)	(0.094)
Distance												
Distance	-0.051**	-0.109**	-0.121*	-0.113	-0.058***	-0.047	-0.055	-0.055	-0.061***	-0.085	-0.097	-0.112
(Mahalanobis)	(0.020)	(0.053)	(0.072)	(0.075)	(0.020)	(0.052)	(0.074)	(0.075)	(0.021)	(0.056)	(0.080)	(0.080)
Distance	-0.228***	-0.396***	-0.297*	-0.311*	-0.208***	-0.150	-0.122	-0.123	-0.517***	-0.432***	-0.583***	-0.583***
(Solow)	(0.047)	(0.104)	(0.163)	(0.164)	(0.048)	(0.101)	(0.164)	(0.164)	(0.052)	(0.114)	(0.202)	(0.202)

Note: Markup, Elasticity of Demand, and Pressure from Foreign Competition each enter the regressions separately. Vertical Transfer of Capability (sales to MNEs, Export, Import), Mahalanobis Distance and Solow residual Distance enter the regressions separately. Full Sample is with current RHS values); 2002&2005 Panel is with current RHS values; 2005 Panel is with both current and lagged RHS values. Sales to MNEs, Export share, and Import share are set as dummy variables equal to one for positive values. The coefficients in columns (a) are different from the corresponding entries in Table 1 because excluding other controls in Table A4 increases the sample. Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A6: Baseline Specification for All Firms.

	New Product	**New Technology**	**New Accreditation**
Export share, t-3	0.311***	0.257***	0.450***
	(0.118)	(0.107)	(0.135)
No. of Observations	5,374	6,151	6,107

Note: The table reports estimates of equation (1). Export share is constructed using retrospective questions about growth rate of sales revenue and exports as well as the current year information on the share of exports in total sales and the level of total sales. Other variables are defined as in the specification reported in Table 1. Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A7: Baseline Specification for All Firms using Solow distance

	New Product	New Technology	New Accreditation
Competition			
Markup	0.517***	0.169	-0.337
	(0.170)	(0.167)	(0.214)
Pressure from foreign competition			
Low	0.043	0.087	0.081
	(0.054)	(0.055)	(0.068)
Medium&High	0.115**	0.149***	0.080
	(0.049)	(0.049)	(0.061)
Vertical Transfer of Capability			
Share of sales to MNEs	0.401***	0.217**	0.340***
	(0.107)	(0.097)	(0.108)
Export share	0.248**	0.160	0.331***
	(0.115)	(0.103)	(0.114)
Import share	0.395***	0.226***	0.108
	(0.059)	(0.058)	(0.072)
Ability			
Distance (Solow)	-0.067**	-0.055*	0.033
	(0.029)	(0.029)	(0.037)
Controls			
lnL, 3yrs ago	0.135***	0.118**	0.265***
	(0.048)	(0.050)	(0.068)
$(lnL)^2$, 3yrs ago	-0.009	-0.008	-0.009
	(0.007)	(0.007)	(0.009)
Capacity utilization, 3yrs ago	-0.523***	-0.189*	-0.122
	(0.108)	(0.106)	(0.132)
Positive R&D dummy	0.301***	0.262***	0.315***
	(0.054)	(0.050)	(0.057)
Share of skilled workers, 3yrs ago	0.060	0.042	-0.085
	(0.071)	(0.073)	(0.093)
Share of workers with higher education, 3yrs ago	0.145*	0.088	0.105
	(0.085)	(0.086)	(0.108)
Firm's age	-0.030	-0.039	0.045
	(0.031)	(0.030)	(0.036)
State owned	-0.347***	-0.167**	-0.101
	(0.072)	(0.072)	(0.085)
Compete in national markets	0.264***	0.236***	0.250***
	(0.051)	(0.053)	(0.068)
Observations	5,020	4,985	5,011

Note: The table reports estimates of equation (1). Definitions of the variables are in Appendix Table A1. Solow residual is calculated using a Cobb-Douglas production function, where the dependent variables is growth rate of sales revenues; the independent variables include three inputs (number of employees, capital, capacity utilization), country and industry fixed effects, and the reported variables. Solow residual distance is the logarithm of ratio the top (country, industry) foreign firm's Solow residual to that of a domestic firm. Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%