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Foreign Investment, Corporate Ownership, and Development: Are Firms in Emerging Markets Catching Up to the World Standard?*

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Abstract

Economic development implies that the efficiency of firms in developing countries is approaching that of firms in advanced economies. We examine the extent of this convergence among all firms as well as a subset of firms near the efficiency frontier in two economies that represent alternative models of implementing market-oriented development policies: the Czech Republic and Russia. Using 1992-2000 panel data on virtually all medium and large industrial firms in each country, we find that privatization to foreign owners markedly improved the efficiency of firms, whereas privatization to domestic owners did not; domestic firms are not catching up to the (world) efficiency standard given by foreign-owned firms. This is due in part to the lower efficiency of domestic startups relative to foreign startups and slower "learning" by domestic firms over time as they converge to a lower level of efficiency. However, foreigners' acquisitions of more efficient domestic firms are also contributing to the gap. Domestic firms closer to the frontier are not more likely to catch up than firms further from the frontier although foreign firms do exhibit this behavior. The distance of the Russian firms to the efficiency frontier is much larger than that of the Czech firms. Nevertheless, after nearly a decade of reforms, neither model of development has resulted in convergence of domestic firms to the world standard.

JEL classification: 01, C33, D20, G32, L20

Key words: efficiency, economic development, foreign direct investment, ownership, convergence, frontier, Czech Republic, Russia

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1. Introduction

Economic development is often viewed as a process through which living standards in poor countries converge to those of the rich countries.[1] A necessary condition for this convergence is that the efficiency of firms in developing countries starts approaching the efficiency of firms in advanced economies. The need for efficiency improvement in developing countries becomes especially relevant as globalization proceeds and greater openness to commodity and factor flows induces more intense worldwide competition. The development policies pursued over the last three decades by many governments intended to increase efficiency in developing countries and reduce the gap between the poor and rich economies by pursuing a number of market oriented reforms, including privatization of state-owned enterprises (SOEs), stimulating the entry of new firms, and encouraging foreign direct investment (FDI) and trade. Given the depth and breadth of initial distortions and extent of subsequent reforms in the transition economies, one may expect the positive effects of globalization and market-oriented policies to be larger and more detectable in these countries than in other developing economies. In this paper we examine whether these policies have propelled domestic firms in transition economies to converge to the world standard.

The implementation of market-oriented development policies in the transition economies have been subject to extensive debate. One group of critics argues that these policies have not contributed to the convergence process and that excessively rapid privatization and other measures account for the relatively poor performance of the former Soviet bloc countries in the early transition (e.g., Stiglitz, 1999). Others proclaim that the problems of the less successful transition economies have been brought about by insufficiently rapid and comprehensive policies (e.g., Sachs, 1996). A nuanced view maintains that an increase in competition encourages innovative behavior of firms and countries that are near the efficiency frontier but stifles those that lag significantly behind (e.g., Aghion *et al.*, 2002 and 2003; Acemoglu, Aghion, and Zilibotti, 2002 and 2003).[2] Finally, a model by Monge-Naranjo (2002) proposes that in the short-run FDI reduces the efficiency

[1] This "convergence" view in development economics dates at least as far back as W. Arthur Lewis (1955).

[2] Interestingly, over two decades ago the converse of this hypothesis was proposed by Findlay (1978, p. 2) who posits that "the rate of technological progress in relatively 'backward' region is an increasing function of the gap between its own level of technology and that of the 'advanced' region which improves at a constant rate, and the degree to which it is open to direct foreign investment." See Kosova (2004) for a review.

of domestic firms and increases the dispersion of their efficiency, but in the long run domestic firms catch up with firms in the developed world.

At the micro level, there is a growing literature questioning whether firms privatized to domestic owners have become more productive than SOEs and whether foreign ownership improves efficiency in the emerging market economies. The evidence from numerous studies has shown that firms with foreign ownership are more productive than domestic firms in all parts of the world.[3] However, the evidence on the performance effects of privatization is mixed, ranging from those that find no or limited systematic effect (e.g., Bevan, Estrin, and Schaffer, 1999; Hanousek, Kocenda, and Svejnar, 2007), to those that cautiously conclude that privatization improves firm performance (Megginson and Netter, 2001), to those being confident that privatization improves performance (Djankov and Murrell, 2002; Shirley and Walsh, 2000).[4]

We examine the evolution of efficiency of industrial firms in two alternative prototypes of transition economies – the Czech Republic and Russia. The two countries constitute useful case studies because they maintained central planning and virtually no private ownership and FDI inflows until the start of the transition, both rapidly privatized most state assets, and yet they otherwise pursued very different paths in opening the economies to market forces.[5] The Czech Republic represents the Central and East European (CEE) model, which emphasizes the opening up to trade and capital flows, developing a functioning market economy and establishing institutions, rules and regulations that make a country eligible for accession to the European Union. Russia is a model of the countries in the Commonwealth of Independent States (CIS), which have remained more closed to world trade and FDI, and have changed their laws, regulations and institutions more slowly and without harmonizing them with those of the European Union.[6] Unlike earlier studies,

[3] See e.g., Caves (1974) for one of the first papers in this literature; Terrell and Svejnar, 1989 for evidence in Senegal; Aitken and Harrison, 1999 for evidence in Venezuela; and Djankov *et al*., 2002 for evidence in transition economies.
[4] See Roland (2000) for a theoretical analysis and overview of privatization in transition.
[5] See Ericson (1991) for a description of an intact Soviet model. Many other transition economies do not represent equally clear-cut shifts of regime. Hungary and Poland for instance introduced important reforms already under communism and hence operated with less tight central planning, significant private ownership and FDI.
[6] For example, in 1997 the Business Environment and Enterprise Performance Survey carried out by the World Bank and the EBRD (1999, 2002) found that 40.1% of the sample in the Czech Republic, as compared to only 20.8% in Russia believed that the legal system would uphold contract and property rights.

we have data for a relatively long period (nine years) after the start of the reforms and can hence explore issues and perform tests that could not be carried out in other studies.

We use the efficiency of foreign-owned firms in each country as the benchmark for the world standard. This choice reflects the finding by Helpman, Melitz and Yeaple (2004) that it is the most efficient firms in advanced economies that engage in FDI. By the mid-1990s foreign-owned firms were well established in all the major sectors of the two economies and it is therefore plausible that the best ones were operating at the norm.[7] Moreover, using the performance of foreign-owned firms in each country as a proxy for the world efficiency standard is superior to using the performance of firms operating in advanced market economies since the latter approach is plagued by problems related to different institutions and shocks in the advanced vs. transition economies, as well as by problems related to carrying out comparisons in the presence of wide exchange rate fluctuations and other cross-country conversion issues.

The performance of domestic firms in emerging markets may lag behind that of foreign firms for a number of reasons, including lower efficiency in generating output from inputs, inability to charge high prices due to lower product quality or inferior marketing, fewer intangible assets, higher cost of capital, more frequent location in highly competitive industries, more inefficient vertical integration, and smaller extent of outsourcing. In order to capture as many of these factors as possible, we focus on revenues of the firm as our dependent variable. In particular, we examine the evolution in efficiency with which firms with different ownership generate revenues from inputs. Our approach thus allows for domestic firms to be catching up over time on account of any of the aforementioned factors. Since transition is a dynamic process, we do not presume that firms are in a technical or economic steady state, but rather that they are trying to improve their performance by discovering new methods of production, importing technologies, launching new products, learning new managerial and marketing techniques, and establishing their brand names.[8]

[7] If the best foreign-owned firms were below the frontier, then we would underestimate the gap that domestic firms need to cover to catch up. Since we find a lack of catch-up *vis a vis* the foreign-owned firms, our results would be even stronger if the frontier were higher.

[8] While providing some evidence related to reallocation of resources across firms (e.g., acquisitions), we do not examine this topic in the present paper.

Our findings are based on comprehensive panel data drawn from the Registries of Industrial Enterprises of the Russian and Czech Statistical Offices. Whereas most studies of firm performance in transition economies have been hampered by small data sets with observations concentrated immediately before and after privatization, our samples approach the populations of large and medium-sized industrial enterprises and cover the period of 1985-2000. Aside from Brown, Earle and Telegdy (2006), no other study uses such comprehensive data on manufacturing firms with as many annual observations as we do. Unlike Brown et al. (2006), we include data on new firms rather than using only firms that existed under communism, examine the nature of the gap and convergence, analyze how the gap and convergence are affected by competition, probability of foreign acquisition, new firm creation, and other industry-specific effects, and use instrumental variables (IVs) in estimation. We analyze the period 1992-2000 after mass privatization took off in both countries, and we exploit the earlier data in constructing a special set of IVs.

We first estimate the average effects of the four different types of ownership (foreign, domestic private, state, and mixed) on revenue efficiency during the entire 1992-2000 period and check the robustness of our results with several estimation methods. We next estimate the efficiency effects of ownership over three sub-periods characterizing the early (1992-94), middle (1995-97) and mature (1998-2000) transition.[9] Our findings for the 1992-2000 period are sobering: while the average efficiency effect of foreign ownership relative to SOE is strongly positive in both countries, the effect of domestic private and mixed ownership compared to SOE is only about 8-10% in the Czech Republic and it is negative (about 11% in our preferred specification) in Russia. This suggests that privatization to domestic owners did not have a major efficiency-enhancing effect during the first post-privatization decade. Moreover, the estimates for the three periods show that the three types of domestic firms are not catching up to the world standard given by the efficiency of the foreign-owned firms. In the Czech Republic the gap between these three types of domestic

[9]In these three sub-periods market institutions increasingly take hold and different shocks occur. In Russia problems such as the overvalued ruble, lack of enterprise restructuring and non-payment of liabilities diminished by 1998, but the country experienced a financial crisis in August of that year. (Interestingly, the effects of this crisis were relatively short as the value of the ruble stabilized and GDP growth resumed within two quarters.) The 1998-2000 period in Russia is hence already one of relatively mature transition. In the Czech Republic, mass privatization, price liberalization and macro stabilization were completed by 1995. A recession set in 1996-1997 but the 1998-2000 period was one of renewed economic growth and mature reforms as the country was preparing for entry into EU.

firms and the world standard is smaller than in Russia and it ceases to increase after 1997, whereas in Russia the domestic firms continue to fall behind even after 1997, albeit slightly. While in both countries the relationship between state, private and mixed firms remains similar throughout the distribution of efficiency and over time, the gap between the best foreign and best domestic firms is much larger than the gap between the worst foreign and worst domestic firms. Neither the more nor the less efficient domestic firms reduced their distance to the frontier over the 1992-2000 period.

We next explore to what extent these findings are driven by differences in the starting positions of foreign and domestic firms or by differences in their learning over time. In other words, are domestic firms not catching up because they consistently enter at a lower level of efficiency or because they increase their efficiency more slowly than foreign firms over time? We find that foreign startups are more efficient than domestic ones, which in turn are more efficient than existing domestic firms. We also show that foreign firms tend to acquire more efficient domestic firms, although the economic effect of this statistically significant result is limited. With respect to learning, we show that on average domestic firms improve their efficiency more slowly than foreign firms. These results are buttressed by our estimates of conditional (β) convergence within ownership-specific distributions of efficiency. We show that in both countries foreign owned firms converge to a higher steady state level of efficiency than the three types of domestic firms and that in Russia the foreign firms are also converging faster than the domestic ones.

The paper is organized as follows. In Section 2 we present our estimation strategy, data, and findings on the evolution of efficiency by ownership. In Section 3 we examine the key factors that may explain the patterns found in Section 2. We draw conclusions in Section 4.

2. Evolution of Efficiency by Ownership

In this section, we establish the key stylized facts. First, we estimate the average efficiency with which firms of different ownership types generate revenue from inputs over the 1992-2000 period. Second, we investigate how the gap in efficiency has changed over time at the mean and at various points in the ownership-specific efficiency distributions.

We carry out our estimations with annual panel data on nearly the entire population of large- and medium-sized industrial firms in the Czech Republic and Russia for the 1992-2000 period. The data are based on the reports from all medium and large industrial (manufacturing, mining and utility) firms submitted to the Russian Statistical Office and the Czech Statistical Office. As seen in appendix Table A1, we restrict our sample to firms in the industrial sector with 100 or more employees in at least one year because the data on smaller firms are not fully representative. Our estimates are based on data for 1,537 to 2,970 firms a year in the Czech Republic and 15,035 to 19,209 firms in a year in Russia. In the Czech Republic, employment in these firms covers between 86% and 100% of total employment in firms with more than 100 employees. The Russian sample represents between 70% and 94% of total employment outside the legally defined small firms.

We have carefully examined the data, removed inconsistencies in variable definitions and measurement units, and standardized as much as possible the classification of industry and ownership across the two countries. For example, we have made the industry categories comparable between the two countries by recoding the 5-digit OKONKh Russian Classification of Industries and the 2-digit NACE Czech Industry Classification into 2-digit ISIC codes. The definitions of the variables are provided in appendix Table A2 and discussed further below. We have also improved the panel nature of the data by using information from previous years and from other registries to find firms that changed their identification number. In particular, in the early 1990s firms that changed their legal status could also change their identification number. We matched these firms to their parent firms by using previous year's information on name, address, and values of variables.

2.1. The Average Gaps for 1992-2000

Our principal results are derived from an overall translog revenue function, which in our data statistically dominates more restrictive functional forms:

$$\ln y_{it} = \beta_0 + \sum_k \beta_k \ln x_{ikt} + \frac{1}{2} \sum_k \sum_l \gamma_{kl} \ln x_{ikt} \ln x_{ilt} + \rho Z_{it} + \delta I_{it} + \varsigma T_t + v_i + \varepsilon_{it} \quad (1)$$

where y_{it} represents the revenue of firm i in period t, x_{ikt} is a vector of k inputs, Z_{it} is a vector of ownership categories, I's and T's denote sets of dummy variables for industries and years, respectively, v_i are unobserved time-invariant firm-specific effects, and ε_{it} is an independently distributed error term. The specification allows efficiency to vary across types of ownership, industries, and time.[10] We also carry out estimations at the level of individual two- and three-digit ISIC industries to capture in-depth variations in technology, extent of competition and the effects of ownership across different industries.

As mentioned earlier, we use revenue as our main dependent variable in order to capture the change in firm performance in a number of dimensions, including improved productive efficiency and ability to charge higher prices on account of marketing and improved product and brand development. In order to control for time-varying differences in revenue across industries, we deflate each firm's revenue by a two-digit industry-specific producer price index.

We use two inputs: capital and labor. For capital, we use the average nominal value of fixed assets for a given year, with annual time dummy variables serving as a capital goods deflator. The labor variable is the average number of full-time equivalent workers. Ideally, we would like to include material inputs as a regressor, but we do not have information on this variable in Russia. In the Czech Republic, however, where the data permit us to estimate equation (1) with material inputs (as well as a value added regression without material inputs), we find that our results are not affected by the exclusion of material inputs.[11]

We use four categories of firm ownership: private (domestically owned), state, mixed, and foreign. In Russia, the categories are based on 100% ownership, except for foreign ownership, where firms with any foreign ownership are classified as foreign. In the Czech Republic, ownership

[10] As we discuss in appendix Table A2, we also include several dummy variables to control for potential outliers and major events.

[11] The lack of difference in the estimates in the Czech data probably stems from the fact that material inputs tend to vary proportionately to labor or capital and in a fixed way across industries.

categories, including foreign, are based on majority ownership. Hence, in the Czech Republic the category of mixed ownership includes firms in which no single type of owners has more than a 50% stake, while in Russia, the mixed category includes firms with no foreign ownership and no single type of domestic owner with 100% ownership. Mixed ownership in Russia therefore includes firms with much more concentrated ownership than in the Czech Republic. Moreover, in the Czech Republic firms classified as foreign are majority foreign-owned, while in Russia they may have only a small foreign ownership stake. Finally, unlike in Russia, in the Czech Republic firms with mixed ownership may (and often do) have significant minority ownership by foreign investors.

As may be seen from Table 1, in terms of number of firms, employment and output, both countries display a pattern of declining state and rising private ownership during the 1990s. They differ in the relative share of firms with foreign ownership, which is much smaller in Russia despite the more inclusive definition of this category. For example, the Russian share of foreign firms in 2000 is about one-fifth of the share in the Czech Republic. In both countries the average foreign firm is larger in terms of both employment and output than the average domestic firm. Note, however, that in the mid 1990s foreign firms in Russia included relatively small firms, so that the foreign share in the number of firms exceeded the foreign share in employment and output.[12]

As with any estimation, endogeneity of regressors is an important issue. The complication in our case is that the common problem of input endogeneity is entwined with the potential correlation between ownership types and the unobserved firm-specific efficiency. Rewrite equation (1) in a vector form as:

$$\ln y_{it} = X_{it}\beta + Z_{it}\rho + v_i + \varepsilon_{it}, \qquad (2)$$

where X is a vector of inputs and dummy variables for industry and years, Z is a vector of categories of ownership, and $E(v_i) = E(\varepsilon_{it}) = E(v_i\varepsilon_{it}) = E(\varepsilon_{it}\varepsilon_{is}) = 0$ for $\forall\ t > s$. Unobserved firm-specific

[12] Our data do not permit us to distinguish foreign firms that are subsidiaries of multinational corporations from those that are not.

productivity could determine the ownership type by influencing the governments' decisions to privatize or investors' decisions to acquire the firm. Moreover, potential new owners may respond to past productivity shocks. Thus, ownership enters equation (2) as a "predetermined variable" that may be correlated with past shocks (ε_{is}) and with firm-specific unobservables (v_i) but not with present errors -- $E(Z_{it}\varepsilon_{is}) \neq 0$ for $\forall \ t > s$, $E(Z_{it}v_i) \neq 0$, and $E(Z_{it}\varepsilon_{it}) = 0$.

Under these conditions, the OLS and random effects (RE) estimators may be biased and inconsistent. The fixed effects (FE) and first difference (FD) estimators allow for the correlation of Z_{it} with v_i but aggravate the measurement error by increasing the noise-to-true signal ratio (e.g., Griliches and Hausman, 1986), thus often leading to zero ownership effects.[13] In addition, the first differencing equation makes ownership endogenous as $E(Z_{it}\varepsilon_{i-1}) \neq 0$ leads to $E(Z_{it}\text{-}Z_{it-1}, \ \varepsilon_{it}\text{-}\varepsilon_{it-1}) \neq 0$. We therefore treat the FE and FD estimates with caution.

To address the endogeneity of inputs, several treatment methods have been proposed, including the Blundell-Bond (2000) system GMM estimator (henceforth BB), the Olley-Pakes (1996) investment proxy estimator, and the Levinsohn-Petrin (2003) intermediate input proxy estimator. There are no such methods to treat the problem of endogeneity in ownership. Largely because of the lack of valid instruments for ownership, the common practice in the privatization literature has been to use OLS, RE or FE estimators.[14] Our data allow us to go further in treating the potential endogeneity of ownership since we can exploit the fact that we have information on the firms' supervisory ministries under central planning. The individual ministries were historically in charge of specific SOEs and had in their jurisdictions firms of various sizes (revenue levels). Most ministries were in charge of specific firms for decades. The individual ministries were also key in determining the timing, extent and nature of privatization. The ministries were independent of one another and in Russia there were over a hundred of them (thirty seven for our industrial firm sample) operating at the federal, regional and municipal levels of government. Given their

[13] The measurement error problem is especially severe for variables with little variation over time. Since we have a significant number of firms for which we do not observe ownership changes (65.6% of firms in the Czech Republic and 46.1% in Russia) and only few firms where we observe ownership changing more than once during 1992-2000 (8.5% in the Czech Republic and 13.4% in Russia), it is preferable not to rely on the FE or FD estimates. With limited observed changes in ownership, a small amount of measurement error in ownership classification may create a high noise to signal ratio. RE estimates use within and cross sectional information and are hence less affected by this problem.
[14] See Hanousek et al. (2007) for an exception.

independence and different regional jurisdictions, their privatization decisions were quite idiosyncratic -- e.g., the federal ones were more likely to be motivated by maximizing the revenues from privatization and the local ones by generating employment. With the regime change in the early 1990s, the ministries lost control over the firms in their jurisdiction and were no longer informed about their performance. In particular, they were no longer able to give binding orders, transfer resources and obtain detailed information about the performance of the firms in the rapidly changing environment.[15]

We use information on the supervisory ministries in two approaches for treating endogeneity of ownership. In the 2SLS-RE estimator, we use ministry categories and one-year lagged X's and Z's to estimate a binary (probit) ownership model for each ownership type:

$$\mathrm{P}\left(Z_t^j = 1 \mid X_{t-1}, Z_{t-1,} M\right) = G_j\left(X_{t-1}, Z_{t-1,} M\right), \tag{3}$$

where j denotes the ownership type and M a vector of ministry categories. We use the fitted probabilities from the probit, $\hat{G}_{ij}$, as instruments for ownership categories and the model is hence exactly identified. The F-test values of the ministry dummy variables in the first stage equation are all well above 100, indicating that they are very good predictors of the ownership categories.[16] The predicted probabilities have useful properties as instruments for binary endogenous variables – the IV estimator is asymptotically efficient, the fitted probabilities stay within the [0,1] range, and the first stage equation need not be correctly specified (e.g., Wooldridge, 2002). Since new firms do not have a supervisory ministry from the communist era, we assign them a special "ministry" dummy variable that reflects the common licensing and other conditions that they have to fulfill to start business.

Our second approach is to treat ownership as a predetermined variable in a static BB estimation. The inputs and ownership variables are instrumented with lags of their own levels in a FD specification, and with lags of their own first differences in a levels specification. The

[15] The correlations between industry dummies in the $\boldsymbol{X_{it}}$ vector of regressors and the ministry dummies identifying the effect of ownership variables are low. In Russia, for instance, firms in the same industry reported to different ministries at the federal, regional, and municipal levels.

[16] The F test values for Russia (Czech Republic) are 4,778 (229) for foreign firms, 5,211 (1,470) for domestic private firms, 965 (124) for firms with mixed ownership, and 4,778 (2,244) for SOEs.

ministries under central planning are included as instruments for all endogenous variables. We find the Hausman test rejects OLS in favor of the IV estimates in BB.

Finally, at a more informal level we have checked that ministries that would be expected to be associated with particular types of ownership changes indeed are more likely to be associated with them than others. We find that shifts from state to foreign ownership are more likely to be observed in ministries dealing with firms (e.g., ministries of industries) than those dealing with strategic institutions (e.g., ministries of foreign affairs or interior).

The estimates of average efficiency effects by ownership for the Czech Republic and Russia during 1992-2000 are reported in Table 2.[17] The ownership coefficients are for private, mixed and foreign firms relative to the SOEs, the base.[18] In order to assess the robustness of our results, we report coefficients from the OLS, QREG, RE, FE, 2SLS-RE, and BB estimations. All six methods yield the same pattern of key results:

First, firms with foreign ownership are found to be significantly more efficient than the SOEs, with the differential being greater in Russia than in the Czech Republic. The true efficiency differences are likely to be above the fixed effects estimates, which are most affected by the measurement-error-driven attenuation bias. For the reasons outlined above, we believe the 2SLS-RE estimates to be the best, which yields an average foreign-SOE efficiency premium for the 1992-2000 period of 34.9 log points (41.7%) in the Czech Republic and 62.9 log points (87.6%) in Russia. These estimates are somewhat higher than those obtained by Brown et al. (2006).

Second, firms with foreign ownership are on average much more efficient than both domestic private firms and firms with mixed ownership. The differences in coefficients are statistically significant at 1% test level.

Third, within each country firms with private and mixed ownership generate similar efficiency coefficients in most estimates. In the Czech Republic, these two types of firms are found

[17] The complete sets of translog coefficients are available upon request. The ownership effects do not change substantially when we constrain the translog production function to have constant returns to scale or use more restrictive functional forms such as Cobb Douglas.

[18] Note from Table 1 that the number of SOEs decreases over time but remains sufficiently large for SOE to be usable as the base. This permits us to avoid switching the base over time and forcing the reader to reinterpret the results accordingly. Using the SOEs as a base is also appealing conceptually since state ownership constitutes the original category from which most firms evolved and to which one naturally wants to compare the alternatives.

to be approximately 10% more efficient than the SOEs, while in Russia the pooled OLS, QREG, and BB estimates suggest that these firms are somewhat more efficient than the SOEs, but the RE, FE, and 2SLS-RE coefficients point to the contrary.

We have performed a number of additional robustness tests. First, we test whether the results are sensitive to the exclusion of material inputs. We re-estimate equation (1) with the Czech data using value added as the dependent variable. The results, reported in the second panel of Table 2, show that there is very little change in the coefficients on ownership in all the specifications with two exceptions: the FE estimates for mixed and the BB estimates for mixed and private firms. The results for the Czech Republic are also very similar when we estimate the revenue equation with materials included as a regressor. All estimates continue to indicate that the gap in efficiency between the foreign and the three types of domestic firms is large in the Czech Republic and the efficiency of domestic private firms is on average only about 10% greater than that of SOEs.

The data for the Czech Republic also enable us to test whether using the Levinsohn-Petrin (2003) method to control for endogeneity of inputs changes our results. We find that the coefficients on the ownership variables (standard errors in parentheses) come close to those of the BB estimates: 0.319 (0.017) for foreign firms, 0.110 (0.014) for mixed firms, and 0.115 (0.013) for private firms, with SOEs as the base. We therefore expect that the BB estimates for Russia provide similar values to those that we would find there if we could use the Levinsohn-Petrin method.

The data for Russia (but not the Czech Republic) in turn permit us to check the sensitivity of our findings to different levels of aggregation of industry. We find that the estimated coefficients on ownership from the specification including four digit ISIC dummies to control for heterogeneity across industries are similar to those using two digit ISIC dummies.[19] Hence, controlling for heterogeneity at the two versus four digit ISIC level does not appear to affect our findings.

To the extent that small firms behave differently from large firms, the unweighted regressions in Table 2 give excessive weight to small companies. For instance, large foreign firms could more likely be subsidiaries of multinationals and as a result could be more efficient than small foreign firms. We have therefore also re-estimated the regressions in Table 2 with all observations

[19] The results are available from authors upon request.

weighted by employment. The coefficients are similar to, but smaller in magnitude than, those in Table 2 for all but the BB estimates, which become insignificant or switch signs. However, the instability of BB estimates (due in part to linear dependency of the moments) has been recognized in other studies (see Gorodnichenko, 2005). Overall, the weighted regression results suggest that the differentials in efficiency exist for firms of all sizes, but are greater among the smaller firms.

Finally, one may ask whether the finding of the relatively high efficiency of foreign-owned firms is being driven by industries where there is a higher share of foreign firms or where there may be less competition. As we show in Tables A3 (for the Czech Republic) and A4 (for Russia), this is not the case. We present the coefficients on foreign, mixed and private ownership estimated at the two-digit (three-digit) ISIC level for industries in which there are at least 10 (40) foreign-firm observations for the Czech Republic (Russia).[20] The tables also contain the number of foreign and total firm observations and the Herfindahl index for each industry. Finally, the industries are ranked by the size of the foreign coefficient so as to make it easier to see that the effect of foreign ownership is not a function of share of foreign firms or degree of competition in the industry.[21]

2.2. Changes in the Gaps over Time

Having established the average differences in efficiency during 1992-2000, we next ask to what extent the gap between the foreign and domestically owned firms is closing over time -- i.e., are domestic firms catching up to the world standard? In order to answer this question, we estimate the revenue function separately for 1992-94, 1995-97 and 1998-2000, allowing the efficiency effects of different types of ownership to change over the three periods. In addition, we compare domestic and foreign firms at corresponding percentiles of their respective efficiency distributions in order to assess how the best and worst firms in each ownership category compare with each other. We define the best (worst) firms as those in the upper (lower) quartile or decile of the distribution of efficiency in their specific ownership type.

[20] In order conserve space, we selected industries with some foreign presence; these industries represent about 90% of all the industries in each data set. We are not able to go beyond the two-digit level classification in the Czech Republic and since we want to show as much detail as possible, we disaggregate to the three-digit level in Russia.

[21] The detailed industry-specific information provided in these tables permits one to examine the industries for any other potential factors that might be driving the foreign-owned coefficient, such as the likelihood of the industry being export-oriented or regulated. None of these other factors appears to be driving the results.

We carry out two estimations comparing firms with different types of ownership at various points of the efficiency distribution. First, we estimate a series of quantile regressions of the form

$$Q_\theta[\ln y_{it} \mid X_{it}, Z_{it}] = X_{it}\beta_\theta + Z_{it}\rho_\theta, \quad (4)$$

where Q_θ is the θ^{th} quantile of ln y_{it} conditional on the covariates X and Z. The estimated coefficients ρ_θ give the relative efficiency of firms with different ownership at the θ^{th} quantile. The quantile approach provides a flexible estimation of all coefficients at different levels of efficiency.

A potential drawback of the quantile estimates is that they do not control for firm-specific unobserved heterogeneity. As a result, we also use the panel estimates of equation (2) and for each firm i we calculate efficiency as $\varphi_i = \rho + \nu_i$ for each ownership type, with E(φ_i) = ρ and E(ν_i) = 0. The idiosyncratic errors (ε_{it}) are excluded from the measure of firm-specific efficiency in order to reduce the effect of transitory productivity shocks and statistical noise. To allow for the variation in efficiency over time, the coefficients are estimated for each three-year panel.

The two approaches permit us to compare the efficiency of firms with different types of ownership at all points of the efficiency distribution, but they differ in their underlying constraints: the panel framework allows productive efficiency to vary across firms but constrains the production function coefficients to be identical for all firms, while the quantile approach constrains productive efficiency to be the same for all firms in a given percentile of the distribution but permits the production function coefficients to vary across percentiles.

The results of the RE, 2SLS-RE and quantile regressions for each sub-period are reported in Tables 3 and 4 for the Czech Republic and Russia, respectively.[22] The results of the quantile regressions are also depicted in Figure 1. They yield the following insights:

i) Foreign firms are considerably more efficient than all three types of domestic firms at virtually all levels of the distribution of relative efficiency – from the best to the worst.[23] At the same time, the differences in the distributions of efficiency of the three types of domestic firms are

[22] The OLS estimates are very similar to the quantile regression estimates and are hence not reported to conserve space.
[23] The exception is the foreign-mixed efficiency differential which is insignificant in the bottom decile in Russia and the bottom half of the distribution in the Czech Republic at the start of the transition (1992-94) and also in the bottom decile in the Czech Republic in mature transition (1998-2000). In this context, it must be remembered that in the Czech Republic firms with mixed ownership include foreign firms with less than 50% ownership stake.

relatively small, with mixed and private firms being 0-25% more efficient than state-owned firms at nearly every point of the distribution and in each of the three periods.

ii) The gap between the efficiency of the foreign firms and all three types of domestic firms is greatest among the more efficient firms (75^{th} and 90^{th} percentiles) and smallest among the least efficient ones (10^{th} and 25^{th} percentiles). An exception is the foreign-state efficiency gap in the Czech Republic during 1998-2000, when the relative efficiency of the worst (remaining) Czech SOEs actually drops and the foreign-state difference in efficiency becomes the greatest in the bottom decile (61.5 log points).[24] The fact that these inefficient SOEs did not go out of business is consistent with the finding of Lizal and Svejnar (2002) that bank lending for investment pointed to important signs of soft budget constraints (bailouts) among the large and medium size Czech firms in the 1990s. The large efficiency differentials that we find in Russia between firms with foreign ownership and all other firms are likely also signs of the presence of soft budget constraints.

iii) Compared to the Czech Republic, the gap between the foreign and domestic firms in Russia is much larger and increases more rapidly from the worst to the best firms. For example, in the first period in Russia the foreign-private domestic difference in efficiency (last column) ranges from -5.9 log points in 10^{th} decile to 97.6 in the 90^{th} decile, while in the Czech Republic the corresponding log point differentials are 16.8 and 31.8.

iv) Using the estimates from Tables 3 and 4, we present in Table A5 the changes over time of the efficiency gap between foreign and domestic firms. In Russia the gap grows at virtually all points of the distribution from early to mid transition, and the growth continues to be positive though smaller in mid to late transition. In the Czech Republic, there is not a significant change in the foreign-domestic gap for mixed and private firms over time, but the foreign-state gap grows at the bottom of the distribution in the presence of the soft budgets of SOEs discussed above.

The corresponding panel results, which take into account firm heterogeneity, are depicted in appendix Figure A1. The figure is constructed on the basis of the RE estimates of φ_i, but the FE and 2SLS-RE estimates are highly correlated and do not alter our conclusions. We order firms in

[24] The fact that in mature transition the remaining least efficient Czech SOEs were considerably less efficient than the other types of firms supports the Gupta, Ham, and Svejnar (2000) models and empirical findings that better firms were privatized first.

each ownership category by φ_i and compare efficiency across ownership categories relative to the SOEs. The patterns in relative efficiency obtained by the RE panel and quantile estimations are very similar: the gap between the foreign and domestic firms is larger in Russia than in the Czech Republic and it is greater among the more than the less efficient firms in all three periods.

In sum, we have carried out several tests of whether domestic firms approach the efficiency of foreign firms during the first decade of the transition. Our findings suggest that the answer is a no in both countries, irrespective of whether we compare the central tendency or counterpart firms at various parts of their respective efficiency distributions. The average results overstate the gap at the bottom of the distribution and understate it at the top. The gap grows in the first half of the transition in both countries, but much faster in Russia. Between the second and third period the gap continues to grow (but more slowly) in Russia in all except the most efficient firms, while it stabilizes or shrinks for all firms except the least efficient SOEs in the Czech Republic. Foreign firms are also increasingly displacing local firms in the top deciles of the efficiency distribution.[25]

3. Factors Affecting Evolution of Efficiency Gap

Why the efficiency gap between foreign and domestic firms is not closing over time and why it is larger in Russia than in the Czech Republic? With respect to the former, we focus on whether the gap results from initial differences between foreign and domestic firms or from differences in the evolutions of their efficiency (learning) over time. We also ask if the gap is due in part to better domestic firms being acquired by foreign investors. Finally, with an eye to policy implications, we briefly explore the nature of differences in the gaps between the two countries.

3.1. Startups

We start by using a nonparametric approach to comparing the efficiency levels of entering firms by ownership type. We use firm-specific estimates of efficiency calculated from standardized

[25] In Russia in 1992-1994, the few foreign firms (1.4% of all firms) are disproportionately represented in the highest decile of the efficiency distribution (4.6%). Over time as the share of foreign firms in the economy rises to 3.3% and 4.9% in 1995-1997 and 1998-2000, respectively, their share in the top decile of the efficiency distribution rises even faster, to 14.3% and 21.8% in these respective time periods. In the Czech Republic one observes a more marked penetration of foreign owned firms and growing representation in the top decile of the efficiency distribution. For example, in 1998-2000 foreign firms represent 25.3% of all firms but 51.5% of firms in the top decile.

residuals of the translog function estimated separately for each year during the 1992-2000 period.[26] Based on its individual efficiency measure, each startup firm is categorized by whether it enters in the bottom, middle or top third of the overall distribution of efficiency in each year. In both countries foreign firms turn out to have a higher (0.5) probability of entering in the top third of the distribution than any type of domestic firms (whose probability is 0.3). The only exception is in the Czech Republic, where firms with mixed ownership, containing firms with significant foreign ownership, have a similarly high probability of entering at the top third of the distribution.

Our first parametric test consists of augmenting equation (1) with interaction terms between ownership dummy variables and a variable "startup," which is coded one in the first year of a firm's existence and zero otherwise. The coefficient on interaction terms gives the average efficiency of startups relative to existing firms in the same ownership category over the 1992-2000 period. Our second test consists of adding to this specification the interaction of the startup by ownership type with calendar time. The coefficients on these terms indicate whether the relative efficiency of startups of different ownership types changes over time. In Table 5 we present the RE and QREG estimates.[27] With respect to our first test, we show that in both countries the newly created foreign firms are less efficient than existing foreign firms. However, by adding the ownership specific startup coefficients to the corresponding base ownership coefficients, we find that with the exception of Czech startups with mixed ownership (which often have foreign investors), foreign owned startups are more efficient than domestic startups. Moreover, except for the RE estimate in Russia, domestic startups are found to be more efficient than existing domestic firms. The question that arises is whether the gap between foreign and domestic startups is closing or widening over time. The RE (but not QREG) coefficients on "Startup*Ownership*Time" indicate that in the Czech Republic the efficiency of startup firms with foreign ownership is rising faster over time than that of domestic startups, hence contributing to a widening of the overall efficiency gap among foreign and

[26] We standardize the residuals because there may be year-to-year variation in the distribution of the residuals that reflects changes in inflation, or shocks to the economy, which need to be controlled for.
[27] We are unable to estimate the 2SLS-RE specification because there are no ministries assigned to the firms that are created after 1992.

domestic firms. The opposite is true in Russia, where both RE and QREG estimates suggest that the domestic startups are gaining over the foreign startups and thus reduce the overall gap over time.

3.2. Selective Acquisitions by Foreign Firms

An alternative but complementary hypothesis about the superior performance of foreign-owned firms is that foreign investors acquire ("cream") the more productive domestic firms. This hypothesis implies that foreign investors (a) reduce the average efficiency of domestic firms by deteriorating their composition and (b) gain efficiency advantage by selective acquisition of firms rather than by special capabilities that they bring in or by superior learning and other gradual improvements in performance. A competing hypothesis, also consistent with the evidence provided earlier, is that foreign investors select less efficient firms and turn them around.

To test these hypotheses we estimate a probit model indicating whether the more or less efficient domestic firms have a greater probability of being acquired by foreign investors. In particular, we test whether the efficiency of a domestic firm in year *t*-1 affects the probability of the firm being acquired by a foreign firm in year *t*.[28] We control for the firm's ownership at *t*-1 and ownership interacted with calendar time, the logarithm of the firm's capital (to control for size), and industry, year and regional dummy variables.[29] The marginal effects from the probit, reported in Table 6, indicate that in both countries foreign investors tend to acquire the more efficient domestic firms. The effect is larger in the Czech Republic than in Russia, but its economic significance is limited in both countries. One standard deviation increase in domestic firm's efficiency leads to an increase in the mean annual probability of the firm being acquired by a foreign firm from 2.12% to 2.87% in the Czech Republic and from 0.41% to 0.45% in Russia. The results hence suggest that foreign investors "cream" but that the part of their superior performance that can be explained by selective acquisitions of local firms is limited.[30] Our estimates reject the competing hypothesis that foreign investors select less efficient firms and turn them around.

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[28] The measure of productive efficiency continues to be the annual RE firm-specific residual estimated from the translog production functions for each year, which we normalize to have zero mean and unitary standard deviation.

[29] Coefficients on more distant lags of the efficiency variable were statistically insignificant. Foreign investors hence seem to be guided by current performance.

[30] Given that SOEs are the base and the linear time trend captures the interaction of state ownership and time, the estimates in Table 6 indicate that in the Czech Republic foreign investors are more likely to acquire domestic private firms than SOEs and that the probability of acquisitions rises for all types of firms (but fastest for SOEs) over time. In

A question that also arises is whether foreign firms acquire firms in less competitive industries and the efficiency differential reflects monopoly rents. To examine this hypothesis, we enter a two-digit Herfindahl index as an additional explanatory variable to the probit equation. As may be seen from Table 6, the marginal effect of the Herfindahl index is negative in both countries and statistically significant in the Czech Republic. Foreign firms hence tend to acquire firms in more rather than less competitive industries in the Czech Republic and the acquisitions are unrelated to the competitiveness in the industry of acquisition in Russia. The greater efficiency of foreign firms hence does not appear to be attributable to acquisition-related monopoly rents.

3.3. Differential Rates of Learning and Innovation by Existing Firms

We next examine how quickly domestic and foreign firms improve their efficiency in the two emerging market economies. In general, foreign firms start their operations in emerging markets with limited local knowledge and their efficiency rises over time as they acquire this knowledge. Domestic firms in turn enter the transition with a lack of knowledge of the market economy, as well as a lack of western managerial and technical know-how. Their efficiency increases as they acquire this knowledge. The question is therefore whether foreign or domestic firms learn more rapidly. A related question is whether firms that are closer to the efficiency frontier learn more rapidly. Finally, we assess whether domestic and foreign firms converge to the same or different steady state level of efficiency and whether they do so at similar or different speed.

We start by adding to equation (1) a vector of regressors capturing the interaction of τ (the length of time since the firm has been in a given ownership) and ownership dummies. The estimates of these time varying coefficients, presented in Table 7, indicate that in both countries foreign firms are improving their efficiency at a faster rate than any of the domestic firms. In the Czech Republic the efficiency of all types of domestic firms has on average declined steadily since the new owners took ownership, while the efficiency of foreign firms has increased. In Russia, the efficiency of domestic owners may or may not have declined, depending on model specification,

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Russia, firms with mixed and private ownership have a lower base probability than a SOE of being acquired by a foreign firm, but their mean probability of being acquired by a foreign investor rises over time. Finally, in both economies, the probability of a firm being acquired rises with the size of its capital stock, indicating that foreign investors tend to acquire larger rather than smaller firms.

but the rate at which foreigners "learn" is much greater, thus contributing to the larger foreign-domestic gap observed in Russia than in the Czech Republic.

We next test the hypothesis, advanced by Aghion *et al.* (2002 and 2003) and Acemoglu, Aghion, and Zilibotti (2002 and 2003), that competition brought about by the introduction of the market system (transition) and entry of new firms encourages learning and innovative behavior of firms that are near the technological frontier, but stifles learning among those firms that lag significantly behind. According to this view, we should observe convergence toward the frontier by the more efficient firms, but divergence or outright failure on the part of the less efficient firms. In order to provide evidence on this hypothesis, we test whether more efficient firms have a higher (lower) probability than less efficient firms of moving up (down) in the overall distribution of productive efficiency in any given year. We also check if the less efficient firms are more likely to exit than the more efficient ones. To carry out these tests, in every year we assign firms to the bottom third, middle third and top third of the overall efficiency distribution on the basis of their individual estimated efficiency.[31] Within each ownership category we calculate the average annual probability that a firm in a given efficiency group moves to one of the other two efficiency groups, stays in the same group, or exits during the 1992-2000 period. These probabilities are reported in 3x4 annual transition matrices for each ownership category in Table 8, with the groups of origin being given by the row names and the groups of destination by column names.

The proximity to the frontier hypothesis is supported by the behavior of foreign firms in Russia and (somewhat less so) in the Czech Republic. It is contradicted, however, by the behavior of all types of domestic firms. As may be seen from Table 8, the probability that foreign firms in the middle efficiency group move into the top group is higher than the probability that foreign firms in the bottom efficiency group move to the middle group (32.7% vs. 18.0% in Russia and 19.9% vs. 14.6% in the Czech Republic).[32] Similarly, the probability that foreign firms in the top efficiency group move down into the middle group is smaller than the probability that they move from the

[31] The measure of efficiency is again each firm's residual from an annual translog production function that is estimated without ownership variables.

[32] The bootstrap standard errors corresponding to the transition probabilities are very small, indicating that the differences in the transition probabilities that we discuss here are statistically significant at the 1% confidence level.

middle to the bottom group (8.8% vs. 14.6% in Russia and 13.7% vs. 14.7% in the Czech Republic). In contrast, the counterpart probabilities are virtually indistinguishable within each of the three categories of domestically owned firms in Russia, and they are actually reversed in the Czech Republic. Hence, in the Czech Republic the probability of moving from the bottom to the middle group is higher than the probability of moving from the middle to the top group within each domestic ownership category (19.2% vs. 14.7% for the SOEs, 15.1% vs. 13.0% for the private firms and 17.9% vs. 11.5% for firms with mixed ownership). Similarly, the probability of moving down from the middle to the bottom group is smaller than moving from the top to the middle group within two of the three domestic ownership categories, with private firms being the exception.

The proximity to the frontier hypothesis also does not receive much support in the probabilities of exit if one ignores the exit rates of the group of the least efficient firms that are likely to have high exit rates in general and on account of various theories. Focusing on firms in the middle and top efficiency groups, it may be seen from Table 8 that in all ownership categories in both countries the probability of exit is similar for firms from the top and middle efficiency groups. In other words, the idea that firms that are further from the frontier are more likely to fail than the ones near the frontier is not supported by data for the top and middle-level efficiency firms.

The transition probabilities in Table 8 also complement our findings in Table 7 that foreign firms learn more rapidly than domestic firms. We find that in both countries foreign firms are more likely to move up in the overall efficiency distribution (especially into the top group) and stay in the top group than firms in any of the three domestic ownership categories, which in turn display similar patterns of mobility. Firms with foreign ownership are also less likely to move down in the overall distribution than the other types of firms. The differential pattern of mobility between the foreign and domestic firms is more pronounced in Russia than in the Czech Republic. For example, in Russia foreign firms in the middle efficiency group have a 33% probability of moving into the top group and a 15% probability of moving into the bottom group within a year. The corresponding probabilities in the state, mixed and private firms are 17-19% for moving to the top and 18-20% for moving to the bottom. In the Czech Republic foreign firms in the middle group have a 20% probability of moving into the top group and a 15% probability of moving into the bottom group.

Czech state, mixed and private firms face a 12-15% probability of moving from the middle to the top group and a 19-23% probability of moving into the bottom group. Our estimates hence indicate that domestic firms are improving their efficiency slower than the foreign owned firms, a finding that is consistent with the hypothesis that domestic firms are learning slower than foreign firms.

Using the 3x3 sub-matrices reflecting the bottom, middle and top efficiency states in Table 8, we also calculate the stationary probability matrices of efficiency by ownership. With bootstrap standard errors being small, we find that in both economies the stationary probability that foreign owned firms are in the top third of the overall efficiency distribution is twice as high as the corresponding probability for any of the three types of domestic firms. In the Czech Republic the stationary probability of the foreign firms being in the top group is 0.45, while the corresponding probabilities of the domestic private, mixed and state firms are 0.21, 0.22 and 0.26. In Russia, the corresponding probability values are 0.69, 0.30, 0.29, and 0.30.[33]

Our analysis does not reveal any signs of convergence of domestic firms to the frontier. The question arises as to whether this is because domestic firms converge to a lower (steady state) level of efficiency than the foreign firms or because they converge at a slower speed. We examine this question by estimating a dynamic conditional convergence equation of the form

$$\varphi_{ip} = Z_{ip}\kappa + \varphi_{ip-1}Z_{ip}\eta + I_{ip}\delta + P\nu + u_{ip}, \qquad (6)$$

where φ_{ip} is the logarithm of the average efficiency of each firm i in each consecutive two-year period p, Z_{ip} is a vector of categories of ownership (averaged across the two years within each period p), κ proxies the steady state efficiency levels of firms with different types of ownership, η is (the negative of the log of) the speed of convergence of firms to their ownership-specific steady state efficiency level, I_{ip} is a set of industry dummy variables controlling for industry-specific (e.g., technology) factors that may affect the steady state efficiency levels of firms, and P are period dummies (e.g., Barro and Sala-i-Martin, 2004).[34] Equation (6) hence allows both the steady state efficiency levels and the speed of convergence to vary with ownership type. In order to reduce the

[33] The stationary probability matrices also indicate that foreign owned firms are much less likely to be in the bottom tier of the efficiency distribution. The respective stationary probabilities for the foreign, mixed, private and state firms are 0.26, 0.40, 0.45, and 0.38 for the Czech Republic and 0.13, 0.36, 0.36, and 0.37 in Russia.

[34] Although the two literatures do not cross-reference each other, equation (6) can be shown to be in the same class of functions as that estimated by Griffith, Redding and Simpson (2002) on British firms.

effects of short-term variations in the data, we use for each firm its estimated two-year average efficiency levels during the 1993-2000 period. We estimate equation (6) by pooled OLS as well as by using the difference between the third and second lags as an instrumental variable for the first lag of efficiency in our level equation (see Arellano and Bover, 1995).

The OLS and IV estimates of the conditional convergence model are reported in Table 9, with the SOEs again serving as the base. As may be seen from the estimates of κ in the second and third rows, all three types of domestic firms are converging to the same steady state level (except possibly for the mixed firms in the Czech Republic). On the other hand, foreign firms are converging to a 0.11 to 0.23 log point higher steady state level in the Czech Republic and a 0.34-0.40 log point higher level of efficiency in Russia. The estimated η coefficient on lagged efficiency in row four measures the speed of convergence of the SOEs (the base category), while the coefficients in rows five to seven give the difference in the speed of convergence of the other ownerships categories relative to SOEs (where the speed of convergence is given by 1– η). The estimates suggest that in the Czech Republic all four types of firms are converging to their respective steady states at the same speed. In Russia, foreign firms converge at a faster speed than the three types of domestic firms, which are converging at the same speed.

3.4. Institutions, Level of Development or Business Culture?

Our estimations also permit us to contribute to an ongoing debate about what generates success in economic development. A broad school of thought emphasizes the role of institutions and the legal system. The Acemoglu *et al.* (2002 and 2003) and Aghion *et al.* (2002 and 2003) literature in turn stresses the importance of the achieved level of development (distance of a country from the frontier) -- a hypothesis that is also present in the literature on the spillover effects of foreign direct investment (e.g., Aitken and Harison, 1999, Griffith, Redding and Simpson, 2002, and Sabirianova, Svejnar and Terrell, 2005). Finally, the business leaders and analysts tend to emphasize the importance of modern business culture, know-how and global networking.

In identifying a smaller domestic-foreign efficiency gap and a more successful relative performance over time in the Czech Republic than in Russia, our data permit us to provide evidence with respect to the above hypotheses. In particular, we can go some way toward distinguishing

whether the different findings for Russia and the Czech Republic are brought about by differences in (a) the institutional/legal structure, (b) the level of economic development, and (c) the market/business culture stemming from the physical proximity to a western market economy. In order to do so, we focus on the Moscow and St. Petersburg regions of Russia. The Moscow region resembles the Czech Republic in that it is economically much more advanced (closer to the frontier) than the other Russian regions. The St. Petersburg region resembles the Czech Republic in that it borders on a western market economy and, like the Czech Republic, is often viewed to have more of a western business culture. The Moscow and St. Petersburg regions could hence be expected to generate similar results to those for the Czech Republic on account of the level of development and business culture, respectively. Yet, the two regions share with the rest of Russia the legal and institutional environment, as well as the more closed nature of the Russian economy.

To assess which effect dominates, we carry out the estimations reported in Table 2 on data from firms located in the Moscow and St. Petersburg regions and check whether the estimated coefficients resemble more those from the Czech Republic or Russia as a whole. We find that the parameter estimates for both Moscow and St. Petersburg are similar to those for Russia as a whole rather than those for the Czech Republic. This suggests that policies and institutional environment rather than the level of development or geographic proximity to western business culture determine the relative performance of foreign and domestic firms in the emerging market economies.

4. Conclusions

The Czech Republic and Russia represent important alternative models of transition and implementation of the market-oriented policies: the Central and East European (CEE) model and the Commonwealth of Independent States (CIS) model, respectively. The two models differ markedly in the degree to which they have opened their markets to competition from trade and foreign direct investment and the extent to which they have developed market-oriented institutions and legal system. They hence provide alternative laboratories for testing the effects of the market-oriented development policies on efficiency of firms. We use large firm-level data sets from these two countries to examine whether market liberalization during 1992-2000 enabled local firms to

converge in efficiency to the world standard, defined as the efficiency of foreign owned firms in these economies. In doing so, we provide micro-econometric foundations for the debate about the effects of globalization, privatization and foreign direct investment (FDI) on development.

The CEE and CIS countries carried out large scale privatizations on the presumption that this would increase the efficiency of firms and speed up economic development. In both sets of economies, observers and analysts have pointed to success stories as well as evidence of mis-management and looting of firms. The Russian and Czech privatization schemes fit into the large scale privatization pattern, with the Russian scheme providing assets to insiders and the Czech one to outsiders. Our estimates suggest that in the Czech Republic the efficiency of firms with domestic private and mixed ownership is quite similar and only slightly (about 10%) higher than that of the state-owned enterprises (SOEs). Depending on the estimation method, in Russia the efficiency of the domestic private and mixed ownership can be slightly higher or lower than that of SOEs. These results suggest that a principal justification for carrying out privatizations to domestic owners has not been borne out by performance during the first post-privatization decade.

FDI has been viewed as a vehicle for development – operating through the higher efficiency of the multinationals and the positive "spillover" effects of foreign firms on domestic firms' efficiency. We find that foreign owned firms are far more efficient than domestic firms in both countries and that the gap between domestic and foreign firms is not closing – it has remained the same in the Czech Republic and has grown in Russia. One factor contributing to this gap is that foreign-owned startups tend to be more efficient than domestic startups. We also show that foreign investors tend to acquire more efficient domestic firms, although the magnitude of this effect is limited. Finally, we find that foreign owned firms are improving their efficiency faster than domestic firms and are converging to a higher level of efficiency. It may be argued that we are observing the short term effects of FDI, as described in the Monge-Naranjo (2002) model. While this may be the case, our results cover an entire decade and thus provide sobering evidence on how quickly one may expect policies to start having the positive expected effect on development.

A recent literature is hypothesizing that the market-oriented development policies are more effective in increasing growth/efficiency in countries/firms that are closer to the technological

frontier, but that the policies are too overwhelming and may even cause failure in the less efficient countries/firms. Our study provides evidence related to this hypothesis at both the firm and country levels. At the firm level we find the hypothesis to be supported by the behavior of foreign owned firms but not by the three types of domestic firms. At the country level, we find that the foreign-domestic efficiency gap is much larger in Russia than the Czech Republic and that it is increasing in Russia while remaining relatively stable in the Czech Republic over the 1992-2000 period. This supports the hypothesis since the Czech Republic is closer to the "frontier" than Russia in terms of its initial efficiency. By comparing the Moscow and St. Petersburg regions to the Czech Republic, we provide evidence suggesting that it is the greater institutional/legal development and liberalization, rather than level of economic development or proximity to western business culture, that account for the different patterns observed in the Czech Republic and Russia.

Both the CEE and CIS countries continue to face the development challenge of how to bring their firms to the world efficiency standard. The CEE economies are meeting this challenge by rapidly increasing the shares of their GDP and exports accounted for by foreign firms – an option that is not readily open to all developing countries and that raises the question of whether foreign capital is too foot-lose to constitute a reliable basis for long term economic development.[35] In contrast, the Russian-style CIS economies are not standing up well to the challenge, which will become increasingly acute as globalization proceeds and the countries become more open. Our results indicate that future research needs to examine carefully the differential effect that development policies, FDI and globalization have on the performance of local versus foreign-owned firms.

[35] Studies by Fabbri, Haskel and Slaughter (2003), Bernard and Jensen (2002) and Bernard and Sjoholm (2003) suggest that controlling for firm size and productivity multinational firms are more likely to close their plants than domestic firms. An evaluation of the welfare effects of foreign ownership hence needs to examine other factors in addition to whether domestic firms that are being displaced by foreign firms are the poorly or well performing ones.

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Table 1: Percentage Share of Industrial Firms, Employment and Output by Ownership Type, for Selected Years

	Czech Republic			Russia		
	1992	1996	2000	1993	1996	2000
Firm Shares						
Foreign	3.5	12.6	30.7	1.8	3.5	5.6
Mixed	0.7	21.0	12.9	32.6	42.7	28.2
Private (domestic)	18.4	57.4	54.1	16.7	38.3	51.3
State	77.4	9.0	2.4	48.9	15.6	15.0
Employment Shares						
Foreign	2.6	12.1	33.7	0.7	1.9	11.5
Mixed	0.1	42.6	25.9	38.0	56.2	35.2
Private (domestic)	10.2	36.7	37.6	9.0	28.0	44.5
State	87.0	8.6	2.9	52.3	13.8	8.8
Output Shares						
Foreign	7.7	21.4	51.1	2.3	3.0	19.6
Mixed	0.1	40.8	22.3	45.5	68.6	33.3
Private (domestic)	7.6	30.6	24.9	6.8	19.5	41.7
State	84.6	7.2	1.7	45.4	8.9	5.4
No. of observations	1537	2283	2084	17923	17138	15035

Notes: In the Czech Republic the ownership category is based on majority ownership while in Russia, it is based on 100% ownership, except for foreign ownership, which can be partial. The sample consists of firms with non-missing values for industry, ownership, output, fixed assets, and employment.

Table 2: Average Effects of Ownership on Efficiency, 1992-2000

Czech Republic

Dependent Variable = Revenue

	OLS	QREG	RE	FE	2SLS-RE	BB
Foreign	0.435**	0.413**	0.319**	0.275**	0.349**	0.657**
	(0.019)	(0.021)	(0.017)	(0.019)	(0.024)	(0.037)
Mixed	0.122**	0.086**	0.110**	0.094**	0.097**	0.074*
	(0.019)	(0.022)	(0.014)	(0.015)	(0.020)	(0.031)
Private	0.145**	0.122**	0.115**	0.117**	0.075**	0.053*
	(0.015)	(0.016)	(0.013)	(0.014)	(0.017)	(0.027)
No. of obs.	19,971	19,971	19,971	19,971	15,142	19,971
No. of firms	4,657	4,657	4,657	4,657	3,781	4,657
R^2	0.754	0.526	0.741	0.656	0.754	…

Dependent Variable = Value Added

	OLS	QREG	RE	FE	2SLS-RE	BB
Foreign	0.429**	0.379**	0.318**	0.174**	0.448**	0.167**
	(0.019)	(0.015)	(0.021)	(0.026)	(0.028)	(0.045)
Mixed	0.067**	0.060**	0.023	-0.015	0.089**	-0.046
	(0.020)	(0.016)	(0.018)	(0.020)	(0.028)	(0.039)
Private	0.163**	0.133**	0.101**	0.039*	0.136**	0.043
	(0.015)	(0.012)	(0.015)	(0.019)	(0.021)	(0.033)
No. of obs.	18,128	18,128	18,128	18,128	13,261	9,536
No. of firms	4,604	4,604	4,604	4,604	3,618	2,698
R^2	0.732	0.542	0.726	0.666	0.735	….

Russia

Dependent Variable = Revenue

	OLS	QREG	RE	FE	2SLS-RE	BB
Foreign	0.994**	0.885**	0.398**	0.176**	0.629**	0.771**
	(0.021)	(0.015)	(0.019)	(0.022)	(0.029)	(0.049)
Mixed	0.124**	0.159**	-0.020**	-0.050**	-0.110**	0.081**
	(0.008)	(0.007)	(0.007)	(0.007)	(0.018)	(0.016)
Private	0.163**	0.174**	-0.019*	-0.060**	-0.114**	0.140**
	(0.008)	(0.008)	(0.008)	(0.009)	(0.018)	(0.017)
No. of obs.	153,402	153,402	153,402	153,402	140,658	153,402
No. of firms	26,286	26,286	26,286	26,286	24,595	26,286
R^2	0.680	0.482	0.670	0.594	0.688	…

Notes: Coefficients = estimated log effects of different types of ownership relative to state ownership. Standard errors are in parentheses (robust in OLS); * significant at 5%; ** significant at 1%. The estimates are obtained from the translog production function specified in equation (1) and which includes industry dummies, year dummies, and controls for data anomalies. τ is the time since the change in the corresponding ownership status. QREG – median regression, RE – random effects estimator, FE – fixed effects estimator, 2SLS-RE – two stage least squares random effect estimator, and BB – Blundell-Bond system GMM estimator (first four lags of levels and differences in inputs and ownership are used as instruments for differences and levels, respectively). Both 2SLS-RE and BB estimators use exogenous information on ministries under central planning as instruments for endogenous variables.

Table 3: Estimates of Ownership Effects by Sub-Periods, the Czech Republic

Specification	Foreign-State (1)	Mixed-State (2)	Private-State (3)	Foreign-Mixed (4)=(1)-(2)	Foreign-Private (5)=(1)-(3)
			1992-1994		
RE	0.246**	0.137*	0.057*	0.109	0.189**
	(0.044)	(0.057)	(0.026)	(0.072)	(0.051)
2SLS-RE	0.331**	0.283*	0.054	0.048	0.277**
	(0.054)	(0.113)	(0.031)	(0.125)	(0.062)
Quantile:					
10	0.187**	0.162	0.019	0.025	0.168**
	(0.057)	(0.090)	(0.035)	(0.101)	(0.056)
50	0.285**	0.156*	0.042	0.129	0.243**
	(0.042)	(0.066)	(0.025)	(0.074)	(0.040)
90	0.389**	0.155	0.072	0.235*	0.318**
	(0.067)	(0.104)	(0.038)	(0.116)	(0.064)
			1995-1997		
RE	0.195**	0.015	0.027	0.180**	0.168**
	(0.025)	(0.016)	(0.016)	(0.030)	(0.030)
2SLS-RE	0.266**	0.065*	-0.008	0.201**	0.274**
	(0.042)	(0.031)	(0.025)	(0.052)	(0.049)
Quantile:					
10	0.347**	0.121**	0.141**	0.225**	0.206**
	(0.038)	(0.037)	(0.031)	(0.038)	(0.033)
50	0.432**	0.063	0.146**	0.369**	0.286**
	(0.033)	(0.032)	(0.026)	(0.034)	(0.027)
90	0.470**	0.041	0.101**	0.429**	0.370**
	(0.051)	(0.050)	(0.039)	(0.053)	(0.042)
			1998-2000		
RE	0.218**	0.019	0.040	0.199**	0.178**
	(0.045)	(0.043)	(0.045)	(0.062)	(0.064)
2SLS-RE	0.301**	-0.008	0.031	0.309**	0.270**
	(0.070)	(0.072)	(0.068)	(0.100)	(0.098)
Quantile:					
10	0.615**	0.551**	0.439**	0.065	0.177
	(0.065)	(0.069)	(0.062)	(0.040)	(0.031)
50	0.449**	0.115*	0.163**	0.334**	0.287**
	(0.046)	(0.048)	(0.045)	(0.028)	(0.020)
90	0.448**	0.000	0.127	0.447**	0.320**
	(0.075)	(0.079)	(0.072)	(0.044)	(0.034)

Notes: Standard errors are in parentheses; * significant at 5%; ** significant at 1%. The estimates in columns 1-3 are obtained from random effects (RE), two stage least squares random effects (2SLS-RE) and quantile regressions of sales revenue on capital and labor inputs (translog specification), industry dummies, year dummies, and controls for data anomalies (see text). The omitted (base) ownership category is state ownership.

Table 4: Estimates of Ownership Effects by Sub-Periods, Russia

Specification	Foreign-State (1)	Mixed-State (2)	Private-State (3)	Foreign-Mixed (4)=(1)-(2)	Foreign-Private (5)=(1)-(3)
			1992-1994		
RE	0.373**	-0.016*	0.005	0.389**	0.368**
	(0.043)	(0.008)	(0.009)	(0.044)	(0.044)
2SLS-RE	0.772**	0.046	0.011	0.726**	0.761**
	(0.077)	(0.093)	(0.058)	(0.121)	(0.096)
Quantile:					
10	0.134*	0.213**	0.193**	-0.078	-0.059
	(0.054)	(0.016)	(0.019)	(0.054)	(0.055)
50	0.455**	0.136**	0.109**	0.319**	0.346**
	(0.036)	(0.011)	(0.013)	(0.036)	(0.037)
90	1.040**	0.059**	0.064**	0.981**	0.976**
	(0.052)	(0.017)	(0.019)	(0.052)	(0.053)
			1995-1997		
RE	0.626**	0.116**	0.116**	0.510**	0.51**
	(0.033)	(0.014)	(0.015)	(0.036)	(0.036)
2SLS-RE	0.985**	0.153**	0.165**	0.832**	0.820**
	(0.049)	(0.031)	(0.031)	(0.058)	(0.058)
Quantile:					
10	0.517**	0.169**	0.230**	0.348**	0.287**
	(0.047)	(0.024)	(0.024)	(0.044)	(0.045)
50	0.850**	0.161**	0.186**	0.689**	0.664**
	(0.025)	(0.012)	(0.013)	(0.024)	(0.024)
90	1.388**	0.138**	0.130**	1.250**	1.258**
	(0.032)	(0.017)	(0.017)	(0.030)	(0.031)
			1998-2000		
RE	0.666**	0.135**	0.203**	0.531**	0.463**
	(0.033)	(0.022)	(0.022)	(0.040)	(0.040)
2SLS-RE	1.223**	0.076*	0.173**	1.147**	1.050**
	(0.054)	(0.032)	(0.029)	(0.063)	(0.061)
Quantile:					
10	0.617**	0.075*	0.163**	0.543**	0.454**
	(0.050)	(0.032)	(0.031)	(0.045)	(0.045)
50	0.980**	0.162**	0.208**	0.817**	0.772**
	(0.026)	(0.016)	(0.016)	(0.024)	(0.024)
90	1.356**	0.188**	0.248**	1.168**	1.108**
	(0.034)	(0.021)	(0.020)	(0.030)	(0.030)

Notes: Standard errors are in parentheses; * significant at 5%; ** significant at 1%. The estimates in columns 1-3 are obtained from random effects (RE), two stage least squares random effects (2SLS-RE) and quantile regressions of sales revenue on capital and labor inputs (translog specification), industry dummies, year dummies, and controls for data anomalies (see text). The omitted (base) ownership category is state ownership.

Table 5: Relative Efficiency of Startups by Ownership Type, 1992-2000

	Czech Republic		Russia		Czech Republic		Russia	
	RE	QREG	RE	QREG	RE	QREG	RE	QREG
Foreign	0.316**	0.406**	0.411**	0.894**	0.315**	0.419**	0.417**	0.904**
	(0.018)	(0.022)	(0.020)	(0.016)	(0.018)	(0.021)	(0.020)	(0.017)
Mixed	0.097**	0.053*	-0.027**	0.143**	0.099**	0.067**	-0.024**	0.148**
	(0.015)	(0.023)	(0.007)	(0.007)	(0.015)	(0.022)	(0.007)	(0.008)
Private	0.100**	0.100**	-0.024**	0.159**	0.101**	0.110**	-0.021**	0.166**
	(0.014)	(0.018)	(0.008)	(0.008)	(0.014)	(0.017)	(0.008)	(0.008)
S_{For}(=Startup*Foreign)	-0.057**	0.075*	-0.182**	-0.224**	-0.047*	0.059	-0.213**	-0.279**
	(0.022)	(0.030)	(0.025)	(0.016)	(0.022)	(0.036)	(0.014)	(0.021)
S_{Mix}(=Startup*Mixed)	0.100**	0.012	-0.039*	-0.135**	-0.124**	-0.109	-0.144**	-0.211**
	(0.038)	(0.040)	(0.015)	(0.037)	(0.036)	(0.062)	(0.043)	(0.064)
S_{Pri} (=Startup*Private)	0.039**	0.419**	0.016	0.080**	0.130	0.183	-0.114**	-0.127**
	(0.012)	(0.071)	(0.014)	(0.020)	(0.067)	(0.117)	(0.029)	(0.041)
S_{Sta}(=Startup*State)	-0.024	0.111**	-0.177**	0.066**	0.047*	0.065*	-0.084**	-0.067
	(0.016)	(0.022)	(0.011)	(0.018)	(0.019)	(0.033)	(0.030)	(0.040)
S_{For}(=Startup*Foreign)*year					0.025	-0.002	0.024**	0.047**
					(0.013)	(0.022)	(0.006)	(0.008)
S_{Mix}(=Startup*Mixed)*year					-0.010	0.063*	0.022**	0.054**
					(0.017)	(0.028)	(0.007)	(0.009)
S_{Pri} (=Startup*Private)*year					-0.005	0.013	0.024**	0.031**
					(0.005)	(0.008)	(0.006)	(0.008)
S_{Sta}(=Startup*State) *year					0.021*	0.040**	-0.014	0.019
					(0.009)	(0.014)	(0.012)	(0.016)
No. of obs.	19,971	19,971	153,402	153,402	19,971	19,971	153,402	153,402
No. of firms	4,657	4,657	26,286	26,286	4,657	4,657	26,286	26,286
R^2	0.742		0.670		0.755		0.681	
P-values:								
Foreign+ S_{For} = Private+S_{Pri}	0.000	0.000	0.000	0.000				
Foreign+ S_{For} = Mixed+S_{Mix}	0.170	0.219	0.000	0.000				
Foreign+ S_{For} = 0	0.000	0.000	0.000	0.000				
Private + S_{Pri} = Mixed+S_{Mix}	0.145	0.000	0.005	0.282				
Private + S_{Pri} = 0	0.000	0.000	0.611	0.000				
Mixed + S_{Mix} = 0	0.000	0.000	0.000	0.000				

Notes: Standard errors are in parentheses (robust in OLS); * significant at 5%; ** significant at 1%. The omitted category is state ownership. The estimates are obtained from the translog function, given by equation (1), which included industry dummies, year dummies, and controls for data anomalies. Startup=1 if firm is a startup at time *t*. RE – random effects estimator.

Table 6: Marginal Effect of Domestic Firm Efficiency and Industry Competition on the Probability of Acquisition by Foreign Investors, 1993-2000

	Czech Republic		Russia	
	d*F*/d*X*	d*F*/d*X*	d*F*/d*X*	d*F*/d*X*
E_{t-1} (Efficiency)	0.750**	0.734**	0.047**	0.039**
	(0.087)	(0.096)	(0.010)	(0.009)
$Mixed_{t-1}$	1.634	0.936	-0.193**	-0.205**
	(1.872)	(1.794)	(0.047)	(0.069)
$Private_{t-1}$	2.030**	1.512**	-0.114*	-0.125
	(0.509)	(0.575)	(0.052)	(0.069)
$Mixed_{t-1}$* Time	-0.297	-0.122	0.080**	0.079**
	(0.177)	(0.211)	(0.013)	(0.017)
$Private_{t-1}$* Time	-0.351**	-0.175	0.058**	0.058**
	(0.113)	(0.138)	(0.013)	(0.018)
Time	0.606**	0.335	-0.004	-0.008
	(0.097)	(0.125)	(0.010)	(0.006)
lnK_{t-1}	0.548**	0.537	0.085**	0.014
	(0.060)	(0.068)	(0.006)	(0.026)
Herfindahl Index $_{t-1}$	--	-0.049**	--	-0.008
		(0.009)		(0.006)
No. of obs.	14,424		122,182	
Pseudo R^2	0.111	0.157	0.146	0.168
Unconditional probability (%)	2.121		0.407	

Notes: The reported marginal effects (multiplied by 100) are obtained from probit estimates. The dependent variable is a dummy indicating whether a formerly domestic firm is acquired by foreign investors. Standard errors (multiplied by 100) are in parentheses; * significant at 5%; ** significant at 1%. The omitted category is state ownership lagged one year. The firm-specific measure of efficiency (E) is obtained from the standardized residuals of the translog function estimated for each year separately, with industry dummies and controls for data anomalies included. Time is calendar time, starting with 1 in 1993. Regional dummies (for Russia) and industry dummies are included in the probit estimates but not shown here.

Table 7: Time-Varying Effects of Ownership on Efficiency, 1992-2000

Czech Republic

	QREG	RE	2SLS-RE
Foreign	0.280**	0.149**	0.208**
	(0.031)	(0.025)	(0.046)
Mixed	0.002	0.009	0.003
	(0.037)	(0.023)	(0.063)
Private	0.142**	0.089**	0.103**
	(0.023)	(0.018)	(0.029)
τ * Foreign	0.006	0.018**	0.033**
	(0.007)	(0.005)	(0.005)
τ * Mixed	-0.013	-0.003	0.020*
	(0.010)	(0.006)	(0.010)
τ * Private	-0.038**	-0.031**	-0.012*
	(0.004)	(0.004)	(0.005)
τ * State	-0.017**	-0.016**	-0.001
	(0.004)	(0.004)	(0.006)
No. of obs.	19,971	19,971	15,142
No. of firms	4,657	4,657	3,781
R^2	0.528	0.744	0.754

Russia

	QREG	RE	2SLS-RE
Foreign	0.616**	0.296**	0.465**
	(0.029)	(0.025)	(0.132)
Mixed	0.373**	0.134**	-0.012
	(0.014)	(0.012)	(0.144)
Private	0.383**	0.124**	0.006
	(0.014)	(0.014)	(0.122)
τ * Foreign	0.152**	0.080**	0.060**
	(0.007)	(0.005)	(0.007)
τ * Mixed	-0.016**	-0.023**	-0.014**
	(0.003)	(0.002)	(0.005)
τ * Private	-0.013**	-0.022**	-0.019**
	(0.002)	(0.002)	(0.003)
τ * State	0.021**	0.014**	0.002
	(0.001)	(0.001)	(0.011)
No. of obs.	153,402	153,402	140,658
No. of firms	26,286	26,286	24,595
R^2	0.484	0.672	0.689

Notes: Coefficients = estimated log joint effects of different types of ownership relative to state ownership. Standard errors are in parentheses (robust in OLS); * significant at 5%; ** significant at 1%. The estimates are obtained from the translog function specified in equation (1) and which includes industry dummies, year dummies, and controls for data anomalies. τ is the time since the change in the corresponding ownership status. QREG – median regression, RE – random effects estimator, 2SLS-RE – two stage least squares random effect estimator. The 2SLS-RE estimator uses exogenous information on ministries under central planning as instruments for endogenous variables.

Table 8: Average Annual Transition Probabilities of Existing Firm Moving Across Efficiency Groups by Ownership Type, 1992-2000

Czech Republic					Russia				
Foreign									
	Bottom	Middle	Top	Exit		Bottom	Middle	Top	Exit
Bottom	0.782	0.146	0.049	0.023	Bottom	0.504	0.180	0.132	0.185
Middle	0.147	0.648	0.199	0.006	Middle	0.146	0.449	0.327	0.079
Top	0.018	0.137	0.833	0.012	Top	0.028	0.088	0.823	0.062
Mixed									
	Bottom	Middle	Top	Exit		Bottom	Middle	Top	Exit
Bottom	0.782	0.179	0.021	0.018	Bottom	0.694	0.163	0.022	0.121
Middle	0.191	0.685	0.115	0.010	Middle	0.180	0.596	0.168	0.056
Top	0.025	0.233	0.735	0.007	Top	0.036	0.187	0.718	0.059
Private									
	Bottom	Middle	Top	Exit		Bottom	Middle	Top	Exit
Bottom	0.801	0.151	0.018	0.031	Bottom	0.659	0.167	0.023	0.152
Middle	0.223	0.625	0.130	0.022	Middle	0.182	0.578	0.166	0.074
Top	0.019	0.199	0.755	0.027	Top	0.037	0.192	0.695	0.076
State									
	Bottom	Middle	Top	Exit		Bottom	Middle	Top	Exit
Bottom	0.679	0.192	0.056	0.073	Bottom	0.708	0.177	0.020	0.095
Middle	0.233	0.572	0.147	0.048	Middle	0.198	0.562	0.188	0.052
Top	0.042	0.247	0.662	0.050	Top	0.035	0.199	0.711	0.055

Notes: The average annual probabilities are based on a firm-specific measure of efficiency (E) obtained from the standardized residuals of the translog function estimated for each year separately (1992-2000), with industry dummies and controls for data anomalies included. Based on its individual E measure, a firm is then categorized each year by where it falls in the distribution of E's: bottom, middle or top third. All transition probabilities are statistically significant at 5% level (using bootstrapped standard errors), except for a middle-to-exit flow of foreign firms and a top-to-exit flow of firms with mixed ownership in the Czech Republic.

Table 9: Parameters of Conditional (β) Convergence by Firm Ownership

	Czech Republic		Russia	
	OLS	IV	OLS	IV
Ownership=Foreign	0.106***	0.226***	0.340***	0.397***
	(0.020)	(0.083)	(0.030)	(0.118)
Ownership=Mixed	0.013	0.143*	-0.006	-0.023
	(0.021)	(0.076)	(0.008)	(0.014)
Ownership=Private	0.004	0.098	0.003	-0.006
	(0.016)	(0.074)	(0.007)	(0.014)
$Efficiency_{P-1}$	0.869***	0.604*	0.862***	0.983***
	(0.033)	(0.365)	(0.015)	(0.060)
$Efficiency_{P-1}$*Foreign	0.017	0.222	-0.084***	-0.287*
	(0.037)	(0.361)	(0.028)	(0.163)
$Efficiency_{P-1}$*Mixed	-0.091	0.159	0.018	-0.074
	(0.062)	(0.364)	(0.019)	(0.059)
$Efficiency_{P-1}$*Private	0.028	0.298	0.024	-0.042
	(0.035)	(0.371)	(0.018)	(0.062)
No. of obs.	7344	1952	65208	24226
R^2	0.696	0.748	0.598	0.631

Notes: Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is firm specific (random effect) efficiency estimated on the 2-year panels. Industry and period dummies are included. The omitted category is state ownership. The difference between the third and second lags of the efficiency level is used as an instrument following Arellano and Bover (1995).

Figure 1: Quantile Estimates of Relative Ownership Effects on Efficiency by Period

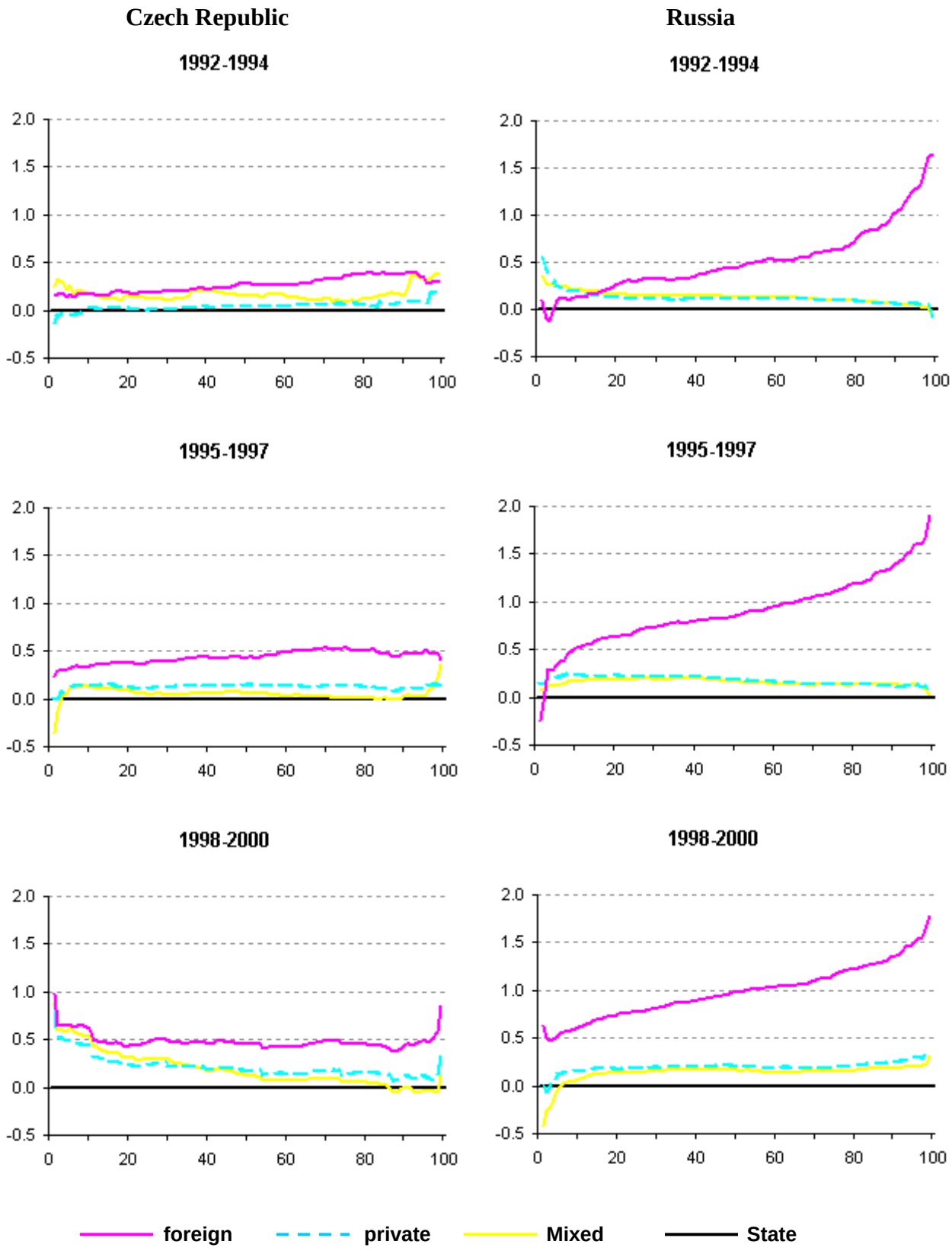

Table A1: Construction of the Sample of Firms, 1992-2000

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Czech Sample									
Initial number of firms[1]	2416	3559	4379	2385	2357	9136	22949	22201	19282
Small firms[2]	454	939	1364	19	16	4791	16688	13294	12064
Non-industrial firms[3]	0	0	0	2	0	0	2634	4721	3260
Firms with missing observations[4]	425	470	45	47	58	2159	1447	1922	1874
Final sample (no. of firms)	1537	2159	2970	2317	2283	2186	2180	2264	2084
Russian Sample									
Initial number of firms[1]	25824	25633	27983	29053	28607	28601	29139	29153	29252
Small firms[2]	7739	6769	7785	8213	8989	9250	10689	10938	11343
Non-industrial firms[3]	872	514	754	970	891	895	963	945	940
Firms with missing observations[4]	580	427	629	661	1589	1768	1404	1392	1934
Final sample (no. of firms)	16633	17923	18815	19209	17138	16688	16083	15878	15035

Notes:

[1] The annual number of firms for the Czech Republic in 1992 and for the entire Russian sample for 1985-2000 are constructed from the total number of firms at the end of the year, whereas in the Czech 1993-2000 sample they are constructed from quarterly observations. Source: Czech Statistical Office and Goskomstat.

[2] Firms with less than 100 employees in all years or which have missing values for number employed in all years.

[3] Firms with a non-industrial or unidentified ISIC classification in all years; 5-digit industry codes (OKONKh) for Russian firms were reclassified into new 2-digit ISIC categories.

[4] Missing values and inconsistencies in other key variables: ownership, output and fixed assets.

Table A2: Description of Variables

Variable	Czech Data	Russian Data
Revenue	1992: Value of production in current prices of enterprises; 1993-2000 Revenue from own production and services plus change in inventory (without taxes);	Volume of production in current prices of enterprises (without taxes)
Capital	1992: equity 1993-2000: tangible and intangible assets	Average value of fixed productive assets used in industrial production in a given year.
Labor	Average number of fulltime-equivalent employees, adjusted on the basis of an eight hour day.	Average number of industrial employees in a given year -- an adjustment is made for contracted part-time workers. All others are considered as one.
Ownership	Available for 1991-2000. Defined as more than 50% ownership: 1. Private - includes private local firms, individuals, cooperatives, and NGOs; 2. State - includes federal and municipal ownership; 3. Mixed - combination of any types of ownership with no one category having 50%; 4. Foreign	Available for 1993-2000. Defined as 100% ownership: 1. Private - includes private local firms, cooperatives, and NGOs; 2. State - includes federal, regional and municipal ownership; 3. Mixed - combination of any domestic types of ownership 4. Foreign -- including partial ownership
Startup	=1 when a firm appears in the registry for the first time	=1 when a firm appears in the registry for the first time
Industry - Old Classification	3-digit old industry codes are recoded into 2-digit ISIC	5-digit OKONH (Russian Classification of Industries of the National Economy) is recoded into 2-digit ISIC
Industry - New Classification	2-digit NACE (some years up to 6-digit) is recoded into 2-digit ISIC	5-digit OKONH is recoded into 2-digit ISIC
Ministry	Available for 1990-1993. 4-digit ministry codes are recoded into 8 ministry categories	Available for 1985-1995. 4-digit ministry codes are recoded into 37 ministry categories

We also use several variables to control for other features of our data and major events. We have for instance included dummy variables for outlier observations of a change in capital stock relative to corresponding changes in output or in employment. .For Russia, we have also included two additional variables: i) an interaction term between a dummy for year 1992 and state ownership and ii) an interaction term between a dummy for year 1992 and the log of capital. The former variable is added because ownership information is not available in 1992 and like others we assume state ownership for all firms in this year, given that large-scale privatization in Russia started only at the end of 1992. The latter variable is included in Russia because 1992 was the first year of high inflation and the end-year capital re-valuation began only in 1993.

Table A3: OLS coefficients on Ownership and Herfindahl Index (HHI) by 2-Digit ISIC: Czech Republic

Industry	ISIC	N		HHI	Foreign		Mixed		Private	
		Foreign	Total		Coef	SE.	Coef	SE.	Coef	SE.
Recycling	37	14	125	1431	0.020	0.566	-0.187	0.326	0.687	0.246
Manufacture of textiles	17	154	1188	214	0.087	0.076	-0.062	0.067	-0.029	0.052
Manufacture of electrical machinery and apparatus	31	309	1012	293	0.158	0.085	-0.028	0.106	0.042	0.089
Manufacture of other non-metallic mineral products	26	246	1247	277	0.166	0.053	0.013	0.053	0.113	0.043
Manufacture of chemicals and chemical products	24	95	561	687	0.195	0.094	-0.002	0.096	0.076	0.074
Manufacture of medical.precision and optical instruments. watches and clocks	33	81	469	528	0.202	0.122	-0.160	0.123	-0.071	0.111
Manufacture of wearing apparel; dressing and dyeing of fur	18	114	607	946	0.226	0.093	0.255	0.090	-0.001	0.073
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	19	52	460	729	0.352	0.128	0.283	0.146	0.233	0.086
Manufacture of other transport equipment	35	27	411	634	0.361	0.097	0.101	0.095	0.150	0.079
Manufacture of machinery and equipment NEC (not elsewhere classified)	29	269	2756	117	0.408	0.043	0.130	0.034	0.128	0.029
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	20	86	599	398	0.425	0.100	0.156	0.100	0.110	0.077
Publishing. printing and reproduction of recorded media	22	95	537	359	0.427	0.095	-0.001	0.106	0.145	0.082
Manufacture of food products and beverages	15	252	2988	127	0.446	0.053	0.102	0.050	0.221	0.041
Manufacture of rubber and plastic products	25	151	615	717	0.463	0.088	0.176	0.127	0.152	0.069
Manufacture of paper and paper products	21	74	378	764	0.477	0.096	0.171	0.096	0.012	0.098
Manufacture of furniture; manufacturing NEC	36	134	1211	481	0.534	0.078	-0.034	0.065	-0.011	0.044
Electricity. gas steam and hot-water supply	40	62	634	685	0.566	0.127	0.387	0.119	0.283	0.091
Manufacture of fabricated metal products. except machinery and equipment	28	263	2043	215	0.617	0.058	0.063	0.059	0.155	0.041
Manufacture of radio, television and communication equipment and apparatus	32	71	332	850	0.630	0.179	0.330	0.143	0.234	0.132
Manufacture of motor vehicles, trailers and semi-trailers	34	171	528	3516	0.652	0.096	-0.004	0.097	0.062	0.091
Manufacture of basic metals	27	67	682	1086	0.654	0.108	0.513	0.113	0.214	0.100
Mining of uranium and thorium ores	12	40	264	548	0.891	0.363	0.950	0.329	0.828	0.313
Manufacture of office. accounting and computing machinery	30	14	44	3900	1.131	0.816	1.019	0.734	1.026	0.575
Mining of coal and lignite; extraction of peat	10	10	131	2333	1.136	0.449	0.838	0.392	0.797	0.318
Others	90	26	149	822	1.634	0.546	0.544	0.551	0.777	0.515

Table A4: OLS coefficients on Ownership and Herfindahl Index (HHI) by 3-Digit ISIC: Russia

Industry	ISIC	N		HHI	Foreign		Mixed		Private	
		Foreign	Total		Coef	SE.	Coef	SE.	Coef	SE.
Manufacture of tobacco products	160	82	261	849	-0.011	0.361	0.127	0.342	0.069	0.336
Production, transmission and distribution of electricity	401	49	3937	165	0.058	0.198	-0.656	0.104	0.272	0.082
Manufacture of motor vehicles	341	68	1313	1578	0.308	0.147	-0.026	0.090	-0.047	0.090
Manufacture of products of wood, cork, straw and plaiting materials	202	165	3348	154	0.461	0.115	-0.227	0.053	-0.140	0.054
Manufacture of beverages	155	289	4820	116	0.484	0.088	-0.012	0.035	-0.093	0.039
Manufacture of non-metallic mineral products n.e.c.	269	145	16619	40	0.504	0.109	0.000	0.020	-0.021	0.020
Mining of non-ferrous metal ores, except uranium and thorium ores	132	40	869	756	0.627	0.330	0.032	0.124	0.541	0.140
Manufacture of special-purpose machinery	292	194	8969	107	0.635	0.095	0.076	0.028	0.110	0.030
Recycling of metal waste and scrap	371	66	728	621	0.669	0.178	-0.068	0.118	-0.046	0.120
Sawmilling and planing of wood	201	626	12891	71	0.686	0.052	0.132	0.019	0.251	0.023
Manufacture of insulated wire and cable	313	45	377	668	0.750	0.294	0.056	0.240	0.311	0.217
Manufacture of general-purpose machinery	291	124	2666	172	0.750	0.117	0.102	0.057	0.128	0.061
Manufacture of basic chemicals	241	87	1175	297	0.770	0.175	0.260	0.102	0.645	0.112
Manufacture of medical appliances and instruments	331	64	1899	190	0.775	0.135	0.027	0.044	0.172	0.059
Manufacture of domestic appliances n.e.c.	293	63	1497	1499	0.819	0.144	-0.038	0.071	-0.140	0.058
Manufacture of paper and paper products	210	109	1387	420	0.821	0.143	0.177	0.095	0.117	0.093
Manufacture of basic precious and non-ferrous metals	272	77	626	1046	0.829	0.201	-0.020	0.180	0.129	0.194
Manufacture of basic iron and steel	271	65	1108	699	0.839	0.214	0.371	0.149	0.433	0.152
Growing of cereals and other crops n.e.c.	111	289	988	524	0.888	0.123	-0.106	0.112	0.137	0.164
Manufacture of plastics products	252	76	927	1590	0.910	0.202	0.291	0.121	0.224	0.127
Manufacture of furniture	361	110	3890	194	0.926	0.151	-0.003	0.047	0.116	0.047
Manufacture of structural metal products, tanks, reservoirs and steam generators	281	56	2113	964	0.952	0.184	0.150	0.077	0.182	0.076
Manufacture of footwear	192	151	2315	240	0.976	0.101	0.332	0.066	0.391	0.066
Spinning, weaving and finishing of textiles	171	28	3684	86	1.016	0.274	0.390	0.062	0.546	0.067
Manufacture of other food products	154	130	12567	59	1.048	0.147	0.000	0.017	-0.098	0.017
Manufacture of other chemical products	242	137	2488	192	1.049	0.111	0.439	0.052	0.482	0.053
Manufacture of electric motors, generators and transformers	311	43	2549	181	1.074	0.181	0.312	0.055	0.049	0.054
Manufacture of wearing apparel, except fur apparel	181	151	8483	127	1.155	0.109	0.271	0.032	0.341	0.031
Dressing and dyeing of fur; manufacture of fur	182	33	458	1526	1.167	0.314	0.885	0.219	1.022	0.215
Production, processing and preservation of meat, fish, fruit, vegetables, oils and fats	151	248	9263	98	1.224	0.088	0.291	0.040	0.316	0.040
Publishing	221	45	2262	1862	1.274	0.248	0.197	0.049	0.089	0.050

Manufacture of refined petroleum products	232	114	952	419	1.289	0.170	0.916	0.115	1.071	0.140
Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods	323	46	524	586	1.553	0.298	-0.066	0.092	0.106	0.125
Manufacture of other fabricated metal products; metalworking service activities	289	68	3369	205	1.594	0.211	0.057	0.057	0.052	0.060
Manufacture of office, accounting and computing machinery	300	40	237	1511	1.602	0.336	0.352	0.154	0.366	0.206
Manufacturing n.e.c.	369	137	2606	961	2.007	0.151	0.292	0.070	0.076	0.063

Table A5: Changes over Time in the Efficiency Gains of Foreign Firms Relative to Other Types of Ownership

Czech Republic

Percentile	Foreign-Mixed		Foreign-Private		Foreign-State	
	95/97-94/92	98/00-95/97	95/97-94/92	98/00-95/97	95/97-94/92	98/00-95/97
RE	0.071	0.019	-0.021	0.01	-0.051	0.023
	(0.078)	(0.069)	(0.059)	(0.070)	(0.051)	(0.051)
2SLS-RE	0.153	0.108	-0.003	-0.004	-0.065	0.035
	(0.136)	(0.113)	(0.079)	(0.109)	(0.068)	(0.082)
Quantile						
10	0.200*	-0.161**	0.038	-0.029	0.160**	0.269**
	(0.090)	(0.048)	(0.056)	(0.040)	(0.004)	(0.004)
50	0.240**	-0.035	0.043	0.001	0.147**	0.018**
	(0.075)	(0.042)	(0.045)	(0.032)	(0.002)	(0.003)
90	0.195)	0.018	0.052	-0.049	0.081**	-0.023**
	(0.113	(0.064)	(0.069)	(0.050)	(0.006)	(0.007)

Russia

Percentile	Foreign-Mixed		Foreign-Private		Foreign-State	
	95/97-94/92	98/00-95/97	95/97-94/92	98/00-95/97	95/97-94/92	98/00-95/97
RE	0.121**	0.021	0.142**	-0.047	0.253**	0.040
	(0.057)	(0.053)	(0.057)	(0.054)	(0.054)	(0.047)
2SLS-RE	0.106	0.315**	0.059	0.230**	0.213**	0.238**
	(0.134)	(0.085)	(0.112)	(0.084)	(0.091)	(0.073)
Quantile						
10	0.426**	0.195**	0.346**	0.167**	0.383**	0.100**
	(0.072)	(0.063)	(0.073)	(0.063)	(0.005)	(0.005)
50	0.370**	0.129**	0.318**	0.108**	0.395**	0.130**
	(0.044)	(0.034)	(0.044)	(0.034)	(0.002)	(0.001)
90	0.269**	-0.082	0.282**	-0.150**	0.348**	-0.031**
	(0.059)	(0.043)	(0.060)	(0.043)	(0.004)	(0.002)

Notes: Standard errors in parentheses are computed by the Delta method (Greene, 2003); * significant at 5%; ** significant at 1%. All coefficients are significant at 5%, except two: last column first and last rows for Russia. The estimates of the coefficients and covariance matrices are obtained from the Chow quantile regressions of output on capital and labor inputs (translog specification), ownership dummies, industry dummies, and controls for data anomalies.

Figure A1: Random Effect Estimates of Ownership Effects on Efficiency by Sub-Periods

Czech Republic **Russia**