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Do market pressures induce economic efficiency?: The case of Slovenian manufacturing, 1994-2001

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Abstract
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Keywords
market pressures, firm efficiency, total factor productivity, TFP, Slovenia

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Do Market Pressures Induce Economic Efficiency: The Case of Slovenian Manufacturing, 1994-2001

A long-held but infrequently tested proposition in economics is that competitive pressure will force firms to be efficient.[1] The transition to market in formerly planned economies offers a natural laboratory to test the competitive hypothesis. As reviewed by Boeri (2000), the consensus expectation at the outset of transition was that competitive pressures from the emerging market system would force greater productive efficiency on enterprises that remained from the old system. Furthermore, converting state-owned enterprises into profit maximizing firms was expected to create incentives to improve the efficiency of these often-underperforming sectors, either through profit motives or through the rigors of investor scrutiny (Brada, 1996). This study examines whether market competition had the expected effect on productive efficiency in Slovenia.

The early evidence from transition economies did not demonstrate immediate evidence of efficiency gains. From an initial reduction in GDP averaging 25% in Central and Eastern Europe and 50% in the former Soviet states, production recovered unexpectedly slowly. Only 2 of 25 transition countries had matched their 1989 production levels ten years later (Campos and Coricelli, 2002). Some of the slow recovery may be that competitive pressures grew slowly. For example, most countries only gradually abandoned tax and transfer policies that effectively taxed the expanding sectors to subsidize those in decline; and it took time to establish legal institutions that supported property rights and limited corruption (Boeri, 2000; Svejnar, 2002). However, some have argued that that increased competition itself may have contributed to reduced production because it disrupted the formerly well-organized trading systems linking Warsaw Pact countries (Blanchard and Kremer, 1997).

As the transition to market has progressed, a consensus is emerging that efficiency gains are forthcoming from competitive market pressures, although the magnitude of the effect is uncertain. The review by Djankov and Murrell (2002), summarizing 23 studies of the impact of increased competition on firm performance, suggested that competition raised efficiency in central and eastern Europe but not in the former Soviet Union. Similarly, their examination of 37 studies on the impacts of privatization found that it raised efficiency in Central and Eastern Europe but not in countries of the former Soviet Union. Even within regions, however, there is substantial variation in the magnitude, and even the sign of the productivity effects, so the average masks considerable variation across studies.[2]

Past studies of the impact of transition on firm efficiency have concentrated on potentially unrepresentative subsets of the firms in transition economies. As we demonstrate in this study, these subsamples can yield misleading inferences regarding efficiency gains in these economies. One common strategy is to concentrate on large, formerly state-owned enterprise that survived into the transition. The focus is natural, as these are the types of firms that existed under socialism, but this approach misses the contributions to efficiency from the entry of new, more efficient firms and from the closing or exit of the least efficient firms. McMillan and Woodruff (2002) argue that the, "success or failure of a transition economy can be traced in large part to the performance of its entrepreneurs." They concluded that the most successful transition economies were those that fostered the entry and success of new firms and not necessarily those that most aggressively privatized former state enterprises. In addition, most studies use a single cross section of data or else a short time frame, but most countries adopted competitive policies only gradually over several years. If efficiency gains were only realized over time, short panels may understate the impact of market competition on efficiency.

This study contributes to the existing knowledge regarding the impact of market forces on production efficiency by utilizing a unique data set encompassing every manufacturing firm in Slovenia over a long time span. Our data include not only continuously existing firms, but also newly formed firms and firms that cease production during the period of study. In contrast to many existing studies, we can therefore identify the impacts of firm entry and exit on productive efficiency in the transition to market. Second, we examine the progress of efficiency over a long period of time -- from 1994 through 2001. The eight year period is sufficiently long to determine whether measured efficiency gains or losses are permanent or a consequence of short-term economic shocks. And third, the paper deals with Slovenia, a country often considered a special case among transition countries, and thus it can provide interesting case findings from the comparative perspective.

Our results strongly confirm the importance of competitive pressures in raising firm total factor productivity. The efficiency gains were progressive, rising each year. They are broad based, occurring in almost all industries examined. While the largest gains were in private firms, competitive pressures at the industry level appeared to increase total factor productivity in firms under state or mixed ownership as well, suggesting that is not ownership type but competition that spurs the greatest gains in efficiency. However, firm ownership type did matter in the aggregate. Competitive pressures at the industry level due to higher market share of private firms, foreign-owned firms, and imported goods in the industry raised the productivity of all firms in the industry, whether privately owned, state owned, or foreign owned. Competitive pressures also contribute to efficiency gains by sorting out the least efficient firms, while entering firms are at least as efficient as surviving firms. This sorting effect is at least as large as the effect of competition on continuing firms in our preferred specification. These conclusions

are not sensitive to alternate specifications or controls for firm-specific factors. As a result, the role of market forces in generating economic efficiency is strongly confirmed.

I. Policies that Affect the Market Competition in Slovenia

As part of former Yugoslavia, Slovenia's economy was characterized by government rather than private ownership of assets. Although nominally under a worker managed system, there was extensive political interference in firm decisions regarding investment, employment and wages. To meet mandated payrolls, a massive system of discretionary taxes and transfers taxed away net revenue from profitable enterprises in order to subsidize failing firms that could not meet their payrolls. Inefficient firms could lose money indefinitely, while efficient firms could not build up reserves that could allow expansion.[3] Restrictions on capital mobility also restricted efficient resource allocations. Socially-owned firms were not allowed to sell their assets, nor could workers obtain a return on capital if they invested in the firm by accepting wage concessions. Consequently, there was little incentive to invest in capital. Private firms were limited to no more than 10 workers, and so also faced limits to growth.

Slovenia's transition began toward the end of 1988. After a lengthy initial contraction that lasted through 1992, unemployment reached 15.4% (Boeri and Terrell, 2002). Since then, it has declined slowly to 5.9% in 2002. Per capita GDP fell initially, but rebounded by 1995 and reached $11,000 in 2002. Accompanying the recovery was a gradual liberalization of the rules and institutions governing the economy. Reforms replaced worker management and government interventions with market institutions and individual incentives that we would expect to increase competitive forces in the economy. We briefly summarize the nature and timing of these reforms.

Policies affecting market competition

Slovenia's structural reforms addressed all vital segments of the economy, from price liberalization, the introduction of new organizational forms of enterprises, promotion of competition, privatization and restructuring of enterprises, reforms of the financial sector, liberalization of foreign trade and foreign ownership, legal ratification of property rights, and dismantling the system of guaranteed employment and centralized pay setting. The European Bank for Reconstruction and Development (EBRD) monitors progress on these various reforms. As shown in Figure 1, Slovenia's structural reforms have progressed steadily but unevenly across sectors. Liberalization of foreign trade and of prices was already well underway by 1991, as was privatization of small firms. Other reforms began later and with slower progress. The legal process for privatization of large state enterprises began in 1993, and started in earnest in 1994. About the same time, reforms of the banking system and of other financial institutions began. Compared to other transition economies, Slovenia's pace of structural reforms was slower than average. Nevertheless, by the end of the period, Slovenia's overall EBRD transition index reached the average of other countries. [4]

Ultimately, we will conclude that it is the combination of these liberalization policies that are important for increasing market pressures rather than any single policy in isolation. Nevertheless, it is useful to provide additional details on the most important avenues by which competition was encouraged. It will be particularly important that policies allow firm entry and exit. As concluded by Olley and Pakes (1996) and Bartlesman and Doms (2000), a large share of productivity growth in industrialized economies has been attributed to resource reallocation through new firm start-ups and closings

Setting up new businesses. The new Law on Enterprises (first passed in 1988) was ineffective until amended in 1993. It allowed the owners of the capital (shareholders) to control firm decisions and it freed private firms from constraints on the number of workers. It also introduced new forms of enterprises, including general and limited sole-proprietorships; limited liability partnerships (the most common form); and joint-stock companies. Previously existing organizational forms including state enterprises, cooperatives, and mixed enterprises (combinations of private, state, and cooperative ownership) were also retained.

While the above law allowed for entry of new private firms, formidable administrative barriers to entrepreneurship have remained. These barriers slowed the reaction to the new opportunities.[5] Private firms are required to register, a process that takes 1-3 months despite recent policies to shorten the process. In contrast, registration in western economies takes only few days.[6] Next, new enterprises must obtain location, construction, and business permits from the local government, a process that requires documentation of business plans, location, and staff qualifications. If land must be acquired for the business, there are additional problems caused by unresolved ownership disputes carrying over from the Socialist era and to cumbersome zoning restrictions. Acquiring a location permit requires clearances by up to 22 local and state authorities. If re-zoning is required, the process can take two years or more. The business permit requires at least 30 documents and several months to be issued. These barriers combine to slow new market entry. Nevertheless, costs related to entry procedures relative to per capita GDP in Slovenia are lower than most transition economies (Estrin, 2002). Most importantly for competition, entry can and does occur.

Privatization of state enterprise. In November 1992, Slovenia adopted the Ownership Transformation Act. The law stipulated that the assets of state enterprise be distributed among

shareholders with a distribution rule allocating 20 percent of the shares to the state;[7] 20 percent to Slovenian citizens (each citizen received an allotment of free certificates that they could exchange for shares in former state enterprises); 20 percent to enterprise employees; and the remaining 40 percent to bid. The enterprise employees could acquire these shares at a 50% discount payable over four years, so there was a built in bias favoring internal ownership. The process of transferring ownership from state to private hands was completed by 1995.

Unsurprisingly, the ownership pattern which emerged immediately upon the completion of privatization programs of individual enterprises corresponded very well to the conditions imposed by the privatization law. Based on a 1994/95 survey of 183 former state enterprises, Simoneti et al (2001) found that internal owners controlled 44 percent of the shares in these firms. Even in firms with a majority of internal owners, managers only controlled 5% of the shares so the shares were broadly distributed among the current and former firm workers and not the managers. The state retained about 30% of the shares. Privatization funds (essentially a mutual fund with a portfolio of former state owned enterprises) owned about 19 percent of the shares. Over time, these relatively diffuse ownership patterns became more concentrated. By 1999, 40 percent of initial shareholders had sold their shares, and the 5 largest owners held, on average, 62 percent of the stock. Managers and large outside investors increased their holdings, while small shareholders and the state reduced their holdings.

Djankov and Murrell (2002) report that privatized firm performance in the transition economies was particularly harmed when workers own the shares. If those results hold for Slovenia, the initial concentration of shares among workers would have hampered firm efficiency, but the later move toward more concentrated ownership among either insiders or outsiders should improve the efficiency of privatized firms.

Policies that allow firm exits

By 2000, the private sector in Slovenia represented 55% of GDP, a low proportion relative to other transition economies (Svejnar, 2002). Private firms can fail, and are more likely to exit if they are inefficient. However, in the Slovene system, state enterprises were also subject to competition and the possibility of financial failure. In contrast, many transition economies maintained formal and informal transfers that retarded both state and private sector firm failures (Estrin, 2002).[8] Bojnec and Xavier's (2004) analysis of the number of firms by industry in Slovenia suggested exit rates from manufacturing of 5% per year. That is roughly consistent with our longitudinal data on Slovenian manufacturing firms: 27% of the manufacturing firms existing in 1994 were gone by 2001.

Foreign competition. Foreign investors purchased less than 1% of the initially offered shares of Slovenian privatized firms and have only made a few acquisitions since that time. Foreign direct investment in Slovenia is low compared to other central European transition economies. Consequently, the most important source of competition from foreign firms is through imports. Slovenia already had liberalized trade restrictions before the transition began, and the Custom and Tariff Acts of 1996 reduced average tariffs to 5.7 percent.

Over time, the Slovenian product markets have become more competitive, whether from lowering barriers to entry for domestic or foreign firms, privatization, relaxation of restrictions on expansion, or import competition. As shown in Figure 1, the process occurred gradually over time. Our interest is in assessing whether there are coincident changes in measures of firm efficiency that correspond to cross-sectional or time series variation in measures of the degree of competition facing firms. Our analysis begins in 1994 when newly installed firm reporting procedures created a consistent set of accounting rules for all incorporated firms operating in

Slovenia, large or small; foreign or domestic; privately owned or state-owned; new entrant or privatized state enterprise. Before that time, accounting methods differed and reports were unreliable.

Summary of structural policy changes

The first year of our data coincides with the installation of the first wave of privatization in Slovenia. By 1994, the easiest efficiency gains from shedding of redundant labor and from bankruptcies of the worst enterprises should have occurred. The past transfer systems that subsidized inefficient firms were completely disabled by the end of 1993. The firms that remained were either private or were state enterprises that could demonstrate potential profitability to investors. Consequently, our efficiency measures are not clouded by remaining direct political and economic interference in firm decisions regarding entry, exit, and resource allocation. Instead, efficiency should reflect the ongoing process of institutional reforms.

II. Methodology

Our strategy is to trace changes in individual firm efficiency over time, using a measure of total factor productivity (TFP).[9] To derive our TFP measure empirically, we assume that the technology faced by the ith firm in the jth industry in year t is assumed to be approximated by the translog production function

$$(1) \qquad \ln q_{ijt} = \alpha_0 + \sum_{k=1}^{n} \alpha_k \ln x_{ijkt} + \frac{1}{2} \sum_{k=1}^{n} \sum_{l=1}^{n} \beta_{kl} \ln x_{ijkt} \ln x_{ijlt} + \varepsilon_{ijt}$$

where the inputs x_{ijkt} include measures of labor, capital and material inputs; α_k and β_{kl} are, respectively, first- and second-order translog production parameters; and ε_{ijt} is an error term. The error term, a variant of the Solow residual, is our measure of TFP. [10]

The total factor productivity has three components that we will explore: time varying industry-specific factors, η_{jt}; time varying firm-specific factors, ψ_{it}; and time invariant firm-specific factors, θ_i. In addition, we allow a purely random technology shock, ξ_{ijt}.[11] The formulation for the error term in (1) is written

(2) $$\varepsilon_{ijt} = \eta_{jt} + \psi_{it} + \theta_i + \xi_{ijt}$$

Our strategy is to specify the elements of the error components in a manner that will allow us to identify factors that are tied to changes in total factor productivity across firms and across time. The industry-specific component is specified as

(3) $$\eta_{jt} = I_{jt}\gamma + \iota_{jt}$$

where I_{jt} is a vector of industry attributes such as industry concentration or import penetration, γ is a parameter vector that translates industry attributes into measured TFP for firms in the industry, and ι_{jt} is a random error. Similarly, we can specify the time-varying firm-specific component as

(4) $$\psi_{it} = f_{it}\delta + \varphi_{it}$$

where f_{it} is a vector of firm attributes that change over time such as ownership structure, δ describes how these firm attributes affect TFP and φ_{it} is a random error.

The time invariant firm component is specified as

(5) $$\theta_i = F_i\mu + \upsilon_i$$

where F_i is a vector of observable firm attributes that do not change over time and υ_i is unobserved time invariant firm productivity.[12]

Equation (5) summarizes the selection issues that could bias our estimates of γ and δ. Suppose that θ_i represents a firm-specific technology component that is observable by potential

investors. Then changes in firm ownership status to private ownership or stock ownership from state ownership will be correlated with θ_i.[13]

If $\upsilon_i = 0$ for all firms, then selection into firm types is based on the observables, F_i. Attractive candidates for inclusion in the vector F_i are ultimate ownership status measures for the firms. In other words, F_i will contain dummy variables indicating whether the firm ultimately became privately owned, of mixed state and private ownership, a publicly held company, or other ownership type. The coefficients on these measures, μ, will reveal whether firms that ultimately attained ownership status F_i had atypically high or low TFP prior to any changes in their ownership. The related estimate of δ will reveal whether there was a change in TFP associated with the change in ownership status.

When $\upsilon_i = 0$ for all i, we can estimate γ, δ, and μ by inserting equations (2-5) into (1) and applying ordinary least squares to the resulting reduced form equation.[14] If υ_i in (5) is not zero but is distributed $N(0, \sigma_i)$, then selection into ownership states on the basis of expected efficiency will still be driven by the observables, F_i. All the parameters $\gamma, \delta,$ and μ can be estimated with the appropriate substitutions of equations (2-5) into (1). However, additional efficiency can be obtained by applying a random effects estimator to accommodate the firm-specific error variance, σ_i.

If $E(\upsilon_i) \neq 0$ for at least some i, then selection into ownership types will be based in part on the unobservable υ_i. The correlation between F_i and υ_i will yield biased coefficients on the γ and δ. With multiple years of data, we can use fixed-effects to estimate a separate θ_i for each firm. We will no longer be able to capture the μ, but we can derive unbiased estimates of γ and δ.

Note that under the null hypothesis that $E(\upsilon_i) = 0$ and $\upsilon_i \neq 0$, the random effects model is appropriate. In particular, υ_i will be uncorrelated with the regressors, most notably, the F_i. A Hausman specification test can be used to test the validity of the random effects specification. Rejection would support the use of the fixed effects model.

III. Data

The data for this study are based on the universe of manufacturing firms existing in Slovenia between 1994 and 2001. The primary information on firms comes from three data sources. The official financial records of the firm, submitted annually under uniform accounting procedures to the government of Slovenia, provide information on the firm's capital stock, material inputs, and revenues from domestic and foreign sales. The Slovenian Business Registry includes information on the four-digit industries that describe each firm's product line(s), the year the firm initiated production, and the firm's type and ownership structure.[15] The work history data set tells us how many employees of each education level work for each firm. These three data sets can be integrated using a common firm identification number used in all three series.[16] The variable definitions and sample means are reported in Table 1.[17]

The employment information includes the number of two- or four-year college graduates, the number of high school graduates, and the number of primary educated workers in the firm. This employment information is in real terms by construction. However, the accounting data on firm output and capital and material inputs are reported in nominal terms. We convert the nominal data into real data, using industry input and output price deflators reported for all years 1994-2001. The material input price deflator is a weighted sum of sectoral prices where the weights are sectoral input shares generated from an input–output matrix of the Slovenian economy. Output price deflators are reported for each industry. There is a single capital price

series that was applied to all firms. Using these input and output price series, we generate series for real output, capital and material inputs for each firm and for each year.[18]

The sample means reveal some preliminary stylized facts about the Slovenian transition. First, total factor productivity rose substantially between 1994 and 2001. The increases in TFP were not due to rising output per firm—in fact average real output fell per firm. However, all capital, employment and material input levels fell by a greater proportion, so firms were producing more with less.

Numerous changes suggest an increase in the competitive pressure on Slovenian manufacturing firms, from imports, foreign owners, more firms, more new firms, and more private firms that presumably will be trying to produce efficiently. There is also considerable evidence that firms fail over the period. The sample means show a dramatic increase in the number and the market share of private firms. Within individual four-digit industries, the Herfindahl index falls over time, indicating greater competition. The proportion of firms under foreign ownership does not change over time, but their market share rises. Import penetration, measured by the proportion of industry sales attributable to imports, rises by 79%. The market share of industry output attributable to new entrants (firms that initiated sales after 1993) rises from 4% to 21%. In 1994, firms that will cease operations by 2001 were responsible for 17% of industry sales.[19] All of these trends suggest rising competitive pressure on firms, but whether these changes are actually tied to increases in efficiency will be explored next.

IV. Total factor productivity growth over time and across firms

This section demonstrates that efficiency gains in Slovenia following the policy reforms were experienced in virtually all sectors of the economy. We also demonstrate that measured

TFP growth is sensitive to the inclusion or exclusion of entrants, exiters, and small firms, and that their exclusion greatly understates the efficiency gains during the transition.

We first demonstrate that the time trend in the growth of productive efficiency in Slovenia manufacturing is robust to alternative assumptions about the error process. Three specifications of the translog formulation (1) were estimated: ordinary least squares, a fixed effects variant that allows for a separate constant term for each firm, and a random effects variant that assumes a different variance for each firm. We report the average errors by year for the three variants in Table 2. The three series are highly correlated and yield the same general inference: there has been a consistent increase in total factor productivity in the 1994-2001 period. The increase in TFP per firm is substantial, varying from .222 to .244 log points, which implies a 24.9 to 27.6 percent increase in total factor productivity.[20] In other words, the average manufacturing firm in Slovenia was producing about 25% more from the same level of inputs in 2001 as in 1994. This rate of TFP growth is faster than rates reported for 13 OECD manufacturing sectors over the 1980-1988 period (Benjamin and Ferrantino, 2001). It is also faster than the annual TFP growth rates reported for the overall business sectors of those 13 OECD countries over the 1981-1995 period, and faster than 12 of the 13 over the 1996-2000 period (Gust and Marquez, 2004).[21]

Had we only included firms that were continuously in existence between 1994 and 2001, the implied TFP growth would have been markedly smaller. The implied productivity gain of 0.177 log points or 19.4% is three-fourths of the true growth of 24.9% reported in column 1. If we exclude firms with fewer than 100 employees, the productivity gains are even smaller: 0.154 log points or 16.6%. Clearly, ignoring the productivity contributions of entrants, exiters and

small firms significantly biases downward the estimated growth in firm efficiency during the transition.

While the gains in efficiency are not uniform across firms, they are nevertheless widespread across firm types and industries. In Table 3, we report TFP growth for different firm ownership structures. Because there was little substantive difference in the time paths of TFP growth using the various estimation methods, we used the TFP levels based on ordinary least squares. The first column repeats the estimates from Table 2 of the average TFP level across all firms to provide a frame of reference. The second column lists average TFP for privately owned firms while the third column lists TFP for all other firms. Firm efficiency was initially significantly lower in private firms, but TFP grew faster in private firms. Some of the growth was due to relatively efficient firms moving from the state sector to the private group, but sorting cannot explain much of the rise in TFP among private firms. First, the initial gap in efficiency is less than 0.03 log points, so the rise in efficiency is much larger than can be explained by sorting alone. Second, TFP is rising in both groups, not just the private group. If migration across firm types were the only factor, we would see decreases in TFP among the firms remaining in the non-private group as the more efficient state firms switched to the private group. One conclusion from Table 3 is that privately owned firms have more rapid TFP growth. However, a second conclusion is that TFP grows in state-owned enterprises as well, albeit more slowly. Over the full period, efficiency in privately owned firms rose 28% while it rose 18 % in non-private firms.

Foreign owned firms were slightly more efficient (.036 log points) than average in 1994. They retained that TFP advantage through the end of the period. Over the eight year period, TFP grew almost the same in foreign-owned firms as in the average manufacturing firm at about 25% growth.

Firms that entered limited liability arrangements may be private, mixed or state owned. They began the period with below average efficiency, but gained efficiency somewhat more rapidly than average. By 2001, limited liability firms were significantly more efficient than other firms, having experienced a 27.5% gain in TFP versus 24.9% for firms on average.

Mixed ownership firms began the period with a small TFP advantage, but experienced slower efficiency gains. By 2001, their TFP advantage had disappeared. Stock-owned companies also started the period with a TFP advantage, but experienced slower TFP growth. By 2001, stock-owned companies had significantly lower TFP levels than did the average manufacturing firm.

Table 4 reports TFP levels by firm size and by entry or exit status. Initially, large firms had a significant TFP advantage, but the faster TFP growth in small firms erased the gap by 1998. The implied efficiency growth was 25.6% in small firms versus 21.3% in large firms, so ignoring small firms understates efficiency growth. Firms that opened for business after 1993 maintained a 0.01 log point TFP advantage over the average firm throughout the period. The average TFP advantage of 0.03 log points for new entrants over the full period is even larger than the annual advantage of 0.01 log points. The reason is that even though TFP levels for new entrants were similar to TFP levels for older firms, there were many more new entrants by the end of the period when prevailing efficiency levels were higher. Hence the weight of the effect of new entrants is to raise efficiency.

On the other hand, firms that exited business by 2001 were significantly less efficient than the average firm. The disadvantage for firms destined to close was quite large with an average TFP gap of 17% over the eight years. Eliminating these inefficient firms had an even larger effect on productivity than did TFP growth in firms continually in business (25.7% versus

19.4%), so ignoring exiting firms biases downward the measured TFP growth in Slovenian manufacturing.

Table 5 carries the investigation of the distribution of TFP growth to the three-digit industry level. The included industries represent about two-thirds of all manufacturing firms. Industries were chosen so that they would have a sufficient number of firms to allow us to estimate the production function with some degree of precision. We estimated the Cobb-Douglas variant of (1) to conserve on degrees of freedom.[22] The results support the view that TFP growth was widespread in the Slovenian economy. Only in the Bakery industry did TFP levels fall, and in only three others did TFP rise by less than 10% (footwear, books and periodicals and printing). In all other sectors, TFP grew rapidly.

The evidence in Tables 2-5 tells a convincing story that virtually all manufacturing firms in Slovenia became more efficient as the transition progressed, regardless of sector, firm size, ownership modality or date of entry, or else they went out of business. It also shows that ignoring the role of small firms, entering firms and exiting firms can understate TFP growth by as much as one-third of the actual growth.

V. Regression analysis of the factors affecting total factor productivity

While there is widespread improvement in productive efficiency across firms, as reported in tables 2-5, the gains are not uniform. This section reviews the extent to which measures of market competition can be tied to the heterogeneity in TFP growth across firms. By embedding equation (2) into the translog specification (1), we can identify factors that are tied to atypically rapid or slow increases in total factor productivity. Our results are reported in Table 6.

To set a basis of comparison, the first specification includes only current firm attributes including whether the firm was a new entrant. The results suggest that private firms and firms

with mixed ownership are more efficient. Firms that entered after the passage of the Amended Law on Enterprises in 1993 are also more efficient, although the impact is small. Stock owned companies have marginally lower efficiency, and foreign owned firms have comparable efficiency to domestically owned firms.

Results in the first column do not control for selection into the various ownership modalities. If, for example, only the most efficient firms are privatized, then private firms may be more productive because of efficiencies that predate the private ownership. To control for this selection bias, we add the remaining constant firm attributes that include the ultimate ownership status for the firm. The coefficients on the future status variables will capture the average effect of all firms that eventually become private firms. The coefficient on the current firms attributes will then capture the change in efficiency associated with the move to the new ownership status.

The coefficients on future attributes suggest that firms that were targeted for foreign ownership were less productive than average. Conversely, firms that came under mixed ownership or limited liability arrangements were less productive than average. The impacts are small, suggesting that there is not a strong selection process driving the results. However, there is strong evidence that firms that will ultimately go out of business have significantly lower total factor productivity. The coefficient on EXIT implies that firms that are destined to close have total factor productivity that is 18% below firms destined to survive.[23]

Once the ultimate firm ownership status is controlled, the impact of current ownership status becomes smaller. Mixed ownership and private ownership are still associated with significant, albeit smaller productive effects, and foreign ownership also has a modest impact on

TFP. However, these effects may still be biased because of the correlation between firm attributes and attributes of the industry in which the firm resides.

In column 3, we add measures of the extent of competitive pressure in the industry. We find that the industry attributes are extremely important in explaining variation in firm efficiency. The Herfindahl index is based on domestic market shares with 0 indicating perfect competition and 1 indicating the firm is a monopolist. The coefficient on the Herfindahl index implies that a monopolist would be 21% less efficient than an otherwise equivalent perfectly competitive firm. Firms in industries with a higher share of foreign owned firms were significantly more efficient. Note that the foreign-owned firms themselves were not more efficient, but their presence made all firms in the industry more efficient. Private firms were more efficient, but their presence in the industry made all other firms more efficient as well. Firms destined to exit are presumably weak competitors. Firms in industries in which exiting firms have a higher output share are less efficient, even those that do not ultimately exit. Firms in industries in which entrants have a greater market share are more efficient, but the effect is small and imprecisely estimated. Finally, firms in domestic industries that have greater import penetration are modestly less efficient.

Entering firms were 2% more efficient than firms that were born before 1994. Of the future status variables, firms that ultimately exit still retained their large TFP disadvantage. Firms that ultimately became private, mixed ownership or limited liability firms had significant TFP advantage. Upon attaining their new status, private firms raise TFP by 6%, stock owned companies lose 4%, mixed ownership firms gain 3%, and limited liability firms lose 3%.

The specification in column 3 presumes that selection into ownership types is based solely on observable attributes so that $\upsilon_i = 0$ in equation (5). If $\upsilon_i \neq 0$, but $E(\upsilon_i) = 0$ for all i, selection will still depend only on observables but a random-effects estimator will provide added

efficiency. Results from that specification are reported in column 4. The test for nonzero variance of the υ_i favored the random-effects estimator over the least squares estimate of column 3. Nevertheless, the results are similar to those in column 3 with the exception that current firm attributes generally lose significance while firm constant attributes gain strength.

Estimates of μ in column 4 suggest that new entrants were 3% more efficient than firms that opened before 1993. Firms destined to exit were 16% less efficient than firms that survived through 2001.[24] Firms that ended the period as private firms, limited liability partnerships or under mixed ownership were more efficient, suggesting that selection into these ownership types were based on observable firm productive attributes. However, the opposite holds for firms bought by foreign owners or that became privatized through the issuance of stock. Taken as a whole, the joint significance of the μ in column 4 suggests nonrandom selection into ownership types. However, the Hausman test suggests that unobservable (to the econometrician) productive attributes were also important, so we turn to the fixed-effect estimates.

When fixed-effects are imposed, only one firm–level current measure retains significance. Limited liability firms still had a TFP disadvantage, albeit only 4% smaller than other firms. No other firm-level indicators mattered. The joint test that the coefficients on current firm attributes were equal zero could not be rejected at standard significance levels. Furthermore, the aggregated impact of the δ, evaluated at the change in sample means from 1994 to 2001 reported in Table 1, explains none of the growth in TFP over the sample period.

On the other hand, all industry level measures still retain signs that are consistent with the implied impact of market competition on productive efficiency. The only imprecisely estimated effect is that of the Herfindahl index which implies a monopolist is only 2% less efficient than a perfectly competitive firm. Recall that the Herfindahl index was defined only on domestic

production, so even a monopolist could face competition from foreign producers.[25] All the other estimated industry effects support the role of competition in significantly enhancing firm efficiency. Firms in industries that have higher market shares (net of own firm production) controlled by private firms, foreign-owned firms, and new entrants all had rising TFP. Note that private firms and foreign owned firms were not themselves more efficient, but that their presence made all the firms in the industry more efficient. Firms in industries with higher import penetration also were more efficient. Firms are less efficient in industries with weak competitors, as indicated by a high net market share going to eventual exiters. The aggregated industry effects, γ, evaluated at the change in sample means over the sample period, sum to 0.088 or 40% of the change in TFP over the period. These represent external benefits from market competition, independent of the impact of current firm-specific factors.

Konings (2005) investigation of price-cost margins in Romanian and Bulgarian firms found similar roles for competition in fostering efficiency. He reported that firms in more competitive sectors had significantly lower price cost margins. To the extent that his results generalize to Slovenia, our finding that firms in more competitive markets also had atypically large total factor productivity gains and hence falling production costs suggests a double benefit of competition to a transition economy. Not only does competition foster more efficient production, but the benefits to consumers in the form of lower prices are even greater than the cost saving to the firm. Konings did not find as strong a role for import penetration in lowering price cost margins in sectors that were already competitive. However, he did find in more concentrated sectors that import competition seemed to force down prices, again suggesting that cost savings from induced efficiencies are passed on to consumers more than proportionally.

A portion of the remaining efficiency gain is due to entry and exit of firms. The contribution of firm exiters, evaluating the estimate in column 3 at sample means, is 0.04 log points. The contribution of new entrants is 0.005 log points. Together, firm entry and exit contribute an additional 21% of the estimated TFP growth over the sample period. The role of firm entry and exit in explaining efficiency growth in Slovenian manufacturing corresponds closely to the proportion of efficiency growth attributable to entry and exit in western economies as summarized by Bartelsman and Doms (2002).

Taking the two sources of TFP growth together, we estimate that 61% of the growth in firm efficiency between 1994 and 2001 can be attributable to increases in measure market competition and firm entry and exit. The remaining 39% of the TFP growth is due to common effects across all firms. These could be due to business cycle effects or reversion to mean efficiency levels following the initial shock of the transition. However, if the competitive policy changes summarized in Figure 1 have an impact, they would be responsible for at least some of the 39% of TFP growth not explained by entry, exit, or our measures of market competition. Therefore, our estimate that competitive pressures and sorting are responsible for 61% of TFP growth is a lower bound estimate of their effects.

The relative unimportance of firm ownership structure in our study contrasts with findings in earlier studies. For example, Konings (2005) found that privatized firms and foreign-owned firms had higher price-cost margins, other things equal. It is possible that our finding that ownership structure did not matter for efficiency gains is a consequence of the fact that all Slovene enterprises, state or private, faced the possibility of bankruptcy. As a result, state firms behaved more like private firms in Slovenia. Second, the scope for improvements of corporate governance in Slovenia may have been smaller than in other transition countries to the extent

that managers in the worker self-managed Yugoslav system had considerable autonomy which may have led some firms to be relatively efficient even before transition. Consequently, the privatized state firms did not experience atypical growth in efficiency. However, the most interesting finding in our context is that while privately owned firms or foreign owned firms were not atypically efficient, industries with higher market shares attributable to private firms, foreign-owned firms, newly entered firms, or foreign sourced goods had faster efficiency growth. When we ignore these industry-level aggregates of firm attributes, it appears that firm private or foreign ownership behaves more as in previous studies. Consequently, earlier productivity effects attributed to ownership structure may have masked the market competition effects that dominate our paper.

VI. Robustness

In Table 7, we replicate the fixed effect estimates under various scenarios. In column 2, we report a variant of the Olley-Pakes (1996) estimation strategy. Their concern was in deriving unbiased estimates of α and β in (1) which is tangential to our concern with evaluating factors affecting the time path of ε_{ijt}. Nevertheless, there may be a concern that unmeasured firm heterogeneity in production is correlated with our industry-level measures of market competition. Under the assumption that firm exit and investment decisions are predicated on firm expectations of future market structure and factor prices, and that firm profits are increasing in capital, the firms idiosyncratic productivity in (4), φ_{it}, can be written as

$$(6) \qquad \varphi_{it} = h(i_t, a_t, k_t, \in_{it})$$

where i_t is current investment, a_t is the age of the firm, k_t is the firm's capital stock, and $\in_{it}$ is an approximation error assumed to be purely random. Inserting (6) into (4) gives us

$$(4') \qquad \psi_{it} = f_{it}\delta + h(i_t, a_t, k_t, \in_{it})$$

Olley and Pakes used an explicit formulation for h(·) in order to derive unbiased structural estimates of the α and β in (1). We are not interested in those parameters, so instead, we replace h(·) with its second-order Taylor approximation and then estimate (1) imposing equations (2), (3) and (4'). The results are reported in the second column of Table 7. The proportion of TFP growth that can be jointly attributed to market competition falls somewhat from 41% to 35%. Nevertheless, the coefficients are very consistent in both sign and magnitude. The null hypothesis that all the coefficients in the approximation of h(·) are jointly zero could not be rejected. Current firm attributes continue to have no effect.

In column 3, we repeat the fixed-effect estimation excluding entrants and exiters from the sample. Current firm attributes continue to have no effect. The market competition measures still retain sign and significance. Their joint effect actually rises to 0.103 or 58% of the TFP growth in those firms. Thus, while using a balanced sample biases downward the overall estimate of TFP growth, it increases the proportion attributable to market competition.

The last column repeats the exercise but excludes firms with fewer than 100 employees. The conclusion that current firm attributes have no effect still holds. However, several of the market competition variables switch signs and significance from the full sample. The share of foreign owned firms and market entrants now lower efficiency. The impact of import penetration is reduced by 60%. The joint effect of market competition on efficiency falls to 0.05 or 33% of the total TFP growth in those firms. It is apparent that excluding small firms from the sample causes significant bias in the estimated impact of market pressures on firm efficiency.

The results from Table 7 demonstrate that the general finding that increased market competition leads to increased efficiency holds when alternative definitions and assumptions

about the error process are imposed. They also show that excluding small firms, entrants and exiters can have large effects on the estimated magnitude of the market competition effect.

VII. Structural Reform and Efficiency

We cannot perform a rigorous test of the relationship between structural reforms and our measures of productive efficiency because the EBRD data presented in Figure 1 are not differentiated by firm or industry. Instead, they are only reported for the country as a whole. Because we have only 7 years of data, we have only 7 degrees of freedom with which to compare our efficiency measures and the EBRD policy indexes. Nevertheless, the correlation between the two series is of interest. In Figure 2, we present the simple bivariate relationship between TFP and the average of the structural reform indexes shown in Figure 1. The average of the EBRD indexes explains 93% of the variation in the TFP measure over time. The average of the various EBRD indexes strongly outperformed any single index, consistent with the presumption that it is the mixture of liberalization policies supporting competition that is important as opposed to any single policy.

VIII Conclusion

Since seceding from former Yugoslavia, Slovenia has undertaken a slow but progressive dismantling of its former socialist economy and replaced it with more market oriented policies. The reforms occurred steadily through the decade of the 1990s. One of the oldest propositions in economics is that competition spurs economic efficiency. The introduction of competition was expected to improve the efficiency of formerly planned economies, moderating the adverse consequences of transition for output. Our evaluation of the data from Slovenian manufacturing is strongly supportive of the role of market competition. TFP growth in Slovenia over the period averaged 2.8% per year, a growth rate that compares favorably to most OECD countries. The

TFP growth is broad-based across industries, across private and state firms, and across small and large firms. It coincides with indexes of the degree of policy liberalization in Slovenia, suggesting that policies fostering market competition contributed to the growth of market pressures.

An analysis of the sources of TFP growth shows that in Slovenia, changes from one ownership type to another had virtually no impact on firm TFP growth. Beyond a firm-specific, time-invariant productivity level, firm-level variables do not alter TFP. However, changes in industry attributes such as the extent of foreign competition, foreign ownership, private ownership, and the market share of new entrants and eventual exiters can explain 40% of TFP growth. An additional 21% can be attributed to the entrance of relatively efficient firms, and more importantly, the exit of relatively inefficient establishments.

Many studies have attempted to measure the impact of transition by comparing the performance of state enterprises against that of private firms. For example, Frydman et al (1999) found that private firms generate more sales than state enterprise, but have similar unit costs. Anderson et al (2000b) found that Mongolian state enterprises had a TFP advantage over privately owned firms. Djankov and Murrell's (2002) review found that privatization had a wide range of effects on productivity, most positive but some negative. In Slovenia, state firms are not protected from competition or risk of bankruptcy. Our results suggest that the distinction between firm ownership types is not as important as whether those firms face competitive pressures. However, firm ownership type did matter in the aggregate. Competitive pressures at the industry level due to increased industry share of private firms, foreign-owned firms, and imported goods raised TFP growth rates of all firms in the industry regardless of ownership structure.

In addition, we find that small firms, new market entrants, and exiting firms have a large impact on measured TFP growth in transition. Efficiency gains appear to occur over time and not at one instance. Past studies that concentrated on large firms, balanced panels, and short time frames may have missed some of the efficiency gains that resulted from the transition to market. Consequently, the efficiency gains from the move to more competitive markets may be much larger than has been apparent from past studies.

Svejnar (2002) has characterized Slovenia as being relatively slow to reform its economic institutions in ways that would free market forces. Our results suggest that the "go slow" philosophy came at the cost of delaying the efficiency gains that spurred economic growth throughout the period we analyze. Presumably these gains could have come sooner had Slovenia pursued these institutional reforms more aggressively earlier in the transition.

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Table 1: Sample means and standard deviations for the full sample and means for 1994 and 2001

Variable		1994-2001 Mean	1994-2001 Std. Dev.	1994 Mean	2001 Mean
ENDOGENOUS					
tfp	total factor productivity from OLS	0.000	0.363	-0.137	0.086
tfpfe	total factor productivity assuming fixed effects	0.000	0.406	-0.159	0.086
tfpre	total factor productivity assuming random effects	0.023	0.367	-0.116	0.108
lnrq	log of real output	6.01	2.03	6.188	6.088
INPUTS					
lnrk	log of real capital stock	4.62	2.45	4.797	4.667
lnrm	log of real value of materials	5.46	2.08	5.746	5.433
lnuniv	log of 2- or 4-year university educated employees	0.60	1.11	0.783	0.565
lnhigh	log of high school educated employees	1.70	1.64	1.890	1.693
lnprim	log of employees with < high school education	1.02	1.59	1.303	0.948
lnmonth	log of months of operation	2.481	0.073	2.480	2.483
CURRENT FIRM ATTRIBUTES					
private	firm is private in current year	0.837	0.369	0.636	0.906
stockco	firm currently issues publicly traded stock	0.075	0.264	0.037	0.085
ltdliab	firm is currently a limited liability firm	0.858	0.349	0.823	0.862
mixed	firm is currently under mixed ownership	0.061	0.239	0.080	0.054
forown	firm is currently foreign owned	0.075	0.263	0.068	0.078
CONSTANT FIRM ATTRIBUTES					
ENTRY	firm's birth year after 1993	0.254	0.435	0.074	0.324
EXIT	firm has no employees by 2001	0.111	0.314	0.265	0.000
PRIVATE	firm becomes private by 2001	0.884	0.321	0.788	0.916
STOCKCO	firm issues publicly traded stock by 2001	0.108	0.311	0.154	0.094
LTDLIAB	firm becomes a limited liability firm by 2001	0.895	0.306	0.868	0.893
MIXED	firm under mixed ownership by 2001	0.089	0.285	0.123	0.074
FOROWN	firm under foreign ownership by 2001	0.096	0.294	0.083	0.088
FOUR-DIGIT INDUSTRY ATTRIBUTES[a]					
HERF	Herfindahl concentration index	0.137	0.151	0.140	0.041
PRIVSHR	Share of industry output sold by private firms	0.589	0.305	0.204	0.732
FORSHR	Share of industry output sold by foreign owned firms	0.100	0.145	0.080	0.132
ENTSHR	Share of industry output sold by new entrants	0.147	0.142	0.036	0.205
EXITSHR	Share of industry output sold by firms that will exit	0.059	0.097	0.168	0.000
IMPORTSHR	Share of industry sales due to imports	0.338	0.22	0.196	0.350
N		28047		2904	4244

[a] Except for IMPORTSHR, these measures are net of own firm's output share

Table 2: Time Path of Alternative Estimates of Firm Total Factor Productivity in Slovenia Manufacturing, 1994-2001

Year	All Firms, tfp[a]	All Firms, tfpfe[b]	All Firms, tfpre[c]	Balanced Panel[d], tfp[a]	Balanced Large Firm Panel[e], tfp[a]
1994	-0.136	-0.158	-0.115	-0.112	-0.087
1995	-0.115	-0.119	-0.090	-0.097	-0.073
1996	-0.048	-0.046	-0.023	-0.032	-0.012
1997	0.010	0.014	0.034	0.016	0.035
1998	0.015	0.021	0.039	0.012	0.024
1999	0.032	0.036	0.055	0.027	0.009
2000	0.081	0.085	0.104	0.067	0.066
2001	0.086	0.086	0.108	0.065	0.067
1994-2001	0.222	0.244	0.223	0.177	0.154
Average	0.000	0.000	0.023	0.000	0.000

[a] tfp is total factor productivity measured as the error from OLS estimates of the translog production function, designated equation (1) in the paper.

[b] tfpfe is total factor productivity measured as the error derived from a fixed effects estimate of the translog production function .

[c] tfpre is total factor productivity measured as the error derived from a random effects estimate of the translog production function.

[d] tfp estimate over the subsample of firms in continuous production from 1994 through 2001.

[e] tfp estimate over the subsample of firms with more than 100 employees in continuous production from 1994 through 2001.

Correlation Matrix of the alternative tfp estimates over 28,047 observations

	tfp	tfpfe	tfpre	
tfp	1.0			
tfpfe	.90	1.0		
tfpre	.99	.94	1.0	

Table 3: Time Path of Firm Total Factor Productivity, by Slovenia Manufacturing Firm Ownership Type, 1994-2001[a]

Year	All Firms, TFP	Private[b]	Not Private[b]	Foreign-Owned[b]	Limited Liability Firm[b]	Mixed Ownership[b]	Stock Company[b]
1994	-0.136	-0.147**	-0.119**	-0.100	-0.148**	-0.107	-0.122
1995	-0.115	-0.116*	-0.143*	-0.115	-0.117	-0.105	-0.052**
1996	-0.048	-0.053	-0.079	-0.016	-0.048	0.009**	-0.001**
1997	0.010	0.015**	-0.018**	-0.005	0.010	0.021	0.044**
1998	0.015	0.022**	-0.032**	0.027	0.015	0.011	0.015
1999	0.032	0.036**	0.000**	0.054	0.032	0.054	0.032
2000	0.081	0.085*	0.046*	0.094	0.084*	0.083	0.061
2001	0.086	0.090	0.050	0.120*	0.095**	0.087	0.039**
1994-2001	0.222	0.247	0.169	0.220	0.243	0.194	0.161
Average	0.000	0.017**	-0.053**	0.026**	0.001	0.012	0.018**

[a] Total factor productivity is measured as the error from OLS estimates of the translog production function , designated equation (1) in the paper.

[b] t-tests of the null hypothesis that mean TFP are equal between the stated ownership type versus all other firms were conducted, allowing for different variances in the two groups.

* indicates significant differences at the .10 confidence level.

** indicates significance at the .05 level.

Table 4: Time Path of Firm Total Factor Productivity, by Slovenia Manufacturing, Firm Size, Entry Cohort, and Mortality [a]

Year	All Firms, TFP	<100 Employees[b]	100+ Employees[b]	Entry[b]	Exit[b]
1994	-0.136	-0.142**	-0.101**	-.129	-.229**
1995	-0.115	-0.118*	-0.090*	-.115	-.223**
1996	-0.048	-0.050**	-0.025**	-.058	-.164**
1997	0.010	0.008*	0.031*	.006	-.114**
1998	0.015	0.014	0.024	.022	-.126**
1999	0.032	0.034	0.018	.045	-.182**
2000	0.081	0.081	0.084	.092	-.205**
2001	0.086	0.086	0.092	.097	0[c]
Difference between 2001and 1994	0.222	0.228	0.193	.226	.229
Average	0.000	-0.0001	0.001	.031**	-.181**

[a] TFP is measured as the error from OLS estimates of the translog production function (equation (1) in the paper).

[b] t-tests of the null hypothesis that mean TFP are equal between the stated ownership type versus all other firms were conducted, allowing for different variances in the two groups.
* indicates significant differences at the .10 confidence level.
** indicates significance at the .05 level.

[c]By definition, TFP = 0 for firms no longer in business.

Table 5: Total Factor Productivity Estimates by Detailed Manufacturing Sector[a]

Industry	SIC[b]	Share[c]	1994	1995	1996	1997	1998	1999	2000	2001	Cumulative 1994-2001
Bakery	15.8	2.9%	0.055	0.008	-0.054	0.039	0.018	-0.008	0.028	-0.067	-0.122
Woven textiles	17.4, 17.5	1.6%	-0.105	-0.087	-0.004	0.048	-0.001	-0.009	0.04	0.042	0.147
Clothing	18.2	8.0%	-0.125	-0.042	0.014	0.032	0.037	-0.024	0.036	0.076	0.201
Footwear	19.2, 19.3	1.9%	0.02	-0.14	-0.03	0.007	0.02	0.023	0.02	0.03	0.01
Lumber	20.1	2.3%	-0.07	-0.095	-0.064	-0.017	0.025	0.041	0.018	0.106	0.176
Plywood	20.2	2.0%	-0.134	-0.075	-0.046	-0.015	-0.004	0.009	0.117	0.049	0.183
Wooden Crates	20.4	1.3%	-0.15	-0.103	-0.084	0.053	0.029	0.024	0.072	0.124	0.274
Paper Products	21.21-21.23	0.9%	-0.135	-0.167	-0.004	0.051	0.03	0.051	0.022	0.063	0.198
Book, Periodicals	22.11-22.13	1.4%	-0.021	-0.146	0.002	0.021	0.032	0.065	0.022	0.003	0.024
Printing	22.21,22.22	2.6%	-0.065	-0.118	-0.031	0.06	0.053	0.093	0.025	0.003	0.068
Rubber	25.1	0.8%	-0.097	-0.183	-0.054	0.037	0.05	-0.149	0.113	0.117	0.214
Plastics	25.2	5.3%	-0.119	-0.179	-0.06	-0.02	0.026	0.038	0.114	0.09	0.209
Cement and Stone products	26.6, 26.7	1.2%	-0.121	-0.149	-0.096	0	0.029	0.082	0.064	0.059	0.18
Metal Castings for plumbing, etc.	27.5	0.7%	-0.055	-0.075	0	-0.074	0.028	0.053	0.068	0.051	0.106
Metal Finishing	28.5	9.8%	-0.108	-0.089	-0.026	-0.077	-0.035	0.033	0.069	0.029	0.137
Cutlery, hand tools	28.6	2.4%	-0.044	-0.113	-0.026	-0.052	0.006	0.072	0.086	0.073	0.117
Manufacturing Equipment	29.2	1.7%	-0.13	-0.149	-0.079	-0.078	-0.04	-0.042	0.092	0.152	0.282
Power hand tools	29.5	2.0%	-0.117	-0.166	-0.045	0.014	-0.011	0.019	0.192	0.221	0.338
Electrical Machinery	31.6	3.5%	-0.221	-0.107	-0.077	-0.037	0.036	0.078	0.121	0.226	0.447
Radio, TV, Communication equip.	32	1.9%	-0.185	-0.092	-0.093	0.045	0.067	0.131	0.287	0.288	0.473
Precision testing and control	33.2, 33.3	1.2%	-0.286	-0.15	-0.112	-0.019	0.019	0.018	0.11	0.153	0.439
Furniture	36.1	8.3%	-0.148	-0.053	-0.019	0.028	0.011	-0.016	0.065	0.084	0.232

[a] Total Factor Productivity measured by residuals from OLS estimation of the Cobb-Douglas form of equation (1), restricting all second order coefficients to zero.

[b] Industrial classification numbers used for the Slovenian National Income and Product Accounts

[c] Industry's share of total manufacturing output in Slovenia. These sectors represent approximately two-thirds of Slovenian manufacturing output over the period.

Table 6: Estimation of impacts of firm and industry variables on total factor productivity in Slovenian manufacturing firms, 1994-2001

Current Firm Attributes, δ	OLS	OLS	OLS	Random Effects	Fixed Effects
private	0.159**	0.114**	0.064**	0.034**	0.018
	(16.7)	(10.7)	(4.55)	(2.41)	(1.19)
stockco	-0.036**	-0.022	-0.044**	-0.040**	-0.021
	(2.73)	(1.26)	(2.47)	(2.29)	(1.13)
ltdliab	-0.015	-0.038**	-0.035**	-0.047**	-0.038**
	(1.49)	(2.66)	(2.42)	(3.04)	(2.15)
mixed	0.123**	0.065**	0.034**	0.024	0.010
	(10.2)	(3.77)	(1.96)	(1.41)	(0.54)
forown	-0.007	0.039**	0.0003	-0.008	-0.010
	(0.87)	(2.31)	(0.02)	(0.53)	(0.61)
Constant Firm Attributes, μ					
ENTRY	0.035**	0.028**	0.021**	0.031**	(dropped)
	(6.81)	(5.57)	(3.95)	(3.17)	
EXIT		-0.201**	-0.154**	-0.172**	(dropped)
		(28.5)	(21.2)	(15.0)	
PRIVATE		0.013	0.024*	0.103**	(dropped)
		(0.96)	(1.76)	(5.23)	
STOCKCO		-0.005	0.017	-0.052**	(dropped)
		(0.30)	(1.07)	(2.18)	
LTDLIAB		0.053**	0.057**	0.054**	(dropped)
		(4.05)	(4.30)	(2.59)	
MIXED		0.036**	0.040**	0.052**	(dropped)
		(2.63)	(2.86)	(2.36)	
FOROWN		-0.038**	-0.002	-0.035*	(dropped)
		(2.51)	(0.12)	(1.75)	
Industry Attributes, γ					
HERF			-0.238**	-0.121**	-0.023
			(16.0)	(7.18)	(1.16)
PRIVSHR			0.154**	0.102**	0.054**
			(18.1)	(11.4)	(5.29)
FORSHR			0.240**	0.151**	0.107**
			(15.0)	(8.48)	(5.23)
ENTSHR			0.013	0.054**	0.070**
			(0.73)	(2.64)	(2.88)
EXITSHR			-0.276**	-0.184**	-0.149**
			(11.4)	(8.01)	(5.90)
IMPORTSHR			-.022**	0.023	0.097**
			(7.98)	(1.60)	(4.90)
N	27949	27949	25726	25726	25726
R^2	.97	.97	.97	.97	.97

Note: coefficients are taken from translog production function estimation of equation (1) augmented with the variables that make up equation (2). The coefficients on the translog specification including all first and second order terms in the logs of real capital, materials, numbers of university, high school and primary school trained workers are withheld to conserve space. Coefficients on the log of months of firm operation, dummy variables indicating no employees an education group, and the constant are also suppressed.
t-statistics are reported in parentheses. * indicates significance at the .10 level. ** indicates significance at the .05 level.

Table 7: Alternative fixed-effect estimation of impacts of firm and industry variables on total factor productivity in Slovenian manufacturing firms, 1994-2001

Current Firm Attributes, δ	Column 5 of Table 6	Olley-Pakes	Balanced Panel	Balanced Large Firm Panel
private	0.018	0.006	0.021	0.031
	(1.19)	(0.36)	(1.28)	(1.31)
stockco	-0.021	0.002	-0.029	-0.025
	(1.13)	(0.10)	(1.52)	(1.00)
Ltdliab	-0.038**	-0.039**	-0.043**	-0.046*
	(2.15)	(2.00)	(2.41)	(1.71)
mixed	0.010	0.003	0.018	0.023
	(0.54)	(0.15)	(0.94)	(0.91)
forown	-0.010	-0.008	0.007	0.013
	(0.61)	(0.48)	(0.36)	(0.33)
Industry Attributes, γ				
HERF	-0.023	-0.019	-0.015	-0.013
	(1.16)	(0.92)	(0.65)	(0.21)
PRIVSHR	0.054**	0.047**	0.063**	0.064**
	(5.29)	(4.21)	(5.71)	(2.27)
FORSHR	0.107**	0.112**	0.108**	-0.070
	(5.23)	(5.05)	(4.86)	(1.12)
ENTSHR	0.070**	0.075**	0.124**	-0.145**
	(2.88)	(2.95)	(4.51)	(2.10)
EXITSHR	-0.149**	-0.115**	-0.157**	-0.225**
	(5.90)	(4.13)	(5.70)	(2.98)
IMPORTSHR	0.097**	0.083**	0.102**	0.040**
	(4.90)	(3.72)	(4.77)	(0.77)
N	25726	22447	16911	2246
R^2	.97	.96	.97	.93

Notes:

Column 1 is taken from the last column in Table 6

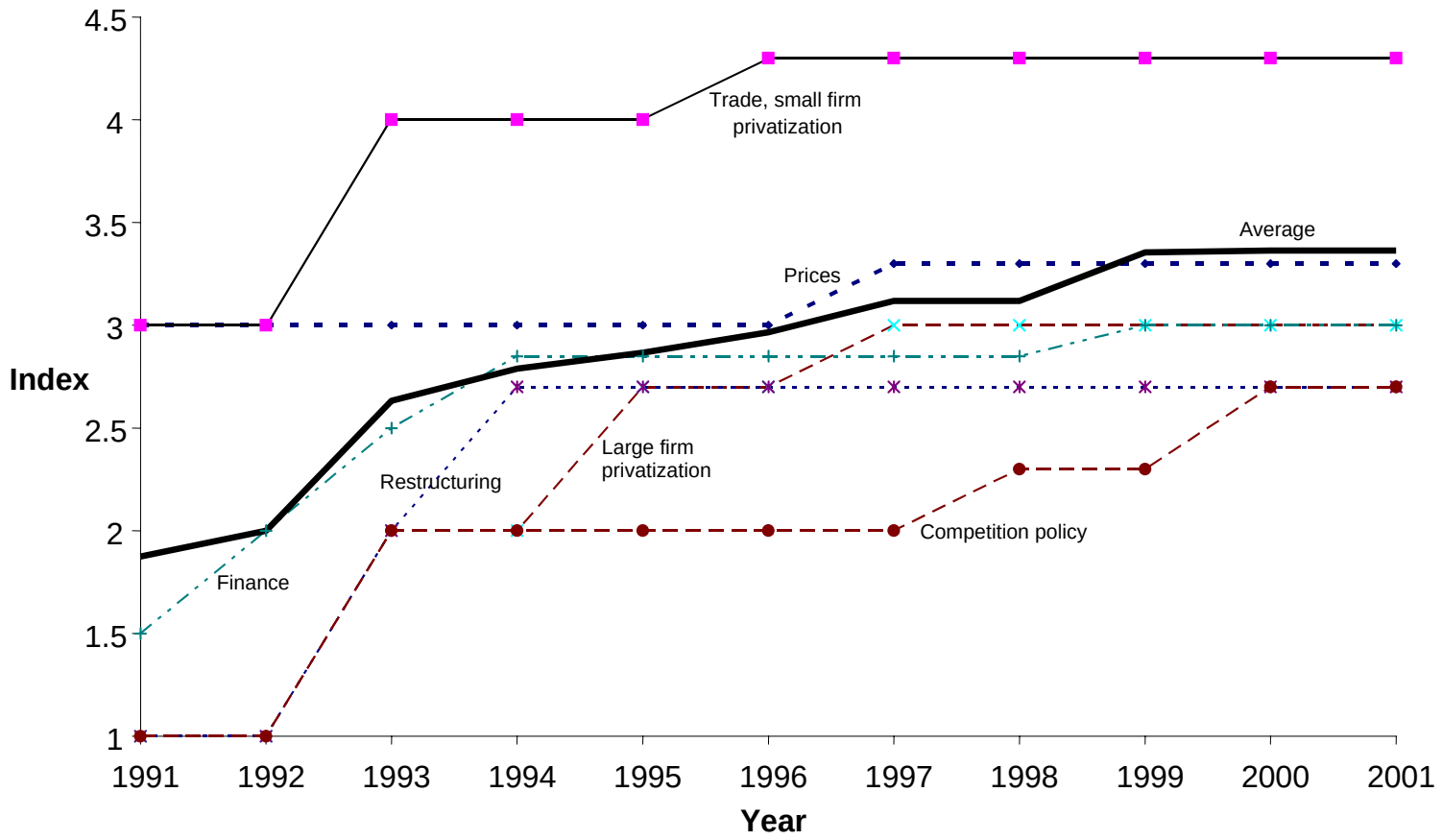
Column 2 is a variant of the Olley-Pakes(1996) specification. In this application, we supplement the specification in column 1 with i, i*k, a*k, a*i, and i^2 , where i is the logarithm of real investment, k is the logarithm of the capital stock, and a is the logarithm of the firm's age. Linear and quadratic terms in firm age are controlled by the fixed effect. The null hypothesis that the five terms can be excluded could not be rejected at standard significance levels ($F(5,16893) = 1.79$.

Column 3 replicates Column 1, but excludes firms that enter or exit the sample.

Column 4 replicates Column 3, but excludes firms with fewer than 100 employees.

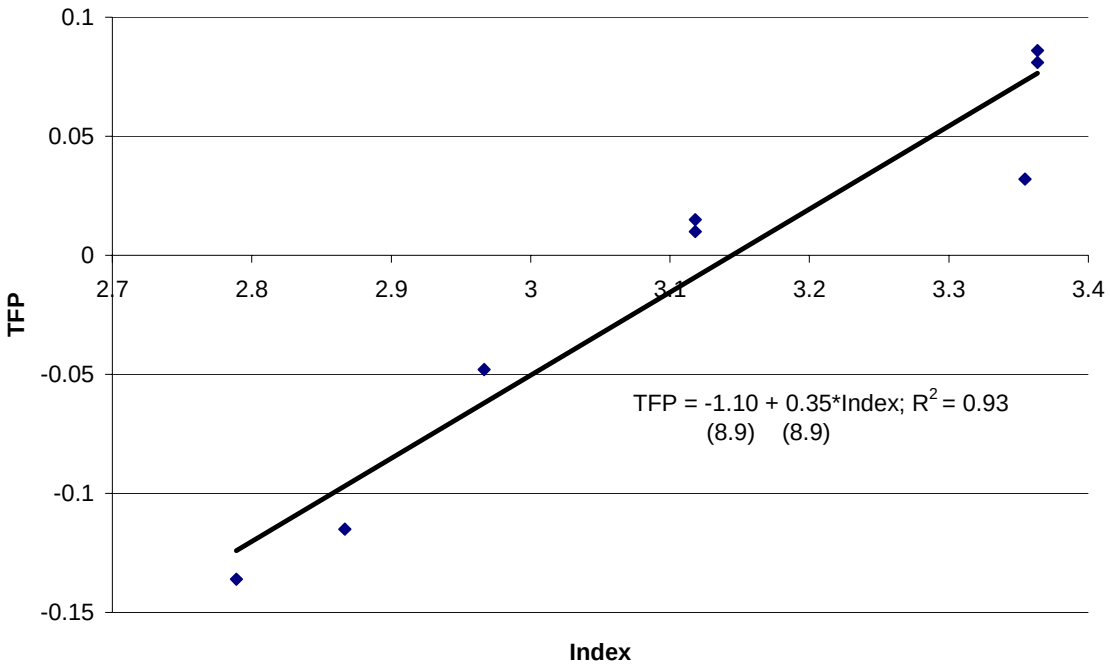
Other notes are the same as in Table 6.

Figure 1: Time Path of Slovenian Structural Reforms, 1991-2001
Source: EBRD Transition Report, various issues



Country policies are graded on the extent to which they encourage free competition from D = 1: least liberalized to A+ = 4.3: most liberalized. The average grade is the simple average across all evaluated policies including legal climate and infrastructure reforms. Labor market policies were not evaluated.

Figure 2: TFP versus Liberalization Index, 1994-2001



Index is the average of the OECD Index values of various structural reforms as shown in Figure 1. The TFP value is that reported in column 1 of Table 2.

Endnotes

[1] The Joskow and Rose (1989) summary suggests that increased market competition from deregulation in the United States and privatization of public enterprise in Europe generally led to increases in labor productivity. The few studies that examine the role of competition in fostering efficiency in unregulated environments yielded mixed results. For example in two studies of British firms, Nickell (1996) found that competition enhances efficiency while Blanchflower and Machin (1996) found no effect.

[2] Of course, much of the variation reflects differences in methodology and measures of firm performance. However, even the most careful studies that control for selection problems can generate conflicting results. For example, Anderson et al (2000b) found that state enterprises were more efficient than private firms while Frydman et al (1999) found that privatization raises measures of firm performance. The differences may be in the measure of firm performance used. When Frydman et al use a measure of efficiency, namely unit cost, the differences between private and state enterprise disappear. Their other measures (revenue growth, employment growth and revenue per employee) do not have an obvious connection to efficiency.

[3] Vodopivec (1993) discusses this system in detail.

[4] The EBRD index did not include labor market reforms, but Slovenia also took a gradualist approach in adjusting labor market policies. Early on, the government imposed many provisions to protect jobs in traditional sectors. By 1991, restrictions on layoffs and mandated severance were reduced. Despite the liberalization, Riboud, Sanchez-Paramo and Silva-Jauregui (2001) concluded that Slovenia's labor policies were the most restrictive of the formerly planned economies that were being targeted for accession to the European Union. Boeri and Terrell (2002) provide a comparative review of labor market policies in transition economies.

[5] This discussion is based on FIAS (2000).

[6] The registration fees themselves are not excessive, ranging from US $500 for a limited liability company to $1,100 for a joint-stock company. Consequently, the cost of these barriers is more in opportunity costs of time than in money.

[7] These shares formed the holdings of the Slovenian state pension fund and an endowment fund from which restitution payments were to be made.

[8] The likelihood that the government will prevent state firm failure may vary even within countries. Anderson et al (2000a) found that only 27% of Mongolian state enterprise thought the government would bail them out at least partially if the firm failed with 73% stating the government would do nothing to help. In China, Li and Liang (1998) found that state enterprises with negative cash flow did not reduce their employment of redundant workers, apparently because all expected the government to make up the losses.

[9] Konings (2005) derives a dual to the traditional Solow residual framework that we employ. His method assumes that firms are maximizing profits, an assumption that is inconsistent within our framework in which some firms may be becoming more efficient over time due to

competitive pressures while other firms that are more insulated from competition are able to remain inefficient. Konings framework is aimed at estimating price-cost margins and not firm efficiency *per se*, and he ends up differencing away the Solow residual that is the focus of our analysis. Nevertheless, our results correspond with his in interesting ways, as will be discussed below.

[10] Note that by construction, ε_{ijt} is orthogonal to the inputs, so it is productivity attached to the firm's overall production, but not to specific inputs.

[11] We could also specify a time varying error component that is common across all firms and industries. The most likely source of such common national shocks would be government tax and transfer policies and regulatory policies. However, these policies were stable over the sample period.

[12] Bartlesman and Doms (2000) concluded that there is considerable persistence in firm productivity, so that highly productive firms in one year are likley to be highly productive in other years. This suggests that the fixed effect component υ_i is likely to be important.

[13] This is almost certainly true. Simoneti et al (2001) found that insider investment was heaviest in firms that had higher profits in the years preceding privatization. It is not clear if the higher profitability was a permanent or transitory state. Our own results suggest the latter, in that firms that became stock-owned had slower TFP growth than other firms.

[14] Note that it is more efficient to estimate the system of equations in one step than to estimate (1), derive estimates of ε_{ijt}, and then to estimate equation (2) with appropriate substitutions for η_{jt}, ψ_{it}, and θ_i.

[15] We distinguish private and state ownership, as well as ownership by domestic and foreign owners. We also have information whether the firm is a publicly traded stock company or a limited liability company.

[16] For more information about the data sets, see Haltiwanger and Vodopivec (2003) which use the same sources.

[17] Note that to suit our empirical analysis, the variables ENTRY and EXIT are defined in a specific way. Namely, ENTRY is set equal to one in all years if the firm came into existence any year after 1993 (thus a firm which was founded in 1995 is considered an entrant also in 1996 and subsequent years of analysis). Similarly, EXIT is set equal to one in all years if the firm had no employees in 2001. Thus, a firm that began operations in 1996 and ceased operations in 2000 will have ENTRY = 1 and EXIT= 1 for all years of its existence.

[18] Most studies of market efficiency in western economies have concentrated on manufacturing because data on inputs and outputs are more readily available and comparable across firms. In our case, we did not have sufficient detail on input and output prices to allow us to perform the

analysis on industries outside manufacturing. For example, we would not be able to assess how much of the revenue changes in the service sector was due to increases in service output versus increases in unit prices. However, our results for manufacturing may not carry over to all sectors. According to IMAD (2003), growth of market-oriented services in Slovenia has been so slow that the gap in the share of these services in GDP rose between Slovenia and the European Community from 1995 to 2001. The slow growth in these services has been attributed to their being shielded from market pressures, causing the service sector to lag behind other sectors in productivity growth.

[19] Employment shares are similar. New entrants were responsible for 16% of all employment in manufacturing in 2001, while firms that exit by 2001 employed 15% of all manufacturing employees in 1994.

[20] Computed, for example, as 100*(exp(.222) – 1).

[21] Finland had faster TFP growth over the 1996-2000 period.

[22] This constrains all the $\beta_{kl}=0$ in equation (1).

[23] Bojec and Xavier (2004) reported that firms were more likely to exit in sectors with greater import penetration and lower (more competitive) Herfindahl indexes, consistent with our presumption that competition helps force exits of inefficient firms.

[24] The percentage change associated with firm exits is computed as 100*(exp(-.172) – 1).

[25] The simple correlation between the Herfindahl index and import share was 0.27, suggesting a modest increase in import penetration in more concentrated sectors.