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The Slovenian transition represents a slow but steady liberalization of constraints on competition. Using a unique longitudinal data set on all manufacturing firms in Slovenia over the period 1994-2001, this study analyzes how firm efficiency changed in response to changing competitive pressures, holding constant firm attributes. Results show that the period was one of atypically rapid growth of total factor productivity (TFP) relative to levels in OECD countries, and that the rise in firm efficiency occurs across almost all industries and firm types: large or small; state or private; domestic or foreign-owned. Changes in firm ownership type have no impact on firm efficiency. Rather, competitive pressures that sort out inefficient firms of all types and retain the most efficient, coupled with the entry of new private firms that are at least as efficient as surviving firms, prove to be the major source of TFP gains. Market competition from new entrants, foreign-owned firms, and international trade also raise TFP in the industry. Results strongly confirm that market competition fosters efficiency.

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

The process of transiting from a planned economy to a market system proved much more difficult than expected. As reviewed by Boeri (2000) the consensus expectation at the outset of transition was that many state enterprises would shut down or shrink, that many workers would lose their jobs, and that unemployment would rise. However, sectors that had been suppressed under central planning such as retail trade or service would expand to absorb the surplus labor from the declining sectors. 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). Rising output from the newly emerging sectors and improved productive efficiency in traditional sectors were expected to replace the lost output from the initial transition.

Empirical evidence on the impacts of privatization and market competition in western economies had come largely from the move to deregulate in the United States and to privatize national monopolies in OECD countries. As summarized in Joskow and Rose (1989), deregulation in the United States has led to rising labor productivity, although it may have slowed the pace of technology adoption. In Europe, privatization also generally led to increases in labor productivity.[1] The potential for efficiency gains in formerly planned economies seemed, if anything, even better than in the formerly regulated or state-owned sectors of western economies because of the much greater departure from market pressures in the formerly planned economies.

These hopeful expectations proved overly optimistic. The magnitude of the output shock from transition proved much larger than anticipated, lowering GDP on average by 25% in the countries of Central and Eastern Europe and by 50% in the former Soviet states (Campos and Coricelli, 2002). The recovery was also much slower than expected, with only 2 of 25 transition countries having matched their 1989 production ten years later (Campos and Coricelli, 2002). Some of the delay can be attributed to policies that retarded the expansion of sectors that had been suppressed under central planning. Policies limited labor mobility that was needed to staff new jobs in nontraditional sectors (Boeri, 2000; Orazem and Vodopivec, 2000). These policies included generous unemployment and pension benefits that lowered incentives for displaced workers to seek new employment; lengthy prior notice and mandatory severance requirements that made it expensive for declining firms to shed labor; and tax and transfer policies that effectively taxed the expanding sectors to subsidize those in decline. Some of the decline was due to delays or limits on the privatization process. Nevertheless, part of the slow recovery was that the efficiency gains from market competition did not materialize as rapidly or as soon as economists had anticipated. Some have argued that that increased competition could even have contributed to the reduction of production because it disrupted the formerly well-organized trading systems (Blanchard and Kremer, 1997). An important concern for policy-makers is whether these efficiency gains are still to be expected or if they will never materialize.

The consensus answer from numerous studies that have examined how transition has affected measures of firm performance is that efficiency gains appear to be forthcoming from 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 generally concentrated 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 new market entrants and from exits. Firm births and deaths may be important contributions of competition on economic efficiency. In addition, most studies use a single cross section of data or else a short time frame. Therefore, it is difficult to assess whether measured gains or losses of efficiency were permanent phenomena or a consequence of cyclical shocks that were occurring at the time. Our premise is that by ignoring the contributions of market entrants and bankrupt firms on efficiency and by looking at short time frames, the impact of market competition on efficiency may have been understated in previous studies.

This study contributes to the existing knowledge regarding the impact of market forces on firm productivity by following the production processes of all manufacturing firms in Slovenia that had at least one employee and that paid taxes, and not just former state enterprises. This allows us to measure the role of firm births in raising efficiency. The sample includes firms that went bankrupt as well as those that remained in business, so the role of firm deaths on efficiency can be assessed. Finally, we examine the progress of efficiency over a long time period 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.

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. 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. Institutional background: Slovenian Transition to a Market Economy

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, which began toward the end of 1988, profoundly changed the rules and institutions governing economic, political and social life. Reforms gradually replaced worker management and government interventions with market institutions and individual incentives. We briefly summarize the progress of transition and the nature and timing of these reforms.

a. Macroeconomic performance

Slovenia led the former planned economies in per capita income before transition and has retained her ranking among the transition economies. After a protracted initial contraction that lasted through 1992, economic growth has rebounded. GDP rose every year thereafter, averaging 4 percent from 1993 through 2002. Per capita GDP fell initially, but rebounded by 1995 and reached $11,000 in 2002. Unlike many of the transition economies, Slovenia had many western trading partners before transition and maintained many of these markets afterward. Exports as a percentage of GDP ranged from 52 to 63 percent from 1992-2002. At first, unemployment was restricted by policies that mandated 24 months prior notice for layoffs and pay substantial severance penalties. By February 1991, these restrictions on layoffs were relaxed and unemployment rose rapidly, peaking that year at 15.4% (Boeri and Terrell, 2002). Since then, it has declined slowly to 6.4% in 2002.

b. Structural reforms

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. Slovenia's reform process was slow relative to other transition economies (Svejnar, 2002). The EBRD transition indexes in Figure 1 show that 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. Slovenia has also taken a gradualist approach to labor market reforms, imposing many provisions to protect jobs in traditional sectors.[4] Riboud, Sanchez-Paramo and Silva-Jauregui (2001) found that Slovenia's labor policies were the most restrictive of the formerly planned economies that were being targeted for accession to the European Union, and were more restrictive than all western European countries except for Portugal. Taken as a whole, Slovenia has lagged behind the most rapid reformers among other transition countries. Its pace of structural reforms was below average through 1999. The pace of reforms accelerated since then, so that Slovenia's overall EBRD transition index reached the average of other countries.

c. Policies affecting market competition

Before transition, the system of discretionary taxes and transfers effectively insulated firms from competition—any business losses were covered by government transfers to prevent bankruptcy. Any possible competition from private firms was suppressed by limitations on firm size. After transition, numerous new avenues for competition were opened. We provide additional details on the most important of these.

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 due in part to 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, entry costs in Slovenia are lower and less complex than in all other transition economies (Estrin, 2002), and 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 the only type of ownership concentration that negatively affected privatized firm performance in the transition economies was 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.

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. Most of the foreign owned firms have been from acquisition of Slovenian private firms that were never state owned (Rojec et al, 2001). Foreign direct investment in Slovenia is low compared to other central European transition economies, due in part to the entry barriers discussed above magnified by restrictions on foreign land ownership. 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.

The first year of data coincides with the installation of the first wave of privatization. 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. In the Slovene system, both private and state enterprises were subject to competition and possibility of financial failure (Svejnar, 2002). That year also represents the start of the post transition growth. By 1994, aggregate employment stabilized and remained steady or grew somewhat thereafter. Consequently, our efficiency measures are not clouded by remaining political and economic disruptions related to the initial break-up of former Yugoslavia and are related mainly to 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). 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

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

where the inputs x_{ijkt} include measures of labor, capital and material inputs, and ε_{ijt} is an error term. The error term, a variant of the Solow residual,[8] is our measure of TFP.

The total factor productivity has three components that we will explore: time varying industry-specific factors, η_{jt}; time varying factors, ψ_{it}; and time invariant firm specific factors, θ_i. In addition, we allow a purely random technology shock, ξ_{ijt}.[9] The formulation for the error term in (1) is written

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

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.

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.[10]

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.[11] 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 γ, δ_1 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 a 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 and its attached assumption of

selection into ownership type on the basis of unobservable firm efficiency (to the econometrician but not the investor).

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 Register 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 ownership structure. The Public Pension Fund data includes information on each employee in the firm including information on education level. These three data sets can be integrated using a common firm identification number used in all three series. The variable definitions and sample means are reported in Table 1.

The employment information includes the number of two- or four-year college graduates, the number if 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.

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.

The sample means show that there was a dramatic increase in the number and the market share of private firms. 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 Herfindahl index, generated at the four-digit industry level falls over time. The share of industry output attributable to new entrants rises over time. All of these trends 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. Whether this rising competitive pressure is actually tied to increases in efficiency will be explored in the next two sections.

IV. Total factor productivity growth over time and across firms

To demonstrate the time trend in the growth of productive efficiency in Slovenia manufacturing, we first undertook an analysis of the various estimates of TFP. We considered three specifications of the translog formulation (1), 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 25 to 28 percent increase in total factor productivity.[12] In other words, the average manufacturing firm in Slovenia was producing 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, 2003).[13]

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 lists the average TFP level across all forms 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 not private to the private group, but sorting cannot explain much of the rise in TFP among private firms. The reason is that the initial differences were not large, so there would be little gain solely from sorting, and also that TFP is rising in both groups. If sorting 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.

The t-tests of the null hypothesis that the two groups have equal mean TFP initially shows that the private firms had a significant disadvantage in productive efficiency. Almost immediately, however, the private firms become significantly more efficient, although the significance disappears by 2001. 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 than average in 1994. Foreign-owned firms retain their TFP advantage in all years but one, although the difference is often insignificant. 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 28% gain in TFP versus 25% 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 the advantage was lost by 1998. By 2001, stock-owned companies had significantly lower TFP levels than did the average manufacturing firm.

While private firm ownership does appear to be related to more rapid efficiency gains, other ownership types also experienced nontrivial TFP increases. It appears that the gains in TFP are experienced broadly by many different ownership types.

Table 4 reports other TFP breakdowns by firm type. Initially, large firms had a significant TFP advantage, but the faster TFP growth in small firms erased the gap by 1998. Firms that opened for business after 1992 were indistinguishable from the average firm throughout the period. Interestingly, new entrants actually had a positive average TFP level for

the period versus zero for the average firm. 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. The implication is that exiting firms raised average TFP in Slovenian manufacturing to a comparable extent as did newly opening firms.

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.

The results support our view that TFP growth was wide-spread 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.

V. Regression analysis of the factors affecting total factor productivity

The results of Tables 2-5 show that there are widespread increases in productive efficiencies in Slovenian manufacturing. While the increases in efficiency are not of uniform size, the evidence that virtually all firm ownership types, firm sizes, and sectors experienced substantial improvement in total factor productivity as the transition progressed. We have yet to identify the proximate causes for those improvements. In Table 6, we embed equation (2) into

the translog specification (1) in order to establish the factors that are tied to increases in total factor productivity.

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 exit have total factor productivity that is 18% below continuing firms.[14]

Once the ultimate firm ownership status is controlled, the current ownership status variables become 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 important in explaining variation in firm efficiency. A higher Herfindahl index lowers TFP to the extent that a monopolist would be 17% less efficient than an otherwise equivalent perfectly competitive firm. Firms in industries with more foreign ownership and with higher share of sales to private firms are also more efficient. Firms in industries in which more firms are exiting are less productive. Firms in industries in which entrants have greater market share are less efficient, but the effect is very small. Finally, firms in domestic industries that have greater import penetration are modestly less efficient.

Of the future status variables, firms that ultimately exit still retain their large TFP disadvantage. Firms that became private, stock-owned, or foreign-owned did not have significantly different TFP levels before they attained that status. Firms that eventually became mixed ownership or limited liability firms did have prior TFP advantage.

Upon attaining their new status, private firms raise TFP by 5%, stock owned companies lose 5%, mixed ownership firms gain 4%, limited liability firms lose 4%, and new market entrants have a 2% TFP advantage.

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.

Both columns 3 and 4 require that selection into ownership type is driven by observables. If instead, $E(\upsilon_i) \neq 0$, then a fixed-effect estimator is appropriate. Hausman tests suggested the fixed-effect estimator dominated the random-effects estimator, so we concentrate our discussion on the results in column 5. However, the fixed-effect estimator does not allow a separate estimate of the effect of constant firm attributes on TFP which are of interest. 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. 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 3.5% smaller than other firms. No other firm-level indicators mattered. When we aggregate the impact of the δ, evaluated at the change in sample means from 1994 to 2001 reported in Table 1, we find that changes in current firm attributes explain none of the growth in TFP over the sample period.

On the other hand, all industry level measures still retain significance, although the magnitudes drop. The only sign reversal is that industry concentration now has no significant impact on TFP. As the fixed-effect estimation holds constant the industry structure before 1994, this suggests that firms in industries that have increased in concentration over the period have grown as rapidly as firms in industries that have become less concentrated.[15] [16] Overall, changes in industry concentration are also very small, so industry concentration had a negligible impact on TFP over the period.

All the other estimated industry effects support the role of competition in enhancing firm efficiency. Firms in industries that have higher market shares controlled by private firms, foreign owned firms, new entrants or import penetration had rising TFP. Industries with high proportions of exiters are less efficient, and so they gained efficiency on average as their least efficient members dropped out. The aggregated industry effects, γ, evaluated at the change in sample means over the sample period, sum to 0.085 or 35% of the change in TFP over the period. These represent external benefits from market competition, independent of the impact of firm-specific factors. For example, there is no evidence that a change to foreign ownership influences that firm's productivity, but higher industry shares controlled by foreign owners make all firms in the industry more efficient.

Because current firm status has a negligible effect on TFP, the balance of the TFP effect is attributable to the firm fixed-effects. In essence, this represents a sorting effect. Over time, the least efficient firms dropped out, while the most efficient firms remained. New entrants had to match the efficiency of the surviving firms in order to compete.

When we redo the exercise of assessing the aggregated impact of the δ, μ, and γ using the column 4 estimates, the same story emerges. Changes in current firm attributes explain none

of the TFP growth. Changes in industry attributes are responsible for 50% of the TFP growth with the balance explained by sorting on observable fixed firm attributes. Therefore, our conclusions are robust to alternative assumptions about the error terms.

VI. Conclusion

Since seceding from former Yugoslavia, Slovenia has undertaken a slow but progressive dismantling of its former planned economy and replaced it with more market oriented policies. Starting in 1994, Slovenia began privatizing many of its state enterprises and began liberalizing rules allowing private firms to enter and expand. Other changes liberalized rules regulating financial markets, labor markets, asset markets, and foreign trade. While the pace of these changes differs across markets, their aggregate effect is to progressively increase the potential for product market competition.

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. We test whether the process of transition led to improvements in economic efficiency as measured by total factor productivity in Slovenian manufacturing firms over the 1994-2001 period. 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.

An analysis of the sources of TFP growth shows that in Slovenia, changes from one ownership type to another had virtually no impact on 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 38% of TFP growth. These gains from competitive pressures represent an important external benefit from markets.

The 62% of TFP growth attributable to the firm fixed-effect is a sorting effect that can also be attributed to market competition. Individual firm efficiency levels do not change over time, but the least efficient leave, while new firms enter with efficiency levels at least as high as surviving firms.

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 (2000) found that 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.

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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					
HERF	Herfindahl concentration index	0.157	0.177	0.158	0.047
PRIVSHR	Share of industry output sold by private firms	0.614	0.306	0.214	0.750
FORSHR	Share of industry output sold by foreign owned firms	0.105	0.154	0.083	0.135
ENTSHR	Share of industry output sold by new entrants	0.154	0.153	0.038	0.211
EXITSHR	Share of industry output sold by firms that will exit	0.062	0.107	0.175	0.000
IMPORTSHR	Share of industry sales due to imports	0.338	0.22	0.196	0.350
N		28047		2904	4244

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]
1994	-0.136	-0.158	-0.115
1995	-0.115	-0.119	-0.090
1996	-0.048	-0.046	-0.023
1997	0.010	0.014	0.034
1998	0.015	0.021	0.039
1999	0.032	0.036	0.055
2000	0.081	0.085	0.104
2001	0.086	0.086	0.108
1994-2001	0.222	0.244	0.223
Average	0.000	0.000	0.023

[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.

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]
1994-2001	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

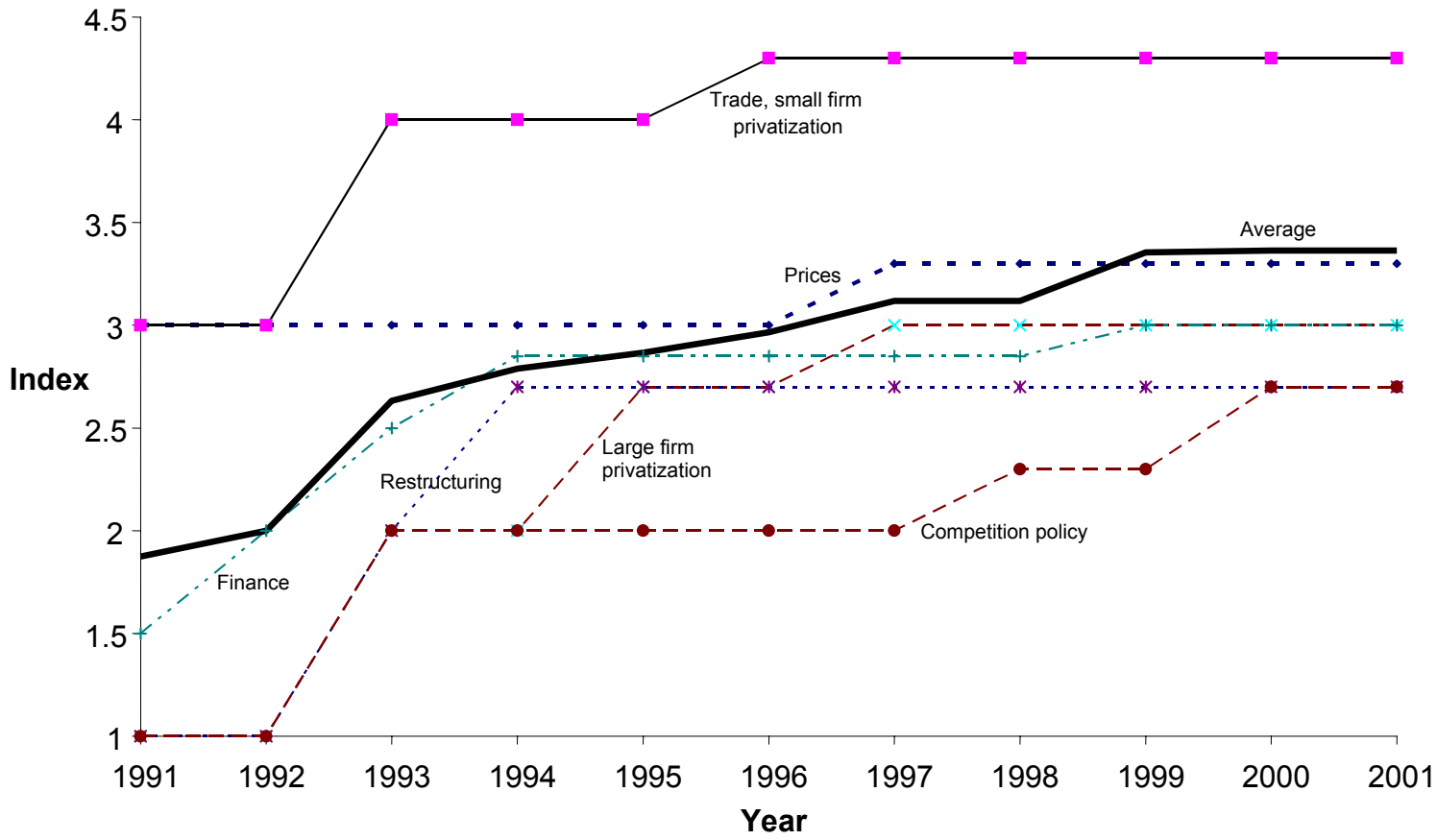
[c] Industry's share of total manufacturing output in Slovenia. These sectors represent approximately two-thirds of Slovenian manufacturing output over the period.

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**	0.054**	0.023*	0.012
	(16.7)	(10.7)	(3.80)	(1.66)	(0.78)
stockco	-0.036**	-0.022	-0.047**	-0.039**	-0.021
	(2.73)	(1.26)	(2.58)	(2.28)	(1.13)
ltdliab	-0.015	-0.038**	-0.035**	-0.045**	-0.036**
	(1.49)	(2.66)	(2.46)	(2.91)	(2.07)
mixed	0.123**	0.065**	0.035**	0.026	0.011
	(10.2)	(3.77)	(2.02)	(1.54)	(0.61)
forown	-0.007	0.039**	-0.015	-0.020	-0.018
	(0.87)	(2.31)	(0.91)	(1.24)	(1.08)
Constant Firm Attributes, μ					
ENTRY	0.035**	0.028**	0.022**	0.030**	(dropped)
	(6.81)	(5.57)	(4.13)	(3.07)	
EXIT		-0.201**	-0.151**	-0.171**	(dropped)
		(28.5)	(20.4)	(14.8)	
PRIVATE		0.013	0.017	0.104**	(dropped)
		(0.96)	(1.30)	(5.26)	
STOCKCO		-0.005	0.014	-0.055**	(dropped)
		(0.30)	(0.89)	(2.28)	
LTDLIAB		0.053**	0.056**	0.053**	(dropped)
		(4.05)	(4.19)	(2.51)	
MIXED		0.036**	0.034**	0.047**	(dropped)
		(2.63)	(2.46)	(2.16)	
FOROWN		-0.038**	-0.002	-0.034*	(dropped)
		(2.51)	(0.10)	(1.72)	
Industry Attributes, γ					
HERF			-0.191**	-0.079**	0.005
			(14.4)	(5.30)	(0.31)
PRIVSHR			0.163**	0.109**	0.061**
			(19.3)	(12.2)	(5.95)
FORSHR			0.234**	0.151**	0.108**
			(15.3)	(8.85)	(5.50)
ENTSHR			-0.005	0.055**	0.086**
			(0.33)	(2.78)	(3.59)
EXITSHR			-0.198**	-0.138**	-0.106**
			(9.02)	(6.59)	(4.37)
IMPORTSHR			-.022**	0.019	0.087**
			(7.85)	(1.26)	(4.23)
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.

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.

Endnotes

[1] There are also a few studies that examine the role of competition in fostering efficiency in unregulated environments with 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 (2000) 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] 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] 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.

[9] 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.

[10] 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.

[11] 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 $\eta_{jt}, \psi_{it}, \text{and} \theta_i$.

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

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

[14] This is computed as 100*[1 - exp(-0.201)].

[15] It is possible that the causality is reversed, so that more efficient firms gain market share while inefficient firms drop out.

[16] The Herfindahl index is defined over Slovenian firms only, so a monopolist may still face competition from foreign trade.

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