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

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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. Use of the comprehensive data set allows us to illustrate that estimated TFP growth is biased downward in data sets that exclude new entrants, exiters, or small firms. Total factor productivity (TFP) grew rapidly in the period with the increase in firm efficiency occurring 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 explains 21% of the TFP growth. Market competition from new entrants, from foreign-owned firms, from import penetration and from the exit of weak competitors, accounts for an additional 40% of the TFP growth. Results strongly confirm that market competition fosters efficiency.

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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. The received wisdom at the time, as summarized by Joskow and Rose (1989), was that deregulation in the United States had 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. 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.[1]

Past studies of the impact of transition on firm efficiency have generally concentrated on balanced panels of large, formerly state-owned enterprises that survived into the transition. The focus is natural, as these are the types of firms that existed under socialism. However, the approach of following a panel of continuing firms can yield biased estimates of the productivity gains from transition. First, 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. A related problem is that most studies of firms in transition have concentrated on medium and large sized firms for which data were available (Djankov and Murrell, 2002), but that concentration misses the large number of small operations that opened as a consequence of the transition process.

Second, studies in western economies have found that a large proportion of aggregate productivity growth is attributable to resource reallocation associated with the exit of inefficient firms (Bertelsman and Doms, 2002).[2] Studies that do not include new entrants or exits risk missing these two important sources of efficiency gains. Furthermore, as demonstrated by Olley and Pakes (1996), if the decision to enter or exit is predicated upon knowledge of firm productivity, exclusion of entrants or exiters will result in sample selection bias.

Another common feature of past studies of productivity growth in transition economies is the reliance on a single cross section or a short time frame. However, if increased competition or policy reforms affect efficiency with a lag, a short panel may understate the efficiency gain. Conversely, initial efficiency gains from a policy shock may dissipate over time. In either case, measured efficiency gains or losses over a short time span could amplify or reverse themselves over a longer period. Our premise is that a longer time frame in which to observe firm reactions to changes in competitive pressures associated with the transition to market should yield more reliable estimated productivity responses.[3]

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 an unusually long time period from 1994 through 2001.

Our results strongly confirm the importance of competitive pressures in raising firm total factor productivity. The fastest efficiency growth occurs in firms facing the strongest measures of market competition. While the largest gains were in private firms, total factor productivity also rose in firms under state ownership but that also faced market competition. Illustrating the usefulness of long panels, efficiency gains are cumulative over time and not short-lived. The importance of unbalanced panels is also demonstrated, in that the fastest efficiency growth occurred in small and newly entering firms, and there were large efficiency gains from sorting

out the least efficient firms. Ignoring small firms or entrants and exiters understates the gains from transition.

I. Institutional background: Slovenian Transition to a Market Economy

As part of former Yugoslavia, Slovenia's economy was characterized by centrally planned production decisions. The government interfered in firm decisions regarding investment, employment and wages. To meet centrally dictated payrolls, a massive system of discretionary taxes removed net revenue from profitable enterprises to pay for subsidies of failing firms that could not meet their payrolls. Inefficient firms were allowed to lose money indefinitely, while efficient firms were constrained from building up reserves for expansion.[4] Restrictions on capital mobility prevented the reallocation of assets toward their most profitable use. Private firms could hire no more than 10 workers, limiting expansion of profitable firms.

Slovenia's transition, which began toward the end of 1988, gradually changed the rules and institutions governing market competition. Reforms eventually relaxed restrictions on market forces including those regulating entry, sale of assets, employment, foreign competition, and bankruptcy. We briefly summarize the nature and timing of these reforms.

a. Labor Policies

Slovenia took a gradualist approach to labor market reforms, imposing many provisions to protect jobs in traditional sectors. Early in the transition, layoffs were virtually prevented by policies that mandated that firms provide prior notice 24 months before a layoff and then pay substantial severance penalties. By February 1991, these restrictions on layoffs were relaxed and the unemployment rate rose rapidly, peaking in 1993 at 9.1%.[5] It held at between 7-8% between 1995-2000 before dropping to 5.9% in 2001. While other restrictions that had the effect of limiting labor mobility across sectors have been reduced since 1991, Riboud, Sanchez-Paramo

and Silva-Jauregui (2001) concluded that Slovenia's labor policies were the most restrictive of the formerly planned economies targeted for accession to the European Union, and were more restrictive than all western European countries except for Portugal.

b. Exit

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. The transfer system continued into the early transition, but was finally completely disabled by the end of 1993. By the start of 1994, the firms that remained were either private or were state enterprises that could demonstrate potential profitability to investors. An important feature of the Slovene system was that all firms, both private and state-owned, were subject to competition and possibility of financial failure (Svejnar, 2002). 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.

c. Entry

The first Law on Enterprises was passed in 1988, but was ineffective until amended in 1993. As an illustration, average employment in the first year of operation for firms "born" in 1992 was 126. Of those born in 1993, first year employment averaged just 2 workers, and first year employment in entering firms remained small thereafter. The data suggest that the firms "born" between 1988 and 1992 were primarily spinoffs of former state enterprises, while those born from 1993 on were truly new entrants. The 1993 law 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. Constraints on private firm size were eliminated.

While the new law allowed entry of new private firms, administrative barriers slowed the initial response to the new opportunities.[6] The registration process took 1-3 months, a process that takes only a few days in western economies.[7] New enterprises must also obtain location, construction, and business permits from the local government, a process that requires documentation of business plans, location, and staff qualifications. Location permits alone require approval from up to 22 local and state authorities. If the new business required the acquisition of land, there were additional delays related to unresolved ownership disputes carrying over from the Socialist era and to cumbersome zoning restrictions. Re-zoning can take two years or more. The business permit requires at least 30 documents and several months to be issued. While entry is cumbersome, entry costs in Slovenia are lower and less complex than in all other transition economies (Estrin, 2002).

Consequently, entry can and does occur, at least eventually. Bojnec and Xavier (2004) reported annual net entry rates of 9% per year. These entrants are heavily weighted to more recent years. In 1994, only 15 new manufacturing firms were born. By 1996, the number of new start-ups in manufacturing had risen to 240. Of all surviving manufacturing firms in 2001, 32% had entered after 1993. Other firms both entered and exited within that time period.

d. Privatization

In November 1992, Slovenia adopted the Ownership Transformation Act. The process was completed by 1995. The law stipulated that 60% of the assets of state enterprise be distributed equally through the allocation of shares between the state pension fund, the current and former employees of the firm, and the Slovenian citizenry.[8] The remaining 40 percent of the

shares were open to bid, but enterprise employees could acquire these shares at a 50% discount payable over four years. This built-in bias favoring internal ownership led to current and former employees controlling 44% of the shares initially (Simoneti et al, 2001).

Gradually, employee control of shares diminished. By 1999, 40 percent of initial shareholders had sold their shares, and the 5 largest owners held, on average, 62 percent of the stock. 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 any impact of the conversion to stock ownership on firm efficiency. The later move toward more concentrated ownership should improve the efficiency of privatized firms.

e. Foreign Ownership and Import Competition

Foreign investors own a very small proportion of the shares of Slovenian privatized firms. 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, and magnified by restrictions on foreign land ownership. By 2001, 8% of the manufacturing firms were foreign-owned, only slightly higher than the foreign-owned share in 1994.

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. Import penetration in manufacturing rose rapidly from 20% in 1994 to 35% in 2001.

f. Summary

Slovenia's reform process was slow relative to other transition economies (Svejnar, 2002). The EBRD transition indexes illustrated 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.

Slow or not, the time paths in Figure 1 show that Slovenian capital, product, and financial markets have gradually become more competitive. 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 between firms and reports were unreliable. Some of the reforms predate our sample period, and so we may miss any initial gains from the policies. However, as we indicated in our review of the policies, reaction to the increased competitive pressures would be expected to occur with a lag due to administrative delays.

The first year of data coincides with the start of the post transition growth in Slovenia. Some of the efficiency gains that occur after 1994 may be due to common business cycle effects and to a reversion to mean productive efficiency after a period of decline associated with transition, rather than to common efficiency gains associated with these policy reforms. However, we can show that efficiency gains occurred atypically in firms facing the most foreign

and domestic competition. In addition, entry and exit contributed significantly to efficiency gains. The combined effect of competitive forces explain over half of the TFP growth in the Slovenian economy over this period.

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

$$(1) \qquad \ln q_{ijt} = a_0 + \sum_{k=1}^{n} a_k \ln x_{ijkt} + \frac{1}{2}\sum_{k=1}^{n}\sum_{l=1}^{n} ß_{kl} \ln x_{ijkt} \ln x_{ijlt} + e_{ijt}$$

where the inputs x_{ijkt} include measures of labor, capital and material inputs, and e_{ijt} is an error term. The error term, a variant of the Solow residual, is our measure of TFP. By construction, e_{ijt} is orthogonal to the inputs, so it is disembodied efficiency attached to the firm's overall production, but not to its choice of inputs. The e_{ijt} will also be purged of unobserved heterogeneity in firm production that is correlated with input choices. Note that our concern is to analyze changes in e_{ijt} and so we sidestep well-known problems associated with deriving unbiased estimates of the production function parameters.

Total factor productivity has three components that we will explore: time varying industry-specific factors, $?_{jt}$; time varying factors, $?_{it}$; and time invariant firm specific factors, $?_i$. In addition, we allow a purely random technology shock, $?_{ijt}$.[10] The formulation for the error term in (1) is written

$$(2) \qquad e_{ijt} = ?_{jt} + ?_{it} + ?_i + ?_{ijt}$$

Our strategy is to specify the elements of the error components in a manner that will allow identification of factors associated with TFP growth across firms and across time. The industry-specific component is specified as

(3) $?_{jt} = I_{jt}? + i_{jt}$

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

(4) $?_{it} = f_{it}d + f_{it}$

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

The time invariant firm component is specified as

(5) $?_i = F_i\mu + ?_i$

where F_i is a vector of observable firm attributes that do not change over time and $?_i$ is unobserved time invariant firm productivity.

Equation (5) summarizes the selection issues that could bias our estimates of ? and d. Suppose that $?_i$ 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 $?_i$.[11]

If $?_i = 0$ 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 d will reveal whether there was a change in TFP associated with the change in ownership status.

When $?_i = 0$ for all i, we can estimate $?$, d, and μ by inserting equations (2-5) into (1) and applying ordinary least squares to the resulting reduced form equation.[12] If $?_i$ in (5) is not zero but is distributed $N(0, s_i)$, then selection into ownership states on the basis of expected efficiency will still be driven by the observables, F_i. All the parameters $?, d_1$ 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, s_i.

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

Note that under the null hypothesis that $E(?_i) = 0$ and $?_i \neq 0$, the random effects model is appropriate. In particular, $?_i$ 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).

Note also that the error term in (4) can be modified to be $j_{it} = t_t + \in_{it}$, where t_t is a common time component, and $\in_{it}$ is a purely random component. The common time component will include productivity effects that are common across firms, including those associated with the business cycle, reversion to mean productivity in the recovery from the recession associated with the early transition, and common policy reform effects. We cannot determine the relative importance of these three factors in j_t, but it is important to note that at least some of the unmeasured efficiency growth in t_t may also be due to common time varying effects associated with competitive policies.

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, as can be seen in Table 1, all capital, employment and material input levels fell by a greater proportion than did output, implying that 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 from a relatively low level. 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

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.[13] 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, 2003).[14]

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 from 0.177 log points is 19.4% rather than the 24.9% implied 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 is 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. 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 exit have total factor productivity that is 18% below continuing firms.[15]

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 coefficiecient 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 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 $?_i = 0$ in equation (5). If $?_i \neq 0$, but $E(?_i) = 0$ 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 $?_i$ 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, $E(?_i) \neq 0$, 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.[16] 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 d, 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.[17] 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, ?, 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.

A portion of the remaining efficiency gains 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.

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 a and ß in (1) which is tangential to our concern with evaluating factors affecting the time path of e_{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 the firm exit and investment decisions are predicted on firm expectations of future market structure and factor prices, and that firm profits are increasing in capital, the firms idiosyncratic productivity in (4), j_{it}, can be written as

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

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') $? _{it} = f_{it} d + h(i_t, a_t, k_t, \in_{it})$

Olley and Pakes used an explicit formulation for h(·) in order to derive unbiased structural estimates of the a and ß 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.

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. 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.

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 (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.

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 large than has been apparent from past studies.

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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]
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, d	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, ?					
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, d	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, ?				
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

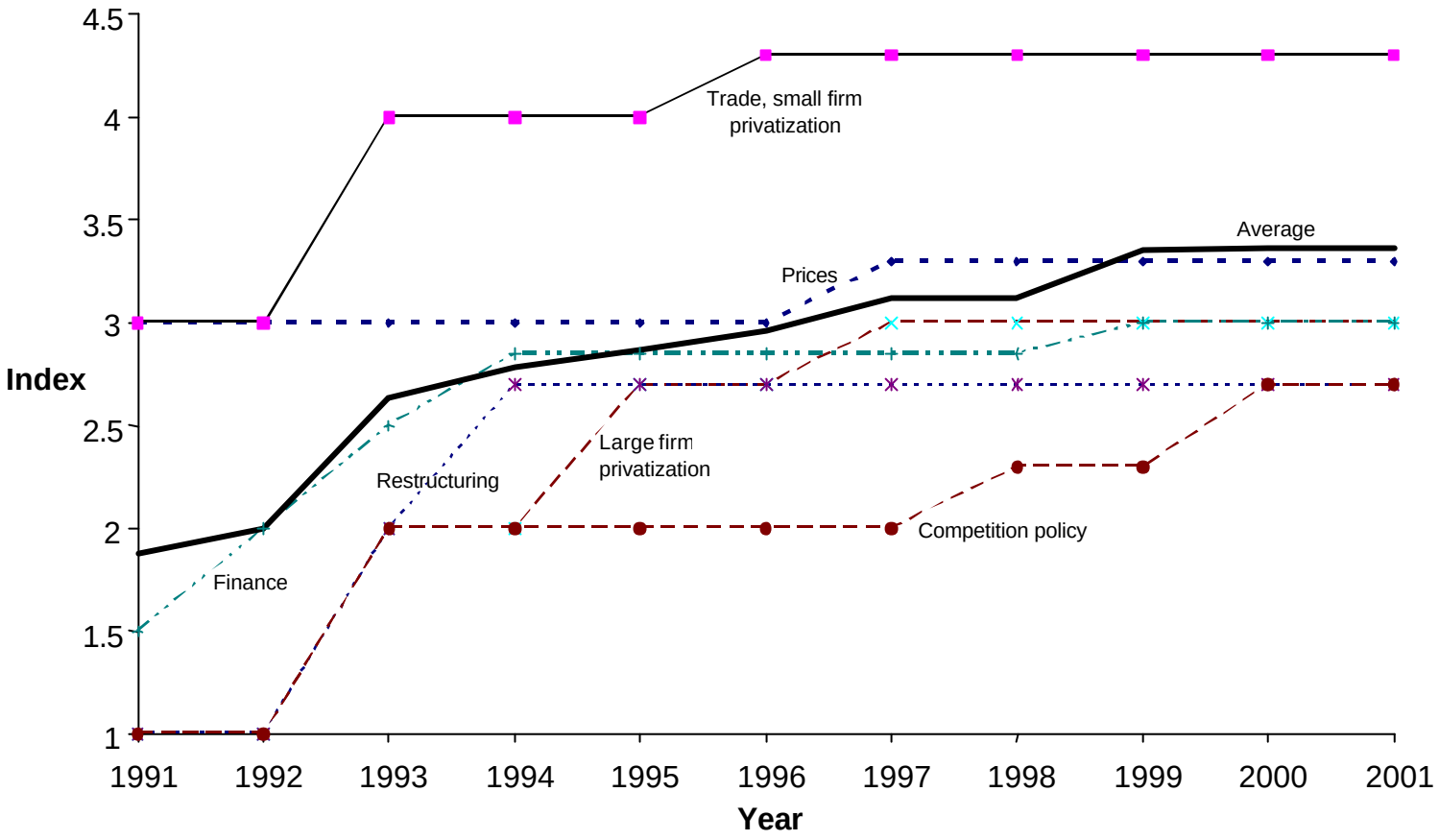
Column 2 is a variant of the Olley-Pakes(1996) specification. In this application, we supplement the specification in column 1 with i, i*k, a*k, a*i, and i^2 , where i is the logarithm of real investment, k is the logarithm of the capital stock, and a is the logarithm of the firm's age. Linear and quadratic 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.

Endnotes

[1] 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.

[2] The exception is Griliches and Regev (1995) who did not find a role for firm exits in explaining productivity growth in the Israeli economy. Unique in that sample is that there was no aggregate productivity growth in the sample period they examined.

[3] As an example, Hay 2001) found that efficiency gains following trade liberalization in Brazil occurred steadily over a five year period.

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

[5] Unemployment measured using ILO definitions.

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

[7] Recent reforms have tried to shorten the registration process. 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.

[8] Each citizen received an allotment of free certificates that they could exchange for shares in former state enterprises.

[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 focuas of our analysis. Nevertheless, our results correspond with his in interesting ways, as will be discussed below.

[10] 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.

[11] 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.

[12] Note that it is more efficient to estimate the system of equations in one step than to estimate (1), derive estimates of e_{ijt}, and then to estimate equation (2) with appropriate substitutions for $?_{jt}$, $?_{it}$, and $?_{i}$.

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

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

[15] 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.

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

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