Summary of the Papers

THIS ISSUE CONTAINS papers presented December 9 and 10, 1994, at the ninth meeting of the Brookings Microeconomics Panel. The papers address topics in labor economics, industrial organization, political economy, and international trade. Most are related by their concern with productivity issues. The industry studies by Casey Ichniowski and Kathryn Shaw and by Frederick Abernathy, John Dunlop, Janice Hammond, and David Weil are part of the Alfred P. Sloan Foundation's Industry Studies initiatives. The Ichniowski and Shaw paper examines the adoption of modern labor practices by U.S. steel firms. Abernathy, Dunlop, Hammond, and Weil examine how information technologies, inventory practices, and changes in distribution channels affect the productivity and profitability of U.S. apparel firms. Ben Craig and John Pencavel examine how the ownership structure of plywood product firms in the Pacific Northwest affects firm productivity. Andrew Bernard and Bradford Jensen use longitudinal plant data to study the relation between wages and exports. Boyan Jovanovic and Yaw Nyarko develop a new learning model that yields empirical predictions about learning curves. Martin Baily and Hans Gersbach compare productivity levels in nine U.S., German, and Japanese industries.

Ichniowski and Shaw on Human Resource Practices

Many academics and managers believe that human resource practices such as incentive pay and team production can increase worker productivity. Much of the evidence on the prevalence and effect of human resource policies is anecdotal. To date, relatively few studies have examined what happens when firms implement these practices. Ichniowski and Shaw present new evidence on the adoption and effect of modern human re-

source practices in U.S. steel plants. Their field study has several advantages over previous studies. Their data pertain to the same production task, they have both time-series and cross-section information on firms and line practices, and they have productivity information.

The authors' main analyses are motivated by the question: If modern labor practices significantly increase productivity, why are they not more widespread? The authors' answer lies in the costs of adopting single versus multiple practices. In their field study, the authors observe that U.S. firms rarely adopt modern practices piecemeal. Instead, they adopt "clusters" of practices. The first part of the paper characterizes the clusters of practices adopted by sample steel firms. The second half of the paper explains why some companies adopted these practices and others did not. The authors argue that differences in adoption rates are caused by differences in both initial and sunk adoption costs. The authors suggest that much of the inertia in firm human resource practices is caused by worker entrenchment. Entrenchment arises because workers expend significant effort mastering work routines.

Because Ichniowski and Shaw do not have data on costs workers and firms incur when adopting human resource practices, they develop econometric qualitative-choice models that explain adoption decisions. These models infer costs from adoption decisions and use variables such as worker tenure, plant age, and firm characteristics to explain costs. Their estimates suggest that new lines with new workers are much more likely to adopt "innovative" or productivity-enhancing practices. Newly reconstituted or refurbished lines are less likely to adopt new practices. The results also show that manager tenure negatively affect adoption. The authors conclude that, although selection effects may increase the likelihood that new plants will adopt new practices, the presence of worker effects is evidence of worker-entrenchment. That is, workers with longer tenure resist change because they have made task-specific and firm-specific investments. The authors also find that firms can affect the willingness of older workers to forgo these specific costs by threatening plant shutdowns or by laying off workers.

Bernard and Jensen on Exporters and Jobs

Free trade advocates claim a main advantage of lower trade barriers is the growth of exports. They argue that countries should encourage

exports because exporting firms earn larger profit margins and pay higher wages. Several academic studies have confirmed that exporting sectors have higher wages, greater rates of employment growth, and greater rates of return on capital. Critics of these studies, however, contend that these findings are illusory. Some, for example, argue that export sectors appear to pay higher wages simply because they employ higher skilled labor. Both sides of the free trade debate agree that more study is needed before the benefits of exports are made clear. Bernard and Jensen move a step in this direction. They examine detailed plant-level data that describe the extent of exporting in U.S. manufacturing from 1976 to 1987. These data permit them to explore finer hypotheses about the links among exports, employment growth, and wages. The authors find that exporters pay higher wages and have greater employment growth but that these premiums are not as great as the aggregate data suggest.

Bernard and Jensen base their study on plant data, newly available from the Annual Survey of Manufactures, which describe output and export trends in U.S. manufacturing from 1976 to 1987. The authors document the extent of exporting by U.S. manufacturing plants, its geographic concentration, and its economic importance. The authors then develop more detailed regression models that relate cross-section and time-series data on export shipments to wage and employment data. Their wage regressions produce several interesting findings. Consistent with earlier studies based on aggregate data, they find that, controlling for industrial classification, plant size, and plant location, exporters pay 9 percent higher wages than nonexporters. Controlling for the same factors, they find that value-added per worker is some 16 percent higher in exporting plants. When they include finer plant-level variables, such as the capital intensity of plants, however, the authors find that the export sector wage premium falls significantly—-export wages are only 2 to 3 percent higher than nonexport wages. Further analysis suggests that the size and composition of a plant's work force plays a critical role in explaining the size of export wage premia.

The final sections of the paper examine the relations among export, employment, and wage growth between 1976 and 1987. The authors conclude that exporters have only slightly greater short-run wage growth than nonexporters but much greater short-run employment growth. An analysis of longer-run growth rates reveals that the firms with the greatest annual employment growth are those that became

exporters between 1976 to 1987. The authors interpret this finding as suggesting that, while exporting firms grow faster than nonexporting firms, today's exporters may not grow nearly as fast as firms that begin to export in the future.

Craig and Pencavel on Worker Participation and Productivity

Academics, managers, and workers often debate the merits of employee ownership and employee involvement in firm decisions. The recent popularity of employee stock ownership plans and the appointment of union and pension fund representatives to several corporate boards has renewed interest in understanding whether employee ownership can make firms more productive and profitable. Few studies, however, have compared the performance of management-run, or "conventional," firms with worker cooperatives. Existing studies usually compare the productivities of firms and workers in different industries. By examining conventional and worker-controlled firms in the same industry, Craig and Pencavel provide a better comparison.

The authors analyze data on the inputs and outputs of Northwestern U.S. plywood product mills from 1968 to 1986. Their data contain observations on conventional, union, and worker co-op firms. From these data, the authors try to determine whether cooperatives can produce more output than conventional firms that use the same level of inputs. To determine this, the authors must control for differences in the scale and products of plywood mills. The authors begin by discussing how worker ownership is likely to affect the use and productivity of inputs. They also discuss factors that affect the formation and failure of cooperatives. The authors hypothesize that the availability, cost, and control of capital play key roles in the formation and continuation of cooperatives.

The authors next compare output produced per worker, output produced per unit of capital, and output produced per unit of timber input. They find that cooperatives have greater productivity per unit of timber input but lower labor productivity. The cooperatives also operate at larger scales than conventional firms. Craig and Pencavel isolate the effects of scale and differences in factor usage by estimating multifactor production functions. These production functions control for differ-

ences in input usage, scale, factor and product prices, and business-cycle effects. Their estimates suggest that cooperatives have slightly better productivities than conventional firms. Output supply function estimates reveal that cooperatives have lower output price elasticities. This latter finding suggests that cooperatives smooth production more than conventional firms when demand unexpectedly changes. In other words, cooperatives are less likely to reduce inputs and output when plywood prices fall or to expand inputs and output when prices rise.

Craig and Pencavel conclude that worker ownership does not have "first-order" consequences for the factor productivity of plywood product firms. Although they find that plywood cooperatives respond differently to demand and supply shocks, these responses do not seem to have much of an effect on firm productivity. The authors conclude by listing factors that affect the formation and survival of cooperatives in this and other industries.

Abernathy, Dunlop, Hammond, and Weil on Technology in Apparel Retailing

Many U.S. manufacturers face intense competition from foreign competitors. Frequently, foreign competitors have much lower labor costs than U.S. manufacturers. To compete, U.S. manufacturers often try to keep ahead technologically through investments in capital. The U.S. apparel industry is used as an example of a U.S. manufacturing industry hurt by cheap foreign labor and price competition. The authors argue that technological and organizational changes in the apparel industry are rapidly transforming firms and the nature of competition. To understand how industry competition is likely to evolve, one must understand these changes.

The authors base their study on an extensive field study, gathering sales, technology, inventory method, and supplier and retailer data from eighty-four apparel manufacturing companies. The data reveal that U.S. apparel firms have responded to foreign competition by increased integration to better manage costs. Central to this strategy has been the introduction of information systems that collect, process, and manage information on consumer demands and firm inventories. These systems permit apparel firms to reduce inventory costs and risks associated with

shifts in consumer tastes. When domestic apparel firms can keep this information and their information systems proprietary, they gain a comparative advantage over foreign competitors.

The paper begins by describing the history of competition and the structures of apparel firms, suppliers, and retailers. The authors note that the industry has recently shifted from an arms-length vertical structure to an increasingly integrated manufacturing-retailing channel. The survey data suggest that changes in information acquisition and information technologies have facilitated many of these changes. They also find that firms that have the greatest incentive to manage inventory costs are also the most likely to make investments in information technologies and inventory control systems. Perhaps the most intriguing finding is that firms that make these investments tend to perform better than firms that do not. Although it is unclear whether this result appears because better performing firms have more funds to invest or the opposite is true, this association suggests that information technologies are important sources of competitive advantage in the apparel industry

Jovanovic and Nyarko on Learning by Doing

Economists use learning curves to describe the rate at which output increases as workers or firms accumulate production experience. The economics and business literatures contain many studies that estimate learning rates for different activities and firms. Missing from most empirical studies is an analysis of what these estimates reveal about production technologies. The absence of such analyses makes it difficult for researchers to compare learning rates across studies or to suggest how managers might change production to increase output. Jovanovic and Nyarko provide a more complete model of learning. Their model generates an empirical "learning curve" from a model in which workers learn about the best input mixes to complete tasks or jobs. Besides providing a better economic foundation for estimated learning curves, their model provides specific predictions about the rates at which learning occurs.

Jovanovic and Nyarko's basic model treats learning as a "decision-theoretic" problem in which workers or managers learn about how best to combine inputs to produce output. The model divides production into

"runs." Workers or firms have some prior idea of how best to combine inputs in a given run. Production during a run is uncertain, and workers cannot perfectly predict what will happen for any specified input choice. Over time, workers observe how output changes as the input mix is varied. They then use this information to update their choice of inputs, thereby raising expected output. A key feature of the model is the Bayesian process by which workers or managers "learn" to update their production decisions.

Later sections of the paper extend the basic model to introduce two new ideas. First, the model changes learning to recognize that production tasks differ in complexity. The model then can explain why learning might differ when one worker performs three successive tasks than when three workers each specialize in one of the three tasks. Second, the authors model how learning changes when experience is not perfectly transferable across products or tasks. These extensions provide richer models of dispersion in learning rates among similar workers performing similar tasks.

The final sections of the paper illustrate how empirical researchers can use these models to estimate parameters that describe task complexity and the uncertainty present in tasks. From sample data on the inputs and outputs of twelve different activities, the authors estimate parameters that describe the complexity and randomness of production processes. In several samples, they find that randomness plays a major role in explaining observed differences in efficiency. Jovanovic and Nyarko argue that these findings are consistent with aggregate differences in estimated rates of total factor productivity growth.

Baily and Gersbach on International Competitiveness

Reductions in trade barriers have exposed domestic manufacturers to greater foreign competition. This competition has caused domestic companies to restructure and reduce costs. Comparisons of manufacturing costs and productivities of firms headquartered in different countries suggest that, although U.S. manufacturing firms have higher average productivity, Japan and some European countries are closing the gap. Cross-country comparisons of manufacturing productivity in specific industries provide a somewhat different picture, however. In some

sectors, Japan and Germany have the lead. International comparisons of firms in the same industry reveal even more dispersion in productivity. To date, relatively few studies have tried to explain these differences across countries, sectors, and firms. Baily and Gersbach summarize the results of a joint study with the McKinsey Global Institute that compared the productivity of U.S., German, and Japanese firms in nine industries. The authors conclude that a significant fraction of cross-border productivity differences can be explained by the exposure of each industry to "best-practice" technologies.

Baily and Gersbach begin by describing the results of an extensive field study conducted with McKinsey. To develop data on productivity differences, the authors and their associates collected data on the operations of firms producing comparable products in the United States, Germany, and Japan. These products are in the automotive, automotive parts, metalworking, steel, computer, consumer electronics, food, beer, and soap and detergent industries. The data primarily cover the 1980s. After adjusting for differences in the value of foreign currencies, the authors find that the data suggest the United States leads Germany in most of the nine industries but lags Japan in automotive industries, metalworking, consumer electronics, and steel. The authors offer two explanations for these differences. The most obvious is that the differences are caused by scale economies, input mix, and allocative differences. Baily and Gersbach develop heuristics for ranking the importance of these factors. They conclude that a significant fraction of observed productivity differences cannot be explained by these rankings.

Baily and Gersbach next argue that the residual productivity differences appear related to an industry's exposure to world markets and what they call "best-practice" technology. They develop this argument by ranking country-industry pairs according to the openness, or globalization, of the domestic market. They find a positive correlation between this globalization index and productivity differences, which they interpret as evidence that exposure to foreign competition increases productivity. The paper concludes by discussing the benefits of international versus national competition.