Ores and Scores:
Two Cases of How Competition Led to Productivity "Miracles"

BY SATYAJIT CHATTERJEE

Macroeconomists have devoted a great deal of effort to understanding the determinants of labor productivity. They've generally emphasized variables such as capital stock per worker, technology, the quality of the workforce, and laws and regulations that govern production. Recent research has shown, however, that this conventional view may leave something out: the degree of competitive pressure faced by a production unit. In "Ores and Scores," Satyajit Chatterjee examines two cases in which increased competition in the product market caused dramatic improvements in labor productivity: iron mines in the Midwest and public schools in Milwaukee.

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The standard of living enjoyed by a nation's residents derives from the productivity of those residents. Given the large differences in the standard of living across countries (and over time for many countries), macroeconomists have devoted a great deal of effort to understanding the determinants of labor productivity. In doing so, they have generally emphasized the positive role of the capital stock per worker (or the stock of material means of production per worker), the sophistication of the technology embodied in that stock, the quality of a country's workforce, and laws and regulations that govern production.

Recent research has shown that this conventional view of the determinants of labor productivity may be incomplete. Aside from the determinants listed above, the *degree of competitive pressure* faced by a production unit can also importantly influence the unit's labor productivity. Specifically, this research has brought to light two examples of increased competition in the product market that caused dramatic improvements in labor productivity. The two cases concern ore production at midwestern iron mines and student achievement in the Milwaukee public schools — hence, the title of the article.[1]

The findings of this research are indeed noteworthy. As we are all aware, falling trade barriers, declining communication costs, and economic development elsewhere in the world are exposing increasing numbers of U.S. businesses to competition from low-cost rivals, both foreign and domestic. This increased competitive pressure was most intense during the years 2001 to 2003, when the U.S. manufacturing and high-technology sectors encountered a three-year slump in demand and the U.S. labor market did poorly in general. Remarkably, during these difficult years, output per hour in the U.S. nonfarm business sector rose at an average annual rate of 3.8 percent per year — well *above* the 2.2 percent rate recorded during the "boom" years of 1995 to 2000.[2] One cannot help but wonder if there is a causal link between increasing competitive pressure and the faster pace of productivity growth.

However, national (or macro-level) labor productivity can grow for many reasons, not the least of which is the fact that during a downturn, average labor productivity of businesses could rise simply because the businesses that fail (and exit) tend to be the ones with below-average labor productivity. This Darwinian selection is a well-known channel through

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[1] These cases have been described in the article by Jose Galdon-Sanchez and James Schmitz and the article by Caroline Hoxby.

[2] The data on which this calculation is based are those available on the BLS web site (www.bls.gov) as of January 8, 2005.

which competition affects national, or industry-level, productivity.

But the noteworthy aspect of the two studies reviewed here is that each examined the impact of increased competition on labor productivity at the *micro* level, that is, at the level of production units that were in operation both before and after the change in competitive pressure. Thus, each study establishes the existence of a causal link running from increased competitive pressure to higher labor productivity that is distinct from the effect of Darwinian selection.

Furthermore, the studies shed new light on the determinants of labor productivity. In principle, increased competitive pressure could increase labor productivity via changes in the conventionally recognized determinants of labor productivity. In both cases, however, the increase in productivity was accomplished without any change in technology, worker quality, or regulation. Capital stock per worker (more generally, inputs per worker) did change, but the effect of this change was too small to plausibly account for the large change in labor productivity. In fact, the increase in productivity resulted from a change in how work was organized within the production unit. Thus, this research reveals that the organization of work, or *work rules*, is an important determinant of labor productivity as well. More crucially, the research shows that work rules respond to competition: When competitive pressure is high, production units choose work rules that enhance labor productivity.

The fact that more productive work rules are adopted under pressure suggests that workers might view such rules with disfavor. After reviewing the two studies, I will discuss some reasons why workers might resist more productive work practices. One reason could be job security if workers fear that jobs

would be lost with the adoption of more productive work rules. This possibility probably explains why midwestern mines did not adopt more productive work rules prior to the steel crises. Another reason could be the higher work intensity – and the attendant costs of stress and fatigue — associated with more productive work rules. This possibility probably explains why work practices in poorly performing Milwaukee public schools changed only after

the voucher program was instituted.

This discussion is useful also because it identifies the types of industries (or occupations) in which resistance to productive work practices can be effective and for which, therefore, an increase in competitive pressure might be expected to raise labor productivity significantly.[3] I use this identification to suggest that the ongoing (indeed, accelerating) diffusion of cutting-edge technologies outside of the industrialized world may be wearing down workers' resistance to more productive work practices in many occupations and sectors of the U.S. economy. Indeed, recent productivity and compensation trends in the U.S. may be starting to show the

footprints of the competitive-pressure effect documented so clearly by the studies reviewed here.

A PRIMER ON LABOR PRODUCTIVITY

For a business enterprise, labor productivity is the ratio of the *value-added* by the production unit over a given period of time — say, a year — to the total number of *full-time equivalent* workers employed by the

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production unit over that same period.[4] The value-added by a production unit is simply the total value of goods and services produced by the production unit over a given period less the value of all goods and services purchased by the production unit from other firms and used up in production in that period. It's a measure of the value of work done by the production unit over the given period. The number of full-time equivalent workers is simply the total of all full-time workers employed by the production unit over the same period of time plus the full-time equivalent of all part-time workers.[5] Thus, the labor productivity of a business

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[3] Unfortunately, micro-level studies of labor productivity that exploit differences in the degree of competitive pressure (on production units) resulting from an outside event are relatively rare. Consequently, it is not possible to directly measure the scope of the competitive pressure effect seen in the case of the midwestern iron mines and the Milwaukee public schools. One other micro-level study that also documents the positive effect of competition on labor productivity is by Harry Bloch and James McDonald for a group of Australian firms.

[4] An example of material used up in production is the iron ore used in the production of steel. When we calculate value-added by a steel company over a month, the cost of the iron ore used up during the month is subtracted from the dollar value of the steel produced that month. The cost of other inputs purchased from firms and used up in production is similarly subtracted from the dollar value of production.

[5] For instance, a firm that has 50 full-time employees working 40 hours per week and six part-time employees working 20 hours per week will have a total of 53 full-time equivalent employees.

enterprise is a measure of the average value contributed by workers over a given period.[6]

For the purposes of this article, it is important to know the kinds of things that can affect labor productivity. In this regard, the most important point to grasp is that labor productivity is a *flow* measure; that is, it has a unit of time associated with it (such as a year). Therefore, one way in which labor productivity can vary is simply through the volume of work a worker can perform in a given amount of time. A production unit in which workers can handle a greater volume of work in a given amount of time will have higher labor productivity.

The volume of work a worker can perform depends, in turn, on several factors. A very important one is the technology and capital stock a worker has access to in the production unit. For instance, a large and highly automated manufacturing plant makes it possible for workers to handle a very high volume of work. Similarly, office workers are able to handle a higher volume of work if they are aided in their tasks by computers and software. Thus, the capital stock per worker is an important determinant of labor productivity.

In addition, there are intangible (but no less important) factors. Workers with high cognitive ability and longer work experience accomplish more in a given period, and labor productivity will be higher in a production unit with better educated and more experienced workers. Also, every production unit operates under a legal and regulatory framework specific to its location of operation. For instance, a manufacturing plant must abide by national or state pollution control laws that might constrain how much output it can produce in any given period. Thus, laws and regulations are also another determinant of labor productivity.

Broadly speaking, these four factors (the capital stock per worker, the level of technology, worker quality, and laws and regulations) have garnered the most attention from economists seeking to understand the determinants of labor productivity. Now let's turn to the evidence that suggests that

the degree of competition can also influence productivity through the choice of work rules.

COMPETITIVE PRESSURE AND THE PRODUCTIVITY OF IRON ORE PRODUCERS

The U.S. iron ore industry is located in the Midwest. Because iron ore is heavy and costly to transport, U.S. ore producers supply ore only to U.S. steel producers located in the Great Lakes region. Between 1979 and 1982, the U.S. economy experienced two recessions, almost back-to-back.[7] This was also a period of depressed economic conditions in most of the industrialized world. As a result, world demand for steel fell sharply, and this decline hit the U.S. steel industry hard. The production of steel declined almost 50 percent between 1979 and 1982.

Since iron ore is used almost exclusively as an input in the production of steel, the shrinkage in the demand for steel led to a corresponding decline in the demand for iron ore. Indeed, the demand for iron ore fell about 50 percent as well. Furthermore, the decline in the world market for steel led to a scramble by ore producers all over the world to find new customers. In the process, despite the huge distances involved, Brazilian mines began shipping iron ore to steel producers in the Chicago area. Thus, both the shrinkage in the demand for iron ore and the appearance of a competitor led to increased competitive pressure on U.S. iron ore producers.[8]

The increase in competitive pressure coincided with a remarkable

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[6] Labor productivity can also be measured as output generated per hour of work. Indeed, a commonly used statistic on labor productivity in the U.S. (available from the Bureau of Labor Statistics) is output per hour of work in the nonfarm business sector.

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[7] In terms of the unemployment rate and loss of GDP, the recession in 1982 was the worst U.S. recession since World War II.

[8] Galdon-Sanchez and Schmitz define increased competitive pressure as an increased likelihood of business failure.

change in the labor productivity of iron ore mines. As José Galdon-Sanchez and James Schmitz document, between 1965 and 1978, there was essentially no change in the labor productivity of U.S. iron ore producers. After 1982, labor productivity began to increase rapidly, and by the late 1980s, the productivity of U.S. iron ore producers had *doubled*.[9] But coincidence does not imply causality. Perhaps labor productivity would have risen even without the increase in competitive pressure. To be sure that the increase in labor productivity resulted from increased competitive pressure, Galdon-Sanchez and Schmitz compared how the collapse of the world steel market affected ore producers in other countries. This comparison is informative because the collapse affected ore producers differently in different countries.

Excluding the United States (which was the third largest producer of ore in 1980 among non-Communist countries), iron ore is produced in significant quantities in seven other countries. In order of volume of production in 1980, these countries are Brazil, Australia, Canada, India, France, Sweden, and South Africa. Based on the average cost of ore production in each country and the location of a country's mines relative to its centers of steel production, Galdon-Sanchez and Schmitz sorted countries according to the degree of competitive pressure experienced as a result of the steel collapse. According to the authors' calculations, mines in Australia, Brazil, and India faced the

smallest increase in competitive pressure, while mines in the U.S., Canada, France, South Africa, and Sweden faced the highest increase.[10] When Galdon-Sanchez and Schmitz looked at how labor productivity evolved in each of these countries, they found that countries that faced the smallest increase in competitive pressure — namely, Australia, Brazil, and India — experienced the smallest increases in labor productivity after the steel collapse. All of the other countries

After 1982, labor productivity began to increase rapidly, and by the late 1980s, the productivity of U.S. iron ore producers had *doubled*. But coincidence does not imply causality.

experienced much higher increases in labor productivity.[11]

Galdon-Sanchez and Schmitz present persuasive evidence that the increase in the labor productivity of U.S. mines was a consequence of increased competitive pressure. The next important question is how this increase was achieved. Remarkably, Galdon-Sanchez and Schmitz argue that the increase in the labor productivity of U.S. mines cannot be accounted for by changes in traditional

determinants of labor productivity.[12] There were no improvements in technology or worker quality and no changes in regulations governing ore production. Capital stock per worker did rise, but the rise was not large enough to account for any significant proportion of the remarkable increase in labor productivity.

Galdon-Sanchez and Schmitz also investigated if mines were shifting into the production of higher quality ore (which would presumably fetch more

in the marketplace, thus boosting value-added and labor productivity), but they found no evidence of such a shift. They also determined that labor productivity did not go up because ore producers were shutting down low-productivity mines.[13] In their words, the increase in labor productivity occurred in "continuing mines, producing the same products and using the same technology as they had before the 1980s."

This, of course, raises the question as to what exactly happened in these mines. In a recent article, Schmitz investigated this issue in detail. It turns out that the increase in labor productivity resulted mostly from changes in *work rules*. In most cases, these changes involved an expan-

[9] It's worth pointing out that there was no such dramatic shift in productivity growth at the national level. Output per hour in the nonfarm business sector rose at an annual rate of 2.2 percent between 1965 and 1978 and at an annual rate of 1.97 percent between 1983 and 1990.

[10] These calculations are based on cost, including freight of ores from various countries. For instance, mines whose basic cost of ore production is relatively low and whose distance from the closest center of steel production is small will face the smallest increase in competitive pressure. These mines will, in effect, be the mines of choice for some steel producers. Thus, shrinkage in the world demand for steel will affect low-cost, close-in producers the least while affecting the high-cost, far-out mines the most.

[11] The only exception to this pattern is France, where labor productivity declined steeply during the 1990s. Iron ore production is nonexistent in France at present.

[12] This point is made in more depth in the recent article by Schmitz.

[13] If an ore producer shuts down mines with low labor productivity, the producer's labor productivity will rise simply because there are fewer low-productivity mines pulling down the average labor productivity of the ore producer.

sion in the set of tasks a worker was required to perform. For example, the changes required equipment handlers to perform routine maintenance on their equipment. Before, this maintenance was the responsibility of repairmen. In addition, the new work rules insisted on a flexible assignment of work; that is, a worker was required to occasionally do tasks assigned primarily to another worker. In both cases, the new work rules led to better use of a worker's time.

To summarize, the evolution of the labor productivity of U.S. iron ore mines during the 1980s shows that labor productivity depends on more than just the stock of material means of production, worker quality, and regulations. It also depends on the work rules in place. Furthermore, work rules appear to be a choice variable. When competitive pressure is high, the production units choose work rules that enhance labor productivity.[14]

SCHOOL CHOICE, COMPETITIVE PRESSURE, AND SCHOOL PRODUCTIVITY

Let's turn now to another example of increased competitive pressure leading to higher productivity: public schools in Milwaukee. Since schools don't sell their "output" in the marketplace, the notion of labor productivity defined earlier is not directly applicable. In this context, we can take productivity to mean what taxpayers get for their money: average student achievement of a school divided by per pupil school expenditures.[15]

The Milwaukee school district introduced school vouchers for poor students in the 1991-1992 school year. With a voucher, an eligible student could go to a private school and have about $5000 of tuition costs reimbursed. The public school district that lost the student would lose about 29 percent of its per pupil revenue. Although many students were eligible for vouchers, the number of vouchers given was capped at 1 percent of public school enrollment. After a long legal dispute, however, this cap was raised to 15 percent, starting with the 1998-1999 school year.[16]

As in the iron ore case, it's possible to classify Milwaukee public schools according to the degree of competitive pressure faced as a result of the voucher program. This classification is based on the fraction of students eligible for vouchers in a school district. Because eligibility depends on household income, this fraction varies widely. Some school districts had more than 90 percent of students eligible for vouchers and others as few as 25 percent. Caroline Hoxby classified school districts with at least 67 percent of students eligible for vouchers as being under the most competitive pressure, while those with less than 67 percent as being under moderate competitive pressure.

Hoxby compared school productivity (the percentile score of a school's fourth-grade class in different subjects per $1000 of per pupil spending) for 1996-1997 (the last year before the

cap was raised to 15 percent) with school productivity in 1999-2000. She finds that school productivity rose 46 percent and 56 percent for math and science and 23 percent and 11 percent for social studies and language in the schools under the most competitive pressure. In contrast, schools under moderate competitive pressure showed increases of 10 percent, 45 percent, 10 percent, and 4 percent, respectively.

To be confident that the increase in school productivity was the result of increased competitive pressure, Hoxby compared the performance of Milwaukee schools with that of other Wisconsin schools that were not part of the voucher program. For this comparison, she selected Wisconsin schools outside of Milwaukee that resembled Milwaukee schools as much as possible. For this comparison group she found increases in school productivity — in math, science, social studies, and language — of 18 percent, 9 percent, and 4 percent, and a decline of 10 percent, respectively, between 1996-1997 and 1999-2000.

Thus, for every subject, the ranking by percentage increase in school productivity was identical. Schools under the most competitive pressure showed the greatest increase, schools under moderate competitive pressure showed the second largest increase, and schools under no competitive pres-

[14] The reasons competitive pressure and labor productivity are linked are discussed later on in the article.

[15] See Caroline Hoxby's article for a more detailed discussion of this measure and Theodore Crone's article for a discussion of student scores as a measure of school achievement.

[16] Hoxby studies the impact of this reform in detail because it satisfies three critical requirements: "(1) there is a realistic possibility that at least 5 percent of regular public school enrollment could go to choice schools, (2) the regular public schools lose at least some money when a student goes to a choice school, and (3) the reform has been in place for a few years." Clearly, (1) and (2) are necessary conditions for a reform to generate competitive pressure on a public school.

sure showed the smallest increase.[17]

What factors contributed to this increase in productivity? In her discussion, Hoxby notes some of the ways a school superintendent could raise the performance of his or her school. These include re-allocation of teacher effort toward basic skill-building classes such as reading and math and rewarding teachers whose students showed improvement in scores while letting unproductive staff go (i.e., moving to more performance-based compensation). Thus, it would appear that these increases in productivity were also the result of changes in work rules.[18]

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[17] Hoxby's findings have attracted a lot of attention. In a somewhat related study, Cecilia Rouse found that Milwaukee students who took advantage of the voucher program and transferred to private/parochial schools did only somewhat better in math and not at all in reading. Although students who left Milwaukee public schools are not Hoxby's focus, Rouse's findings have led some to question the usefulness of school choice as a way of raising student achievement. In a more recent study, Rajashri Chakrabarti has analyzed the impact of the Florida voucher program and re-affirmed the importance of voucher programs in providing incentives to improve school productivity.

[18] However, the nature of the voucher program complicates this inference for the following reason. When a student uses the voucher program, the school that loses the student loses only 29 percent of per pupil revenue. Consequently, schools that lose students to the voucher program see an *increase* in the resources available per (remaining) pupil (provided, of course, the overall school budget does not change for some other reason). Increase in per pupil spending is akin to an increase in inputs, and that could be a factor in the improved performance of schools. Schools under the most competitive pressure did see an increase in average spending per pupil. This increase was about 6 percent. Over the same period, the comparison schools outside of Milwaukee saw an increase of 2 percent in per pupil spending. This suggests that spending per pupil in the schools under the most competitive pressure probably rose about 4 percent as a result of the voucher program. Of course, the price of education inputs probably rose over this period as well, so that the actual real increase in spending per pupil was less than 4 percent. Unless an increase of 4 percent or less in spending per pupil had a huge effect on school productivity, most of the increase in school productivity probably resulted from changes unrelated to the quantity of inputs.

WHY DOES COMPETITION AFFECT THE CHOICE OF WORK RULES?

The main lessons to be drawn from these two studies are that work rules are an important determinant of labor productivity and that work rules respond to competition. Why might this be so? Although the connection between competition and productivity may seem obvious, there is something to be gained from thinking carefully about it.

Thinking generally about the fact that more productive work rules are adopted under pressure suggests one of two things. First, it may be that more productive work rules are invented only when the need for such rules becomes acute. In other words, necessity may be the mother of invention in the case of work rules (as in so much else). Alternatively, the knowledge of more productive work rules may exist, but such rules are adopted only under pressure because workers view such rules with disfavor. In what follows, I will leave aside the issue of organizational innovation and consider only the second alternative in more detail. Therefore, I will focus on the case of relatively simple changes in work rules that raise labor productivity.

Why might workers view more productive work rules with disfavor? One possibility is that workers experience increased job insecurity as a result of such rules; that is, workers associate more productive work rules with a higher likelihood of job loss.[19] Certainly, more productive work rules mean that any given level of output can be produced with fewer work-

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[19] This discussion draws heavily on the 2004 paper by James Schmitz and on the book by Stephen Parente and Edward Prescott. Parente and Prescott discuss barriers to the adoption of new technology (as opposed to work rules), but much of what they say is relevant for the choice of work rules as well.

ers. With no change in a firm's sales, adopting more productive work rules will result in some workers being laid off. Workers as a group may then resist adopting the rules until a crisis threatens business failure and the loss of *all* jobs. Then, the more productive work rules will be adopted because doing so saves some jobs that would otherwise be lost.

But one must ask under what circumstances workers can actually resist more productive work rules. Three conditions must be satisfied. First, if owners (or their representatives, the managers) can unilaterally dictate work practices, they can insist that more productive work rules be adopted. Because such rules increase profits — at a minimum, the firm can produce the same output with fewer workers and hence at lower cost — owners obviously have an incentive to do so. Thus, for there to be any resistance at all, the right to dictate work practices must reside partially with workers.

Second, a *new* firm does not have to face established employees worried about job security and can therefore adopt the more productive work rules. If workers in established firms do not have the right to dictate work rules in new firms, and if the threat of competition from new entrants is sufficiently real, workers in established firms will feel compelled to adopt more productive work rules as soon as these rules become known.[20] Thus, the threat of a new entrant with more productive work rules must be low or nonexistent.

Finally, it must be in workers' interest to resist more productive work rules. That depends on whether the firm can sell the additional output — delivered by an unchanged number

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[20] Entry by a more efficient competitor is like a crisis: It threatens business failure and the loss of all jobs.

of workers using more productive work rules — without precipitating a large drop in price. If the firm is a small player in a big market, the increased production may cause little or no drop in price. In this case, the firm's revenue will go up without any increase in costs. By passing on some of the additional revenue to workers, the firm can induce workers to accept the more productive work rule. Thus, for job security to be an issue, the firm must be large relative to the market it serves.

These three conditions — the worker's right to partially dictate work rules, barriers to entry by new firms, and large firm-size relative to market — are features of monopolistic industries.[21] Thus, workers in monopolistic industries may have the ability and the incentive to resist productive work rules for job security reasons. The mining example certainly fits this pattern. Work practices in the midwestern mines were partially under the control of labor unions, so managers could not unilaterally dictate work practices. The high cost of shipping iron ore over long distances kept the threat of entry by new firms low. Finally, the midwestern mines were big relative to their market — there being only a handful of mines serving the Great Lakes steel producers. Thus, loss of job security could explain why miners resisted more productive work rules until the steel crisis broke that resistance down. Indeed, when these rules were adopted, the mines eliminated a significant number of jobs.

But loss of job security cannot be the reason some Milwaukee public schools had poor student achievement prior to the voucher program. Better student scores would have led to teachers being lauded rather than being laid off! To understand this example, we must consider the possibility that workers may view more productive work rules with disfavor because such rules demand more effort and therefore feel more onerous. This possibility seems natural if we recall that labor productivity is determined by the volume of work handled by a worker. Since a higher volume of work — with no change in technology or capital stock per worker — is likely to be associated with a higher level of work intensity, work rules that promote higher labor productivity may well feel more onerous to workers.

But, again, we must ask under what circumstances would workers have the ability to resist more onerous but more productive work rules and whether they would have an incentive to do so. Let's assume that workers have the right to at least partially dictate work practices and that the threat of entry by new firms with more productive work rules is low or nonexistent. Then workers would certainly be able to resist changes in work rules. Further, let's assume that workers do not fear the possibility of job loss from adopting the work rule — the firm is a small player in a big market.

Because work rules are onerous, workers would want additional compensation to offset the costs associated with adopting the rule. If the maximum additional compensation

that owners can pay is less than the minimum workers will accept, the rule would not be adopted. The additional compensation demanded by workers will depend importantly on what happens if the rule is not adopted. If the refusal to adopt results in both workers' and owners' carrying on as before, there will be less urgency on the part of workers to adopt the rule. In such circumstances, workers will be aggressive in their demand for additional compensation, and the rule may not be

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adopted. On the other hand, if the refusal to adopt results in an impairment of the firm's ability to compete and thereby raises the likelihood of layoffs or business failure, workers would be less aggressive in their demand, and the rule is more likely to be adopted.[22]

This logic can make sense of the voucher program's effect on Milwaukee public schools. Since teachers unions partially dictate work practices, one of the preconditions for resistance to changes in work rules is certainly met. By its nature, entry into the "market for public schools" is restricted, so the

[21] Strictly speaking, a fourth condition must also be met. One must ask why a firm with too many workers doesn't buy its excess workers out – paying for the buyout from future reductions in operating costs. Schmitz observes that a firm's ability to finance the buyout will depend on its borrowing capacity. But because a firm has the option to default on its debt, the amount it can credibly borrow may not be sufficient to cover the cost of a full buyout. Consequently, it may not be possible to buy out all excess workers.

[22] For readers familiar with the theory of bargaining, I should point out that (Nash) bargaining will lead to an efficient outcome. That is, all work rule changes that are sufficiently productive would be adopted, and workers would be adequately compensated for putting up with the rules. But the requirement of efficiency does not pin down the compensation work rule package because there are many efficient packages. Which efficient package is picked will depend on the outside options of workers and owners. When workers' outside options deteriorate, the bargaining will move the compensation work rule package in the direction that makes workers worse off and owners better off; that is, compensation will fall and work rules will become more onerous.

second pre-condition is also met. Before the voucher program was set up, the incentive to adopt work practices that improved school performance was weak because failure to adopt meant the status quo. But by giving a significant fraction of students the option to withdraw from poorly performing schools, the voucher program linked a school's nonperformance to loss of resources and, possibly, jobs.[23] Since improvement in school performance would presumably obviate the need for parents to switch schools, there was now a stronger incentive to adopt work rules that enhanced school performance.

IMPLICATIONS FOR RECENT PRODUCTIVITY AND COMPENSATION TRENDS

So far the discussion has emphasized workers' right to partially dictate work practices and the low threat of entry by new firms as two important pre-conditions for workers to successfully resist more productive work rules when they have an incentive to do so. But the workers' "right" to dictate work practices and barriers to entry by new firms are, to some degree, features of every U.S. industry. Although the bulk of the U.S. workforce is not unionized, workers exert considerable influence on the choice of work rules because a business can ignore worker preferences concerning work practices only at the cost of (excessive) employee turnover. Similarly, while most U.S. industry is generally open to competition, established firms in any industry wield considerable advantage over new entrants, an advantage that constrains how well new entrants can compete with established firms. Thus, the choice of work

rules will be influenced by the "bargaining strength" of workers to some degree in every industry. When that bargaining strength is weakened, there will be a tendency for more productive work rules to be adopted.

Competitive pressure and the choice of work rules may be relevant in understanding recent productivity and compensation trends in the U.S. As noted earlier, the U.S. economy has experienced significantly faster growth

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in labor productivity since 1995. Interestingly, between 1995 and 2000, the growth rate of output per hour in the nonfarm business sector was roughly matched by the growth rate of hourly compensation, adjusted for inflation, in this sector.[24] Economic theory predicts that productivity growth that is due to the diffusion of new technology should result in a comparable increase in the growth rate of compensation per hour. Since this is what happened, neither the pickup in productivity growth nor the pickup in compensation per hour is mysterious. Both are generally attributed to the diffusion of new technologies.

Since 2001, however, the situation has been quite different. The growth rate of worker compensation per hour has not kept pace with the growth rate of labor productivity.[25] Why has this happened? One possibility is that the recession, by raising the likelihood of business failure, weakened workers' resistance to more productive work practices. This would explain why productivity has risen without a comparable increase in labor compensation. But a more important force working in the same direction is the ongoing diffusion of modern technology to countries outside the developed world. This diffusion is gradually increasing the threat of entry by new low-cost producers in many lines of business, a trend that has become particularly noticeable since the late 1990s. Perhaps this development is also contributing to a weakening of worker resistance to more productive work practices.

It's worth noting that regardless of the reasons for worker resistance to more productive work practices, some workers are made worse off by the adoption of such rules. Thus, the benefits stemming from improved labor productivity must be set against the loss experienced by some workers. It's natural, then, to wonder whether this offset completely swamps the benefits. Historically, improvements in labor productivity have served as the foundation for a general improvement in the standard of living, even when the improvements initially affected some portion of the population adversely. There is no reason yet to think that the same will not be true of the ongoing improvements in labor productivity.

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[23] Withdrawal of a sufficiently large number of students would result in the loss of teaching positions and, therefore, in the loss of jobs for some teachers.

[24] Output per hour grew at an annual rate of 2.2 percent, while hourly compensation grew at an annual rate of 2.0 percent.

[25] Over these three years, output per hour in the nonfarm business sector rose at an annual rate of 3.8 percent, while hourly compensation rose at an annual rate of only 1.5 percent.

CONCLUSION

The concept of labor productivity is an important one in macroeconomics. Economists who study the determinants of labor productivity generally focus on the positive role of the capital stock (the material means of production), the level of technology embedded in that stock, worker education, and laws and regulations. Two recent research studies suggest that this list ought to be amended to include the choice of work rules as well. These two studies — one dealing with the productivity of iron ore mines and the other with that of public schools — clearly demonstrated that an increase in competitive pressure can lead to adoption of work rules that enhance labor productivity.

The studies used a very similar methodology to make their case. The first step was to identify an event that led to increased competitive pressure on production units. In the case of the midwestern iron mines, it was the collapse of steel production in the early 1980s; in the case of the Milwaukee public schools, it was the introduction of a voucher program. The next step was to sort production units (mines and public schools) by the degree of increased competitive pressure faced as a result of that event. Then, in the final step, the change in pre- and post-event labor productivity of the production units that faced the most increase in competitive pressure was compared with the change in pre- and post-event productivity of units that faced the least increase in competitive pressure. Both studies found that labor productivity grew most in the units that faced the most increase in competitive pressure.

If adopting more productive work rules had no adverse consequences for workers, it would be hard to understand why a more productive work rule would not be adopted as soon as workers or owners think of it. The fact that such rules are adopted under pressure suggests that workers lose something from adopting such rules. More productive work rules may result in loss of jobs, and workers, understandably, resist such rules. Alternatively, more productive work rules may require workers to handle a greater volume of work, a situation that may make such rules seem onerous. These reasons could explain why productive work rules are not adopted until increased competitive pressure forces workers to relent.

Competitive pressure on a business goes up when it experiences a decline in demand for its product. Such declines can happen during a downturn or when the firm encounters new low-cost rivals vying for customers. Since 2000, we have seen both. There was a recession and increased competition from firms in the developing world. Arguably, these developments may account for why the pace of productivity growth has risen and why the pace of labor compensation growth has slowed since 2000. For this reason, the evidence on the role of competitive pressure in labor productivity reviewed in this article is noteworthy and relevant. ®

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