The Ledger

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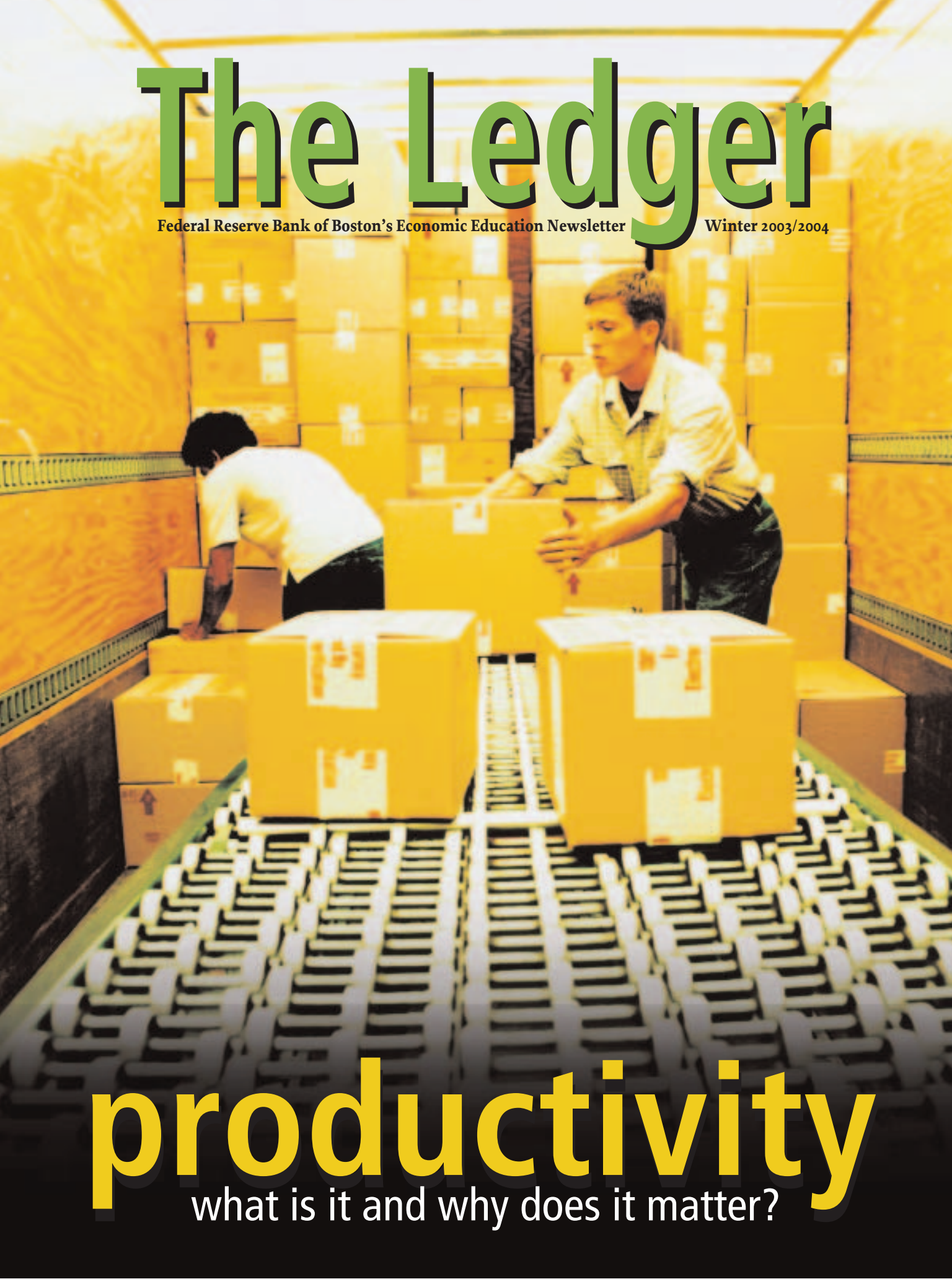

productivity

what is it and why does it matter?

The Ledger

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in this issue

productivity matters

When one of your toes pokes through a sock, or your elbow wears away your sleeve, do you:

a) reach for a sewing kit?

or

b) grab your wallet and head for a clothing store?

For most of us, this is an easy one. Why fumble with a needle and thread when good quality clothing is so inexpensive?

Wait! Did someone say *in*expensive?

Well . . . yes.

The price tags on our clothes may be higher than they used to be, but the amount we spend on clothing accounts for a much smaller share of our total spending. In fact, the three essentials of life — food, clothing, and shelter — each claim a smaller share of our personal consumption expenditures today than they did in the past.

Even in categories that claim a larger share — transportation, recreation, and medical care — you could make the case that we're getting more for our money. Our cars are better-equipped, our forms of recreation are more varied, and the quality of our medical care is considerably better than it was 100 — or even 20 — years ago.

But perhaps the most striking difference between past and present is that we now expend far less time and effort to clothe and feed ourselves — two tasks that were once the primary focus of life for most Americans. Take the example of Julia Baker Kellog, an upstate New York farm wife, who made the following entry in her diary on November 1, 1883:

"Went to Olmsteadville. Sold 60 pairs of socks. Got lots of things."

PERSONAL CONSUMPTION EXPENDITURES

1929 versus 1999

Selected Categories, Percent of Total

	1929	1999
Food	27.4	15.4
Clothing	14.5	6.3
Housing	15.1	14.5
Household operation	13.8	10.8
Medical care	4.0	17.6
Transportation	9.9	11.4
Recreation	5.7	8.4

Source: U.S. Census Bureau.
Statistical Abstract of the United States, 1999 , Table 1424.
Statistical Abstract of the United States, 2002, Table 639.

Left unsaid was the fact that those 60 pairs of socks represented her entire output for the fall season (http://adirondackhistory.org).

By contrast, production levels at a 21st century American sock factory often reach 2500 pairs of socks per *worker per week*. Or to look at it another way, one person working at home in 1883 produced approximately seven pairs of socks per week, whereas one person working as part of a team in a modern factory now produces 2500 pairs in the same period of time.

Farm production numbers tell a similar story. In 1800, 73.7 percent of the American labor force worked in agriculture — three out of four workers toiled to meet just two basic human needs: food and fiber.

Two hundred years later, only 2.3 percent of the labor force still worked in agriculture, yet we were producing more food than ever — and we were producing it far more efficiently.

And therein lies the key to our improved standard of living. If there's one thing most economists agree on, it's this: Improvements in our material standard of living depend on increases in productivity.

Sounds simple enough. But if we had to explain it to a friend, many of us would be hard-pressed to say exactly why productivity has an impact on how well we live. In fact, we might even have trouble explaining what productivity is.

Which is why this issue of *The Ledger* will focus on productivity — what it is and why it matters.

YIELD PER ACRE

(bushels/rounded to nearest bushel)

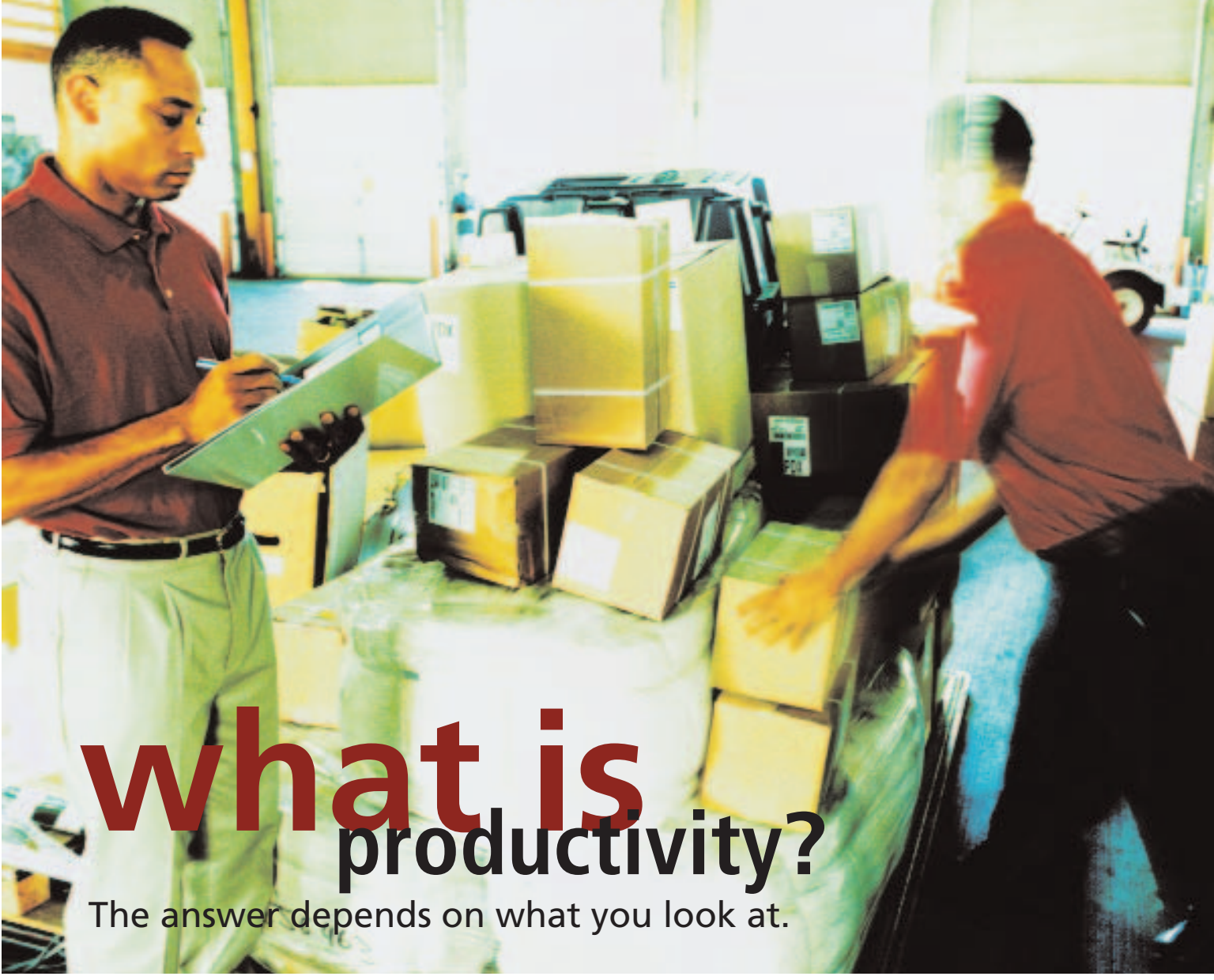
	1800	1900	2000
Wheat	15	14	40
Corn	25	16	138

Source: *Historical Statistics of the United States*, U.S. Census Bureau, and U.S. Department of Agriculture.

WORKER-HOURS REQUIRED TO PRODUCE 100 BUSHELS

	1800	1900	2000
Wheat	373	108	3 to 5
Corn	344	147	3

Source: *Historical Statistics of the United States*, U.S. Census Bureau, and U.S. Department of Agriculture.



what is productivity?

The answer depends on what you look at.

Labor Productivity

When news stories mention "productivity," they almost always mean *labor productivity*, which measures the output that an hour of labor produces. Often expressed as "output per hour" or "output per worker-hour," labor productivity tends to focus on manufacturing rather than services because manufacturing output is easier to quantify.

Measuring productivity at an auto assembly plant, for example, is fairly straightforward. It's either:

- **a physical measure —** the total number of cars produced in a given period of time (a week, a month, a year) divided by the number of worker-hours needed to produce them, or

- **a monetary measure —** the total dollar value of cars produced in a given period of time divided by the total number of worker-hours needed to produce them.

And if you want productivity figures for the *entire* auto industry, the numbers are readily available. The Big Three — Daimler-Chrysler, Ford, and General Motors — know exactly how many vehicles roll off their assembly lines, and they have an accurate idea of how many hours their employees work.

Measuring labor productivity in services industries is more of a challenge. Take nail salons, for example. Theoretically, you could gauge the productivity of a single nail salon if someone kept track of how many manicures the staff performed in a week or a month. But you'd have a tough time mea-

suring productivity for the entire industry because there are thousands of nail salons, and no one keeps track of how many manicures and pedicures they perform.

To learn more about the fine points of measuring labor productivity, visit the U.S. Bureau of Labor Statistics web site: **http://www.bls.gov/lpc/faqs.htm**

Another View: Multifactor Productivity

Whereas labor productivity measures the output per unit of *labor* input, *multifactor productivity* looks at a combination of production inputs (or factors): labor, materials, and capital. In theory, it's a more comprehensive measure than labor productivity, but it's also more difficult to calculate.

To get a better handle on the difference between labor productivity and multifactor productivity let's look at what economist Jack Triplett had to say on this topic during a panel discussion organized by the National Association of Business Economists in 2001.

Here are Jack Triplett's remarks:

"Let's look at equation 1:

(1) Labor Productivity (output per hour)=Output/Labor Inputs

"Labor productivity is the output per hour worked. When we examine labor productivity, our units of measurement are always rates of growth rather than levels.

"Let's now look at equation 2:

(2) Multifactor Productivity=Output/(KLEMS)

"Multifactor productivity growth is the rate of growth in output relative to the rate of growth of all production inputs. In equation 2, KLEMS represents all production inputs: K is capital services; L is labor services; E, energy; M, materials; and S refers to purchased services — business services, for example. It is a complicated index number — the idea is to get a measure of the change in output relative to the change in all of the inputs.

"I like to tell an anecdote that illustrates the difference between labor productivity and multifactor productivity. A number of years ago I visited a machine tool plant that made very, very high-tech machine tools. It was quite an old plant — built in the nineteenth century. It had three stories. Workers always brought the materials in on the first floor, did the subassemblies on the second floor, and the final assembly on the top floor. They had always done it that way. Over the years the machines got bigger and bigger so that it became difficult to get them down from the top floor. One day someone said, "Why don't we just bring the materials in on the top floor and do the final assembly on the bottom floor?" So they did and the result had a big positive effect on productivity.

"Now, that's an illustration of multifactor productivity in the sense that somebody had a bright idea that resulted in the change in the labor productivity — not because there was a big technical change but because it was a good idea. Did it change labor productivity? Sure, because more output was produced with the same number of workers or a smaller number of workers. Did it change multifactor productivity? Well, that's a little more complicated because you've got KLEMS. Suppose that a management consultant had made the suggestion.

Management consultants are "S." And suppose the management consultant had been paid the discounted stream of saving over this period — then it would show up as "S" and would have no increase in multifactor productivity output. But suppose this had just been a bright idea from a worker who said, "Hey, I'm tired of getting these machines down from the top floor — let's change this." He didn't get paid for it. Then there's no input that's accounted for, and in conventional accounting that would show up in multifactor productivity.

"The point I'm making here is that the multifactor productivity measure is often preferred because it's a measure of technological change. But it's a measure of a lot of stuff. It's a measure of all the things that changed output but didn't get accounted for in KLEMS, our conventional classification of inputs. And that can be a big technological change, but it can also be a very small change that just occurs on the factory floor. And it's an accumulation of those small changes that give you the rate of change in multifactor productivity."

A transcript of the entire discussion is available online at http://www.findarticles.com/cf_0/m1094/3_36/78177929/print.jhtml

In Other Words

Sometimes it helps to hear things said in different ways. We hope the following excerpts and quotations will add to your understanding of productivity.

Productivity is a measure of how efficiently an economy transforms its labor, capital, and raw materials into goods and services.

Bank of Canada web site
http://www.bankofcanada.ca/en/backgrounders/bg-p4.htm

Productivity is a broad, shorthand measure that economists and government statisticians use to describe the output that an hour of labor produces. It is calculated simply by dividing the government's estimate of total output by the number of hours worked by all employees and the self-employed. If output per hour worked rises, productivity is said to increase.

Martin and Kathleen Feldstein
http://www.nber.org/feldstein/bg081401.html

Productivity . . . is seen as a key to rising living standards. . . . because if workers produce more per hour companies can sell more, boost profits and raise wages at the same time without raising prices. If productivity falters, pressures for higher wages could force companies to raise prices, worsening inflation.

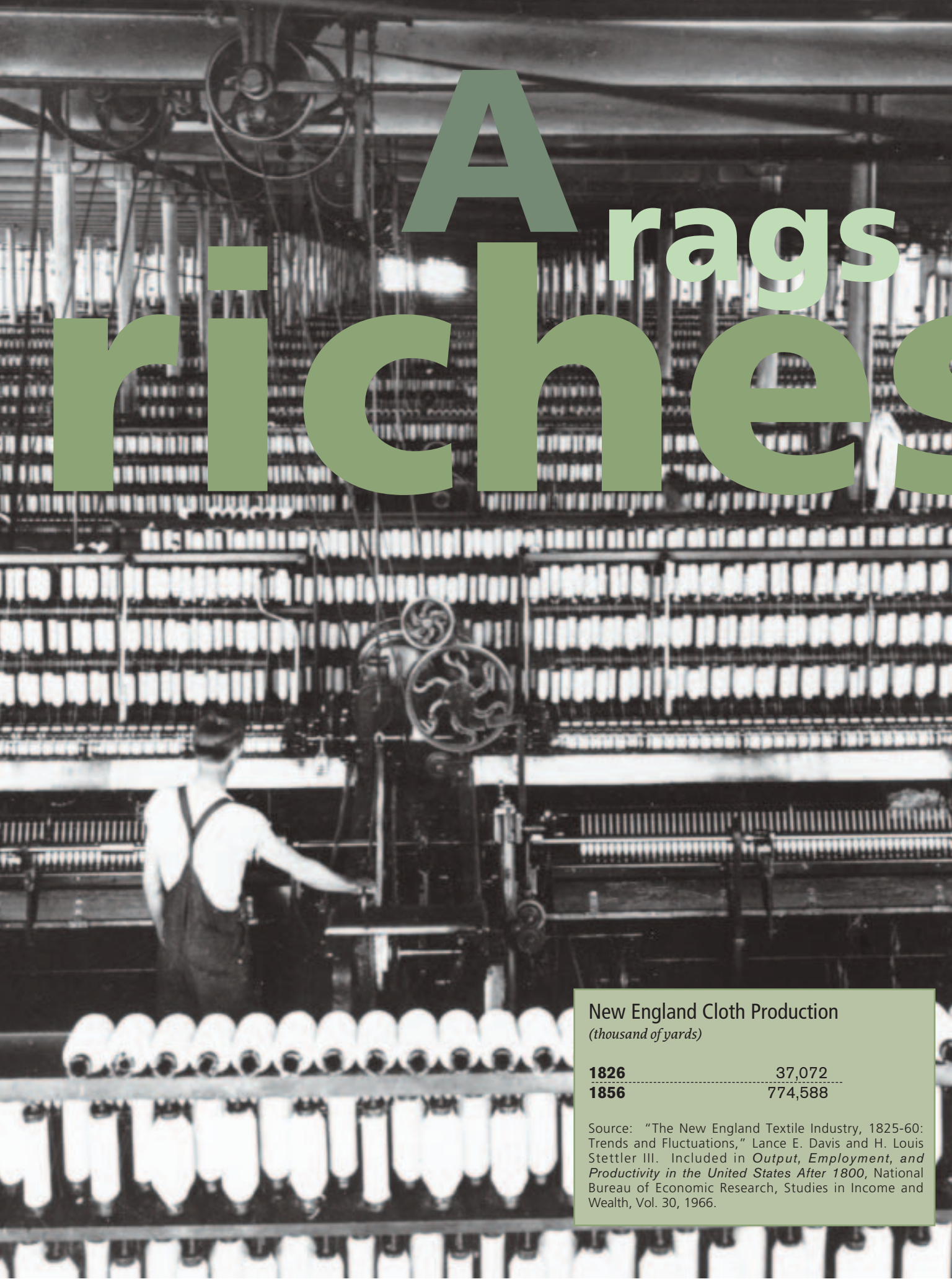
CNN/Money web site
11/07/01

The biggest factor in increasing economic growth and raising living standards over time is the economy's ability to produce more out of less, also known as productivity.

"But Don't Forget the Silver Lining"
Justin Fox, *Fortune* magazine, 9/2/02
http://www.fortune.com

Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker.

– Paul Krugman



A rags riches

New England Cloth Production

(thousand of yards)

1826	37,072
1856	774,588

Source: "The New England Textile Industry, 1825-60: Trends and Fluctuations," Lance E. Davis and H. Louis Stettler III. Included in *Output, Employment, and Productivity in the United States After 1800*, National Bureau of Economic Research, Studies in Income and Wealth, Vol. 30, 1966.

to

s

tale:

Thanks to higher productivity, you don't have to wear the same clothes all week

HIGHER PRODUCTIVITY
U.S. Textile Mills

Output per Worker per Year
(yards of cotton cloth)

1820	2,000
1859	9,410

Output per Spindle per Year
(yards of cotton cloth)

1820	142
1859	219

Source: "The New England Textile Industry, 1825-60: Trends and Fluctuations," Lance E. Davis and H. Louis Stettler III. Included in *Output, Employment, and Productivity in the United States After 1800,* National Bureau of Economic Research, Studies in Income and Wealth, Vol. 30, 1966.

The name "Abraham Charles" probably doesn't ring a bell. There's really no reason it should. Mr. Charles came into the world in 1716, spent most of his years working the land in central Massachusetts, and died in 1804.

The world he left behind was not so very different from the one he had entered 88 years earlier. Early 19th century New England was still a mostly rural place where change came slowly, and tending to the basic necessities of life took all the time and strength a body could muster.

Two things set Mr. Charles apart from most of his neighbors: He survived to the age of 88, and he attained a modest level of prosperity.

But prosperity is a relative condition. Like almost everyone else in the early 1800s, Abraham Charles led an austere existence.

The inventory of his estate reads like a list of yard sale remainders: "3 junk bottles," "1 Iron ring," and a "half pint tin cup." The adjective "old" — as in 1 old hand saw, 1 old brass kettle, 6 old chairs, and 15 old casks — appears often.

But the most instructive part of the inventory is the section that catalogs his wardrobe.[1] Here it is — complete with archaic spelling and a monetary value for each item:

4 pair stockins	1.00
wollin shirt	.50
Great Coat	4.00
Coat & wescoat	1.00
2 pair of Breeches	.59
old coat	.25
Coat and wescoat	1.67
2 silk Handkercheefs	1.00
1 pair of shirts	.59
1 Gown	1.25
1 Gown	1.42
two aprons	.60
one cloak	.75
5 old Handkercheefs	.83
2 old Handkercheefs	.25
two aprons	.83
Total Value:	**$16.53**

In terms of quantity and selection, the word "meager" comes to mind. And if you think $16.53 was a lot of money in 1804, well . . . think again. It had roughly the same purchasing power that $250 has today.

Quick Change

The paradox of pre-industrial life — in New England and elsewhere — was that people toiled endlessly but seldom had much to show for their efforts. Intense physical exertion yielded relatively little output. Basic hand tools and muscle power defined the limits of production.

Clothing provides a good example. Anyone who's ever tried to make clothes knows how time-consuming the process can be. Today it's more often a labor of love than a matter of economic necessity.

[1] The inventory of Abraham Charles' estate is used courtesy of Jack Larkin, Director of Research, Collections, and Library at Old Sturbridge Village. And be sure to check out *Ask Jack* **http://www.osv.org/kids/askjack.htm,** which features Jack Larkin's answers to questions about New England village life in the early 1800s. Although it's intended mainly for kids, we're sure adults will enjoy it, too.

Prints and Photographs Division, Library of Congress.

LOWER PRICES

Wholesale Price of Cotton Sheeting
(per yard)

1814	$22.68
1834	8.53
1854	.08

Wholesale Price Index for Textile Products
(1910-14 = 100)

1814	300
1834	161
1854	124

Source: U.S. Census Bureau, *Historical Statistics of the United States, Colonial Times to 1970.*

But in the early 1800s, cash was scarce and store-bought goods were expensive, so if you wanted clothes, you almost always had to make them yourself. Not only would you have to stitch them by hand — sewing machines weren't commercially available until the 1850s — you'd often have to weave the fabric as well.

Even in good years, when there was enough extra cash to spend on clothes, shopping options were limited. You could:

a) wait for a traveling peddler to stop at your door,

b) buy clothes from a neighbor who could make them better and faster than you could, or

c) inch your way to town on roads that ranged from poor to impassable.

But no matter which option you chose, the drawbacks were the same: high prices and a small selection.

Then came the Industrial Revolution, and within a generation, life changed forever.

What exactly was the Industrial Revolution? Short answer: a series of events and improvements that led to an extraordinary change in the way people produced things. It started in Europe during the mid- to late-1700s and spread to North America in the early 1790s with the opening of Slater Mill, a Rhode Island textile mill that used water-powered machinery to spin cotton into yarn in quantities unmatched by individual spinners working at home or in small workshops.

But Slater Mill was only a first step. Most finished cloth still had to be woven on household hand looms — a painstaking process that yielded relatively little output.

The next major advance came in 1814 when a group of investors opened America's first integrated textile mill in Waltham, Massachusetts — a mill that had the capacity to spin yarn *and* weave cloth. Seven years later, in 1821, another large-scale mill began operation in Lowell, Massachusetts, and by mid-century the New England textile industry was producing cloth in quantities that would have seemed unimaginable 50 years earlier. (See table: New England Cloth Production, page 8.)

But increased production isn't the same as increased *productivity*. It's possible to boost production without raising productivity. Take the example of a textile mill owner who hopes to produce more cloth by hiring more workers. With the right tools and efficient organization, the additional workers might help to increase the mill's total output, but labor costs would go up, too, and the money to pay for those added worker-hours would have to come from somebody's pocket, either the mill owner's or the consumer's. The mill's productivity won't improve unless the increase in cloth production is more than enough to offset the rise in labor costs.

What mill owners really want is to produce more cloth per worker-hour; more cloth for each hour of labor they're paying for. That helps to reduce the mill's *per-unit costs* — the cost of producing a yard of cloth — and lower per-unit costs create the potential for more good things to happen: 1) higher profits, which can be shared with workers in the form of higher wages or reinvested in the mill, and 2) lower prices for consumers.

And that, more or less, is what happened during and after the Industrial Revolution. Productivity soared, and prices fell. (See tables: Higher Productivity and Lower Prices, pages 9 and 10.)

What Is Real?

The dollar amount on a paycheck – also known as the **nominal wage** or **money wage** – doesn't always reflect a person's actual buying power. That's why economists often focus on the **"real"** wage, which more accurately gauges the level of goods and services a paycheck will buy.

During the second half of the 19th century, most American workers saw their average money wage decline. The average "money wage" for American workers was lower in 1900 than it was in 1865. But thanks to increased productivity and the resulting drop in prices, many workers experienced an increase in real wages.

Average Annual Earnings for Nonfarm Employees

	Money Wage	Real Wage
1865	$512	$328
1900	$483	$573

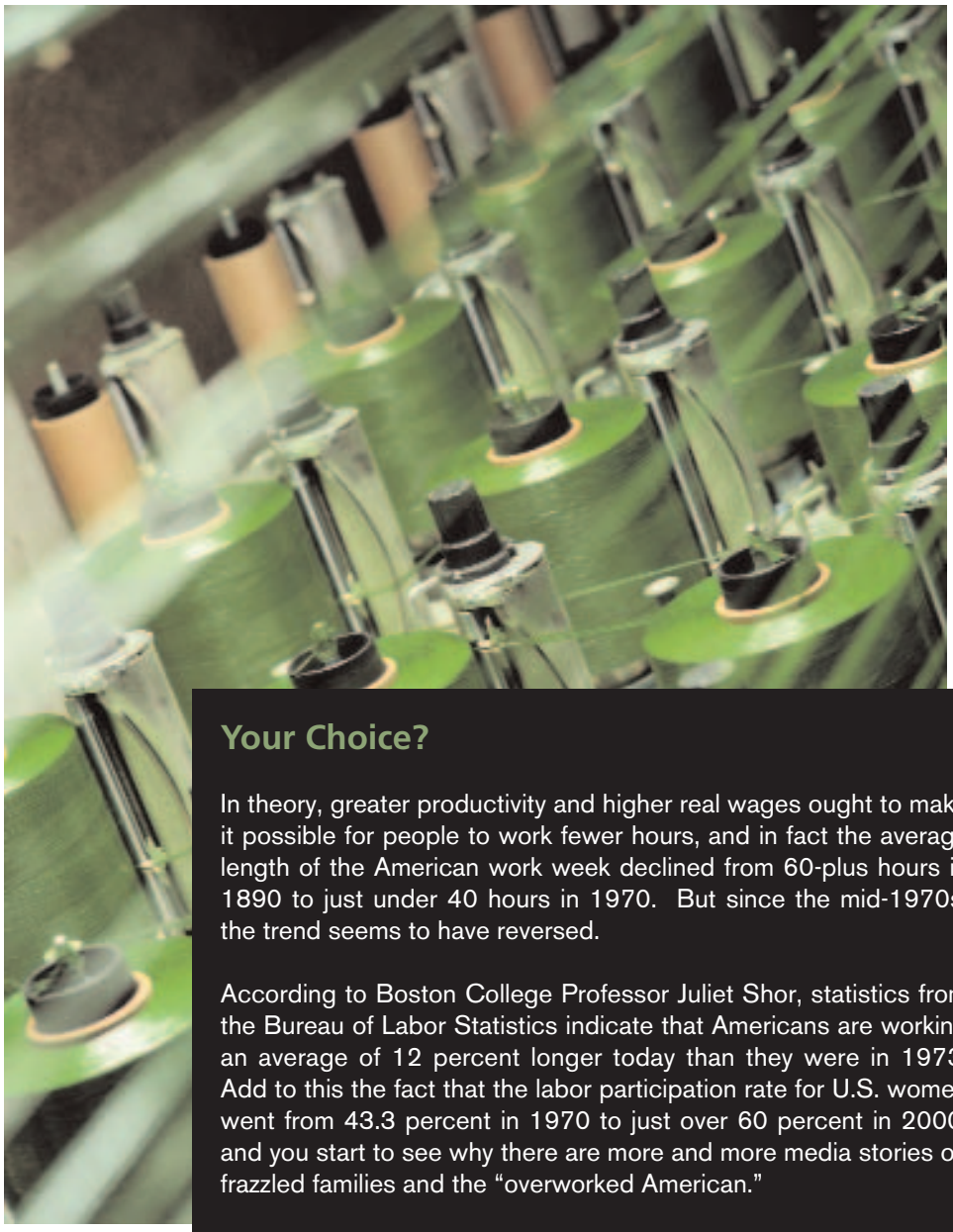
Source: U.S. Census Bureau, *Historical Statistics of the United States, Colonial Times to 1970.*

More cloth at lower prices ultimately translated into more clothes at lower prices. At first, that meant more and better *homemade clothes*, especially after home sewing machines became more widely available. But by the early 1900s, American factories were doing their best to meet a growing demand for ready-made clothing. Department stores offered city dwellers a dizzying selection. And the Sears Catalog enticed farm families with page after page of fabrics and fashions — everything from denim overalls to silk underwear.

Productivity gains also had an effect on wages, but in a less straightforward way. During the second half of the 19th century, the average "money wage" for American workers actually fell. (See box: WHAT IS REAL?) But in "real" terms, workers had more buying power. They were able to buy more with the money they earned — more food, more clothes, more consumer goods.

Why did real wages go up? In large part, because productivity increased. Labor-saving machinery, standardized parts, better organization, improved transportation, and more efficient capital markets all made it possible for factories and farms to reduce their per-unit costs. Farmers were able to produce more bushels of wheat per acre at a lower cost per bushel and more bales of cotton at a lower cost per bale. Mills and factories were able to produce more cloth at a lower cost per yard and more stockings and pants at a lower cost per pair.

By the end of the 20th century, Americans had reached the point where clothing accounted for less than five percent of personal consumption expenditures, yet the quantity and selection of clothes in most closets was greater than ever. In fact, if Abraham Charles had died in 2003 instead of 1804, the inventory of his wardrobe would have been at least two pages long and his surviving family members probably would have been scratching their heads, wondering what to do with all his clothes.



Your Choice?

In theory, greater productivity and higher real wages ought to make it possible for people to work fewer hours, and in fact the average length of the American work week declined from 60-plus hours in 1890 to just under 40 hours in 1970. But since the mid-1970s, the trend seems to have reversed.

According to Boston College Professor Juliet Shor, statistics from the Bureau of Labor Statistics indicate that Americans are working an average of 12 percent longer today than they were in 1973. Add to this the fact that the labor participation rate for U.S. women went from 43.3 percent in 1970 to just over 60 percent in 2000, and you start to see why there are more and more media stories on frazzled families and the "overworked American."

There have been suggestions that, when it comes to work and leisure, Americans should try to be more like Europeans. An article on the CNNMoney web site – Should America Be France?, October 9, 2003 – noted that "Americans, on average, work 350 hours more each year than Europeans." The article went on to point out that French law "guarantees workers 11 public holidays, a minimum of five weeks paid vacation, and a 35-hour work week."

Sounds pretty good. But don't hold your breath waiting for it to happen in the U.S. Despite what we say about feeling pressed for time, Americans seem inclined to take their productivity gains in the form of more stuff rather than more leisure time. Given the choice, they'll tend to work more and spend more, rather than work less and spend less.

The one exception: If you're among the legion of low-wage American workers who put in long hours for short money, you don't really have a choice. You just work, and work, and work . . . and hope you don't fall too far behind.

living standards and economic growth

Improvement in living standards is the direct result of economic growth. Our per capita consumption of goods and services has increased because our per capita production (or output) of goods and services has increased. When we produce more, we can consume more.

The following section helps to explain why labor productivity is the key factor in determining our material standard of living. It is excerpted from *Living Standards and Economic Growth: A Primer*, which you can read in its entirety on the New England Economic Adventure web site **http://www.economicadventure.org/teachers/primer.pdf**

Living Standards

For economists, a good measure of living standards would be the "value of all goods and services consumed per capita" (per capita = per person). Ideally, goods and services would be defined broadly and would include not only goods and services that are purchased (such as a loaf of Wonder Bread), but also goods and services produced at home (such as a loaf of home-baked bread). Goods and services provided by the government (such as public parks and fire protection) would be included, as would the value of leisure time. The ideal measure would also include the enjoyment of environmental amenities (such as clean air and water) and good health, and it would incorporate adjustments for demographics, such as the differing consumption needs of children and adults.

Such a comprehensive measure does not exist; so we turn to approximations. The most commonly used measure of standard of living is national output per capita, usually measured as GDP or GNP per capita. This has a number of weaknesses. It *does not include* the value of home production, nor does it capture the quality of the environment or public health. It does include something we do not consume — investments in equipment and factories; these are not consumption goods but instead have value for us because they increase our ability to produce more, and ultimately to consume more, in the future. . . .

Produce More, Consume More

The improvement in living standards is the direct result of economic growth. Our per capita *consumption* of goods and services has increased because our per capita *production* (or output) of goods and services has increased. When we produce more, we can consume more.

The key to producing more per capita is higher labor productivity. Productivity is how much one worker can produce in one hour. . . . [I]f the output of goods and services produced will rise relative to the population, GNP or GDP per capita will rise. Labor productivity is, thus, the key factor in determining our standard of living.

Economic Growth Theory

To understand labor productivity and how it increases over time, it is necessary to have a rudimentary understanding of economic growth theory and accounting.

Goods and services are produced by people working with machines, equipment, structures and the like. Economists refer to the people, regardless of the nature of their work, as *labor*; and they refer to the machines, equipment, and structures as *capital*. Land is sometimes included with capital, but it is also sometimes identified as a separate economic input. Improvements to land, such as buildings, are considered capital. Economic growth, or the growth in the *quantity* and *quality* of the goods and services produced, occurs when there are (1) increases in the quantity or quality of economic inputs, or (2) improvements in how the economic inputs are combined to produce output.

More machines and more worker-hours are examples of increases in the *quantity* of economic inputs; better machines and higher-skilled workers are examples of increases in the *quality* of economic inputs. Sometimes there is no measurable increase in the quantity or quality of the inputs, but the way in which economic inputs are combined is improved so that more goods and services are produced. Economists refer to this improvement as technological change.

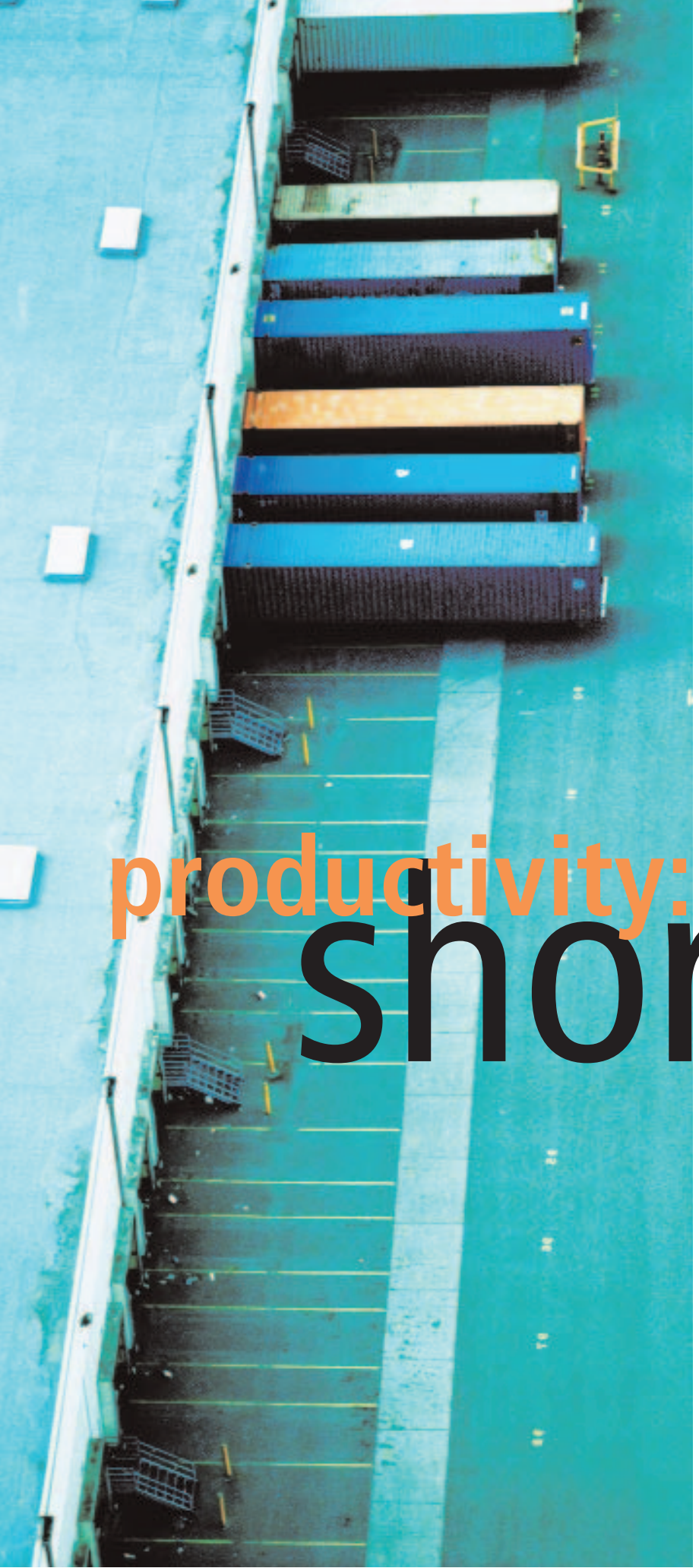
While most people associate the term "technological change" with major new inventions and innovations, technological change in growth theory is a residual category. It is that part of growth that is not due to measurable changes in the quality and quantities of the inputs. It includes the effects of major changes in technology, such as the advent of electricity or the invention of the steam engine. But it also includes growth that comes from more mundane changes. Improved efficiency associated with learning-by-doing, gradual improvements in how machinery and workers are organized and utilized, and increased specialization made possible by the expansion of markets all fall into the "technological change" category.

A key measure in economic growth theory is the *ratio of capital to labor*, or *capital-labor ratio*. Labor productivity increases as the capital-labor ratio increases. As workers have more, and higher quality, equipment to use, they can produce more per hour of their time. For example, an auto mechanic can perform repairs faster if he has a full set of hand tools available than if he has to share tools with another mechanic. And he can work faster still if he has some power tools available (and faster yet if he has a diagnostic computer, a lift, etc.). When the capital-labor ratio increases, economists call this *capital deepening*.

Investing in capital does not always increase the capital-labor ratio (and labor productivity). As the number of workers increases, new investment is needed just to equip each additional worker with the same capital as each worker had before. And some investment is needed to replace equipment and buildings as they wear out. Economists use the term *capital depreciation* to describe the wearing out of equipment and other capital. . . .

Improvements in labor "quality" have consistently accounted for about one-sixth of the growth in labor productivity. Workers who are better trained and better educated tend to be more productive. In many cases, more advanced or more capital-intensive production techniques require more educated or more highly trained workers to use them effectively. For example, earth moving at a construction site can be performed by workers with little education or training using hand shovels and wheelbarrows, or it can be performed by trained workers operating heavy construction equipment. Economists often speak of improvements in labor quality as investments in *human capital*. Increases in human capital typically require that people devote time to education and otherwise building their store of knowledge. This knowledge will enable them to be more productive in the future, but acquiring this knowledge requires postponing work that would permit higher consumption in the present. . . . Most people have little control over the current state of technology or the pace of capital investment, but they are able to influence their own economic future through the education and training options they choose.

State Historical Society of Wisconsin, McCormick-IHC Collection.



productivity: shorts

The following section is for those of you who prefer to receive information in bite-size portions rather than feast on a full-length narrative.

How Productivity Affects Standard of Living

At least since the time of Adam Smith, economists have recognized that enhancing living standards is as easy as P.I.E.: combine productivity, innovation, and education. Productivity growth is the critical factor that determines future living standards. Such growth, in turn, depends on the birth of new ideas — innovation and invention — and our ability to turn such ideas into usable technology — that is, technology transfer. Both, in turn, depend on education.

— William Poole, President,
Federal Reserve Bank of St. Louis
http://stlouisfed.org/news/speeches/2002/04_25_02.html

Productivity is seen as a key to rising living standards "because if workers produce more per hour, companies can sell more, boost profits and raise wages at the same time without raising prices. If productivity falters, pressures for higher wages could force companies to raise prices, worsening inflation."

— *CNN/Money*, 11/07/01

What took a worker in 1890 an hour to produce takes a worker in a leading economy today [2000] only about seven minutes to produce. . . .

As far as the ability to produce material goods is concerned, in the twentieth century the human race has passed through and left the realm of necessity — where providing basic food, clothing, and shelter took up the lion's share of economic productive potential. . . . Our collective production is no longer made up largely of the necessities of survival but of conveniences and luxuries.

— J. Bradford DeLong, *"The Shape of Twentieth Century Economic History,"* National Bureau of Economic Research, Working Paper 7569
http://www.nber.org/papers/w7569

An Example of How Higher Productivity Can Lead to Lower Prices

"I'm going to democratize the automobile." declared Henry Ford in 1909. "When I'm through, everybody will be able to afford one, and about everybody will have one."

That car turned out to be the Model T — a dependable, no-frills vehicle that helped put the middle class on wheels. The key to its success? Increased productivity.

And while you probably know that Ford used moving assembly lines to build cars faster and cheaper, here are some numbers to show just how dramatic the productivity gains were:

• "In 1914, 13,000 workers at Ford made 260,720 cars. By comparison, in the rest of the industry, it took 66,350 workers to make 286,770."
Source: **http://www.wiley.com/legacy/products/subject/business/forbes/ford.html**

• Between 1908 and 1916, annual production of the Ford Model T jumped from less than 6,000 to nearly 600,000. The price dropped from $950 to $360.
Source: *From the American System to Mass Production*, David Hounshell.

• Time required to assemble a Ford Model T chassis (rounded to nearest half-hour):

January 1913
No assembly line:
12.5 worker hours

August 1913
Rope-driven assembly line:
6.0 worker hours

December 1913
Continuous chain-driven assembly line:
1.5 worker hours

Source: *From the American System to Mass Production*, David Hounshell.

Productivity and Wages

Productivity growth allows real wages to increase by lowering prices, thus leading to real improvements in our standard of living.

— Bank of Canada web site
http://www.bankofcanada.ca/en/backgrounders/bg-p4.htm

If labor productivity remained unchanged, then rising wages would increase the cost of producing a given quantity of output. If this occurred across the economy, then prices would rise, even under competitive conditions, undermining any real gain in worker purchasing power. On the other hand, if labor productivity is rising, then nominal wage growth is expected to outpace inflation, implying rising wages and purchasing power.

— South-Western EconData
http://www.swcollege.com/bef/economics.html

Productivity and Service Industries

There has been tremendous productivity growth in the computer industry. You see spectacular reduction in price. That represents costs reduction and productivity increases, but it's not clear that this improvement has spread to sectors using computers. Some 80 percent of IT hardware is sold to the service sector, but it's not showing major increases in productivity. It could be we don't measure productivity in service industries correctly, but I doubt this is the whole story.

— Robert Solow
Nobel Laureate in Economics

[W]e see the computer age everywhere but in the productivity statistics.

— Robert Solow, 1987

It took a while for businesses to learn not only how to use information technology, but how they needed to organize themselves.

— Robert Solow, quoted in *The Wall Street Journal*,
November 7, 2003

Productivity on the Farm

The average American farm in 1790 was 100 acres. This figure more than doubled over the next 60 years. By 1910, 500 acre wheat farms were not uncommon. . . . With the use of new equipment and fertilizers, wheat yields increased seven times between 1850 and 1900.

— *The Draft Horse in America*
http://www.imh.org/imh/draft/dr1.html

The story of U.S. agriculture is a story of productivity growth: fewer workers producing more food and fiber from the same amount of land with more capital and other purchased inputs. Between 1960 and 1994, the quantity of farm output doubled, while farm employment shrank by 57 percent.

— *Rural Migration News*
April 2002

An International Perspective

Americans like Japanese products: high-quality cars, innovative electronics, eye-popping video games. What's not to like?

And because Japan's largest companies are so good at turning out products that combine quality and value, you might be tempted to believe that the Japanese economy provides a productivity model for others to follow. But that's not exactly the case. The following excerpts, from an article by Jim Frederick in the December 9, 2002 issue of *Time* ("Going Nowhere Fast"), help explain why.

"If you want a look at what's really ailing the Japanese economy, just drive over on any given weekend to the Ito-Yokado shopping center parking lot . . . . [T]here are four guards at the intersection directing traffic. Another man is on hand to make sure you don't miss the turn that leads to the garage. Five meters down the path, an attendant removes the ticket that the machine just generated and hands it to you. Head up the slope to the first floor and a woman will wave you on, just in case you missed the brightly lit No Vacancy sign over her head. (Every floor, whether full or not, gets its own guard.) When you exit, you get the same treatment in reverse. . . . By the end of your visit, at least 20 employees have provided you with a service of nearly zero value that could easily have been — and was clearly designed to be — completely automated.

"Japan's labor force is one of the most unproductive in the industrialized world. And not by a little. According to the Japan Productivity Center for Socio-Economic Development, a government-affiliated research center, Japanese laborers are 40% less efficient than Americans, 20% less efficient than the French, and 11% less efficient than the Germans.

"Although the country's showcase export industries such as automobiles and electronics have redefined competitiveness and economic advantage worldwide, the country's far, far-larger domestic sectors — construction, retailing, agriculture, health care and financial services, among others — have languished. Shielded from competition, by a tangle of government subsidies, tariffs and protectionist policies, the nation's domestic manufacturers and services have hardly changed — let alone improved — for decades."

Japanese export industries are "20% more productive than the worldwide benchmark. . . . [But] together, they make up only 10% percent of Japan's workforce and 10% of its GDP."

In Japan, mom-and-pop businesses "are the rule, not the exception, making up 55% of the retail labor force.

"The result of all that inefficiency? Layers of increased costs are passed on to Japanese consumers, who face one of the world's highest costs of living.

"Americans, for example, consume 63% more clothes, spend more than twice as much at restaurants and hotels, and about 2.5 to 3 times as much on books and cars.

"Many Japanese commentators claim that high unemployment is unacceptable because the nation does not have a well-developed social-welfare system — not seeming to realize that allowing an estimated 17 million surplus workers to remain on the nation's payrolls is a much more expensive version of the same thing."

want to know more about productivity?

NBER Productivity Program, **http://www.nber.org/programs/p/p.html** — features a complete list of National Bureau of Economic Research working papers related to productivity.

U.S. Bureau of Labor Statistics, **http://www.bls.gov/lpc/faqs.htm** — eleven frequently asked questions about productivity.

"A Most Important Number," Martin and Kathleen Feldstein, National Bureau of Economic Research web site. **http://www.nber.org/feldstein/bg081401.html**

"Living Standards & Economic Growth: A Primer," New England Economic Adventure web site — looks at the relationship between productivity and standard of living. **http://www.economicadventure.org/teachers/primer.pdf**

"Productivity Growth," Evan Koenig, Federal Reserve Bank of Dallas — a single, clearly written page on what productivity is and why it's important.**http://www.dallasfed.org/eyi/usecon/0003growth.html**

Backgrounders: Productivity — a one-page summary of why productivity matters. **http://www.bankofcanada.ca/en/backgrounders/bg-p4.htm**

"Revolutions in Productivity," *2000 Annual Report*, Federal Reserve Bank of St. Louis — an entire issue on productivity and economic growth. Be sure to check out the section on "Inventions That Made History." **http://www.stls.frb.org/publications/ar/2000/index.html**

"As Easy As P.I.E.: Productivity, Innovation, and Education," Federal Reserve Bank of St. Louis. **http://stlouisfed.org/news/speeches/2002/04_25_02.html**

"The Microchip Flexes Its Muscle. Can It Compete with History's Best?" Kevin L. Kliesen and David C. Wheelock, *The Regional Economist*, July 2001, Federal Reserve Bank of St. Louis — explores the relationship between high-tech innovation and productivity. The sections on 19th

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www.econo

the adventure begins

Boston Fed Launches New Educational Exhibit and Web Site

Maybe you're going through one of those periods when modern life is getting to you — the traffic, the stress, the complexity. Our prescription for this: a visit to the "New England Economic Adventure" at the Federal Reserve Bank of Boston. One look at the chamber pot in the Adventure's "Material Life" display should be enough to convince you that the pluses of early 21st century life probably outnumber the minuses.

The Adventure is the latest initiative in the Boston Fed's longstanding commitment to help raise overall public awareness of economic issues and concepts. Geared primarily to middle school and high school students, the Adventure uses interactive games, exhibits, and activities to help visitors understand how 200 years of economic change and technological innovation have affected the everyday lives of New Englanders.

The Adventure is open, free of charge, to school groups and community groups, but groups must make reservations in advance. (Unfortunately, we are unable to accommodate walk-in visitors.)

There's also an Adventure web site **www.economicadventure.org** for those who might not have an opportunity to visit — or who want to expand on what they learned during their visit.

The site explores Adventure-related concepts — standard of living, economic growth, labor productivity — from many perspectives. Here's some of what you'll find:

- the *Rising Standards Gazette* — a description of the bumpy course of economic growth in New England, an overview with interesting details
- an illustrated timeline of major economic events in New England's history
- profiles of Francis Cabot Lowell, Colonel Albert Pope, and Ken Olsen — the three entrepreneurs featured in the Adventure's Invest-in-Growth games
- terms and theory — explanations of economic growth theory, standard of living, and time value of money; glossaries of terms
- lesson plans, student projects, online quiz, classroom activities
- recommended resources — books, other readings, videotapes, other web sites
- information on teacher workshops
- scheduling/directions/contact information for visits to the Adventure
- pre- and post-visit teaching materials
- a place for you to tell us how we're doing — we want your comments!

micadventure.org

want to know more about productivity?

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and early 20th century productivity advances is particularly interesting.**http://www.stls.frb.org/publications/re/2001/c/pages/lead-article.html**

Are We in a Productivity Boom? Evidence from Multifactor Productivity Growth, Paul W. Bauer, Federal Reserve Bank of Cleveland — "explores the relationship between labor productivity and multifactor productivity, a measure that accounts for factors other than technological improvement. It concludes that MFP provides a better measure of productivity due solely to technical change." **http://www.clev.frb.org/Research/Com99/1015.htm**

"Mass Production," **http://www.willamette.edu/~fthompso/MgmtCon/Mass_Production.html** — short, clear explanations of mass production, machine tools and interchangeable parts, the assembly line, and the effects of mass production on the organization of work.

"Henry Ford and the Model T" — focuses on how Ford put America on wheels by increasing productivity and bringing down the price of cars.**http://www.wiley.com/legacy/products/subject/business/forbes/ford.html**

The Michigan Historical Museum's web site has a section on productivity in the auto industry's early years. **http://www.sos.state.mi.us/history/museum/explore/museums/hismus/1900-75/erlyauto/onwheels.html**

Adirondack History Network — the section on women's lives takes you back to a time when life was labor-intensive. **http://adirondackhistory.org**

An Outline of American History, Chapter 7: "Growth and Transformation" — looks at the 19th century period when America transformed itself "from a rural republic to an urban state."**http://usinfo.state.gov/usa/infousa/facts/history/ch7.htm**

The Shape of Twentieth Century Economic History, J. Bradford DeLong, National Bureau of Economic Research, Working Paper No. w7569, February 2000 **http://www.nber.org/papers/w7569**

From the American System to Mass Production, 1800-1932, David a Hounshell, The Johns Hopkins University Press, Baltimore, 1984 — a classic that covers the development of manufacturing technology in the United States.

"The New England Textile Industry, 1825-60: Trends and Fluctuations," Lance E. Davis and H. Louis Stettler III. Included in *Output, Employment, and Productivity in the United States After 1800*, National Bureau of Economic Research, Studies in Income and Wealth, Vol. 30, 1966. — this article is almost 35 years old and hard to find, but it contains lots of useful data.