

IN THIS ISSUE

- Learning Basic Math in School Pays Off in Life
- Should the Stagnant Homeownership Rate Be a Source of Concern?
- Openness Promotes Faster Economic Development
- Hidden Gains from Trade

Learning Basic Math in School Pays Off in Life

Changes in the labor market returns to education over the past decade or two are well documented. For example, a recent NBER study by **Richard Murnane, John Willett, and Frank Levy** shows that for 24-year-old male high school graduates, the average wage (after adjusting for inflation) was 16.5 percent lower in 1986 than in 1978. For 24-year-old male college graduates, on the other hand, the average wage was only 1 percent lower in 1986 than in 1978. Similarly, for 24-year-old female high school graduates, the average wage was 4 percent lower in 1986 than in 1978. In contrast, for 24-year-old female college graduates, the average wage was 1 percent *higher* in 1986 than in 1978.

In **The Growing Importance of Cognitive Skills in Wage Determination** (*NBER Working Paper No. 5076*), the three authors examine whether basic cognitive skills (as distinct from formal schooling) are becoming more important in determining wages. They focus on a central question: does mastery of basic mathematics by individuals graduating from high school in 1980 play a larger role in determining their wages at age 24 than it did for individuals graduating from high school in 1972?

The types of mathematical skills

that this study finds to be increasingly important determinants of wages among 24-year-olds include the ability to follow directions, manipulate fractions and decimals, and interpret line graphs. The relevant mathematics test used in the research included no test of advanced algebra or geometry. Thus it appears that a high school senior's mastery of skills taught in American schools no later than the eighth grade is an increasingly important determinant of subsequent wages.

hour. The same pattern is present for females, with the difference in test scores resulting in a 39-cent wage differential at age 24 for 1972 graduates who did not go to college, and a 74-cent differential for 1980 high school graduates. The authors report that, for women, the increase in the return to cognitive skills between 1978 and 1986 accounts for all of the increase in the wage premium associated with post-secondary education.

The increased importance of

"The increased importance of cognitive skills in determining wages means that high school graduates entering the market with weak basic math skills are at a greater disadvantage relative to their peers than was the case in the 1970s."

Murnane and his coauthors illustrate their results with data on wages for high school graduates who did not go to college. Those males graduating from high school in 1972 with strong basic math skills earned 24 cents more per hour (in 1988 dollars) at age 24 than males graduating in that year with average math skills. Among such males graduating from high school in 1980, the comparable wage differential was 53 cents per

cognitive skills in determining wages means that high school graduates entering the market with weak basic math skills are at a greater disadvantage relative to their peers than was the case in the 1970s. In fact, the hourly wage at age 24 (\$7.40) for males entering the labor market directly after graduating from high school in 1980 with weak math skills corresponds to annual full-time earnings of \$12,950 (in 1988 dollars), which is

just above the 1988 poverty line for a family of three.

The increasing role of cognitive skills in determining wages six years after high school is rooted in shifts in demand, Murnane and his coauthors find, and primarily reflects changes within occupational groups. It holds for persons of all

educational levels, and in part explains the 30 percent increase since 1970 in wage variation among individuals with the same amount of formal education.

One caveat is that it takes several years after high school graduation for the math skills to affect wages. While the relationship is

strong for 24-year-olds, there is no relationship between math skills and wages for 20-year-old males, and only a modest relationship for females. Thus the lure of higher wages provides an incentive to work hard in school only for those high school students with an eye to the future.

Should the Stagnant Homeownership Rate Be a Source of Concern?

The homeownership rate in the United States was essentially stagnant during the 1980s. This stagnation should be a source of concern if it reflects stagnant economic conditions and ownership opportunities, but not if it simply reflects changing demographic conditions

appeal had a neutral effect overall on the aggregate rate of homeownership, Green concludes.

In Should the Stagnant Homeownership Rate Be a Source of Concern? (*NBER Working Paper No. 5176*), Green investigates four

percentage points more likely to be singles with children in 1990, both because the divorce rate remained at a high level and because the number of never-married parents with children increased. This had a profound impact on the ownership rate: changes in tastes for household types predict a 2.7 percentage point decline in the percentage of owner-occupied households.

“[T]he combination of improving affordability conditions and worsening financial appeal had a neutral effect overall on the aggregate rate of homeownership.”

Within a given household type, changes in demographics and tastes for homeownership also tended to boost the homeownership rate. Singles without children became far more likely to choose homeownership during the 1980s, while singles with children became far less likely to choose ownership. Among married couples, tastes for owning continued to increase, despite the fact that the ownership rate among young married couples declined between 1980 and 1990.

or preferences.

Now, a recent paper prepared for the NBER Study on Housing Dynamics by **Richard Green** finds that homeownership opportunities actually improved during the 1980s; this suggests that the cause of the stagnant rate was something other than economic conditions. In fact, he finds that both demographics and changes in preferences led to an increase in the proportion of households headed by single people; all else being equal, this would have tended to push the owner-occupancy rate downward. Further, tax code changes and real interest rates pushed up the “user cost” of owning a home almost everywhere in the 1980s, reducing the financial attractiveness of owning a home. Apparently, the combination of improving affordability conditions and worsening financial

influences on the homeownership rate in the United States between 1980 and 1990: demographically induced changes in household types; changes in the tastes for household types; demographically induced changes in the demand for homeownership within household types; and changes in tastes for homeownership within household types. He finds that changing demographics during the 1980s brought about a modest shift from households headed by married couples toward households headed by singles. Because the ownership rate among singles is roughly 40 percentage points less than the ownership rate among marrieds, this contributed to a decline in the aggregate ownership rate of 0.6 percent.

Types of households changed even more dramatically: households became more than 10 per-

Green uses the shares of each household type from the 1980 public use microsample to get the weighted average impact of changes in the demand for owning within household types. He finds that the overall impact of these changes increased the ownership rate by 3.1 percent between 1980 and 1990. Combined with the impacts of the predicted changes in household types, the predicted change in the homeownership rate between 1980 and 1990 as the result of these changes and demographics is a negative 0.2 percent.

Because the ownership rate in fact declined by 0.2 percent, it may be inferred that the economy had no net impact on the ownership rate between 1980 and 1990: improved affordability conditions were offset by the reduced financial attractive-

ness of owning.

Green concludes that housing affordability did not worsen between 1980 and 1990. The homeownership rate declined a bit because more people chose to remain single

(that is, put off marriage) or become single (that is, get a divorce). All else being equal, singles buy homes less often than married couples. Thus the stagnancy over the 1980s should not be a source of concern.

Openness Promotes Faster Economic Development

“Is there a tendency for the [world’s] poorer countries to grow more rapidly than the richer countries, and thereby to converge in living standards?” **Jeffrey Sachs** and **Andrew Warner** ask in a recent NBER Working Paper. Probably, they conclude, if the “poorer countries follow reasonably efficient economic policies, mainly open trade and protection of private property rights.”

In **Economic Convergence and Economic Policies** (*NBER Working Paper No. 5039*), Sachs and Warner determine that “convergent growth can be achieved by all or virtually all countries that follow a reasonable set of political and economic policies, including civil peace, basic adherence to political and civil rights, and (most decisively) an open economy, through the absence of trade quotas, export monopolies, or inconvertible currencies. All developing countries that followed such a pattern achieved per capita growth between 1970 and 1989 of two percent per year

or greater,” they conclude.

For their analysis, Sachs and Warner define a subset of countries that have sustained “appropriate” market-based economic policies during 1970–89. They observe that these “qualifying countries” display a strong tendency toward economic convergence, with the countries

per capita growth of less than 1.2 percent per year. Nor was there a single qualifying developing country (that is, with less than \$4000 per capita income) that grew at less than 2 percent per year. “In fact, with the single exception of Haiti, there is not a single developing country that had substantially

“[W]ith the single exception of Haiti, there is not a single developing country that had substantially open trade and yet failed to grow by at least 2 percent per year.”

with the initially low per capita income levels growing more rapidly than the richer countries. The “nonqualifiers” do not display any tendency toward convergence, they note.

Further, there is not a single country in their sample (covering 117 countries and about 90 percent of the world’s population as of 1985) that pursued appropriate policies during 1970–89 and had

open trade and yet failed to grow by at least 2 percent per year,” they note.

Thus, “openness” is almost a perfect determinant of convergence. By Sachs and Warner’s count, there are 12 developing countries that pursued appropriate policies, and all grew at more than 2 percent per year.

Hidden Gains from Trade

Scientific research and product development are major sources of economic growth in the industrial world. Nations in earlier stages of economic development, however, have few resources to devote to creating new technologies and new products; 96 percent of the world’s R and D takes place in high-income countries. The lack of a research capability of their own,

some scholars have asserted, condemns developing countries to technological backwardness and slow growth, while rich countries can become even wealthier, thanks to productivity gains made available by the latest products and technologies.

But recent work in growth theory suggests that new technology can be transmitted across borders

by being incorporated into traded goods and services. In **North-South R and D Spillovers** (*NBER Working Paper No. 5048*), **David Coe**, **Elhanan Helpman**, and **Alexander Hoffmaister** examine whether international trade actually does enable developing countries to enjoy the benefits of R and D conducted abroad. They find strong evidence that trade can be a

conduit for new technology, leading to higher productivity.

Coe, Helpman, and Hoffmaister examine the trading patterns for 77

less open to imports. Each country's productivity, however, also depends on its trading partners. Countries that trade heavily with R

"Countries that trade heavily with R and D-intensive countries show higher productivity gains than countries that trade mainly with countries that do little R and D."

developing countries from 1971 to 1990. In about half the countries in the sample, total factor productivity barely changed over those two decades, while 12 countries saw productivity increases of more than 50 percent. Much of the difference, the authors say, depends on trade. All other things equal, countries with high levels of imports, relative to the size of their economies, exhibit higher productivity than those

and D-intensive countries show higher productivity gains than countries that trade mainly with countries that do little R and D.

The effects of these spillovers are substantial. In 1990, the authors estimate, the spillover effects of R and D conducted in more developed countries raised total output in the 77 developing countries by \$21 billion—an amount equal to more than 40 percent of official

foreign aid. The United States, which has the largest stock of R and D capital and is a major trading partner to many developing countries, plays a particularly important role: a 1 percent increase in the U.S. R and D capital stock raises total factor productivity for the 77 countries by 0.04 percent. Each \$100 invested in R and D in the United States raises output in the developing countries by \$22, the authors calculate. An increase in Japan's investment in R and D has a similar impact, although the benefits are concentrated in Asian countries, particularly China and Indonesia, whose trade is centered on Japan. Their findings, the authors say, support the widespread belief that trade is important in economic growth. "A country that is more open to trade derives a larger marginal benefit from foreign R and D," they conclude.

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