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INSIDE THIS ISSUE

Bang for the R&D Buck Is in a Long, Steady Decline

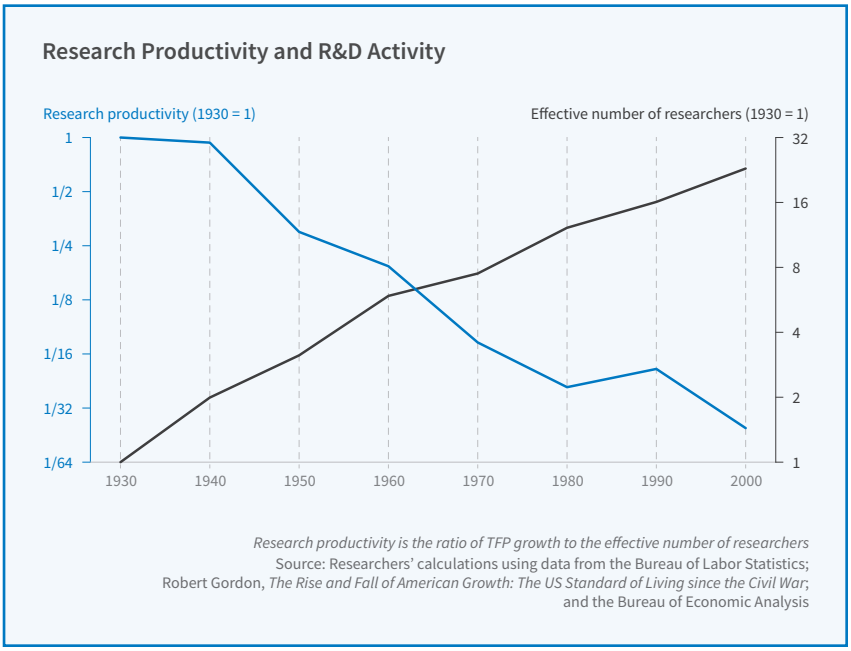
In **Are Ideas Getting Harder to Find?** (NBER Working Paper No. 23782), Nicholas Bloom, Charles I. Jones, John Van Reenen, and Michael Webb argue that, to maintain a given rate of economic growth, resources devoted to research must increase over time. They cite both aggregate evidence and measures of R&D productivity in specific industries, in particular computers, agriculture, and medicine.

They illustrate their finding by reference to Moore's Law, the observation by Intel co-founder Gordon Moore in 1965 that the density of computer chips was doubling every two years. "[B]ecause of declining research productivity, it is around 18 times harder today to generate the exponential growth behind Moore's Law than it was in 1971," the researchers calculate. Bang for the buck from research on computer chips has declined at an average annual rate of 6.8 percent, they find.

Similarly, ever-increasing R&D effort has been required to keep crop yields for corn, soybeans, cotton, and wheat increasing at an annual rate of 1.5 percent per year since 1960. The researchers estimate that research productivity has declined by 4 to 6 percent per year.

> Declining U.S. research productivity means ever-increasing R&D expenditures are required to keep computer technology, medicine, and yields of major crops improving.

The medical field also shows diminishing returns to research dollars, but the results there are more mixed. Looking at the number of drugs approved by the Food and Drug Administration from 1970 through 2015 and the amount spent by the pharmaceutical industry on R&D, the researchers estimate that research productivity has fallen at an average annual rate of 3.5 percent, although the decline has slowed since 2007.



Research productivity is the ratio of TFP growth to the effective number of researchers
Source: Researchers' calculations using data from the Bureau of Labor Statistics; Robert Gordon, *The Rise and Fall of American Growth: The US Standard of Living since the Civil War*; and the Bureau of Economic Analysis

The researchers also compare mortality rates to the flow of new medical research as measured by published studies and, more narrowly, clinical trials. Based on clinical trials, average annual research productivity declined by 7.2 percent for heart disease for the years 1968–2011 and 5.2 percent for cancer in 1975–2006.

In aggregate, the researchers estimate that research productivity in the U.S. has

declined by an average rate of 5.3 percent per year. "[J]ust to sustain constant growth in GDP per person, the U.S. must double the amount of research effort searching for new ideas every 13 years to offset the increased difficulty of finding new ideas," they conclude.

Declining research production may in part be explained by firms "shifting to 'defensive' R&D to protect their market positions." Further, they say that overall research productivity may have suffered because of a decline in basic research spending stemming from reductions in publicly funded research as a share of GDP.

In conclusion, the researchers note that their findings call into question prevailing economic growth projections. "The standard approach in recent years employs models that assume constant research productivity, in part because it is convenient and in part because the earlier literature has been interpreted as being inconclusive," they write. "We believe the empirical work we have presented speaks clearly against this assumption."

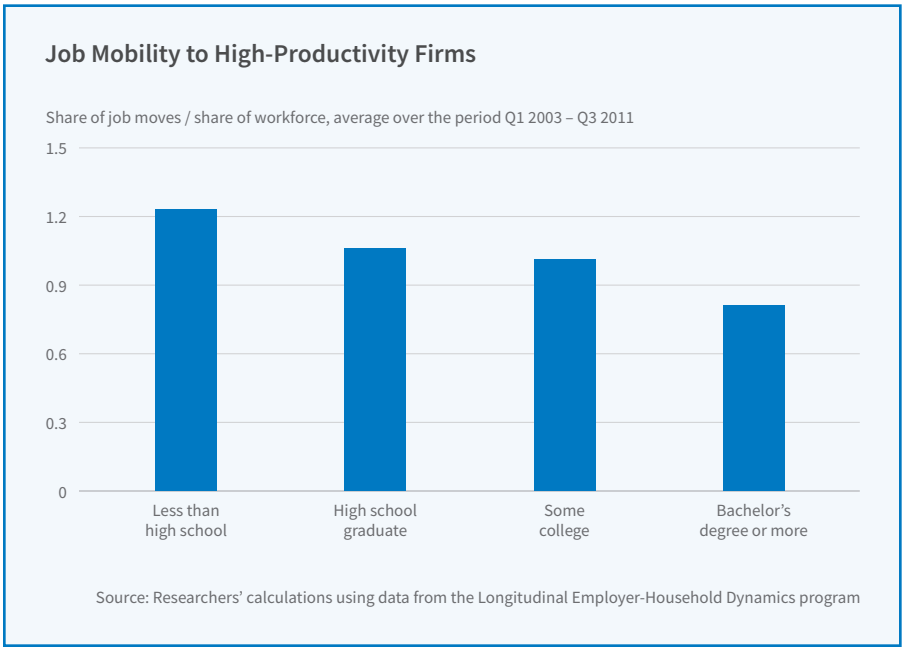
—Steve Maas

Exploring the Job Ladder to High-Productivity Firms

Upward movement of workers on a "job ladder" from low-productivity to high-productivity firms is heavily dependent on the business cycle. During booms, net employment at high-productivity firms grows faster than at low-productivity firms, resulting in workers moving up the ladder. During busts, these upward job-to-job changes essentially stop. Net employment flows are instead driven by layoffs, with low-productivity firms losing comparatively more workers than their higher-productivity counterparts.

In **Who Moves Up the Job Ladder?** (NBER Working Paper No. 23693), John Haltiwanger, Henry Hyatt, and Erika McEntarfer examine demographic patterns in job ladder mobility over the business cycle. Using several datasets from the U.S. Bureau of the Census, they analyze earnings, employment, productivity, and demographic data for 65 percent of the national private sector workforce for the years 1998–2011. Their analysis relies on firm productivity data for a shorter period, 2003–11.

> Less-educated workers are disproportionately likely to move up the job ladder during expansions, but they also slide down during downturns.



The researchers find that younger workers are disproportionately likely to climb the ladder by moving to more productive firms. Workers under 25, for example, account for only 16 percent of the workforce but 37 percent of the outflows from low-productivity firms and 29 percent of the inflows to high-productivity firms.

Less-educated workers also are disproportionately likely to move up the job ladder during expansions. More-educated workers are less likely to enter employment at low-productivity firms in the first place, but once in such firms they are less likely to separate from them. The researchers hypothesize that more-educated workers may be more specialized, and thus less mobile across firms.

The positive rate of job ladder mobility for younger and less-educated workers is not observed during tough

economic times. During contractions, younger and less-educated individuals who are unemployed or out of the labor force are less likely to be hired at all. If working, they are less likely to move up the job ladder to more productive firms, and they are more likely to be knocked off the ladder entirely as a result of job loss. Economic slowdowns, while imposing costs throughout the labor market, are particularly harmful to the employment prospects of younger, less-educated workers.

The researchers note that much of the previous research on the consequences of labor market dynamics during a recession has focused on college graduates, and they suggest that more attention should be paid to the long-term effects on less-educated workers. Because mobility up the job ladder plays a particularly important role in the career paths of younger, less-educated workers, labor market frictions may play an important role in explaining wage differentials between them. In particular, the declining fluidity of the labor market, which has been recently noted, may make it more difficult to climb the job ladder.

— Dwyer Gunn

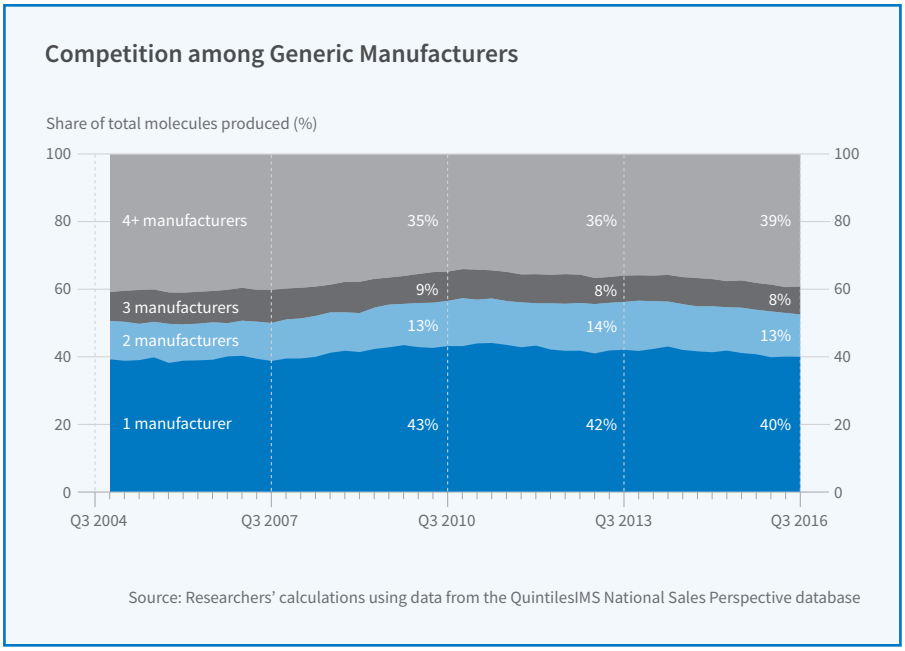
Competition in Generic Drug Markets

Amid news reports of price gouging and shortages of off-patent prescription drugs, a new study finds that the market for generic drugs is dominated by small-revenue products with only one or two producers. Ernst R. Berndt, Rena M. Conti, and Stephen J. Murphy examine how market forces, regulatory changes, and expanded insurance have affected the supply of and demand for off-patent (generic) prescription medication in **The Landscape of U.S. Generic Prescription Drug Markets, 2004–16** (NBER Working Paper No. 23640).

Generics have become a major factor in the U.S. drug market. In 1994, they accounted for just 36 percent of U.S. prescriptions; by 2015, their share was 87 percent. The researchers attribute this dramatic increase to expanded drug insurance, first for seniors in 2006 with changes in Medicare, and then for the entire population a decade later through the Affordable Care Act. Both Medicare and private prescription drug plans have used tiered copay structures that encourage the use of generics.

> Most generic drugs are produced by only one or two firms, and the weak or nonexistent competition is associated with high prices.

Meanwhile, on the supply side, a significant number of "blockbuster" branded drugs went off patent, stimulating market entry by generic producers.



The researchers describe conventional wisdom as suggesting that generic entry should have resulted in a "virtuous circle: increasing access to safe and effective treatments for chronic diseases, and ever-declining prices." The reality has been different. The researchers find that between 2004 and 2016, the trend has been toward less competition among generic drug producers. More than 50 percent of generic drugs have at most two competitors; for 40 percent of drugs, there is just one manufacturer. Competition is more vigorous in the market for generic drugs that can be taken orally than for drugs infused or injected into patients.

The researchers suspect that some government policies may have the unintended consequence of reducing the number of drug suppliers. They postulate that high user fees implemented under the Generic

Drug User Fee Act of 2012 may have raised barriers to new firms entering markets while encouraging existing companies to leave.

A key finding is that the U.S. generic drug industry is composed of numerous relatively small firms with small product portfolios. Median inflation-adjusted sales revenues were $400,000 annually at the start of the study, doubling to $800,000 annually at the end. Mergers among such companies are likely to fall beneath the radar of the Federal Trade Commission and the Department of Justice, "resulting in near-monopolies of generic drug markets with minimal if any public scrutiny."

The consolidation of generic markets is also associated with higher prices. The researchers hypothesize that price hikes might have been greater had it not been for increased buyer power that resulted from the consolidation of pharmaceutical benefit management firms and other bulk purchasers.

— Steve Maas

Rising Debt Levels among Near-Retirees

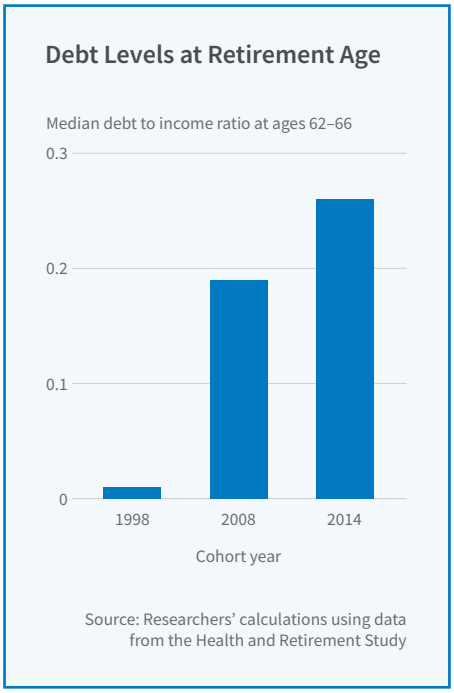
In **Debt and Financial Vulnerability on the Verge of Retirement** (NBER Working Paper No. 23664), Annamaria Lusardi, Olivia S. Mitchell, and Noemi Oggero show that, in recent decades, more and more Americans are entering retirement with significant debt. Debt-to-asset and debt-to-income ratios, as well as total debt, have been on the rise. Most seniors seem to be paying off their debt in retirement, but the trends reflect a higher risk of default and bankruptcy, especially for those faced with variable interest rates and falling incomes.

Drawing upon data from the Health and Retirement Study, the researchers examined the debt patterns of three different cohorts — Americans on the verge of retirement (aged 56–61) in 1992, 2004, and 2010. They also studied the debt patterns of older respondents (aged 62–66) to better analyze retirement security. To learn more about older individuals' ability to manage debt and shield themselves from financial shocks, they also analyzed responses to the 2012 and 2015 waves of the National Financial Capability Study.

Indicators of total debt — including the percentage of individuals arriving at retirement with debt, the median amount of debt, and the debt held by the top quartile and the top 10 percent — increased with each cohort. The increase in the median amount of debt was particularly sharp from 1992 to 2004, from $6,800 to $31,200. Top-quartile debt doubled between 1992 and 2004, and almost tripled by 2010.

For Americans aged 56–61, median indebtedness rose sharply from 1992 to 2004. For the top quartile, debt doubled between 1992 and 2004, and almost tripled by 2010.

Indicators of debt burden, such as the ratio of debt to liquid assets and the ratio of debt to total income, also increased. Primary-residence mortgage debt rose in part because people were buying more expensive homes with lower down payments; this also meant that the home represented a progressively greater percentage of total assets. Incidence and median amounts of credit card and other non-mortgage debt, including high-interest non-collateralized debt, also increased. In 2010, many more senior households held non-mortgage debt equaling or exceeding their liquid assets, suggesting missed opportunities to reduce high-interest debt. The median ratio of debt to total income jumped from 14 percent in 1992 to 45 percent in 2004, and to 50 percent in 2010, making many more households potentially vulnerable to interest-rate increases or financial shocks.



Despite the rise in debt levels, most retirement-age borrowers seemed to be servicing their debt. The researchers found that those in the 62–66 age group carried less debt than those aged 56–61, even though they carried more debt than their counterparts from previous years. They were also less likely

to report carrying credit card debt, incurring late fees, and using high-cost borrowing methods such as paying only the minimum due or using their credit cards for cash advances.

— Deborah Kreuze

How Much Wealth Is Stashed in Tax Havens?

Offshore tax havens in exotic locales have been the subject of Hollywood movies and best-selling novels. But data on the importance of tax havens, and the amount of wealth held in them, is elusive.

In **Who Owns the Wealth in Tax Havens? Macro Evidence and Implications for Global Inequality** (NBER Working Paper No. 23805), Annette Alstadsaeter, Niels Johannesen, and Gabriel Zucman make country-by-country estimates of tax haven wealth holdings. They estimate that wealth worth about 10 percent of global GDP is held offshore.

There is substantial variation across nations in the share of their citizens' wealth that is held in tax havens. Scandinavians hold only a few percent of GDP offshore wealth, but that number rises to about 15 percent for continental Europe as a whole, and to almost 60 percent in some Persian Gulf countries and some Latin American nations.

The researchers analyze recently released offshore bank deposit information from the Bank for International Settlements, including breakdowns of deposits by individual countries. The data were first reported in the early 2000s. The researchers estimate total wealth, including bond and equity holdings, held in shell companies and other accounts set up in tax havens.

For 2007, the researchers estimate that $5.6 trillion was held in tax havens. They note that this estimate is conservative, since it does not include assets such as art collections, gold, and real estate holdings.

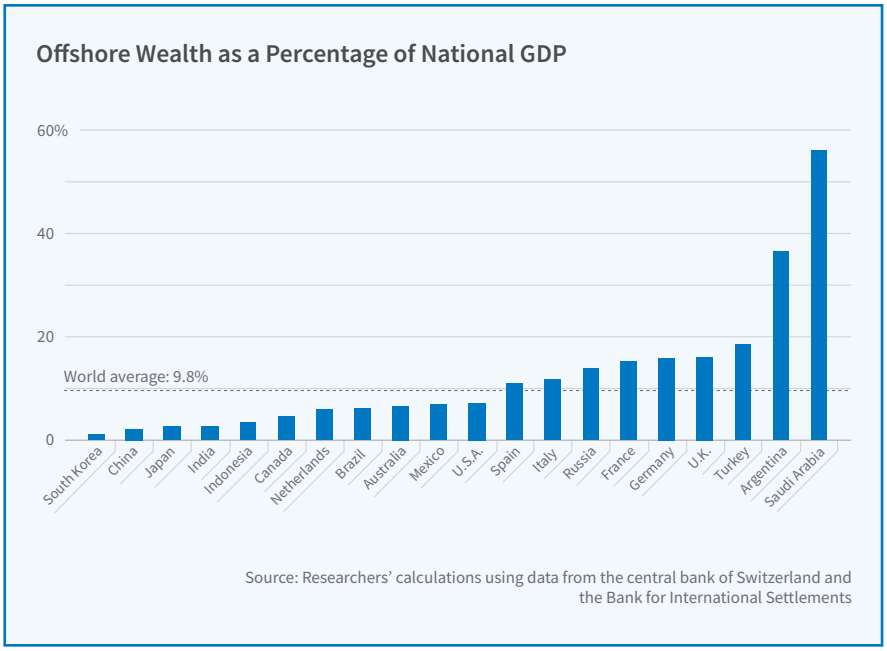
> New estimates based on data from the Bank for International Settlements suggest countries vary widely in the share of wealth held offshore.

The volume of offshore wealth is not easily explained by tax rates or political factors within individual countries. Some of the nations with the lowest shares of offshore assets are high-tax countries, such as Denmark and Norway, while others are low-tax nations, such as South Korea and Japan. Nations with large shares of offshore assets include autocracies, such as Saudi Arabia and Russia, countries with a recent history of autocratic rule, such as Argentina and Greece, as well as long-established democracies, including the United Kingdom and France.

Geography seems to matter. The emerging tax havens of Asia have largely attracted wealth from Asia, while Caribbean havens have attracted wealth from the Americas, and Switzerland has attracted wealth from Europe and the Middle East.

The researchers explore the implications of tax haven wealth for measuring wealth inequality. When assets held in tax havens are included, not surprisingly, wealth inequality is greater than when it is estimated from data reported on tax returns. Because offshore wealth is very concentrated at the top, accounting for it increases the wealth share of the 0.01 percent highest net worth households in Europe substantially, even in countries whose citizens do not use tax havens extensively. Including offshore assets has dramatic implications in Russia, where the majority of wealth at the top is held outside of the country. In the United States, offshore wealth also increases inequality, but the effect is more muted than in Europe.

— Jay Fitzgerald



Explaining the Good Fortune of Dragon Year Children

Is a child born in a certain zodiac year really destined to have more good fortune and success in life than a child born in another year? Many parents in China believe that's the case for children born in a Year of the Dragon, and some education statistics would appear to confirm it.

But in **Can Superstition Create a Self-Fulfilling Prophecy? School Outcomes of Dragon Children in China** (NBER Working Paper No. 23709), Naci H. Mocan and Han Yu show that the higher educational achievements of Dragon year children in China are largely due to the much higher expectations of their parents. Some parents time marriages so as to have children born in Dragon years, and many of them invest more time and money in their children than other parents, thereby helping to fulfill their lofty expectations.

In Chinese astrology, one of the oldest horoscope systems in the world, each year in a 12-year cycle is represented by an animal, and there is widespread popular belief that individuals born in different zodiac years are inherently different. Those born in the Year of the Dragon supposedly are destined for good fortune and greatness. Previous studies of a number of Asian cultures have shown that fertility rates increase in Dragon years.

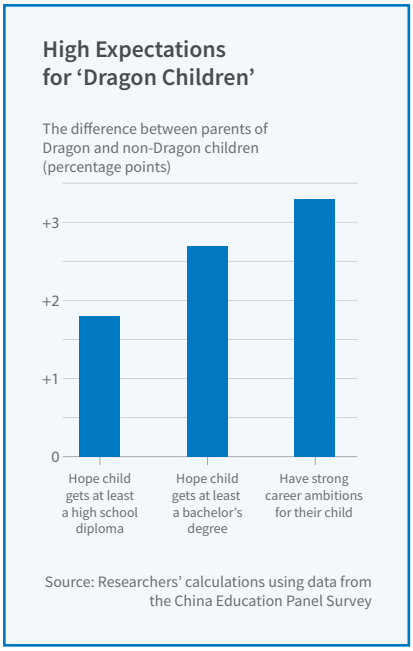
Previous studies of the educational achievements of Dragon year children produced mixed results. Some showed no effects, and others found negative educational effects, leading to speculation that higher birth rates in Dragon years actually harm children who are subsequently exposed to larger classroom sizes and more competition for college and job openings.

In this study, the researchers analyze data about marriages, births, demographic backgrounds of children and their families, school test scores, college entrance exam results, family surveys, and other information from sources including the China Health Statistical Yearbook, the China Civil Affairs Statistical Yearbook, the China General Social Survey, the Beijing College Students Panel Survey and the China Education Panel Survey.

> Those born in a Year of the Dragon are more likely than others to obtain a bachelor's degree or higher — because parents invest more in them.

After adjusting their data to account for the differences between zodiac and Gregorian calendar years, they find spikes in Chinese marriages in the two years prior to the most recent Dragon years: 2000 and 2012. Both Dragon years saw birth rate increases. Live births increased by 289,224 in 2000 compared to the year prior, and by 935,854 in 2012 compared to 2011. Conversely, the researchers find a sharp decrease of more than 400,000 births in 2003, the Year of the Sheep, an unfavorable year for births in the Chinese astrological system. Children born in a Dragon year were 14 percent more likely than children born under the other 11 signs to obtain a bachelor's degree or higher. Those born in Dragon years also scored higher on college entrance exams and middle school tests.

Differing income and educational levels of parents cannot explain the higher educational achievements of Dragon year children. However, in analyzing government surveys of parents, the researchers find that mothers and fathers of Dragon year students have consistently higher expectations for their children than do parents of children born in other years. Moreover, the parents report investing more time, money, and effort into making sure their Dragon-year children succeed — and even provide them with more pocket money and require them to do fewer household chores, presumably so they can focus more on school work.



"Even though neither the Dragon children nor their families are inherently different from other children and families, the belief in the prophecy of success and the ensuing investment become self-fulfilling," the researchers conclude.

— Jay Fitzgerald

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