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## The Economics of Derivatives

Derivatives are financial instruments whose promised payoffs are not the result of ownership of the cash flows of a particular company, but rather are derived from the value of some financial asset or something else altogether. For instance, derivatives exist with payments based on the level of the S&P 500, the temperature at Kennedy Airport, or the number of bankruptcies among a group of selected companies. Derivatives have been traded for centuries, with early examples including tulip bulb options in Holland and rice futures in Japan during the 17th century. But futures markets were relatively small until the 1970s when developments in pricing methodology spurred spectacular growth. The derivatives market has grown 100-fold over the past 30 years, with estimates of the current size of the market at more than \$200 trillion, based on the notional value of contracts outstanding.

According to NBER Research Associate René Stulz, we should not be afraid of derivatives, but rather should have a healthy respect for the benefits that they bring — at the same time being vigilant to the risk of large losses at the company level that may, in some instances, lead to systemic risks. In **Should We Fear Derivatives?** (NBER Working Paper No. 10674), Stulz surveys the nature, growth, and development of derivatives markets, the companies that use derivatives, and the way in which they are used.

Derivatives allow individuals and companies to hedge risks. This means that they make it more likely that risks are borne by those best able to bear them. This makes it possible for individuals and companies to take on more risky projects — with higher promised returns —

and hence create more wealth by hedging those risks that can be hedged. Surveys suggest that 64 percent of US companies use derivatives. Non-financial firms are most likely to do so to hedge interest rate and currency risks. This leads to a more productive economy — and to greater economic welfare.

However, inexperienced or reckless investors and companies may get into trouble — taking on risks they are poorly equipped to quantify and understand. Since one trader's loss is another's gain, this need not typically create problems from an economy-wide perspective. But there can be problems when an individual investor's or corporation's exposure to derivatives becomes

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excessively large relative to the overall market. In 1998, the collapse of Long-Term Capital Management — which had capital of \$4 billion, assets of \$124 billion, and derivatives exposure of more than \$1 trillion — was seen as a systemic risk serious enough that the Federal Reserve called in its creditors to organize a bailout.

The derivatives risks of banks and investment banks are generally well understood and managed, Stulz says, but the derivatives risks taken by insurance companies, hedge funds, and Fannie Mae and Freddie Mac — the government-sponsored agencies — are not equally well understood.

Derivatives also may lead to less transparency and reliability in accounting statements. There may

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be scope for substantial management discretion, for example, as to how to account for derivatives. Freddie Mac, the government-sponsored housing finance company, got into trouble in 2003 because it used derivatives to hide billions of dollars of profits to achieve a smoother earnings path. Derivatives that trade in liquid markets can be bought and sold at the market price — meaning that the valuation is relatively straightforward. Illiquid markets make price discovery more difficult. Surveys show that while traders may be in close agreement on the value of actively traded derivatives they may be wide apart on less liquid securities. This can lead to situations where similar derivatives are valued

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at very different prices in different companies. Accounting statements may be of little help in detailing how derivatives are used and in assessing the overall risk of the portfolio without an adequate accompanying explanation of the use of derivatives.

Stulz concludes that derivatives should be treated in the same way as airplanes. We do not fear flying because there is a risk of a crash, but rather we regulate the airline industry to make planes as safe as it makes economic sense for them to be. While derivatives have been blamed, sometimes wrongly, for large losses — from Barings to Enron — the benefits are widely dispersed and may not make for good headlines. On balance, the benefits outweigh the threats.

— Andrew Balls

## Investing in Commodity Futures

Imagine an asset class whose returns are the same as those on the stock market but less volatile, and which are negatively correlated with stock-and-bond returns and positively correlated with inflation. That asset class is an investment in commodity futures. And, despite being a very old asset class, commodity futures are not widely appreciated.

In **Facts and Fantasies About Commodity Futures** (NBER Working Paper No. 10595), co-authors **Gary Gorton** and **Geert Rouwenhorst** show that over a 45-year period a diversified investment in collateralized commodity futures has earned historical returns that are comparable to stocks. The economic rationale for these returns is the reward that investors in commodity futures receive for providing price insurance to commodity producers. That reward, rather than foreseeable trends in commodity prices, is the key to the returns that a futures investor can expect. Individual commodities can be very volatile, but much of this volatility can be avoided by investing in a diversified index of commodities.

Futures contracts are agreements to buy or sell a commodity at a future date, at a price that is agreed upon today. Except for collateral requirements, futures contracts do not require a cash outlay for either buyers or sellers. On average, the buyer of a futures contract is compensated by the seller of futures if

the futures price is set below the expected spot price at the time of the expiration of the futures contract. The opposite is true when the futures price is set above the expected future spot price. In 1930, John Maynard Keynes postulated that sellers of futures (hedgers) would compensate the buyers of futures (speculators), a situation he referred to as “normal backwardation.” By examining the returns to futures over long periods, Gorton and Rouwenhorst indirectly test this Keynesian prediction.

They construct a dataset of returns on individual commodity futures going back as far as 1959. The dataset combines information

return on T-Bills by about 5 percent per annum. This is about the same as the historical risk premium on stocks (the equity premium) over the 1959-2004 period, but the commodity index has slightly lower standard deviation than the S&P 500. The relatively low volatility of the commodity index stems from the fact that the pair-wise correlations between individual commodities are relatively low.

Commodities are also less risky by other standards. First, the distribution of commodity returns is skewed right, whereas equity return distributions are skewed left. In other words, relative to a normal “bell-shape” curve, equities experi-

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about individual commodity futures prices obtained from the Commodity Research Bureau (covering, among other exchanges, the CBOT and CME) and the London Metals Exchange. Investment returns are computed by “rolling” positions in individual futures contracts forward over time. Commodities are combined into an equally weighted index; much of the paper is concerned with the behavior of this index.

Historically, the average return on the equally weighted index of commodity futures has exceeded the

ence proportionally more crashes, whereas the “crashes” in commodities occur most often on the upside, leading to positive returns to investors. Further, Gorton and Rouwenhorst show that commodities have the ability to diversify portfolios of stocks and bonds. The sources of the diversification benefits are the ability of commodities to provide a (partial) hedge against inflation — stocks and bonds are poor hedges by comparison — and to partially offset the cyclical variation in the returns of stocks and bonds.

## Measuring the Growth from Better and Better Goods

Much economic growth occurs through growth in quality, as new models of consumer goods replace older, sometimes inferior, models. For 1995, as an example, researchers have estimated that the Bureau of Labor Statistics (BLS) methods of determining economic growth allowed for as much as one percent average quality growth in goods.

However, it is often argued that the BLS methods miss much of the growth in goods’ quality. The Boskin Commission Report (1996) suggests that the BLS overstates inflation by perhaps one percent a year, with unmeasured growth in the quality of goods the most important component of that overstatement, contributing 0.6 percent per year.

In **Measuring the Growth from Better and Better Goods** (NBER Working Paper No. 10606), NBER Research Associate **Mark Bils** estimates that quality growth for durables has been understated by 3 percent per year for the past 15 years. This suggests an actual growth rate of at least 5.8 percent per year, even with computers excluded. These

results indicate much faster quality growth for durables, particularly vehicles, than reported by the Boskin Commission.

Bils points to the difficulty of distinguishing quality growth from true price increases for goods such as durables that display frequent model changes. To calculate the consumer price index (CPI), the BLS tracks a large set of prices, with each price specific to a particular product at a particular outlet. At regular sample rotations, the BLS draws a new sample of stores and products within a geographic area to better reflect current consumer spending. But, in addition, a store may stop selling a particular product. The BLS agent then must substitute another model of that brand or of a similar product. These (forced) substitutions occur about once every three years for all non-housing CPI items. They occur much more frequently, nearly once per year, for consumer durables.

Using microdata from the CPI, Bils shows that much of price increases captured in the CPI for durable goods since 1988 reflects not increases in price for a given set of products, but rather shifts to a newer

set of product models that have higher prices. He shows that one can arrive at vastly different measures of price inflation and real growth under plausible competing assumptions on how much quality change accompanies these product turnovers.

To judge quality growth, Bils examines how consumer expenditures respond to product substitutions. For automobiles and consumer electronics, he finds that consumer spending clearly moves away from static goods, that is, those with no

that prices for static models respond very little to competing product substitutions, suggesting that price increases accompanying these product substitutions may reflect higher perceived quality as well. This would imply that quality growth is as much as 1.6 percent faster than suggested by BLS measurement methods for these goods.

Product substitutions are more important for consumer durables than for most other consumer goods, so Bils points out that it

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model changes. This suggests a true rate of inflation that is even lower than that exhibited by these static goods.

For vehicles, the results of this study suggest that quality growth has been understated by as much as 4.4 percent per year. Bils suggests that growth for consumer electronics also has been substantially faster than historically measured, by 2.9 percent or more per year. For the balance of durables, Bils observes

would not be appropriate to project his findings to non-durables. But the approach could be extended beyond durables by obtaining information for additional goods on how market share responds to product substitutions. Bils suggests that greater availability of scanner data should gradually provide researchers with market information for a broader set of goods and for longer sample periods.

— Les Picker

## The Economics of World War I

**D**id World War I produce a major economic break from the past in the United States? Did the U.S. economy change in some fundamental and lasting ways as a result of that war? NBER Research Associate **Hugh Rockoff** addresses these questions in his recent study **Until It's Over, Over There: The U.S. Economy in World War I** (NBER Working Paper No. 10580). After surveying the U.S. mobilization and financing for the war, Rockoff concludes that perhaps the greatest impact of World War I was a shift in the landscape of ideas about economics and about the proper role of government in economic activities.

When the war began, the U.S. economy was in recession. But a 44-month economic boom ensued from 1914 to 1918, first as Europeans began purchasing U.S. goods for the

war and later as the United States itself joined the battle. “The long period of U.S. neutrality made the ultimate conversion of the economy to a wartime basis easier than it otherwise would have been,” writes Rockoff. “Real plant and equipment

lion people were added to the military and half a million to the government. Overall, unemployment declined from 7.9 percent to 1.4 percent in this period, in part because workers were drawn in to new manufacturing jobs and because the mil-

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were added, and because they were added in response to demands from other countries already at war, they were added precisely in those sectors where they would be needed once the U.S. entered the war.”

Entry into the war in 1917 unleashed massive U.S. federal spending which shifted national production from civilian to war goods. Between 1914 and 1918, some 3 mil-

itary draft removed many young men from the civilian labor force.

Rockoff estimates the total cost of World War I to the United States at approximately \$32 billion, or 52 percent of gross national product at the time. He breaks down the financing of the U.S. war effort as follows: 22 percent in taxes, 58 percent through borrowings from the public, and 20 per-

cent in money creation. The War Revenue Act of 1917 taxed “excess profits” — profits exceeding an amount determined by the rate of return on capital in a base period — by some 20 to 60 percent, and the tax rate on income starting at \$50,000 rose from 1.5 percent in 1913-15 to more than 18 percent in 1918. Meanwhile, Treasury Secretary William Gibbs McAdoo crisscrossed the country peddling war bonds, even enlisting the help of Hollywood stars and Boy Scouts. The prevalence of patriotic themes created social pressure to purchase the “Liberty bonds” (and, after the armistice, the “Victory bonds”), but in practice the new bondholders did not make a tangible personal sacrifice in buying war bonds, since the yields on these debt instruments were comparable to those on standard municipal bonds at the time. As Rockoff notes, “patriotic motives were not sufficient to alter market prices of assets during the war.”

As part of the war effort, the U.S. government also attempted to guide economic activity via centralized price and production controls administered by the War Industries Board, the Food Administration, and the Fuel Administration. Rockoff judges that the overall impact of these programs on reallocating resources was “rather small.” Timing

played a role, since some of the agencies were only established once the United States entered the war, and they took time to begin fulfilling their roles. Also, management problems emerged. For example, the War Industries Board attempted to create a “priorities system” for determining the order in which producers would fill government contracts for industrial goods. Unfortunately, all policymakers gave their order the highest rating (“A”). Leaders then created several higher priority ratings (such as “A1”), with much the same result. “Replacing price signals with priorities is not as simple as it sounds,” surmises Rockoff.

Finally, the author assesses the legacies of World War I for the U.S. economy. When the war began, the United States was a net debtor in international capital markets, but following the war the United States began investing large amounts internationally, particularly in Latin America, thus “taking on the role traditionally played by Britain and other European capital exporters.” With Britain weakened after the war, New York emerged “as London’s equal if not her superior in the contest to be the world’s leading financial center.”

In matters of economic ideology, Rockoff argues that, although the U.S. government took on such

an active role in economic affairs during the war, this evolution did not ratchet up the government role in peacetime. Subsequent increases in federal spending resulted mainly from war-related matters (such as veterans’ benefits), and most of the wartime regulatory agencies soon disappeared due to the efforts of conservative politicians. Nevertheless, the successful wartime experience “increased the confidence on the left that central planning was the best way to meet a national crisis, certainly in wartime, and possibly in peacetime as well.” This view became increasingly important after the Democrats reached power during the Great Depression. “Almost every government program undertaken in the 1930s reflected a World War I precedent,” explains Rockoff, “and... many of the people brought in to manage New Deal agencies had learned their craft in World War I.” The author concludes that the scope and speed of government expansion in the 1930s were likely greater because of the impact of the war on the world view of new economic and political leaders, who in turn inspired future generations of reformers. “For America, to sum up,” writes Rockoff, “the most important long-run impact of the war may have been in the realm of ideas.”

— Carlos Lozada

## Changing Demographics of U.S. Science-Engineering PhDs

In 1966, U.S.-born white males received 71 percent of science and engineering PhDs, U.S.-born females earned 6 percent of those degrees, and foreign-born students received 23 percent of those doctorates. By the year 2000, U.S.-born white males received just 35 percent of science and engineering PhDs, while 25 percent of those doctorates were awarded to females and 39 percent to foreign-born students. In **Where Do New U.S.-Trained Science-Engineering PhDs Come From?** (NBER Working Paper No.10554) authors **Richard Freeman, Emily Jin,** and **Chia-Yu Shen** also find that

between 1970 and 2000 there was a huge increase in the number of science and engineering PhDs with undergraduate degrees from foreign institutions.

Among U.S. citizens, there has been a substantial upward trend in the proportion of PhDs granted to minorities: Asians and Pacific Islanders, blacks, and Hispanics. They earned fewer than 3 percent of all PhDs granted to Americans in 1966, and 9 percent of those degrees in 2000. In the case of science and engineering PhDs only, minorities increased their share of the PhDs received by U.S. citizens to 2.7 per-

cent in 2000, compared to a negligible number in 1973. But their PhD share remains well below their share of the total population.

The authors note that “there is no clear explanation why women and minorities have chosen science and engineering PhDs in increasing numbers while fewer white men have gone on to earn science and engineering PhDs.” One possibility is that they find these degrees financially more attractive. But this demographic group is also entering medical and law schools in greater number. So “it cannot be much of the story,” the authors write.

One reason for the pickup in foreign students, particularly those with foreign bachelors' degrees, is that they often can earn much more from a U.S. doctorate than from working in other careers in their native country. That's in part because the science and engineering doctorate opens the door to working in the United States or working for U.S. and other multinational firms.

American students, the authors write, have other diverse U.S. educational prospects, such as medical school, law school, and business school, and they can work as scientists or engineers without obtaining a PhD. So, they have less incentive to invest in a science and engineering PhD than comparable foreigners with undergraduate degrees.

In the United States, the number of universities and programs granting science and engineering PhDs has increased substantially. In 1970, 214 universities granted them; in 2000, the number had grown to 339 universities/campuses. In 1960, there were 6,520 science and engineering PhD graduates in science and engineering. By 1970 there were 18,052 PhD graduates and by 2000, there were 29,951. Among the big schools, producing 400-500 science and engineering graduates a year, are: the University of California, Berkeley; University of Illinois at Urbana; University of Wisconsin at Madison; University of Michigan; University of Minnesota; MIT; and Stanford.

This study finds that the pro-

portion of science and engineering PhDs coming out of such traditional leading doctorate institutions has declined. These universities have tended to maintain the size of their PhD programs, so that growth in the number of PhDs has occurred largely from smaller, less prestigious, yet often selective, schools. In the year 2000, women were less likely to obtain a PhD from the higher quality and larger universities than were other demographic groups. Perhaps, the authors suggest, women tended

ten among recipients of federal R and D money fell sharply from 1985 to 2000: indeed, the number of PhDs from the top ten R and D schools was lower in 2000 than in 1985.

An economic explanation for this trend, the authors note, is that the cost of expanding PhD programs at traditional PhD-producing universities can be quite high, because of capacity constraints set by faculty, plant, or other characteristics of existing programs. Another

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to enroll in smaller, newer PhD programs because they specialized in biological science areas. Or, the women didn't want to travel so far from home for family reasons. Or, they just didn't get admitted to the most prestigious and larger school programs.

Further, schools granting PhDs in science and engineering now face a “highly competitive” market, one which 30 years ago was only “moderately concentrated using standard definitions of market concentration from industrial organization,” the authors find. The increase in science and engineering PhDs in the United States largely came from an expansion of smaller and less prestigious programs. One indication of this trend is that the proportion of PhDs coming from universities in the top

explanatory factor could be the willingness of state legislatures to fund a new PhD program in their own state universities, but not to support the education of students from their state at a program in some rival state. Private institutions may find it easier to raise funds to improve the quality of existing programs than to develop a “clone institution” at some other location.

This study uses data from the annual Survey of Earned Doctorates to detect demographic changes in science and engineering PhDs. The number of these graduates is relatively small when compared to, say, bachelors' degrees. But these PhD graduates often are considered significant to a nation's technological competitiveness.

— David R. Francis

## Antidumping in Historical Perspective

Over the last 20 years it has become much easier for American firms to successfully block certain imports from other countries by claiming that they are being sold or “dumped” in the United States at artificially low prices and thus should be subjected to high import duties. But while these so-called “antidumping” claims are now a more prominent feature of American trade policy, the number of products targeted in complaints has actually fallen since

the mid-1980s.

In **The Rise of U.S. Antidumping Action in Historical Perspective**, (NBER Working Paper No. 10582), NBER Research Associate **Douglas Irwin** looks back at the evolution of the arcane but politically popular world of antidumping actions which, in this era of trade liberalization, have become one of the few legal ways for countries to protect domestic firms from foreign competition.

Irwin notes that the current interest in antidumping laws — best known of late for their use in slowing imports of cheap steel — is largely uninformed by an historical view of their application. He suggests that there has been insufficient appreciation of the political and economic variables that have made antidumping claims today's import-fighting weapon of choice.

A key finding of Irwin's study is that throughout much of the 20th

century American firms have routinely tried to slow imports of a wide variety of products by claiming that they were being sold to U.S. customers at a price that was either below production costs or less than their fair market value. Contrary to the conventional wisdom that there were not many antidumping cases prior to 1980, Irwin shows that the number of antidumping investigations in the 1930s, 1950s, and 1960s was roughly equivalent to the current rate.

Irwin identifies two major differences between pre- and post-1980 antidumping policy. In the past, most antidumping complaints did not result in the imposition of import duties. Today's antidumping cases are much more likely to be successful. Irwin attributes the high success rate of today's cases not to an increase in dumping but to "legal changes and bureaucratic incentives." For example, legislation was enacted in 1980 stripping the authority to review antidumping cases from the Treasury Department, which many in Congress considered unsympathetic to domestic industry concerns, and giving the authority to what was widely seen as the more business-friendly Commerce Department.

The other difference is that contemporary cases usually charge that the dumping involved imports from several countries simultaneously. Indeed, the rise of multiple peti-

tions that accuse several countries of dumping the same product accounts for much of the post-1980 increase in antidumping actions. But if measured by the number of products subjected to complaints, antidumping complaints peaked around 1985 and declined since then.

This is also attributable to legislative changes. In 1984, the International Trade Commission, which reviews complaints after the Commerce Department, was directed to

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add up the total value of the imports involved when calculating whether a domestic industry had suffered any harm. This shift motivated companies to file antidumping complaints that focused on many countries. An antidumping complaint that includes petitions targeting imports from more than one nation boosts the total value of what's being labeled as suspect, thus increasing the chances of gaining a favorable decision. "This gave import-competing firms an incentive to file more antidumping petitions against other countries for a given product," Irwin states.

The combination of a particularly favorable venue and the shift to multi-country complaints appears to have dramatically altered the dynam-

ic in favor of domestic industries alleging harm. Irwin finds that prior to 1980, most cases alleging dumping were rejected at an early stage; of those given a full review, only about one quarter — or five percent of all cases — were decided in favor of the domestic industry. But he notes that since the mid-1980s, almost every antidumping complaint has gotten a full review. And, in roughly half of the complaints the government determined that dumping had

in fact occurred and that punitive duties should be imposed.

Irwin reports that other variables can make antidumping complaints more likely in a given year. These include a rise in the value of the dollar, which makes imports cheaper, and a rise in the unemployment rate. Irwin also points out, not surprisingly, that the attractiveness of antidumping complaints also is influenced by international trade agreements, which are producing ever-lower tariffs. According to Irwin, "this decline in trade barriers exposed many industries to foreign competition and may have pushed them toward using antidumping duties to protect themselves."

— Matthew Davis

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