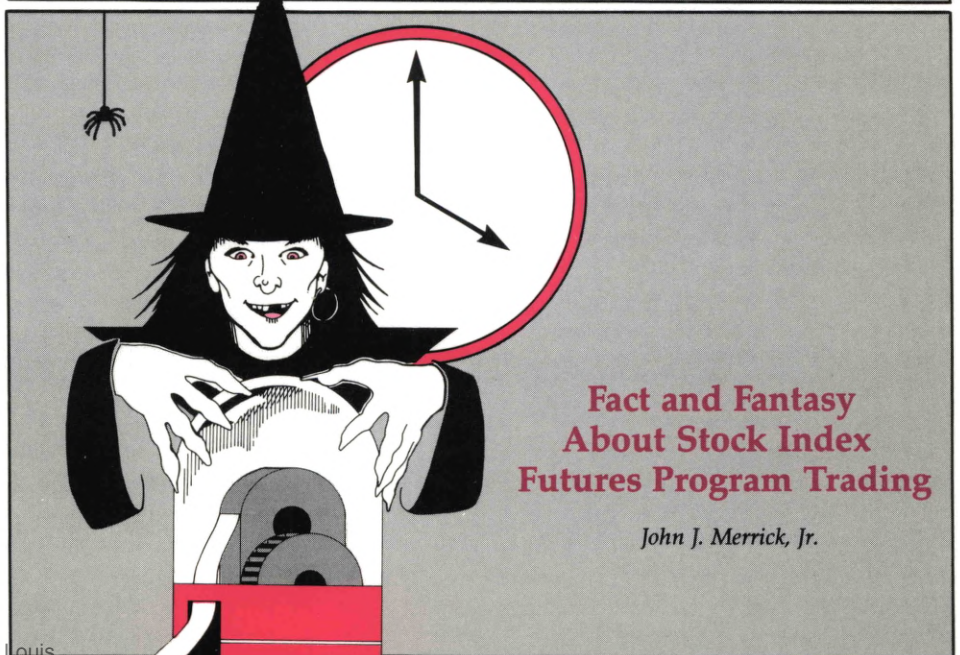
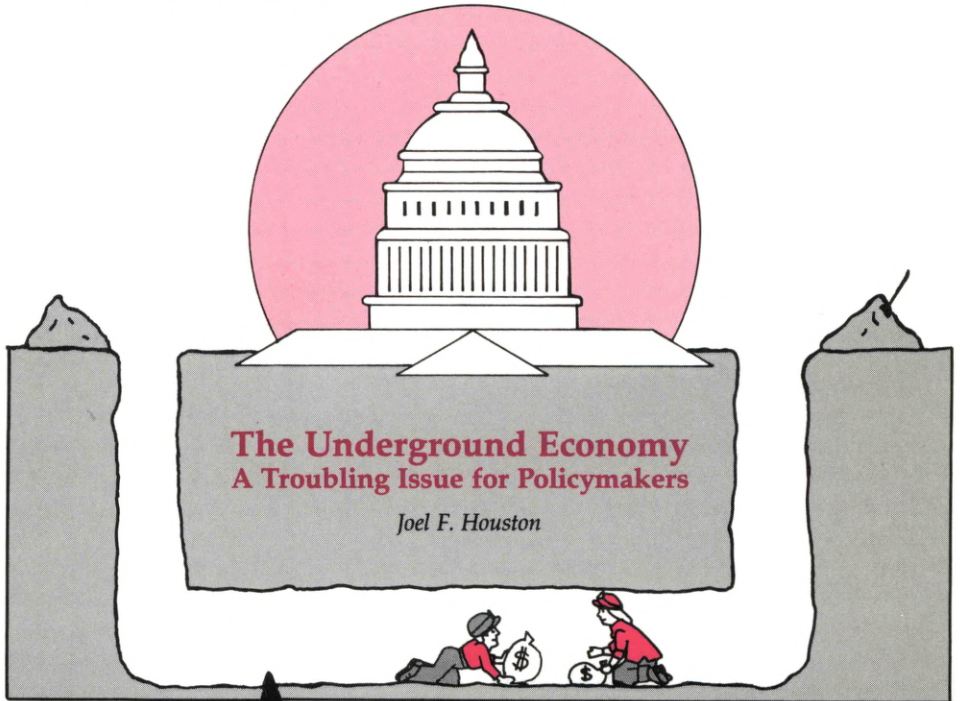


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Fact and Fantasy About Stock Index Futures Program Trading

John J. Merrick, Jr.

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THE UNDERGROUND ECONOMY: A TROUBLING ISSUE FOR POLICY- MAKERS

Joel F. Houston

The existence of the underground economy leads to tax rates and budget deficits that are higher than necessary, unfairness in the tax system, and potentially misguided fiscal and monetary policies. But getting a handle on the underground economy is no easy task. Depending on the definition, economists' estimates of its size range as wide as 5 to 25 percent of GNP, or \$200 billion to \$1 trillion! Moreover, how policies will affect the underground economy also depends on how it is defined.

FACT AND FANTASY ABOUT STOCK INDEX FUTURES PROGRAM TRADING

John J. Merrick, Jr.

Futures markets in stock indexes, such as the S&P 500, are an astounding success story. And some are concerned that arbitrageurs' "program trading," which tries to profit from abnormal price differences between these futures markets and the cash market for stocks, has grown too much. Pointing to the price swings in the stock market on "Triple Witching Days," they claim that program trading makes stock prices volatile overall. But a careful analysis of the impact of program trading suggests that limiting arbitrage activity could do more harm than good.

The Underground Economy: A Troubling Issue for Policymakers

*Joel F. Houston**

In making economic decisions, households, businesses, and government officials all rely on information concerning the current and expected performance of the economy. The most widely recognized barometer of economic performance is the measure of gross national product (GNP). In principle, GNP represents the value of all final goods and services produced for a given time period.

In practice, however, not all economic activity is accounted for in GNP. Empirical evidence suggests that a significant portion of economic activity takes place in a sector that has been alternatively referred to as the “shadow,” “hidden,” “irregular,” or “underground” economy, where goods and services—some legal, some not—are produced but not reported. For policymakers who want to account for this activity, the problems of doing so are daunting. The underground economy does not just sit “out there,” unchanging; rather, many diverse elements make up the underground economy, and both the size of its components and its overall size vary over time. Parts of the underground econ-

*Joel F. Houston, Assistant Professor of Finance at the University of Florida, prepared this article while he was an Economist in the Macroeconomics Section of the Philadelphia Fed’s Research Department.

omy, for example, may move in response to changes in government policy. To the extent that policymakers do not, or cannot, take the underground economy into account, they may not achieve their desired goals.

Interest in understanding and estimating the size of the underground economy has increased recently, due in part to the current political environment in which budget deficits and tax reform have dominated the news. High budget deficits have led legislators to search for untapped sources of revenue. At the same time, tax reform was designed to lower marginal tax rates and to promote a more equitable distribution of the tax burden. And while tax reform was designed explicitly to be revenue neutral, it represents a net tax cut for individual taxpayers. By "getting at" income generated in the underground economy, the potentially contradictory goals of increasing revenue and lowering tax rates can both be met. But in order to do so, the two-way link between the underground economy and policy should be carefully explored.

AN INTRODUCTION TO THE UNDERGROUND ECONOMY

What Is the Underground Economy? The underground economy conjures up a variety of images. Often, people first think of illegal activities, such as selling drugs, gambling, or loan-sharking. They might also think of income earned in perfectly legal activities but not reported, for example, income earned moonlighting "off the books" to avoid taxes or to supplement social security or unemployment benefits without facing a reduction in benefits. More generally, the underground economy incorporates all unmeasured economic activity. Thus it includes other activities as well, such as bartering goods and services: the dentist wires braces for the electrician's child, and in return the electrician wires the dentist's house. It even includes activities like growing your own food or doing your own repairs.

Obviously, the underground economy defined this broadly is not homogeneous. It is made up

of lots of different people who are influenced by many different factors. For example, the factors influencing whether or not you decide to deal drugs may be entirely different from the factors affecting whether or not you neglect to report all of your income on your taxes.

These differences are especially important to keep in mind when it comes to interpreting studies claiming to measure the size and impact of the underground economy. Estimating the size of the underground economy cannot be separated from the fundamental question concerning what the underground economy comprises. Indeed, estimates of the underground economy vary, at least in part, because they often focus on different components of the underground economy.

While the underground economy can be defined quite broadly, most researchers have focussed on a more narrow definition that does not consider activities such as barter and growing your own food. These activities are often extremely hard to detect, and individuals' reasons for engaging in them are difficult to pinpoint. The dentist and electrician, in the previous example, may be merely exchanging acts of friendship, as opposed to trying to circumvent the tax laws. Policymakers, it would appear, have little or no impact on whether or not acts of friendship occur, or on whether or not an individual chooses to grow his own food. Policymakers, however, can more directly influence certain other types of underground activity, such as taxes that are evaded on income that is earned legally, and income illegally earned, which presumably also is untaxed. These activities represent a more narrow definition of the underground economy, and will make up what we refer to here as the underground economy.¹

¹In adopting this more narrow definition we are limiting the discussion to that part of the underground economy that has been the primary focus of past research and policy discussions. This does not imply, however, that there is no link between public policy and activities such as barter and growing your own food. As discussed in Donald C. Cox and

How Big Is the Underground Economy? For some very obvious reasons, it is impossible to come up with a direct estimate of the size of the

Robert H. DeFina, "Warm Feelings and Cold Calculations," this *Business Review* (March/April 1986) pp. 15-22, even acts of friendship have important implications for the success or failure of certain policy initiatives. At the same time, changes in policy may make barter and growing your own food more or less attractive. Indeed, the main points concerning the links between policy and our more narrow definition of the underground economy also may directly apply to these other activities as well.

underground economy. By definition, participants in the underground economy are actively trying to avoid detection, so there is no simple and direct place to look for information about its size. This makes the underground economy inherently difficult to measure.

Studies that have tried to measure it have used a variety of *indirect* techniques. (See MEASURING THE SIZE OF THE UNDERGROUND ECONOMY.) The various estimates differ considerably, ranging from 5 to 25 percent

Measuring the Size of the Underground Economy

A number of techniques have been employed in an attempt to measure the underground economy, with each giving a somewhat different view of its size and variation.^a Two related issues help explain the differences among these various estimates. First, each uses a different methodology; for instance, the IRS estimates rely on audits of tax returns, while others rely on unexplained currency holdings.^b Second, there is no guarantee that the alternative procedures have captured the same portion of the underground economy. This is true despite the fact that all available estimates focus only on market transactions and ignore barter transactions. For example, the IRS estimates may be picking up mainly legally earned, but not reported, income, while currency-based estimates may be capturing mainly illegally earned income. It is important to keep this lack of perfect comparability in mind when examining the estimates. See SELECTED BIBLIOGRAPHY, p. 12, for full references.

Study	Estimate (billions \$)	Percent of GNP	Year of Estimate
IRS	145	8	1976
Bureau of Economic Analysis Adjusted Gross Income Gap ^c	184	5.4	1983
Monetary Based Approaches:			
Gutmann	420	14-15	1981
Feige	600+	27	1979
Tanzi	118-159	4.5-6	1980
O'Leary ^d	432	15.2	1985
Houston	400	14.7	1980

^aFor a more comprehensive review of these estimates see, Carol S. Carson, "The Underground Economy: An Introduction," *Survey of Current Business* 64 (May 1984 and July 1984). Some of the estimates in the chart follow directly from a similar chart presented in these articles.

^bFor a critical summary of these approaches, see R. Porter and A. Bayer, "A Monetary Perspective on Underground Economic Activity in the United States," *Federal Reserve Bulletin* (March 1984) pp. 177-189.

^cThe Bureau of Economic Analysis stresses that caution should be taken in interpreting this measure. See Robert Parker, "Improved Adjustments for Misreporting of Tax Return Information Used to Estimate the National Income and Product Accounts, 1977," *Survey of Current Business* (June 1984) pp. 17-25, and Carol S. Carson, "The Underground Economy: An Introduction," *Survey of Current Business* 64 (May 1984 and July 1984).

^dFor a description, see Leonard Silk, "Underground's Hidden Income," *New York Times* (September 10, 1986) p. D2.

of reported GNP in recent years. Most of the estimates, however, suggest its size is quite large and lies in the more narrow range of 5 to 15 percent of reported GNP. At the beginning of 1987, that amounted to between \$200 and \$650 billion.

The large disparity among the various estimates is perhaps not surprising, since the different methodologies used probably pick up different aspects of even our narrow definition of the underground economy. Estimates from the Internal Revenue Service (IRS), for example, rely on information gained from audited tax returns, and so may be a more accurate measure of tax evasion of income legally earned. Other estimates focus on what are believed to be abnormal holdings of currency. In contrast to the IRS strategy, these approaches may do a better job of detecting changes in illegally earned income.

The wide range of estimates serves as a reminder of how slippery the underground economy is, and thus of the difficulties policymakers face when trying to get a handle on it. But despite those potential difficulties, policymakers cannot afford to ignore the underground economy. For as it happens, the success or failure of a variety of economic policies may well hinge on the existence and behavior of the underground economy.

THE EXISTENCE OF THE UNDERGROUND ECONOMY HINDERS EFFECTIVE POLICYMAKING

For a number of reasons, the viability of the underground sector makes policy initiatives less effective than they would otherwise be. It can, for example, force tax rates or budget deficits to be higher than is desirable. It can also lead to an unfair distribution of the tax burden; and, by obscuring policymakers' view of the overall health of the economy, it can lead to misguided fiscal or monetary policies.

The Underground Economy Can Lead to Higher Taxes or Larger Deficits. A key feature of underground activity is that it remains untaxed,

and thus represents a potentially large source of lost revenue. This loss of revenue implies that the government must either increase taxes, run a larger deficit, or cut government spending. While an increase in taxes may offset the lost revenue due to the underground economy, tax increases raise the costs of public services for current taxpayers and reduce the incentives to work and invest, which in turn may weaken the economy. Alternatively, increasing deficits may lead to higher interest rates, which also may discourage investment and economic growth. Slashing government spending is not likely to reduce investment, but it does imply that taxpayers are receiving fewer government services than they would if all underground activity were somehow taxed. Consequently, the loss of tax revenue due to the underground sector poses serious problems for fiscal policy, regardless of whether the lost revenue is offset by higher taxes, higher deficits, or lower spending.

Back-of-the-envelope calculations suggest that the potential revenue losses due to the underground economy may be staggering. The average range of estimates indicate that this sector currently represents between \$200 billion and \$650 billion. If all of this underground income were taxed at the average marginal tax rate of 22 percent, then the government would receive between \$44 billion and \$143 billion in additional revenue, everything else equal. This suggests that if this underground income could be discovered and taxed, current deficits could be reduced significantly, or tax rates could be cut. Alternatively, spending could rise anywhere between \$44 billion and \$143 billion with no corresponding rise in taxes or deficits.

The Underground Economy Diminishes the Fairness of Our Tax Structure. The loss of tax revenue due to the underground economy also raises some important issues concerning fairness and equity. For example, all of us receive some benefits from public goods, such as defense spending, park maintenance, law enforcement, and pollution control. To finance these services, we are expected to pay our "fair share" of taxes,

as determined by Congress and codified in the tax structure. But those who choose to participate in the underground economy enjoy the benefits of these services while paying less than their fair share of taxes. Some individuals in the underground economy may even pay no taxes at all. Tax evasion necessarily increases the burden on those who choose not to participate in the underground economy. Consequently, the presence of the underground economy leads to an unfair distribution of the tax burden.

The Underground Economy Can Lead to Misguided Policies. There are at least two distinct ways in which the underground economy may distort policymakers' perception of the economy, and hence lead to inappropriate fiscal or monetary policy actions. First, it prevents policymakers from accurately determining the average level of economic activity. Second, it distorts policymakers' views on how total economic activity fluctuates over the course of business cycles.

The key point is that individuals base their economic decisions on total income (that is, aboveground plus underground income), whereas policymakers observe movements in only the aboveground, or reported, economy. At least in part, individuals decide how much to save, how much to work, and even where to work based on all income opportunities that are available, as opposed to just the income that is reported to the IRS. For example, historical data on reported income and consumption might lead policymakers to conclude that household saving rates have been either low or declining. But if households have been earning money in the underground economy, this conclusion may be way off the mark. Instead, if the gap between consumption and actual income were quite large, policies designed to encourage savings would be misguided. In this instance, policymakers would be making incorrect decisions, because they do not have complete information about the average level of the economy's performance.

At the same time, policymakers' attempts to

stabilize the economy may be limited by their inability to observe movements in the underground economy over the course of business cycles. Since individuals base their economic decisions on their total income, it follows that interest rates and prices respond to changes in total as opposed to reported income. For example, we may observe inflationary pressures in the economy if total income is climbing, even if reported GNP is sluggish. For this reason, policymakers may care to stabilize the *total* economy. However, they are constrained by the fact that data exist only for the *reported* economy. If policymakers fail to understand the ways in which the aboveground and underground economies are linked, then they will misread the strength of the total economy, which may lead them to make inappropriate stabilization decisions.

As an example, consider the following scenario: We observe a recession in the reported economy, although at the same time the underground economy is expanding. So while reported GNP is declining, the total level of economic activity is not declining as much, or is possibly even increasing because of the increase in the underground economy. Observing the recession in the reported economy, policymakers become convinced that the economy is quite weak, and implement countercyclical policies to promote recovery. However, since the total economy is stronger than reported figures indicate, countercyclical policies that attempt to stimulate the economy may serve only to increase inflationary pressures in the total economy.²

Alternatively, the total economy may be subject to wider swings in performance than

²Policymakers might not care about inflationary pressures if they affected only *illegal* goods and services. Higher prices for narcotics and prostitution, for example, might be considered beneficial since they probably discourage their consumption. However, it is extremely unlikely that price increases would be isolated to illegal goods and services. As a practical matter, then, the main points stressed in this section represent relevant concerns to policymakers.

reported statistics suggest. In this situation, policymakers could be lulled into believing that the economy is growing at a steady rate, while in fact total economic activity may be subject to fairly dramatic swings over the course of business cycles. If policymakers aim to stabilize the total economy, then countercyclical policies may actually be appropriate, even if the reported economy appears to be stable.

The underground economy would present less of a problem for stabilization policy if it remained constant in size, or if it remained a constant percentage of GNP. In either case, at least the *direction* in which the overall economy is moving could be gauged, and policymakers could successfully stabilize the total economy by looking only at reported data. Unfortunately, available estimates suggest that even this may not be true: indirect measures indicate that the underground economy may fluctuate significantly relative to reported GNP (see RATIO OF

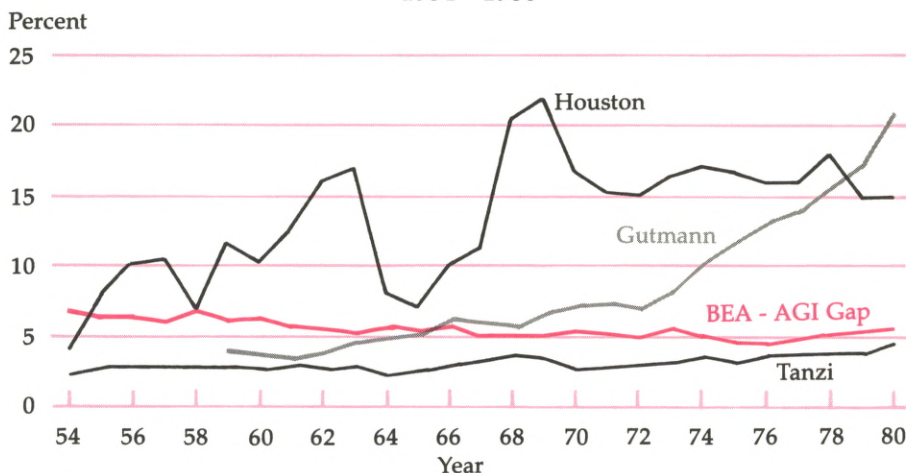
THE UNDERGROUND ECONOMY TO GNP). As a result, policymakers may well be “missing the boat” by focusing solely on the aboveground economy.

SOME SECTORS OF THE UNDERGROUND ECONOMY MIGHT RESPOND TO POLICY CHANGES

So far, we have looked at one part of the two-way link between the underground economy and policy, namely, the way the existence of the underground economy thwarts desired policy outcomes. Now we focus on the other part of the link, the way policy changes can affect the behavior of the underground economy. The first step to understanding this link requires a behavioral theory of the underground economy. With that in hand, we can then discuss the implications that policy initiatives have for the underground economy.

Why Do People Participate in the Underground

FIGURE 1
Ratio of the Underground Economy to GNP
1954 - 1980



NOTE: See SELECTED BIBLIOGRAPHY (p. 12) for references to data sources. The BEA-AGI Gap data are from Thae S. Park, “The Relationship Between Personal Income and Adjusted Gross Income, 1947-78” *Survey of Current Business* (November 1981) and the updates and revisions published in the *Survey* thereafter.

Economy? In all likelihood, a variety of considerations affect people's decisions to participate in the underground economy. Social factors, for example, probably play an important role. For instance, if an individual's parents, friends, and neighbors all cheat on their taxes, he might conclude that "everyone is doing it," and that he has an obligation to himself to do the same. It is also conceivable that while someone is at first reluctant to participate in the underground economy, once she has taken the plunge, she is unwilling to leave the underground economy. This may be in part because she has overcome any moral obstacles that would have precluded her from going underground; but it also may be because she knows that if she did decide to "come clean," she might bring attention to past underground activity.

Many of these social factors are hard to quantify, however, and hard for economists, in particular, to address through policy prescriptions. As a result, economists look for the *economic* factors affecting where and how an individual chooses to work.

Financial Incentives Are Probably Important . . . Economic theory suggests that individuals respond to financial incentives, and will choose to work where they believe they will receive the greatest net benefit. The total net benefit from employment in the aboveground sector equals the dollar wage received plus the value of any benefits earned, less the amount of taxes paid. For example, if a worker earns \$10 an hour at his aboveground job, earns no fringe benefits, and pays 20 percent of his income in taxes, his net hourly wage is \$8.00.

What happens when he decides to go underground and not report his income? In this case, his *expected* net benefit from working in the underground economy comprises the dollar wage received less the expected penalties he has to pay in the event of being caught. For example, suppose the worker believes that he has a 10 percent chance of being audited, and that if he is audited he will have to pay twice the amount of the taxes owed, or \$4.00 for every hour he works

underground, instead of \$2.00 in aboveground taxes. In other words, his *expected* penalty is 40 cents an hour (10 percent probability of being caught times the \$4.00), so his expected hourly wage earned from working in the underground economy is \$9.60.

This reasoning also applies to felonious activities, where individuals must assess the chances of being caught by the police, as well as the penalties that may be imposed once caught. These factors must be balanced against the income earned from the chosen activity in determining the net wage.

. . . As Is People's Aversion to Risk. This framework highlights one important distinction between the net wages earned in the two sectors. While aboveground wages are known and fixed, people in the underground economy incur some risk concerning the actual net wage they will receive, because they are never sure when or if they will be caught. In the previous example, the worker's *expected* net wage was \$9.60 an hour, though the *actual* net wage received will depend on whether or not the worker is caught or audited. In the event that the worker escapes detection, he would receive the full amount of his underground income, or \$10.00 per hour. However, if the person is caught and forced to pay the penalty, he must pay \$4.00 per hour in taxes and penalties, so he would receive only \$6.00 an hour for working underground.

It is generally believed that individuals would rather avoid risk, and all else equal would prefer certainty over uncertainty. For example, most people given the choice between receiving \$1,000 with certainty or having a 50 percent chance of receiving \$2,000 would prefer the \$1,000 with certainty, even though they can in principle expect to receive \$1,000 in either case. This implies that since working in the underground economy involves additional uncertainty, workers must receive a bonus, or "risk-premium," in the form of a higher net wage in order to induce them to participate in the underground economy.

While it is hard to pinpoint the factors that

affect an individual's willingness to take risks, one factor that seems to matter significantly is the individual's level of wealth, which is directly affected by changes in income.³ Unfortunately, economic theory is unable to say anything decisive about this relation. That is, theory has identified good reasons why aversion to risk may rise with income and other reasons why it may fall with income. Moreover, theory suggests that while an individual's willingness to risk a *fixed* amount probably increases with income, his willingness to risk a given *portion* of his income may decline with income. For instance, it seems likely that a millionaire would be more comfortable betting \$10 on a coin flip than would someone who is currently unemployed. However, it is not obvious that a millionaire would be more willing than an unemployed worker to wager 10 percent of his wealth on a coin flip. Since we are hampered by the fact that we cannot directly observe people's willingness to take risk, empirical evidence has not been able to uncover how risk aversion varies with income. It does, however, seem plausible that income levels and risk aversion are related, even if the exact dependency remains unknown.

Policies Can Alter the Risks and Rewards of Being in the Underground Economy. This economic perspective suggests that there are two important considerations that determine whether or not someone will choose to be in the underground economy: the net wages in both the aboveground and underground economy and the individual's willingness to take risks. Therefore, policy changes that influence either the net wages or an individual's willingness to take risks can affect participation in the underground economy. Unfortunately, the net impact of such policy changes is unclear; conceivably a change in policy may affect net wages and people's willingness to assume risk simultaneously.

Worse yet, since we cannot directly observe movements in the underground economy, empirical tests cannot completely resolve many of these issues.

From a conceptual viewpoint, an increase in tax rates both reduces the effective aboveground wage and lowers an individual's take-home pay, which may affect that individual's tolerance of risk. The reduction in the effective aboveground wage makes the underground economy more attractive to would-be tax evaders, and if such individuals are more willing to take risks as their after-tax income falls, then this also encourages their movement into the underground economy. However, if potential tax evaders are generally less willing to take risks as their income falls, then shifts in tax rates have an ambiguous effect on the underground economy. By the same token, raising the likelihood of detection or imposing stiffer penalties works to reduce the net underground wage, which makes the tax evasion component and the illegal activity part of the underground economy less attractive. But again, increased enforcement reduces the expected income of workers in the underground economy, which may alter both their willingness to take risks and their willingness to participate in the underground economy.

Policy decisions regarding the degree of progressivity in the tax structure and the level of unemployment compensation may also affect the size of the tax evasion element of the underground economy. In particular, changes in the tax structure and in unemployment compensation alter the cyclical behavior of the underground economy, and may ultimately determine whether or not the underground economy is procyclical or countercyclical. For instance, since the U.S. tax structure is progressive, an individual finds that his tax bill increases at a faster rate than does his income. Consequently, the financial incentives from working in the underground economy rise as his income rises. Assuming his willingness to take risks remains the same, a self-employed businessperson may decide to hide a greater portion of

³For a complete discussion on the impact of wealth on risk aversion, see Kenneth Arrow, *Essays in the Theory of Risk-Bearing* (Chicago: Markham Publishing Company, 1971).

income earned when times are good to avoid being pushed into a higher tax bracket. This works to make the underground economy procyclical.

Alternatively, it seems plausible that the underground economy is a place where many turn when times become tough in the reported economy. For instance, a person laid off in the middle of a recession may choose to paint houses “off the books,” while collecting unemployment benefits and waiting to be rehired. If this case is dominant, the presence of unemployment benefits may make the underground economy more attractive in cyclical downturns. In this case, the underground economy is countercyclical and acts to smooth out shifts in the above-ground economy.

Exactly how policy changes will alter the underground economy will depend on which conflicting effect dominates. Empirical evidence is crucial in this regard. But while sorely needed, reliable evidence is sparse mainly due to the unobservability of the underground economy. The scant information that is available regarding the impact of policy changes chiefly concerns the effect of tax changes.⁴ The results of these

studies suggest that high tax rates may encourage participation in the underground economy.

WILL TAX REFORM SHRINK THE UNDERGROUND ECONOMY?

To the extent that high tax rates have been a factor in increasing the underground economy, the Tax Reform Act of 1986, which lowers marginal tax rates, should provide the additional benefit of reducing the size of the underground economy. Indeed, if the above evidence is correct, tax reform may be expected to increase tax revenue by flushing out part of the underground economy. But here the sociological issues may also come into play. Conceivably, people are reluctant at first to participate in the underground economy. However, once they cross the line it may be harder to bring them back. Thus, while the steady increases in tax rates over the years may have led people into the underground economy, as empirical evidence suggests they have, it may not follow that symmetric reductions in tax rates will bring them back aboveground.

For policymakers, the key point to keep in mind is that tax reform will affect both the above-ground and underground economies. However, we will only observe directly how it affects the reported economy. Difficulties will undoubtedly persist in trying to assess the economy’s overall performance. This emphasizes the importance of continuing to study the underground economy.



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Fact and Fantasy About Stock Index Futures Program Trading

*John J. Merrick, Jr.**

INTRODUCTION

Exchange-traded stock index futures contracts** have been among the most important financial innovations of the 1980s. With these products, investors can adjust the exposure of their portfolio to fluctuations in the average level of stock prices quickly and cheaply. This capability is extremely attractive to pension fund managers and other institutional investors. In

fact, in less time than the typical reader will take to read this article, he or she could buy an index futures contract, change opinion on the market and sell it off, and, upon further reflection, revise opinion once again and buy it back.

Trading in these futures contracts has grown enormously since their introduction in the early 1980s. During fiscal 1986, the dollar value of the Standard and Poor's (S&P) 500 stock index** futures contracts that traded hands was about 60 percent greater than the value of actual stock trading on the floor of the New York Stock Exchange. The four major stock index futures contracts are the Chicago Mercantile Exchange's S&P500 index contract (by far the most active), the New York Futures Exchange's New York

* John Merrick, Associate Professor of Finance, New York University Graduate School of Business Administration, prepared this article while he was a Visiting Scholar in the Macroeconomics Section of the Philadelphia Fed's Research Department.

**See the Glossary (pp. 24-25) for a definition of this and other terms with ** throughout the text.

Stock Exchange Composite** index contract, the Kansas City Board of Trade's Value Line** index contract, and the Chicago Board of Trade's Major Market** index contract.¹

Perhaps because of the astounding growth in these index futures markets, traders, investors, and the financial press have made much ado about their possible adverse effects. In particular, the impact of program trading** between index futures and cash market** stocks by arbitrageurs** has become a hot contract design and market regulation issue. The concern centers on whether program trading has increased price volatility** in the cash stock markets. Excess price volatility is undesirable because investors may have to buy stocks at artificially high prices or sell them at artificially depressed prices, thus creating windfall gains and losses in a market where the gains and losses from the "fundamentals" are variable enough.²

As it turns out, the adverse impacts of arbitrage program trading probably have been overblown. It is true that, during the so-called "Triple Witching Days" that occur four times a year when the major stock index futures contracts expire, program trading magnifies stock market price volatility. However, in more normal circumstances, available evidence indicates that such trading has had no significant impact on volatility.

Moreover, the arbitrage process underlying program trading provides important benefits to investors, through both enhancing the liquidity** of futures trading and ensuring fairer relative pricing between stock and stock index futures markets. In conjunction with attempts to lessen the pricing distortions that occur when index futures expire, the exchanges and their regulators should avoid inhibiting overall activity in the arbitrage sector.

¹Options on stock indexes and options on stock index futures also have attracted large trading interest. In fact, today, the most actively traded options are the Chicago Board Options Exchange's S&P100 stock index option contracts.

²Excess stock price volatility is also undesirable since it decreases the informational content of prices.

INDEX FUTURES CONTRACTS AND THEIR MARKETS

A futures contract is a standardized agreement to buy or sell a particular asset or commodity at some deferred date.³ The underlying "asset" for a stock index futures contract is a specific price index of cash market stocks. For example, the S&P500 stock index futures contract is based upon the S&P500 index of stock prices, a weighted average of the prices of all 500 stocks comprising Standard and Poor's list.⁴ (Each S&P500 index futures contract represented about \$145,000 of stock market value as of May 1987.) Stock index futures contracts cover only four expiration months a year—March, June, September and December. Thus, in May 1987, the June 1987 expiration contract was the "near" contract. The nearest expiration contract tends to be the most actively traded of all contracts up to a short time prior to its expiration day.

Traditional futures contracts, such as those for gold or Treasury bills, allow final settlement by delivery of the underlying assets. In stock index futures, actual physical securities (the individual stocks themselves) are not involved. Instead, stock index futures make their final settlement through a cash payment. For example, on each third Friday of the months of March, June, September and December, the nearest S&P500 index contract expires. At the expiration moment, the contract is assigned a value based upon the current value of the underlying cash market index. The net gain or loss on an index futures position depends upon the change in the futures price between the time when the contract is entered initially and the date it expires

³For a short introductory guide to financial futures markets, see John J. Merrick, Jr. and Stephen Figlewski, "An Introduction to Financial Futures Markets," *Occasional Papers in Business and Finance*, Salomon Brothers Center for the Study of Financial Institutions, No. 6 (August 1984).

⁴The weight for each individual stock price in the index is the ratio of the total dollar value of all outstanding shares of the stock to the total dollar value of all 500 stocks in the index (that is, each stock price in the index is "capitalization-weighted").

or the position is offset** (Most users of futures will close their futures contract position out prior to expiration through a reversing trade—for example, selling another contract to offset one previously bought.)

The terms of the S&P500 index futures contract are that each one point move in the futures price is worth \$500. For example, a rise in an S&P500 index futures contract's price from 290 to 291 would entail a gain of \$500 to investors who were long** the contract (that is, those who had bought) and an equivalent loss to those who were short** (that is, those who had sold). The final cash settlement feature of the stock index futures contract is designed to avoid the costs and inconvenience of final settlement through physical delivery which, in the case of the S&P500 contract, would involve the purchase, delivery and (probably) resale of the properly weighted basket of 500 individual stocks.

Stock Index Futures Lower Portfolio Management Costs. Investors find stock index futures useful because they are a convenient and relatively low-cost way to speculate on future movements in the stock market or to hedge the market risk of a stock portfolio. Speculators who are confident in their ability to predict swings in stock prices find long or short index futures positions convenient ways to take on desired market risk exposure. Other, perhaps less confident, investors enter index futures positions designed to hedge their current cash market positions. For example, if the hedger is holding a cash market portfolio of stocks (that is, if he is long cash stocks), he will sell a properly weighted number of stock index futures contracts to reduce his net market risk exposure.⁵ The hedge works to reduce total return risk since a loss (gain) from a fall (rise) in cash market stock prices will be at least partially offset by a gain (loss) from

the short futures position as long as futures prices move in the same direction taken by cash prices.

Of course, investors could speculate or hedge their risks without resorting to futures market transactions. The would-be bullish speculator could simply buy a broad portfolio of stocks (or shares in a mutual fund). The would-be hedger could simply sell out the stock portfolio and invest the proceeds in Treasury bills until a less uncertain environment prevailed. However, executing these strategies in the cash market can be cumbersome. The speculator would be hampered because only 50 percent of a stock position can be financed by margin loans. Similarly, the hedger who sold off the stock portfolio would bear not only the direct costs of selling these stocks, but also the costs of reconstructing the perhaps painstakingly acquired initial position at the onset of more favorable market conditions.

While transactions in standardized index-based futures contracts also entail margin requirements and direct trading costs, these are substantially lower than those for the cash market. For example, the direct commission cost of a "round-trip" purchase and sale of 100 S&P500 index futures contracts is about \$2,500. Assuming commission costs in the cash market of \$.07 per share and an average share price of \$45, the cost of buying and then selling an equivalent amount of stocks (roughly \$14.5 million in May 1987) would be about \$45,100. Thus, stock index futures contract purchases and sales provide large investors with cost-efficient means of making desired portfolio adjustments and are properly viewed as institutional solutions to trading problems.

INDEX FUTURES ARBITRAGE: LINKING CASH AND FUTURES MARKETS

Index Futures Prices Versus the Cash Index.

Since an index futures contract is a close substitute for the basket of stocks underlying the cash market index for many users, one might expect the index futures price to be closely related to the cash index. Certainly the tie between the

⁵A thorough practical treatment of hedging using financial futures markets is contained in *Hedging with Financial Futures for Institutional Investors*, by Stephen Figlewski with Kose John and John J. Merrick, Jr. (Cambridge, MA: Ballinger Publishing Company, 1985).

futures price and the cash index value is tight on the contract's expiration day when, by the contract's design, the two are equal. However, prior to expiration day, the potential user of the futures should "comparison shop" to see whether the contract is overpriced or underpriced relative to the prices of the stocks in the cash market. For example, is it cheaper to buy a one-year-to-maturity S&P500 futures contract at 300 or the underlying portfolio of stocks if the cash S&P500 index stands at 286? Clearly, the futures should usually sell for more than the cash index since, while both futures and cash indexes converge within a year, there is a net cost to carrying** the stock portfolio (financing costs less dividends earned).⁶ However, is 300 too high or too low?

As it happens, answering the question of fair relative pricing between futures and cash markets also explains how arbitrageurs make money by trading between the two markets following what are called "program trading" rules. While comparison shopping by hedgers and speculators puts some limits on potentially abnormal deviations of index futures prices from their cost-of-carry values, most of the responsibility for maintaining fair pricing between the futures and cash markets falls on "program traders"—members of the arbitrage community who have come to specialize in intermarket trading. Program traders attempt to extract profits from any discrepancy that arises between the futures contract's price and its cost-of-carry value, following the old adage "buy cheap, sell dear." That is, they buy (or sell) index contracts in the futures market and sell (or buy) the equivalent value of the actual stocks in the cash market.

Cost-of-Carry Pricing and Arbitrage. The theoretical difference between the initial futures price and the initial index value is solely determined by the difference between the stock portfolio's financing cost and its dividend yield.** For example, suppose that the S&P500 stock

index currently is 286; that the dividend yield on the underlying cash market S&P500 stock portfolio is 3.2 percent; that the one-year interest rate is 7.1 percent; and that transactions costs can be ignored. In this case, the net cost of carry equals 3.9 percent—the 7.1 percent financing rate less a 3.2 percent dividend yield. The cost-of-carry pricing argument would maintain that a one-year-to-expiration S&P500 index futures contract should sell for 297.15 index points, or 3.9 percent above the current cash index value.

To see why this pricing structure makes sense, consider what happens when an arbitrageur purchases the stocks and sells the futures. He is assured of making the current futures-cash index spread** ($297.15 - 286 = 11.15$ index points) via convergence *regardless* of whether the year-end level of the index is higher, equal to, or lower than its current level. For example, if the expiration day closing index value is 300, the cash position gains 14 points ($300 - 286$) and the short futures position loses 2.85 ($297.15 - 300$) for a net gain of 11.15. If, instead, the index closes out at 275, the cash position loses 11 points ($275 - 286$), but the futures position gains 22.15 ($297.15 - 275$) to again net a gain of 11.15. "Convergence" ensures that the initial 11.15 point spread between the futures and the cash index ($297.15 - 286$) is earned. This position also will earn 9.15 points in dividends ($.032 \times 286 = 9.15$). Thus, total gross earnings for this riskless investment will be 20.3 index points. However, this gross profit is exactly what the initial capital would return if it were invested at the current interest rate of 7.1 percent ($.071 \times 286 = 20.3$).

The futures price of 297.15 is fair relative to the current cash index value precisely because the "program" of buying cash stocks and selling index futures is a perfectly hedged position. If the futures were selling at 298 instead, this riskless buy/sell program would gross 21.15 points (yielding $100 \times 21.15 / 286 = 7.40$ percent). Such a program would dominate the simple 7.1 percent riskless investment. Thus, this particular program trade by arbitrageurs, or other investors seeking to swap the riskless cash/futures program

⁶The futures position entails no meaningful initial investment but accrues no dividends.

for a “plain vanilla” riskless investment (say, a Treasury bill) whenever rate of return discrepancies arise, would drive the futures price down (and/or the cash price up) if the futures rose above 297.15. Likewise, if the futures price fell below 297.15, arbitrageurs would profit from the *reverse* trade of selling the stock basket and buying the underpriced futures. Again, the result would be pressure on both cash and futures prices to return to their fair relative values.

These calculations ignore transactions costs. Typically, the largest players in index futures program trading are the major stock brokerage houses. These firms already have invested in developing economical systems for trading stocks. For a S&P500 index futures program trade by a major brokerage house arbitrageur, total transactions costs might be reasonably approximated as 0.5 percent of the S&P500 cash index (or, 1.43 index points in the example above).⁷ Thus, the futures price actually could wander anywhere within a band between 298.58 and 295.72 without violating fair pricing boundaries.⁸ Certainly, the proposed price of 300 that began this discussion is too high in this sense. However, some hedgers and speculators would still find the futures an attractive buy at 300 if their cash market trading costs were relatively high (greater than 2.85 index points), or if it were important to avoid delay in executing the trade.

In sum, deviations from cost-of-carry pricing

that cannot be attributed to transactions costs present signals for arbitrageurs to buy cheap and sell dear. These program traders enter both a position in index futures contracts and an offsetting position in an appropriately selected basket of stocks. The basket is constructed in such a way that movements in its value mirror movements in the stock index upon which the futures contract is based. The position is designed to deliver a “riskless” hedged return that yields more than alternative riskless securities.⁹ The arbitrage process should continue until the futures and cash stock markets have returned to a fair relative pricing relation.

The Economic Role of Arbitrageurs. As explained above, arbitrageurs seek to profit from misaligned relative prices. This last statement might be construed as an academic way of stating that “these people make easy money at the expense of true investors.” However, such an interpretation would be misleading. First, the arbitrage process itself is costly. Arbitrage firms must invest heavily in communication, trade evaluation, and trade execution systems. Second, the trades themselves are not completely riskless. Risk enters because of the marked-to-market** daily settlement feature of futures, because of restrictions on short sales of stocks, and because the stock baskets assembled by the arbitrageur do not always track the stock index perfectly.¹⁰

But most importantly, it can be argued that arbitrageurs actually help true investors. By working to bring about cost-of-carry pricing, arbitrageurs allow speculators and hedgers to

⁷See Hans Stoll and Robert Whaley, “Expiration-Day Effects of Index Options and Futures,” *Monograph Series in Finance and Economics*, Salomon Brothers Center for the Study of Financial Institutions, New York University (1986).

⁸This 0.5 percent or 1.43 index point transactions cost estimate overstates the average transactions costs incurred by active arbitrageurs who constantly look either to unwind their positions early at a reversed mispricing or to roll their hedges into the next contract expiration at a more favorable price spread. These arbitrageurs receive additional arbitrage profits without incurring the full set of additional transactions costs. Thus, some aggressive players might choose to be active even at futures prices that lie within the transactions cost bounds described. One active arbitrageur estimates his average transactions cost at about one S&P500 index point.

⁹The hedge underlying intermarket arbitrage trading can also be constructed by combining the cash market stocks with index option positions. Thus, arbitrageurs will use both options and futures programs depending upon which hedge yields the highest riskless return.

¹⁰Gains and losses from futures price changes are settled in cash at the end of each day by means of marked-to-market settlement. Therefore, losses on futures contracts are not “paper losses,” but entail real cash outlays even when the position has not yet been closed. Likewise, gains on futures positions entail immediate cash inflows. Short sales of stock refer to sales of stock temporarily borrowed from other investors.

open and close futures positions at prices that are fairer relative to the underlying cash market than those they would have obtained without arbitrage trade price pressures.¹¹ Thus, arbitrageurs help reduce some of the uncertainty that users of futures markets bear. Furthermore, arbitrage trading adds to market liquidity. Additional liquidity in a market benefits all market users. In particular, it lowers total transactions costs by shrinking the bid-ask spread** and allows larger orders to be placed with shorter time delay.

One useful way to view the contribution of arbitrageurs concerns the sequence of events surrounding the decision of a previously bullish portfolio manager to turn bearish on the stock market. However, assume that the portfolio manager still believes that his individual stock "picks" will outperform the market over time.¹² Consequently, he keeps his portfolio intact, but sells S&P500 futures contracts of equivalent value to hedge his position against market risk. Since no sell order on the cash side is entered, only the futures market is initially affected by the portfolio manager's change of heart: In order to find buyers to absorb this new futures contract sell order, the index futures price is nudged down a bit.

If prices were initially in their fair cost-of-carry relation, now they are slightly misaligned (futures are cheap relative to cash). This is the signal for the arbitrageur to act. He buys the underpriced futures contract and sells a basket of stocks carefully selected to mimic the value change of the S&P500 index.¹³ The arbitrageur's

orders put some upward pressure on the index futures price and (at last) downward pressure on the prices of the stocks comprising his basket.

The net effect of the portfolio manager's shift to bearish sentiments is to lower both futures and cash stock prices. In effect, the portfolio manager made the sell decision, but delegated responsibility for the actual stock market sales to the arbitrageur. The "fee" collected by the arbitrageur consists of the spread implicit in the initially underpriced futures. The portfolio manager was willing to pay this fee (that is, sell the futures at less than full cost-of-carry) because the implied transactions costs of accepting this "low" futures price were lower than his direct transactions costs of selling out and then subsequently rebuilding his cash stock portfolio. Also, the futures sale is accomplished almost immediately, whereas the liquidation of a large portfolio might take some time.

Through implicitly delegating his cash market sales to the arbitrageur, the portfolio manager shifts the burden of selling a large complex stock portfolio to an agent who has come to specialize in such sales (or purchases). Thus, one can interpret the advent of stock index futures arbitrageurs as a response to the institutional investor's desire to develop low-cost ways to acquire or liquidate large portfolio holdings. In fact, the term "program trading" as applied to futures/cash arbitrageurs makes perfect sense in this regard, since investment houses servicing large-scale portfolio restructurings for institutional investors traditionally referred to their services as "doing a program" long before the advent of index futures trading. For the case of arbitrage in futures, however, the stock portfolio involved is always the index-based basket or a reasonable facsimile.

ARBITRAGE EFFECTS ON THE CASH STOCK MARKET

The Historical Evidence. Data on the volume of futures contracts give us a clear picture of how active these instruments are and how actively

¹¹See John J. Merrick, Jr., "Hedging With Mispiced Futures," Federal Reserve Bank of Philadelphia Working Paper No. 87-11, June 1987 for an analysis of the interrelationships between arbitrage sector performance and hedging cost and effectiveness.

¹²That is, he thinks that the portfolio will lose less than the S&P500 in bear markets and gain more than this index in bull markets.

¹³The arbitrageur may accomplish the stock sale half of the position either by selling out of his firm's preexisting inventory (a swap) or by short sales.

arbitragers have been involved with them. Between 1983 and 1986, while the dollar volume of stocks traded on the cash markets of the New York Stock Exchange broke records, the dollar volume of S&P500 futures contracts rose even higher (see Figure 1a, FUTURES CONTRACTS SOAR . . .). Arbitrage activity can be inferred from looking at the growth in the number of contracts settled in cash on expiration day. Market participants other than arbitragers, who use futures contracts to hedge their portfolios or to speculate, are less inclined to hold expiration-month contracts to their final settlement day. Instead, these traders typically would roll their contract positions over to maintain their hedge or open speculative position. Between 1983 and 1986, the volume of contracts settled in cash (presumably by arbitragers) more than quintupled, from about 6,000 to almost 33,000. In addition, the relative importance of arbitragers has increased. The increased presence of arbitragers can be inferred by comparing the growth

in the number of contracts settled in cash relative to the growth of the average month-end open interest** (see Figure 1b, . . . AND ARBITRAGE ACTIVITY GROWS, TOO). Over this time period, the proportion of cash-settled contracts rose from about 28 percent to 38 percent of average month-end open interest.

Deviations From Cost-of-Carry Pricing. Figure 2 (p. 20) presents a plot of the percentage deviation of the actual daily closing prices for near expiration S&P500 index futures contracts from their theoretical cost-of-carry levels for the May 17, 1982 to May 30, 1986 period. It is clear that while most of the deviations are within the 0.5 percent transaction cost bounds (shown as a shaded band), there have been instances in which such deviations were large and persistent. For example, the futures was grossly overpriced throughout the month of October 1984. In the 1985-86 period, however, instances of mispricings in excess of transactions costs are less frequent than in the earlier 1982-84 period,

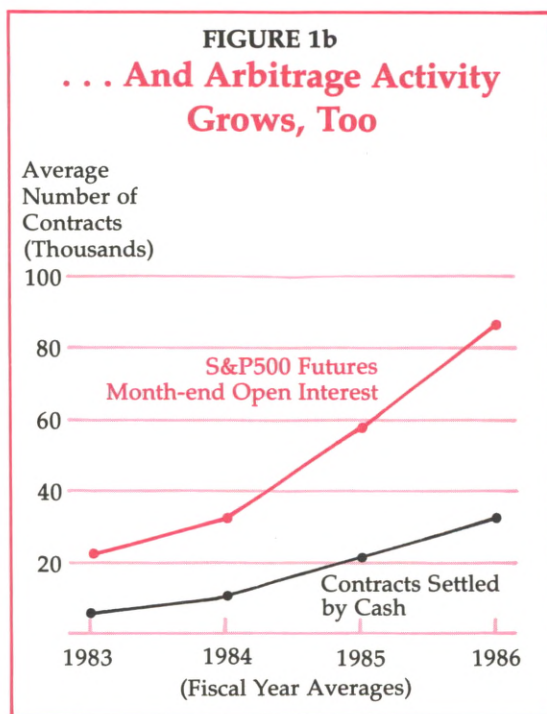
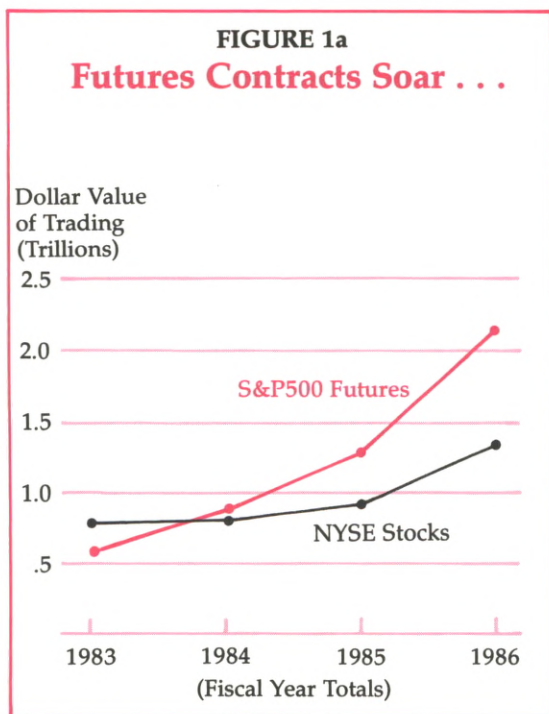
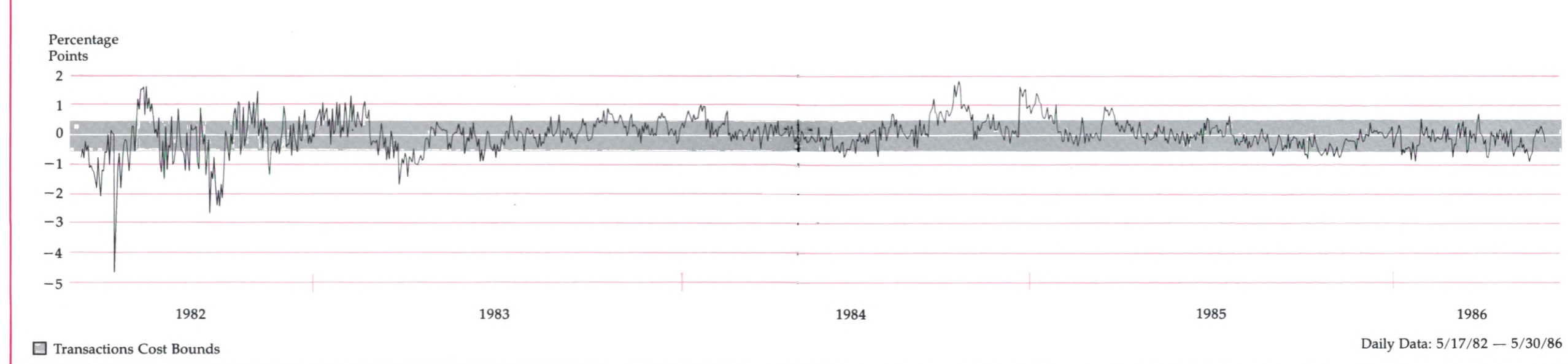


FIGURE 2
Near Contract S&P500 Futures Mispricing
As Percentage of Theoretical Value



probably because of the marked expansion of the arbitrage sector during the later years.

Volume, Volatility, and the Arbitrage Deviation. It's natural to ask why mispricing might ever arise in the face of expanded arbitrage trading activity. While it is certainly true that index futures arbitrage programs pour millions of dollars into these trades, arbitrageurs apparently are not always able to bring prices back into their cost-of-carry relation quickly. Thus, one might be suspicious of at least some of the charges linking volume and price volatility effects to arbitrage activity.

In fact, looking at daily data for non-expiration months over the 1982-1986 period, recent research has uncovered virtually no evidence that arbitrage mispricings predict any significant percentage of the variation in daily return volatility (for both S&P500 and NYSE cash indexes). There is evidence linking futures/cash arbitrage

mispricings to increased NYSE cash market trading volume. Such effects have become more pronounced in the recent 1985-1986 period. However, fluctuations in trading volume are more highly correlated with return volatility than with arbitrage mispricings.¹⁴ In addition, there is stronger evidence that fluctuations in trading volume and return volatility portend larger arbitrage mispricings than vice versa.

The evidence that the volume effects of arbitrage trading have become more important recently does not necessarily make arbitrageurs the ultimate source of cash stock price movements. Certainly arbitrageurs cause pressures on

¹⁴See John J. Merrick, Jr., "Volume Determination in Stock and Stock Index Futures Markets: An Analysis of Volume and Volatility Effects," Federal Reserve Bank of Philadelphia Working Paper No. 87-2, January 1987 (forthcoming in *The Journal of Futures Markets*, October 1987).

cash market prices. However, such price pressures generated by arbitrage trading only bring the cash market in line with the valuation reflected by the previous movement in the futures. For instance, suppose that, as in the earlier "bearish portfolio manager" example, the futures shifts down suddenly from an initial full cost-of-carry equilibrium and becomes underpriced relative to the cash index. Suppose further that, as the prices become realigned through arbitrage activity, cash prices fall more than futures prices rise. Indeed, while cash market selling by program traders directly leads to the cash index decline, in this instance the cash market fell because of the previous weakness in the futures price. The futures market "discovered" the new bearish sentiments of the investing public.¹⁵ Arbitrageurs

¹⁵The available evidence suggests that the S&P500 index futures market has played the dominant price discovery role

ensured that this "bad news" was transmitted to the cash markets in individual stocks. While investors holding positions in these stocks need not be pleased, there is no reason to adopt a "kill the messenger" attitude.

"Triple Witching Hour" Congestion Effects. One adverse effect of index futures arbitrage on cash stock markets that *does* receive strong empirical support is the so-called "Triple Witching Hour" congestion. Prior to the June 1987 expirations, the Triple Witching Hour occurred at the 4:00 p.m. close of trading on the New York

(relative to the cash market) since 1985. Prior to 1985, the cash stock market dominated the price discovery process. This reversal in price discovery dominance roles occurred not long after the volume of trading in the futures market eclipsed that in the cash market. For details, see John J. Merrick, Jr., "Price Discovery in the Stock Market," Federal Reserve Bank of Philadelphia Working Paper No. 87-4, March 1987.

Stock Exchange on the quarterly expiration Fridays of the stock index futures contracts. Stock index options and options on individual stocks also have expirations that occur at this time.

Taken at face value, contract expirations would not appear to be such dramatic events. After all, trade in the various commodity and other financial futures contracts has occurred for years, and individual contract expirations have come and gone with very little public attention. However, the cash settlement design of the stock index futures (and index options) contracts presents special problems on expiration days when arbitrageurs "unwind" their positions.

Recall that arbitrageurs hold offsetting positions in stocks and index futures. Their return is hedged perfectly if they liquidate their stock basket at the moment the futures contract expires, since the futures price is marked to the value of the cash stock index at that time. Thus, the planned expiration day strategy of the arbitrageur was to submit market-on-close** orders to the specialist** on the floor of the exchange trading each stock held in the stock basket.¹⁶ On expiration days that the net (long or short) aggregate stock position of arbitrageurs was large, order imbalances appeared in each specialist's book at the market's close, which produced unusual temporary price swings in one direction or the other. The imbalance occurs because the index futures are settled in cash, not through *delivery* of the securities. In brief, at market close on expiration day, arbitrageurs supplied or demanded an abnor-

mal quantity of stocks, but nothing in the futures settlement process provided an automatic mechanism to generate offsetting stock orders to absorb the disturbance.

Congestion effects in the cash markets during the last hour of trading on index futures expiration days have been documented. Specifically, three effects have been found for index component stocks: cash market volume in the last hour of trading is approximately double that of non-expiration Fridays; last-hour cash market return volatility for index component stocks is significantly higher than for non-expiration days; and abnormal price reversals occur on the morning following these quarterly expirations.¹⁷ The symptoms accompanying expiration days have been likened to the temporary cash market distortions of "block" trades in individual stocks.

Since these expiration day effects are so localized, two reactions are defensible. The first would be to live with the problem in its present form, though endeavoring to educate investors concerning the increased uncertainties of trading during these four days of the year. There is some reason to believe that, with proper market education, the expiration day problem would correct itself. Small investors would be wary of trading on expiration days. In contrast, large investors might choose to act strategically, altering their normal behavior to pick up "bargains" through either selling at the temporarily high or buying at the temporarily low cash market prices induced by expiration day price "spikes".¹⁸ Both sets of market responses would tend to ameliorate expiration day pricing distortions.

The second response would be to attempt some fine-tuning of either the design of the

¹⁶Actually, the trigger for the unwinding is related more closely to the return of the futures price to its cost-of-carry relationship. Of course, this return is assured at expiration by the contract's convergence feature. But if a return to cost-of-carry pricing (or an appearance of a reverse mispricing) occurs before the expiration, arbitrageurs who close out early will earn higher returns than they initially expected. For example, early close-outs were optimal for short futures/long cash positions during the weeks leading up to the September 1986 contract expiration since the previously overpriced September futures became substantially underpriced (in fact, futures were trading at a discount to the cash market stock index).

¹⁷These results are found in Stoll and Whaley, "Expiration-Day Effects of Index Options and Futures." Stoll and Whaley find smaller price and volume effects on days on which index options expire but index futures do not.

¹⁸Such strategic positioning is not without risks, in that the direction of expiration day congestion price effects is not perfectly predictable.

stock index futures contracts or trading procedures. However, many of the solutions proposed to date have adverse effects on the smooth functioning of the market—especially in diminishing market liquidity—which may outweigh their calculable benefits.¹⁹ One major change effective with the June 1987 contracts for the S&P500 and NYSE index futures is to shift the expiration of these contracts to the cash market's *open* rather than its *close*. This change should help reduce excess expiration day volatility since it effectively expands the amount of time that NYSE specialists have to assemble large orders to offset any imbalances created by arbitrageurs. First, arbitrageurs must submit their market-on-open unwinding orders prior to 9:00 a.m. on expiration day. Second at 9:00 a.m., the New York Stock Exchange will announce any buy or sell order imbalances of 50,000 shares or more in 50 selected "blue chip" stocks. Furthermore, as on any other day, the specialists will be able to advertise unusual excess demand or supply situations by indicating the expected opening price prior to the actual opening of trading. Finally, as on any other day, each specialist will retain the prerogative to delay the opening of trading for stocks faced with unusual pricing patterns. In turn, potential buyers or sellers of the stock, given extra time and more complete information about the nature of net arbitrage activity, should find it easier to

respond to perceived imbalances with offsetting orders.

CONCLUSIONS

"Program trading" based upon stock index futures arbitrage is growing in practical importance. The positive effects of arbitrage trading include increased market liquidity and fairer pricing. Both factors benefit "true investors" (hedgers and speculators). One adverse effect of arbitrage is the temporary distortion in the cash stock markets caused by the unwinding of positions by arbitrageurs on the days of the quarterly futures contract expirations. However, these distortions are not particularly serious, especially since their effects are so localized.

The evidence that arbitrageurs distort cash markets on non-expiration days is scant. There is very little evidence that daily cash index return volatility is affected by observed index futures mispricing. In fact, the evidence suggests that the degree of mispricing itself is influenced by fluctuations in volatility.

The periods of persistent mispricing of index futures contracts observed since the beginning of trading in 1982 appear to indicate that the arbitrage sector has historically been undercapitalized or otherwise impeded. Because of these implied imperfections in this sector, futures-cash mispricing inefficiencies tended to persist, and hedgers were forced to bear undesired excess risk on positions closed out prior to contract expiration. Pricing performance by an expanded arbitrage sector has improved in recent years. For this reason, as they grapple with the expiration-day congestion issue, futures exchanges and their regulators should ensure that any possible contract redesign or other trading change does not hamper the arbitrage sector in a manner that will eliminate the recent gains in contract pricing efficiency.

¹⁹These anti-congestion proposals include (1) altering the cash settlement procedure on the index futures contract, (2) telescoping of position limits on the futures, (3) restricting expiration day market orders, and (4) requiring early disclosures of expiration day futures and options positions by large traders (the Securities and Exchange Commission sponsored a 3:30 p.m. expiration day stock position disclosure policy which came into effect as of the September 1986 expiration). See Franklin R. Edwards, "Stock Index Futures and Stock Market Volatility: Evidence and Implications," *Commodities Law Letter*, 6 (November/December 1986) pp. 3-6, and Stoll and Whaley for discussion.

Glossary

Arbitrage A strategy designed to create riskless profits through taking matched opposite positions in two investments that have identical payoffs but are trading at different prices.

Bid-ask spread The difference between the price currently bid on the exchange floor for the purchase of a stock (or futures contract) and the price currently asked for the sale of that same stock. "Market" orders to buy a stock will be transacted at the asked price. "Market" orders to sell a stock will be transacted at the bid price.

Cash market The market for (immediate) exchange of title of a security or other asset for cash.

Dividend yield The dividend income accruing to, say, a portfolio of stocks expressed as a fraction of the stock or portfolio value.

Futures contract A standardized agreement to buy or sell a particular asset or commodity at some deferred date.

Liquidity The continuity of the order flow and therefore the orderliness of price changes in an asset market. Other things held constant, a market's liquidity rises with its size.

Long position The position created through the purchase of a contract.

Marked-to-market settlement The procedure by which all open accounts are debited or credited the cash amount of the change in contract value due to the daily change in the futures price.

Major Market index An equally-weighted index of 20 "blue-chip" stocks which tends to track the popular Dow Jones Industrial Average.

Market-on-close order Order placed with the specialist to buy or sell the stock at the market asked or bid price at the 4:00 p.m. close of trading. This type of order was particularly attractive to program traders who want to unwind their cash stock positions at the futures expiration.

Net cost-of-carry The difference between the financing cost and the productive yield of a cash market position over the period ending with the future's expiration date.

New York Stock Exchange Composite index A capitalization-weighted index of the prices of all stocks traded on the New York Stock Exchange.

Open interest The number of contracts entered but as yet neither offset nor otherwise satisfied by a final settlement such as delivery.

Option contract A contract that gives the right but not the obligation to buy an asset (a “call” option) or sell an asset (a “put” option) at a fixed price on or before a specified expiration date.

Position offset An equal and opposite (“reversing”) transaction to counteract a previously established position. For example, a sale of a June futures contract on May 15 to close out a position established previously by an April 25 purchase of a June futures contract.

Program trading The popular name given to arbitrage trading between the stock index futures market and the cash market in stocks.

S&P500 index An index number that relates the current value of a weighted average of the prices of the stocks that comprise Standard and Poor’s list of 500 stocks to that of a historical base period.

Short position The position created through the sale of a futures contract or the sale of borrowed stock.

Specialist The marketmaker—price setter and order flow matcher—for a stock in the New York Stock Exchange system for stock trading.

Spread The difference between the prices of two assets.

Transactions costs Costs of executing a trading strategy. For the program trader, these costs consist of commissions and the bid-ask spread on the cash stock side and the commission and one-half of the bid-ask spread on the futures side.

Value Line composite index A geometric average of 1,700 stock prices. It is the broadest of the four indexes on which actively traded futures contracts are based. This stock index places relatively more weight on smaller stocks than the other major indexes.

Volatility A measure of the dispersion of possible percentage price changes about their mean value.

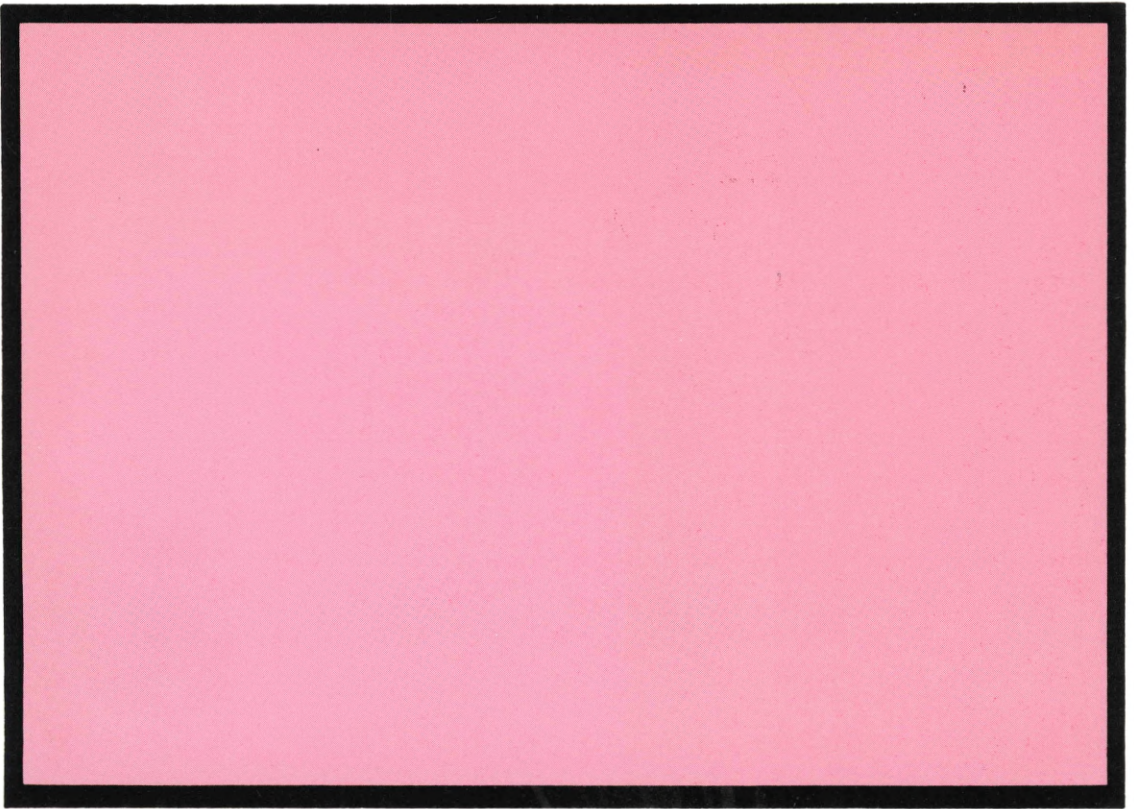
Working Papers

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