Financial Market Frictions

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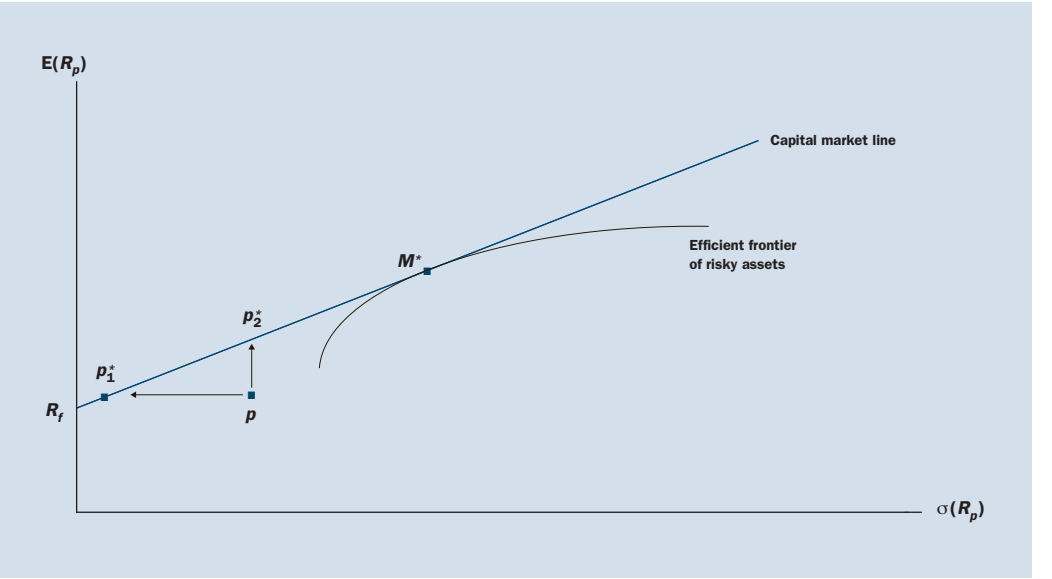
What comes to mind when we hear the phrase "financial market frictions"? Most of us think first of taxes and transactions costs. These are obvious examples, but market frictions are diverse and widespread, affecting virtually every transaction in some way. Capital gains taxes, for example, influence decisions to trade stocks and bonds. The financial market friction need not be a monetary cost: We sometimes must stand in line to pay a lower price. New businesses must charge lower prices than companies with established reputations. Companies include stock options in their compensation packages to mitigate well-known incentives for agents to shirk and to avoid rules that trigger tax penalties for "nonperformance-based compensation" that exceeds $1 million.[1]

What is a market friction? In the context of the capital asset pricing model (CAPM), this article defines a financial market friction as anything that interferes with trade. This interference includes two dimensions. First, financial market frictions cause a market participant to deviate from holding the market portfolio. By implication, these frictions can cause a market participant to be exposed to more or less risk than she might prefer. This definition at first seems very limited but is, in fact, only as limited as the definition of the market portfolio. In this article, the term *market portfolio* means not only financial assets but also real estate, human capital, investors' time, and so on. Put differently and somewhat less obscurely, financial market frictions generate costs that interfere with trades that rational individuals make (or would make in the absence of market frictions).

This concept can be clarified within the context of the capital market line (CML) (see Figure 1). The CML shows, in two dimensions, the optimal holdings available to investors, defined by the standard deviation of the portfolio, $\sigma(R_p)$, and the expected return on the portfolio, $E(R_p)$, given that a risk-free asset exists and that investors can freely borrow and lend at that rate. Risk-averse investors prefer portfolios lying above and to the left of those lying below and to the right—they want the highest

Figure 1
The Capital Market Line and the Efficient Frontier of Risky Assets



expected return and the lowest risk. In a financial market with no frictions, investors achieve this risk-return trade-off by holding the market portfolio, M^*, and a (possibly short) position in the riskless asset, R_f. Intuitively, they hold the maximally diversified portfolio and achieve their preferred risk level by adjusting their holding of the riskless asset. This allocation dominates a portfolio of only risky assets in all cases except the point of tangency between the efficient frontier of risky assets and the CML.

In a financial market with frictions, though, investors cannot costlessly adjust their holdings. An investor holding the suboptimal portfolio p (perhaps because of an illness, inheritance, or change in employment or marital status) could lower her risk without sacrificing expected return by rebalancing to hold portfolio p_1^*. Or she could improve her expected return without accepting any more risk by rebalancing her portfolio to hold portfolio p_2^*. But rebalancing is costly or impossible in a financial market with frictions. It may pay to accept portfolio p's inferior combination of risk and expected return rather than to incur the costs of trading. For example, consider a stock investor who prefers a fifty-fifty mix of stock and bonds. If stock prices rise while bond prices do not, then the portfolio becomes overweighted with stocks and is too risky for this investor. But selling some of the equities to reestablish the fifty-fifty mix would trigger capital gains taxes. Because of this, the investor may choose to retain the unwanted risk exposure rather than incur a tax liability.

To appreciate this concept algebraically, define α_{ij} as the proportion of investor i's portfolio held in asset j, and define A_{ij} as the value of asset j held by investor i (with A_j defined as the value of asset j.) Also define M^* as the value of the market portfolio, which includes all risky assets. Then $\Sigma_j A_j = M^*$ because all assets must be held. Under the CAPM, $\alpha_{ij}^* = (A_j/\Sigma_j A_j)$ for each asset j. The CAPM tells an investor to invest α_{ij} of his portfolio in asset j, where α_{ij} equals the value of asset j relative to M^*. The result is that he holds a fraction of the market portfolio. In this paper, a financial market friction is anything that drives a wedge between α_{ij}^* and α_{ij} with expected-

utility maximizing investors, or anything that drives a wedge between the amount of risk that the investor bears and the amount that he prefers to bear given the trade-off between risk and expected return.

We make an important distinction between market financial market frictions and market inefficiencies. We assume that asset prices reflect all available public information but not necessarily all private information. Pricing errors, if they exist, are not financial market frictions. Even if an asset's price is wrong, market participants base their choices and weight their portfolios using this incorrect price. By our definition (as with most), markets can be efficient yet have frictions that interfere with trade.

Why Do We Care about Financial Market Frictions?

Financial market frictions matter for three main reasons:

- Financial market frictions can generate real costs for investors. Recognizing these costs helps us understand the total costs of transactions and decide where to place them and even whether to make them at all. The capital gains tax is an obvious example. Constantinides (1984) shows that the option to take or defer capital losses or gains has substantial value. The option's exact value—and the corresponding optimal trading strategy—depends on factors such as transactions costs, the capital gains tax rate, and the asset's volatility.
- Financial market frictions also generate business opportunities. After all, many costs are paid to someone or to some entity. Institutions that can lower costs stemming from market frictions have a competitive advantage. Until competing firms adapt, they can earn economic rents. One example from the financial markets is mutual funds, which relax wealth constraints and asset indivisibilities.[2] (See DeGennaro and Kim 1986.) Other examples are two exchange-traded funds, the American Stock Exchange's Standard and Poor's Depositary Receipts, better known as Spiders, and Nasdaq-100 Index Tracking Stock, better known as QQQs. Spiders and QQQs provide another solution to the asset indivisibility problem. Sodano (2004) reports that Spiders and QQQs are the two most actively traded securities in the world.
- Financial market frictions can and do change over time. The degree of existing market frictions varies, new ones appear, and existing frictions disappear. Bank analysts now face the daunting task of analyzing far larger and more complex institutions than existed twenty years ago, but this challenge is offset in part by a vast increase in the information and computing power now available to them. Kane (2000) shows that regulators face a similar problem: The complexity and difficulty of resolving an undercapitalized institution increases with the size of the institution, and megamergers have the capacity to shift the political calculus of a resolution, and all the financial market frictions that entails, enormously. Another change is the shift from qualitative information to quantitative information. For example, a note stating that a credit applicant has a good reputation may now be quantified as having a FICO (credit) score of 790. This tool lowers the cost of lending at a distance.

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1. According to Section 162(m) of the Internal Revenue Code, publicly held corporations cannot deduct compensation in excess of $1 million paid to a "covered employee" from taxable income. The code makes an exception for stock option plans, though, provided that they meet certain requirements.
2. In theory, an investor can hold an infinitesimally small fraction of any asset. In practice, doing so is impossible. Economists refer to this dilemma as the asset indivisibility problem.

Market Structure

Financial market frictions, especially transactions costs, depend in part on market structure. Market structure, in turn, depends on both the risk of the traded asset and trading volume. In thin markets for risky assets, participants search for counterparties directly because the fixed costs of capital investments (including communication) are too large to be offset by the lower marginal costs of each transaction if transactions are few. As trading volume increases, markets evolve from direct search through brokered, dealer, and continuous auction markets. This evolution is a simultaneous process: As volume increases, the structure evolves, and as the structure evolves, trading volume increases. The potential size of the market determines the equilibrium structure.

As trading volume increases, it begins to make sense to invest in capital and to acquire specialized knowledge about potential buyers and sellers to facilitate trading. Stockbrokers are one example. If volume increases still further, or if risk decreases, brokers find it efficient to buy and sell on their own accounts. Although holding inventory is risky, if the asset value is sufficiently stable or if its liquidity is sufficiently high, then this risk is worth taking because holding inventory permits the dealer to make more trades in less time. For some assets, trading volume is so high that a continuous auction is possible. A good example is the secondary market for U.S. Treasury securities.

Of course, the market for some assets switches from one structure to another. The market for equities might be dominated by brokers most of the time, but at other times, dealer markets or continuous auctions might emerge. The specialist, for example, often simply crosses buy and sell orders but sometimes fills orders from his own inventory.

Some participants with expertise or investment in one type of market structure, such as real estate agents, might tend to resist changes that dilute their competitive advantage. In general, though, society tends to move from higher-cost market structures to lower-cost ones. For example, Cox and Koelzer (2000) say that the Internet has transformed the way that agents and consumers form their relationships. Housing is not a standardized commodity, so a market similar to the New York Stock Exchange is impractical. However, buyers today find it much easier to bypass a real estate broker entirely. If they do use a broker, the Internet is often the tool they use to select one. The Internet is particularly important for buyers from distant locations.

In short, as trading volume increases, markets tend to evolve from a structure with low fixed costs and high marginal costs for transactions to markets with high fixed costs and low marginal costs. Transactions costs are lower in these high-volume markets.

Can We Classify Financial Market Frictions?

The answer is yes, at least in part. The universe of financial market frictions can be partitioned in many ways. Because there are many financial market frictions, though, no structure can hope to be complete. Neither can it hope to be very precise; for any feasible partitioning, some financial market frictions can fall into more than one category. Still, providing such a structure is useful. How can this be done?

We build our structure on the economic forces underlying financial market frictions. This structure also takes a step toward identifying those entities best able to reduce the costs of market frictions. We use five primary categories: transactions costs, taxes and regulations, asset indivisibility, nontraded assets, and agency and information problems.

Transactions costs. We partition transactions costs into two categories: the costs of trade and the opportunity costs of time.

The costs of trade. The costs of trade in financial markets include postage, telephone charges, computer power, and similar real expenditures of resources. These have been declining with technological improvements. Over some periods these costs may have risen in real terms, but the costs of communication and data analysis have fallen over time. For example, the cost of an e-mail message is effectively zero. And the costs of virtually all other mechanical costs of trade have fallen. There is no reason to expect this trend to stop. For example, on March 7, 2006, the New York Stock Exchange merged with Archipelago, an electronic trading firm, and the two firms became wholly owned subsidiaries of NYSE Group Inc. This merger is likely to lower bid-ask spreads and therefore the marginal cost of trading securities for some investors.

Financial market frictions can generate real costs for investors. Recognizing these costs helps us understand the total costs of transactions and decide where to place them and whether to make them.

The opportunity costs of time. Trading requires time, which includes both search costs, or the time to gather information (including finding a trading partner), and the time to make the trade itself. Minimizing these costs represents a profit opportunity. One partial solution is to automate the process by means such as automatic electronic payments. Many investors fund their 401(k) plans this way, often via payroll deduction. Another example is dividend reinvestment plans, which let investors hold securities directly and automatically reinvest dividends (DeGennaro 2003). In all these cases, investors need to act only once to make several investments over an unspecified and possibly very long period. Other reductions in the time required to trade are sure to follow, both because technology continues to advance and because the opportunity cost of time tends to rise over time.

The future of transactions costs. Transactions costs are probably among the most familiar financial market frictions. Today, though, they might also be among the least important. Advances in communications and data-handling technology have reduced not only the costs of trade to a fraction of what they were just a few years ago but also the time needed to make trades. Together, these forces probably more than offset an increase in the opportunity cost of time itself. Vayanos (1998), for example, finds that realistically small transaction costs have negligible effects on asset returns and mainly affect the portfolio rebalancing frequency.

Taxes and regulations. The second major category in our taxonomy of financial market frictions is taxes and regulation. We use the term *regulation* loosely in this paper to encompass laws passed by legislative bodies as well as rules imposed by government agencies and industries themselves. Privately imposed rules, therefore, such as exchange-imposed trading rules, count as regulations. Taxes and regulatory costs may be either explicit or implicit. The corporate income tax is explicit: The statute imposing the tax calls it a tax, and the corporation sends funds to the government. Other taxes are implicit, such as capital requirements that insured banks must meet (Buser, Chen, and Kane 1981). In this case, the statute authorizing the capital requirements does not refer to them as taxes, and the banks do not send funds to the government to discharge the liability. But these requirements still increase the cost of doing business and operate like a tax. Regulation varies widely across jurisdictions both within the United States and internationally, as does the degree of coordination between the United States and other countries. We focus on the United States for space considerations, though the concepts are applicable to other jurisdictions.

Explicit taxes. Everyone is familiar with any number of pecuniary taxes; governments both within and outside the United States impose explicit pecuniary taxes in hundreds if not thousands of ways. Corporations pay taxes on income, which change prices.[3] Taxes can even affect the medium of exchange. For example, corporate acquisitions paid for with stock can receive more favorable tax treatment than those paid for with cash.

Individuals pay income and capital gains taxes, and these payments surely affect their investment decisions and trades. Just as surely, income taxes affect individuals' consumption decisions and their willingness to work.

The universe of financial market frictions can be partitioned in many ways, so no structure can hope to be complete or very precise.

Taxes can also be nonpecuniary, paid not in dollars but in effort, time, and resources. Miller and Scholes (1978) give a good example of a nonpecuniary tax.[4] They show how investors can generate deductions to offset dividends earned in order to eliminate the tax on the dividends. In practice, though, this offsetting is costly. The cost to taxpayers of an explicit tax extends far beyond the dollars remitted to the taxing authority. Taxpayers can and do take steps to minimize the amount they pay, and the costs of these steps count toward the total tax burden. Other examples are the costs of becoming informed about tax avoidance and the cost of suboptimal portfolio choices.

Implicit taxes. Privately imposed regulations (or restrictions) are easy to find. For example, the May 1, 2006, prospectus (page 11) for the RetireReady℠ Choice annuity issued by Genworth Life and Annuity Insurance Company gives surrender charges (as a percentage of purchase payments partially withdrawn or surrendered) of 6 percent for years one through four, 5 percent for year five, 4 percent for year six, and zero after that. Because underwriting contracts is costly, annuities are designed to be long-term investments, and issuers impose these fees to discourage customers from canceling the contracts after short periods. Otherwise, if investors hold such contracts for only short periods, transactions costs would harm the contract's performance. In turn, this lower performance would make the contract less attractive to those who seek a low-cost, long-term investment. Still, these restrictions do limit trading because an investor wishing to abandon this annuity and invest the proceeds elsewhere might find it too costly to do so. Although the result is that he holds a subobtimal portfolio, doing so can be preferable to paying the surrender charge.

Another example of a privately imposed regulation is short-sale restrictions. Rule 3350 of the National Association of Securities Dealers Inc. (NASD) forbids its members from short selling securities on the Nasdaq National Market System in situations that it fears might magnify price declines. Members cannot short sell at or below the best bid (the highest bid by all market makers quoting that stock) if the best bid is below the previous best bid for that stock. Such a restriction limits members' trading, thus fulfilling the definition of a financial market friction, but restrictions on short sales can also keep prices from adjusting to equilibrium levels as fast as they would otherwise. Informed traders would prefer to sell an overpriced security short, expecting to profit when the price returns to its equilibrium level. These short sales tend to eliminate the overpricing sooner. With short-sale restrictions, though, any deviation from equilibrium can persist longer. Thus, a financial market friction tracing to regulation can lead to pricing errors.

Govenment-imposed regulations can also create financial market frictions. Some of these closely parallel self-imposed regulations. For example, Rule 10a-1 under the Securities Exchange Act of 1934 governs securities registered on an exchange. Rule 10a-1's key provision is the tick test: Subject to certain exceptions, an exchange-listed security may be sold short only at a price at least as high as the last different reported price. This rule is very similar to NASD Rule 3350.

Reporting requirements are another example of nonpecuniary implicit taxes. The U.S. Securities and Exchange Commission (SEC), for example, requires numerous filings. Economists might debate the value of these reports, but no one can dispute the claim that they impose costs on businesses. The SEC's EDGAR Web site (www.sec.gov/edgar.shtml) gives some idea of how extensive this burden is. Another well-known example of a govenment-imposed reporting requirement is the Sarbanes-Oxley Act of 2002. Among this sweeping legislation's provisions are an increase in management accountability and the requirement that companies institute certain internal controls. Compliance has been expensive. Financial Executives International (2005) surveyed 217 public companies with revenues averaging $5 billion and found that the costs of compliance averaged $4.36 million per firm.

How do these compliance costs affect portfolio allocations and trades? If a corporation decides that the burden is large enough, then one option is to take the firm private because privately held companies are not required to file most of these forms. Thus, these requirements provide incentives to forgo access to the public capital markets, making it more costly for investors to hold them in their portfolios. In such a situation, the investors are imperfectly diversified, and the portfolios lie below the capital market line.

Clearly, the breadth and influence of taxes and regulations are enormous. Managing and coping with them requires a correspondingly large investment; hundreds of thousands of lawyers, accountants, and practitioners labor daily to comply with taxes and regulations in the least costly way for firms and households.

Asset indivisibility. If assets were infinitely divisible, then investors could hold an arbitrarily small portion of each asset. This practice would permit all investors, even those with little to invest, to hold the market portfolio of all investable assets. In fact, though, assets are lumpy—the minimum traded unit is finite. This means that most investors must decide whether to hold the smallest traded unit of an asset or to omit it from their portfolios. Either way, their resulting portfolios will not be invested in the same proportions as the market portfolio and thus will lie below the capital market line in Figure 1. For wealthy investors, asset indivisibility is a smaller problem than it is for less wealthy ones. In addition, a wealthy investor can hold a larger number of assets. Combined with trading costs, which usually have a fixed component, asset indivisibility makes it harder for investors of limited means to begin investing because their portfolios tend to lie farther below the capital market line. Asset indivisibilities are an important reason mutual funds and derivative securities such as Spiders and QQQs exist. By pooling funds from many investors, they permit investors to hold portfolios that more nearly approximate the market portfolio. This process is costly, though, and some indivisibilities remain because it is too expensive to eliminate them all.

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3. Financial economists realize, of course, that corporations do not really pay taxes. Rather, they collect taxes and remit them to the government.
4. Some people might classify tax avoidance as an implicit tax rather than a nonpecuniary explicit tax. That approach would make sense, and this duality illustrates the inherent difficulty with constructing a taxonomy of financial market frictions.

Nontraded assets. Becker (2005) reports that human capital now makes up at least 70 percent of all wealth in economically advanced nations. This enormous capital stock tends to drive workers away from holding the market portfolio. For example, consider an employee of a publicly traded corporation. In a perfect market, he should hold less of his employer's stock than he otherwise would for diversification purposes because he is more likely to lose his job if his employer's stock has done poorly. The positive correlation between job loss and invesment losses magnifies risk. This strategy is unavailable to employees of privately held companies, though. In general, employees of privately held companies are forced to hold a disproportionate stake in their own human capital.

The separation of ownership and control is a financial market friction because this separation can lead to incentive problems, and financial contracts cannot handle them at zero cost.

Or are they? In a market free of frictions, an investor has an alternative to reducing his stake in his employer's shares to compensate for his increased exposure through his salary. Instead of holding fewer shares, he can sell claims on his human capital. Consider a musician. Typically, he performs and earns income over time. But suppose that instead he sells claims on his future earnings and invests the proceeds in the market portfolio, M^*. In this case, the investors who buy the claims collect pro rata shares of the funds the musician earns over time.

Selling claims against one's human capital is not as impossible as it sounds. In fact, examples are becoming increasingly common. Palacios (2002) gives one explicit example for human capital contracts for financing higher education in the United States.[5] Palacios's solution to the problem of human capital sale is impractical for at least two reasons. First, transactions costs exist. Second, and more importantly, incentive problems can remain (see the following section). We can expect financial markets to develop ways to reduce these costs, and, even now, these contracts fill an important gap in financial markets.

Financial innovation has spawned other intriguing examples. For example, in January 1997 David Bowie raised $55 million by issuing ten-year asset-backed bonds.[6] What is innovative about this issue is that future royalties from twenty-five albums that Bowie recorded before 1990 are the collateral backing these bonds. That such a performer could issue such securities serves as a good example of financial ingenuity. Similar deals were soon arranged with other artists, including James Brown (June 1999), the Isley Brothers (September 1999), and the estate of Marvin Gaye (September 2000).

Financial innovation continually removes items from the list of nontraded assets by introducing new instuments that render assets effectively tradable. In addition to the human capital examples above, recent years have seen credit-card securitizations, credit-spread derivatives, collateralized mortgage obligations, and many others. In some of these cases, bundling the assets reduces idiosyncratic risk. In others, the innovation permits unbundling the assets' risk and selling parts of it to investors who are better able to bear it (for example, credit-default swaps). This is not to say that if an asset begins to be traded, then the market friction has been eliminated. More accurately, the friction has been mitigated or exchanged for another (presumably) less onerous friction. Taking the example of human capital sales, one obvious problem is that it might not be legal to sell certain claims on future income. If not, then that legal restriction (in this article, a regulatory financial market friction) complicates the problem of an asset being nontraded. After all, traded assets are also subject to

financial market frictions. Conflicts of interest, or what economists call agency problems, are another problem with human capital sales.

Agency and information problems. Jensen and Meckling (1976) wrote the seminal paper in this area, but the concept has been known since at least Adam Smith (1776). Smith notes that the directors of large companies, who manage large amounts of other people's money, cannot be expected to exercise the same vigilance that they would exercise for their own money. He adds that negligence and inappropriate expenditures result.

Smith's insight is consistent with the familiar adage, "If you want the job done right, then do it yourself." The problem is that for all but the smallest businesses, doing it yourself is simply impossible. With size comes the separation of ownership and control because so few individuals have the wealth to own an entire company, and no one can operate a firm of any size without hiring agents to assist him.

Why is the separation of ownership and control a financial market friction? The answer is that this separation can lead to incentive problems, and financial contracts cannot handle them at zero cost. Suppose that a blues musician wishes to sell shares on the income from his future performances. The chances are good that he will find few buyers, and those who are willing to buy are almost sure to demand a large discount from what the musician views as fair market value. The reasons include adverse selection and incentives to shirk. First, the musician knows more about his ability and willingness to work than buyers, but buyers know that he knows more. This is Akerlof's (1970) familiar "lemons problem." Second, like Smith's directors, the blues musician's ability and willingness to work can be affected by the asset sale itself. Having a large sum of money might prevent the blues singer from performing with the same amount of feeling as he did without the funds—he may no longer have the blues. It is hard to imagine a contract that could costlessly eliminate this problem. This difficulty can reduce or even eliminate trading assets based on human capital because no one will pay the fair value of the musician's income stream.

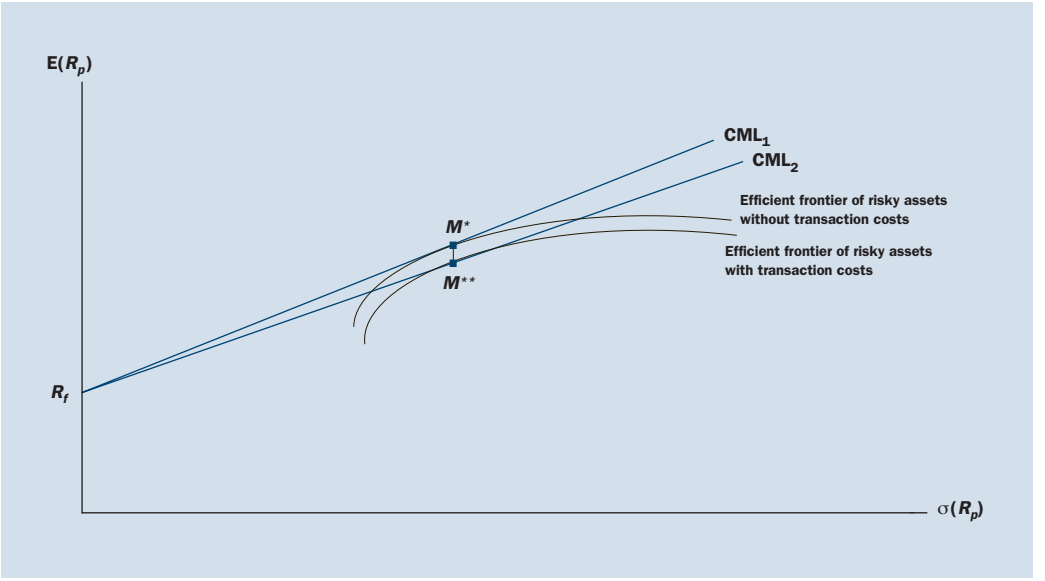
But if agency problems would hinder the musician's sales of claims against future earnings, then why were the sales of Bowie bonds successful? The answer is that the Bowie bonds were sales against future royalties from existing albums. Bowie has no ability to shirk or to reduce the quantity or quality of the albums already produced.

Other agency problems include perverse incentives to manage income. If the human capital contract is infinite or for a very long term, then sellers have an incentive to hide earnings or consume perquisites. If the contract is for a finite term, then sellers also have an incentive to delay earnings. This problem is familiar at the corporate level, where earnings management and fraud have led to the dismissal of corporate executives and even criminal charges. Bebchuk and Fried (2005) describe perhaps the most notorious example: The Federal National Mortgage Association rewarded executives for reporting high earnings but did not require them to reimburse shareholders when the earning were restated (downward) later.

Even abstracting from ownership and control, asymmetric information can also affect prices and prevent markets from clearing. The classic example is Akerlof (1970). Although he uses automobiles to illustrate his point, his insight is equally valid for financial assets. Consider initial public offerings (IPOs). Investors usually have great

5. See www.myrichuncle.com. Also see www.lumnifinance.com/, which offers human capital contracts in Chile, Columbia, and Peru, and www.career-concept.de/, which offers them in Germany.
6. The following discussion draws heavily from "Who's Who in Bowie Bonds" at www.ex.ac.uk/~RDavies/arian/bowiebonds.html.

Figure 2
The Capital Market Line in the Presence of Transaction Costs



difficulty valuing the new securities. Obviously, no recent market price is available, financial statements might be limited, and analysts rarely provide much coverage. In addition, the current owners know more about the company than potential buyers do. In the context of Akerlov's lemons problem, the owners know whether the company is a good company or a bad company. In addition, they have incentives to overstate the company's value. Investors are aware of the information problem, of course, so they assume that the company is bad and bid accordingly. In fact, unless the current owner of a good company is able to credibly certify that the company is good, he will not take a good company public. Without access to certification, the IPO market for good companies fails.

The lemons problem thus represents a profit opportunity for institutions that can evaluate IPOs and certify their value. In fact, investment banks serve that role. In addition to providing a distribution channel and advice, investment banks stake their reputations on the value of the IPO. This endorsement increases the likelihood that an IPO is good, and investors bid accordingly. The result is that good IPOs fetch higher prices than they would without certification, and trades are completed successfully.

Many researchers have applied Akerlof's insight to other markets. For example, Longhofer and Peters (2005) show that a lender's beliefs about the creditworthiness of a borrower's group (for example, his race, marital status, or educational attainment) can affect his assessment of the individual's creditworthiness. If the group's average creditworthiness exceeds the individual's, then the borrower benefits from group membership. But if the individual's creditworthiness exceeds the group's average, then the borrower suffers from group membership. The information asymmetry can work either in favor of or against various groups. Thus, imperfect information can lead to inaccurate credit decisions, in turn meaning that lenders miss some good loans and make some bad loans. The key point for our purpose is that collecting more information about individual lenders would solve this problem, but only at a cost, and

at some point the necessary information is simply not worth collecting. At least some part of the financial market friction remains.

Corporations are not immune to the lemons problem. A good example is the "pecking order" hypothesis of Myers and Majluf (1984). In that paper, management knows the correct value of the company, but investors do not. Investors know that management knows, and they know that management is issuing shares rather than borrowing or using cash to take projects. Myers and Majluf show how this information problem can cause firms to forgo profitable projects and to issue more debt and hold more cash. Because virtually any contract is subject to information asymmetry and agency problems, these financial market frictions touch virtually every area of financial economics. Jensen (1986), for example, has implications for dividend policy; with market frictions, dividends can create clienteles for high- and low-dividend stocks, depending on whether investors prefer current consumption or future consumption. In turn, these investors' preferences can drive a wedge between an investor's optimal holding and M^*. Tkac (2004) shows that investors and investment advisers have inherent conflicts of interest because they have different goals—investors want maximum returns with minimum risk, and advisers want maximum profits with minimum effort. It is difficult to imagine these types of conflicts vanishing.

The Economic Significance of Financial Market Frictions

Clearly, frictions abound in modern financial markets, but how influential are these frictions in changing the behavior of market participants? Can we see evidence of the effect of frictions on stock prices or the returns on investors' portfolios? One obvious place to turn for the answer to this question of the economic significance of market frictions is the academic research literature. Unfortunately, much of the empirical research on asset pricing is conducted within a framework of frictionless asset markets. For example, researchers often assume that agents can buy and sell securities at the same price, do not face transaction costs, and are not subject to short-selling constraints when they formulate models to explain asset returns, such as the CAPM. This section presents what we do know from current research and suggests some issues that should prompt further work in this area.

As the previous section detailed, we have plenty of informal observations that frictions affect financial decisions. Consider, for example, the gap between the interest rates at which consumers can borrow and lend. This gap is a major source of profits for financial institutions and exists because intermediation (the linking of borrowers to lenders) entails costs to overcome information asymmetries. More generally, the U.S. Census Bureau reports that as of 2003, almost 6.5 million people—5.7 percent of the workforce—worked in the finance and insurance sector in the United States. Many of these workers provide some costly intermediating service between buyers and sellers of assets.

In the case of borrowing and lending, market frictions lower the rate at which consumers can lend compared to a hypothetical world in which these frictions are not present; in that case, the rate gap would be eliminated, with lending rates likely somewhat higher and borrowing rates likely somewhat lower. Frictions likely have a similar effect on investors' optimal holdings of risky assets, such as stocks. For example, in the presence of transaction costs, the efficient portion of the mean-variance frontier may shift downward, as shown in Figure 2.

Figure 2 shows the efficient frontiers of risky assets with and without transaction costs when the risk-free rate for lending and borrowing is the same (that is, no

Table
Sharpe Ratios

	Individual stocks	Aggregate stocks	International stocks
Unconstrained	0.30	0.33	0.16
Sharpe ratios	(5.63)	(7.06)	(2.54)
Constrained	0.23	0.18	0.16
Sharpe ratios	(4.43)	(3.60)	(2.54)

Note: Figures in parentheses are *T*-statistics showing the statistical significance of the Sharpe ratio estimates.
Source: Authors' calculations

frictions exist due to asymmetric information).[7] For a given standard deviation of returns, the difference between the expected returns on M^* and M^{**} reflects the transaction costs. Transaction costs, even if small, make investment more costly. For example, if an individual buys $100 worth of stock through a broker, he must pay the broker a small fee, say $5. This makes his total cash outlay equal to $105. If the stock price increases by 10 percent the next day, the stock is worth $110, but he has made only $5 on his $105 investment, which is a return of only 4.76 percent. In the presence of transactions costs, economic agents must either give up part of the expected return to maintain the same level of risk or accept higher risk in their portfolio to obtain the same expected return.

To illustrate and quantify the potential economic impact of other market frictions on the risk-return trade-off of a mean-variance investor, we present a simple empirical example in which an investor faces short-sale constraints and must hold a positive amount of each asset (short selling is the equivalent of holding a negative position). We can then compute the efficient frontiers both in the case where short-sales are allowed (no frictions) and where they are forbidden. Again using a common risk-free rate for borrowing and lending, we can compare the M and M^* portfolios available to an investor in each of these cases. Because investors prefer higher returns and, all else being equal, lower risk, we can compare these portfolios based on the level of return per unit of risk. This quantity is known as the Sharpe ratio; the higher the Sharpe ratio, the higher the return for a given level of risk. Higher Sharpe ratios mean more favorable risk-return trade-offs.

Comparing the Sharpe ratios for the unconstrained portfolio M with that of the portfolio achievable with no short selling allows us to estimate the utility cost of this market friction to investors. The lower the Sharpe ratio of M^* relative to M, the more valuable are the opportunities that are unavailable to the investor. Our empirical analysis uses three different data sets corresponding to varying degrees of aggregation of stock and bond returns: individual stocks, aggregate stocks (decile portfolios based on market value of equity), and international stocks.[8] We use three different sets of assets because we want to show that market frictions sometimes, but not always, influence the Sharpe ratio of a given portfolio.

The results of the empirical exercise are summarized in the table above, which shows unconstrained and constrained Sharpe ratios for individual stocks, aggregate stocks, and international stocks. *T*-statistics to assess the statistical significance of the difference in Sharpe ratios are in parentheses. The general picture is that the Sharpe

ratio that embeds the no-short-sale constraint is lower than the unconstrained Sharpe ratio, meaning that market frictions do indeed impose utility costs on investors by making preferable investment portfolios unattainable. These results quantify the inward shift of the efficient portion of the mean-variance frontier illustrated in Figure 2. Specifically, the deterioration in the risk-return trade-off is 30 percent for individual stock returns and 83 percent for aggregate stock returns. Notice that for international stock returns there is no deterioration in the Sharpe ratio of the tangency portfolio. The reason is that during the sample period the short-sale constraint is not binding in this latter case. In other words, the *M* portfolio that can be formed from international stocks does not include any short positions. More generally, the impact of this constraint on attainable Sharpe ratios is likely to be smaller if only a subset of assets cannot be sold short.

Market frictions may have a negligible impact on the risk-return trade-off of a given portfolio and, at the same time, a substantial effect on portfolio rebalancing frequency. In other words, transactions costs could leave the frictionless risk-return trade-off, represented by the "without transactions costs" line in Figure 2, practically unchanged. However, the constrained (with frictions) portfolio weights that guarantee the same risk-return trade-off might be very different from the unconstrained (frictionless) ones. In turn, very different portfolio weights could depend on the fact that, in the presence of transaction costs, portfolio rebalancing becomes more costly.

Consistent with this empirical example, academic studies that incorporate market frictions seem to show that investors who ignore market frictions compound the harm done by the frictions themselves. Since frictions affect the investment opportunity set of investors, investors who do not take frictions into account in their decisions can do even worse. In particular, Balduzzi and Lynch (1999) find that realistically small transactions costs tend to prompt much less rebalancing on the part of investors. They estimate that ignoring these transaction costs and rebalancing more frequently can cost investors from 0.8 percent up to 16.9 percent of wealth.[9]

So, do investors respond optimally to the existence of market frictions and, in the case of transactions costs, trade less? The answer is yes. Lo, Mamaysky, and Wang (2004) show that even small transaction costs can have a substantial effect, causing investors to refrain from trading. From an aggregate perspective, Amihud and Mendelson (1986) present some evidence that stock returns reflect the effects of market frictions. Their empirical analysis shows that the bid-ask spread affects stock returns. In particular, they find that the average returns on stocks with larger bid-ask spreads tend to be higher. This result may stem from investors' lower demand for high-transaction-cost stocks. This lower demand reduces the prices of these stocks and boosts their average return to the point where investors are willing to hold them. Investors seem to pay a price premium for the liquidity of stocks with low bid-ask spreads.

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7. For the case of different borrowing and lending costs, see DeGennaro and Kim (1986).
8. See the appendix for a description of the data used in the empirical example.
9. Vayanos (1998) builds a general equilibrium asset pricing model with transaction costs. He shows that a stock's price may increase as transaction costs rise because an increase in transaction costs has two opposing effects on the stock's demand. While investors buy fewer shares, they hold shares for longer periods, and either effect can dominate. Vayanos finds that realistic levels of transaction costs have very small effects on asset returns but large effects on investors' trading strategies and turnover. Constantinides (1986) argues that transaction costs have only a second-order effect on equilibrium asset returns: Investors accommodate large transaction costs by drastically reducing the frequency and volume of trade.

As discussed earlier, in principle, market frictions should be explicitly considered in the context of asset pricing theories, such as the CAPM described in the first section of the paper, and in the context of optimal portfolio formation. To date, though, little empirical research regarding the impact of frictions has been done. A few papers have demonstrated that including frictions may be a fruitful avenue for further academic research. Currently, most theoretical models are rejected by the empirical data from the capital markets. He and Modest (1995) and Luttmer (1996) argue that transaction costs, short-selling constraints, and margin requirements can together reconcile popular asset pricing models such as the CAPM with the observed asset return data. Estimates presented in these papers show that the inclusion of multiple market frictions makes popular asset pricing theories such as the CAPM, the C-CAPM (consumption CAPM) and the I-CAPM (intertemporal CAPM) more consistent with the data.

To summarize, market frictions can affect the investment opportunity set available to investors, reduce investors' utility, and prompt investors to change their behavior (that is, trade less).

Summary and Conclusions

It bears repeating that because the underlying business problems remain, financial market frictions never collectively go to zero. The conflicts of interest discussed in Tkac (2004) are one example. Another example is the age-old, ongoing problem of conducting business over long distances with unknown counterparties. In the nineteenth century, negotiable banknotes were a workable solution. But negotiable banknotes are unworkable for the online payments of the twenty-first century. Yet Quinn and Roberds (2003) show that today's online payments have evolved into a form very similar to negotiable banknotes. Both provide payment finality, thus mitigating a key problem for faceless, unknown counterparties conducting business across long distances. The fundamental business problem did not change, but the specific form of the problem did. We should not be surprised that the solution did too.

We have only begun to describe the incredibly broad array of financial market frictions, leaving much ground for others to cover. As mentioned above, for example, Figure 1 assumes that investors can borrow freely at the riskless rate. In fact, though, borrowing restrictions limit the amount of leverage that an investor can take. These restrictions, of course, are market frictions. Should they be classified as a regulatory matter, tracing to limited liability? Or should they be classified as an agency or information problem? The list of financial market frictions we have ignored is of necessity very long.

This article also focuses on financial markets within the United States, leaving room for theoretical and empirical research on product markets and international trade. Nor have we addressed tariffs, for example, which are huge impediments to trade. Nor have we addressed the political arena, in which some participants attempt to circumvent certain financial market frictions while others try to maintain them. Future research could also estimate the liquidity premium due to market frictions and the composition of the optimal portfolio in the presence of a variety of trading frictions.

Finally, the success of online payment providers reminds us that financial market frictions are more than simply impediments to trade. They also represent profit opportunities. Identifying and solving these business problems remains an ongoing challenge.

Appendix
Data Description

Data used in the empirical example are monthly and are expressed in percentage per month. The one-month Treasury bill (TB) rate pertains to the shortest bill with at least one month to maturity and serves as the risk-less asset in the analysis (Ibbotson Associates, SBBI module). All rates of return are nominal.

Individual Stocks

The period considered is February 1962–October 1998. We use holding period stock returns (including dividends) of firms listed in the Dow Jones Industrial Average (DJIA). Specifically, this data set includes all of the stocks in the DJIA that have monthly return data since April 1961 (twenty-two stocks) plus eight other blue-chip stocks.[1] This set of stocks is chosen to mimic a portfolio manager's variance minimization (or tracking error minimization) problem because portfolio managers tend to trade blue-chip stocks because of their higher liquidity. All stock returns are from the Center for Research in Security Prices (CRSP), and most of them are traded on the New York Stock Exchange.

Aggregate Stocks

Data are monthly and are expressed in percentage per month. The period considered is March 1959–December 1996. We use decile portfolio returns on NYSE-, AMEX-, and Nasdaq-listed stocks. Ten stock portfolios are formed according to size deciles on the basis of the market value of equity outstanding at the end of the previous year. If a capitalization was not available for the previous year, the firm was ranked based on the capitalization on the date with the earliest available price in the current year. The returns are value-weighted averages of the firms' returns, adjusted for dividends.

The securities with the smallest capitalizations are placed in portfolio one. The portfolios on the CRSP file include all securities, excluding ADRs (American depositary receipts), that were active on NYSE-AMEX-Nasdaq for that year.

International Stocks

The period considered is April 1970–October 1998. The universe of equities includes the Morgan Stanley Capital International (MSCI) national equity indexes. The nominal returns are denominated in U.S. dollars and are calculated with dividends. All indexes have a common basis of 100 in December 1969 and are constructed using the Laspeyres method, which approximates value weighting.[2] U.S. dollar returns are calculated by using the closing European interbank currency rates from MSCI. The focus of the empirical analysis is on the four countries with the largest market capitalization: the United States, the United Kingdom, Japan, and Germany.[3]

1. The tickers of the 22 stocks that are currently in the DJIA are: T, ALD, AA, BA, CAT, C, KO, DIS, DD, EK, XON, GE, GM, HWP, IBM, IP, JNJ, MRK, MMM, MO, PG, and UTX. The other eight blue-chip stocks are: BS (Bethlehem Steel), CHV (Chevron), CL (Colgate Palmolive), F (Ford), GT (Goodyear Tire and Rubber), S (Sears, Roebuck & Co.), TX (Texaco), and UK (Union Carbide).
2. See MSCI Methodology and Index Policy for a detailed description of MSCI's indexes and properties.
3. As of 1996, the market capitalization weight for these countries is 76.2 percent of the market capitalization worldwide.

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