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Year-end Forces in Securities Markets

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ABSTRACT

Private-issue money market prices shift rapidly upward in the first days of the year, but Treasury bill prices do not. On a year-to-year basis, the price shifts on the money market are highly correlated with the returns to small stocks in January. This paper attempts to discriminate between various hypotheses that can potentially explain this phenomenon. Cross-sectional experiments on prices and flow of funds evidence on trades by institutional investors suggest that both of these patterns are driven by agency problems related to disclosures to claimholders and regulators.

1. Introduction

The large and significant upward shift in small-stock prices across the turn of the year - the so-called January Effect - draws attention to the distinctive features of the year-end. A substantial literature explores the possibility that one or more of these features influence investor behavior in a way consistent with an apparently large opportunity cost to buying small stocks after the year-end rather than before. These explorations have broadened understanding of year-end forces but have not established their impact on security prices.

A major obstacle to discriminating between the competing hypotheses is the similarity of their cross-sectional predictions in the stock market. Turn-of-the-year returns have been associated by different models with liquidity, risk, capital losses, and firm size, which can often be hard to distinguish. The goal of this paper is to strengthen these experiments by repeating them in markets in which confusion between the relevant cross sections is not a problem.

The observation motivating these experiments is that the upward shifts in small-stock prices are cosynchronous and highly correlated across years with upward shifts in private-issue money market prices. Including money market instruments in the scope of the January Effect presents a new challenge to models designed for the turn of the year with only stocks in mind. The correspondence between the two patterns suggests a true model that predicts both, which may be out of reach for some popular explanations.

This paper is divided into two parts. The first part tests the predictions of five models of turn-of-the-year price shifts on observations of money market yields. It begins by establishing that the yields imply annual price shifts in the same direction and on the same days as the small-stock price shifts, and considers the implications for the models. It then examines the turn-of-the-year experience in a new database covering a market in which risk and liquidity are nearly independent and discusses which models could predict the result. Finally, it demonstrates the high correlation across years between the money market and small-stock price shifts, and looks for a model that could act like a single force on the two markets. Along the way, the experiments show how to predict the price shifts in both markets with considerable accuracy. One of the models that survives these experiments attributes the price shifts to a seasonal spike in underlying risk, whereas the other attributes the price shifts to the strategic response of financial intermediaries to year-end disclosure requirements.

The second part takes a closer look at the empirical implications of disclosure requirements. Haugen and Lakonishok (1988) argue that the January Effect is caused by a combination of the responsibility of many intermediaries to report their December 31 portfolios with the latitude of many intermediaries to substitute between asset classes. I test this hypothesis in the money market on quarterly observations of aggregate portfolios of investor types by segregating the types into groups with or without significant disclosure events on December 31 and estimating the December 31 seasonals in their holdings of private-issue money market instruments. Finally, I examine the relationship between the seasonals in holdings and the observed price shifts.

The rest of this paper is organized as follows: Section 2 describes the data; Section 3 collects the predictions of the various models for both the stock and money markets; Section 4 documents the turn-of-the-year pattern in money market prices, its relationship to the small-stock pattern, and implications for the models; Section 5 tests for the influence of disclosure events on the portfolios of money market intermediaries; Section 6 compares the portfolio shifts of intermediaries to Money-Market prices; and Section 7 summarizes and concludes the paper.

2. Description of the Data

The observations of money market yields used here are daily averages collected by the Federal Reserve. For every trading day with available data, the Fed reports average quotes for initial placements of prime-quality commercial paper (one, three, and six months to maturity) and bankers' acceptances (three and six months), and secondary-market offer quotes for certificates of deposit (one, three, and six months), Eurodollars (one, three, and six months) and Treasury bills (three and six months). The database stretches back from 1993 to the 1950s, but most daily series are not available until 1973. Starting there gives us 20 year ends (1973/4 - 1992/3). Bankers' acceptance rates are not consistently reported until 1976. Six-month commercial paper rates are available on a weekly basis going back to 1958; the value reported for a week is the equal-weighted average over the trading days in the seven days ending with Friday. Where possible, I use the one-month Treasury Bill rates reported for month ends by the Center for Research in Security Prices (CRSP). All stock returns are also taken from CRSP.

Another source of money market rates is an issue-by-issue database covering most of the Dutch auction-rate preferred (DARP) market. This was compiled from hardcopies published by Salomon Brothers: one that covers all dividends up to July 1988 of all issues placed by then, one that covers all dividends up to May 1992 of issues placed but not called back by then, and one that covers all dividends up to November 1992 of issues placed but not called by then. The resulting database is therefore not exhaustive, but with results of 5,288 auctions, it is extensive, covering substantially more than half of all dividends from the August 1984 inception of the DARPs market to November 1992. A detailed description of DARPs is given as an appendix.

Observations of aggregate industry portfolio allocations come from the flow of funds tables published by the Board of Governors of the Federal Reserve System. These are quarterly observations of the financial holdings, broken down into broad categories, of various investor types. The figures cover the first quarter of 1952 through the fourth quarter of 1993. The accuracy of the figures varies considerably from one investor type to the next.

3. Models of Turn-of-the-Year Price Variation

The abnormally and consistently high returns of small stocks in January have inspired a sizable literature connecting features of the year-end to asset prices. The most popular of these features are the change in tax year after December 31 (12/31), the concentration of financial transactions in December, and the concentration of portfolio disclosure events on 12/31. Elsewhere in the literature is the argument that the days of high returns are days on which the expectation of bad outcomes is larger but by chance is not realized to date. These models can be distinguished by their predictions for turn-of-the-year returns across risk, liquidity, past returns, and firm size, which are collected in a table for later reference.

3.1 Tax Loss Model

An early and enduring explanation for the high returns of small stocks in January is that the tax code encourages the realization of capital losses before 12/31. Stocks with poor recent performance are more likely to represent unrealized capital losses to their holders and tend to be small. Compounding the effect on small stocks is their typically low liquidity, leading to worse second-best uses across the year-end. Constantinides (1984) and others complain that, while capital losses are more valuable sooner than later, this story has investors sticking to a precise but particularly unwise schedule of transactions, leaving them needlessly uninvested at the worst possible time. This might be a mortal blow to the theory were it not for its repeated success in empirical tests. Reinganum (1983) and Roll (1983) confirm that past losers are the big January winners, and Dyl and Maberly (1992) and others confirm a refinement of the theory, that bigger market wide losses precede bigger January returns.

Tests to confirm the significance of tax laws have been less successful: Tinic, Barone-Adesi and West (1987) find a January effect in Canada before and after the first year (1972) of the Canadian capital gains tax, other papers have found the January Effect in countries, such as Japan, that have never taxed capital gains. On the other hand, Jones, Lee, and Apenbrink (1991) argue that 1917-8 was the first year with a January Effect, and they point out that it was the first year in which tax loss selling was reasonably profitable.

This model, which I shall call the Tax Loss model, predicts a direct negative relationship between the cross section of past returns, proxying for capital losses, and turn-of-the-year returns. This direct relationship induces a negative relationship between liquidity and turn-of-the-year returns. The Tax Loss model has no predictions for money market instruments, which do not generate capital losses or gains.

3.2 Liquidity Supply Model

A different line of thinking relates the price changes to the arrival of cash in the hands of stock investors. Ogden (1990) reads the January small-stock effect as an outward shift of the demand by individuals for equities at the turn of the year. The theory is that individuals receive unusually large amounts of cash on and around 12/31 (i.e. dividends, coupons, bonuses, etc.), which they immediately invest according to the usual pattern of individuals. According to Ritter (1988), this pattern is biased toward small firms. Ogden goes on to assert that these payments should be smaller when monetary policy is tighter and demonstrates that the January Effect is smaller when the Fed Funds/Tbill spread - which he takes to be a measure of tight money - is high. This story, which I shall call the Liquidity Supply model, predicts a direct negative connection between the cross section of turn-of-the-year stock returns and the cross section of firm size, which could induce a negative connection to the cross section of liquidity. There is no prediction for the money market.

3.3 Liquidity Demand Model

Similarly, the well-known demand for money to lubricate holiday transactions could provoke the liquidation of financial assets as the year-end approaches, followed by reinvestment when the network of transactions unwinds in January. This Liquidity Demand model is not a likely story for the equity market, where brokerage fees and bid/ask spreads make short-term liquidations expensive (especially for small stocks), but it might drive a wedge between private-issue money market instruments maturing across the period of high demand and those maturing previously or issued afterward. The high costs of selling these instruments back to market makers before maturity may temporarily depress demand for them relative to more liquid Treasury bills, showing up in prices as a decrease in spreads as the seasonal money demand passes. The model predicts a direct negative connection between turn-of-the year returns in the money market and the cross section of liquidity, which may appear to be a positive connection to the cross section of risk in markets in which risk and liquidity have a large negative correlation. Across years there would be a procyclical pattern in spread changes, since larger spikes in money demand should be associated with greater economic activity.

3.4 Windowdressing Model

Intermediaries report their portfolios to claimholders and other outsiders as of predetermined dates, of which the most popular by far is December 31. In the weeks leading up to a disclosure date, an intermediary may decide that its portfolio is not the best portfolio to be seen holding and may choose to rebalance away from the less attractive assets until the moment of disclosure has passed. Then they are repurchased for whatever reason they were chosen for the portfolios in the first place. The demand for assets considered unattractive will accordingly shift down and then up, showing up in prices as large positive returns in the first days after the moment of disclosure.

Haugen and Lakonishok (1988) propose this Windowdressing model as a substitute for the Tax Loss explanation for the large turn-of-the-year returns of stocks with bad recent performance. They argue that equity market intermediaries prepare for 12/31 disclosure events by selling or avoiding showing bad recent performers, out of fear of signaling bad judgment to the public. By extension, intermediaries also avoid riskier issues to decrease their apparent volatility. The demand shift is especially hard on thinly traded issues, which tend to be small.

This logic can be applied to the money market, where private-issue instruments, which carry default risk, trade alongside Treasury bills, which do not. The share of the private-issue market held through intermediaries is nearly 100%, since these issues trade in denominations too high for all but a few individuals. By tilting away from the private-issue instruments until the 12/31 disclosure is over, cash managers can lower the riskiness of their reported portfolios. This would show up as a rapid increase in the price of private-issue instruments at the turn of the year, and within the private-issue market, it would show up as a larger increase for the riskier instruments. So the Windowdressing model predicts a direct positive connection between turn-of-the-year returns and the cross section of risk in both the money market and the stock market, and a direct negative connection between turn-of-the-year returns and past returns in the stock market. Across years, turn-of-the-year returns should be higher when the spread between high risk and low risk is greater. Observations of intermediary portfolios should show greater investment in private-issue instruments or small stocks on nondisclosure days than on disclosure days.

3.5 Big Risk Model

Some research eschews the demand disaggregation approach in favor of a representative-investor approach in which demand is stable and the assets change. Keim and Stambaugh (1986) postulate that small stocks outperform large stocks in January because they are more exposed to a surge in the probability of bad news. Big returns reward the successful passage through a period of high expected disaster, which has by chance never occurred. They do not specify the potential source of the bad news or why January would be riskier than other months. In both the equity market and the money market, this Big Risk story has January returns increasing with riskiness.

3.6 Summary

I can summarize the cross-sectional predictions of the different models with a three-way table:

Table 1

cross-section:	Risk		Past Ret.		Liquidity		Size	
market:	MM	EQ	MM	EQ	MM	EQ	MM	EQ
Tax Loss				-		(-)		
Liquidity Supply						(-)		-
Liquidity Demand					-			
Windowdressing	+	+		-	(-)	(-)		
Big Risk	+	+						

MM is Money Market; EQ is Equity market; Risk, Past Ret., Liquidity, and Size are the cross sections of risk, past returns, liquidity, and firm size, respectively. A plus indicates that the model predicts that turn-of-the-year returns will increase for assets in the specified market as the specified attribute (e.g. risk) increases. A minus indicates a prediction of a negative relationship. A plus or minus in parentheses indicates a relationship that may be induced by but is not necessary for the model.

Table 1 guides the testing of specific hypotheses. The Tax Loss story does not apply to the Money Market, so we can test unambiguously for non-tax-related January forces on money market yields. Only the Windowdressing and Big Risk models predict a direct relationship between January price changes and the cross section of risk, so if we can control for the other variables, we can test for these models exclusively.

4. Tests of Models on Asset Prices

The experiments of this section incorporate results from the money market into the discussion and evaluation of turn-of-the-year models. First, I document the turn-of-the-year behavior of money market prices across instruments, maturities, and years; I discuss the price behavior in the context of existing models of money market prices; I consider the implications of the Money-Market results for the various models of turn-of-the-year behavior; and finally I analyze the relationship between money market and equity turn-of-the-year effects and its implications.

4.1 The Turn of the Year in the Money Market

There are several ways to establish that private-issue money market prices increase rapidly at the turn of the year. Figure 1 is a plot, in the event study tradition, of the spread between six-month commercial paper (CP6) and Treasury bills (TB6) around the year-end, averaged across the 20 year-ends (1973-92) in the database (all tables and figures except Table 1 are at the end of the paper). Day 0 is the last trading day of the year, day -1 is the second-to-last, day +1 is the first trading day of the next year, and so on. The spread change over January discovered by Keim and Stambaugh (1986) corresponds roughly to the change from day 0 to day 20.

Figure 1 reveals that most of the change over these 20 trading days occurs early. On the last trading day of the year and the first four of the next year, the same days on which Roll (1983) and others find an abrupt upward shift in small-stock prices, the graph shows an abrupt upward shift in the price of CP6 relative to TB6. From day -1 to day 4, the mean spread drops by 24.30bp from 70.55bp to 46.25bp (bp = basis point; 1/100 of one percent), which compares to 24.40bp from day 0 (67.55bp) to day 20 (43.15bp).

To gauge the robustness of this observation and to learn which of the spread components is doing the shifting, we can plot the change across the end of the year for each instrument in each year. This is given as Figures 2A (one-month), 2B (three-month), and 2C (six-month). We see that the yield of each private-issue instrument shows a decline across 12/31 in almost every year and that the Treasury bill changes are distributed around zero. Table 2 summarizes the yield changes, reporting unconditional spread levels, mean turn-of-the-year yield changes, number of positive changes, and t-statistics for difference from zero. Every one of these figures can reject by itself the hypothesis that private-issue prices do not increase across the turn of the year. The pattern of Figure 1 is evidently real and pervasive in the trillion-dollar private-issue money market.

Earlier observations of money market prices show this significant pattern to be a recent development. Weekly averages of CP6 and TB6 yields going back to 1958 reveal that the turn-of-the-year price increases do not extend much beyond the 20 years of daily data. Figure 3 plots the average spread in the week ending with the last Friday of each year minus the average spread two weeks later. The large spread increases across 12/31/67 and 12/31/68 suggest 12/31/69 as an early bound on the starting date for the pattern in Figure 1 as a significant economic event.

4.2 Existing Models of Money Market Yield Variation

A review of the literature on money market yield variation indicates that the turn-of-the-year pattern requires a new explanation. Existing models of the relative yields of private-issue and Treasury issue instruments cannot reconcile the velocity, magnitude, and predictability of the yield changes with observable variation in economic forces.

4.2.1 Differential Taxation

Cook and Lawler (1983) argue that the marginal investor in certificates of deposit (CDs) pays state income tax on CD interest but not on Treasury bill (TB) interest. They conclude that the CD/TB spread imputes his marginal rate to equalize net risk-required returns. Accordingly, they predict that the spread increases with the TB yield at a rate in the neighborhood of prevailing state tax rates. With a variety of models, they accept this hypothesis with tax rates of around 10%, at the high end of state marginal rates. To the extent that the TB rate changes quickly, this dependence can lead to high-frequency spread changes, but a 25bp swing in the spread would require a simultaneous 250bp swing in TB yields. This is not the case at the turn of the year, when the TB rate averaged across years hardly moves at all.

The imputed state tax could result in discrete spread changes without TB rate changes if the issues compared matured in different years. The interest on CP6 placed at the end of June is taxed in the same tax year, whereas the interest on an otherwise identical issue placed at the beginning of July is taxed in the following year. This implies that a lower discounted tax liability shows up as a smaller spread. While this may indeed occur, it does not apply to the yield changes in question because they occur between issues taxed in the same year.

4.2.2 Supply of Treasury Bills

In an earlier article, Lawler (1978) argues for the impact of some special features of Treasury securities on spreads. He points out that Treasury bills qualify where private-issue instruments do not for required reserves and collateral for certain transactions, and he proposes that these services should add to Treasury Bill prices a premium that decreases as the supply of Treasury securities increases. As evidence, the seasonal pattern in Treasury supply (up until February, then down until June) related to the tax payment schedule is shown to match closely the seasonal in the CD3/TB3 spread (down until February, then up until June) over the 15 years ending with 1977. Cook and Lawler (1983) add a transformation of the Tbill supply to their regressions explaining the CD3/TB3 spread and find that it enters negatively and significantly.

These results suggest that the Tbill supply can induce variation in spreads of the necessary magnitude and predictability, but not the observed velocity. The pattern described by Lawler (1978) is discernible in Figure 4, which plots mean spreads for each week of the year averaged across the 20 years for each three-month instrument and reveals a widening spread in the second quarter (i.e. weeks 14 to 26). The supply-induced seasonal in spreads is a low-frequency pattern in the TB rate, not a high-frequency pattern in private-issue rates.

4.2.3 Monetary Policy

Recently, Kashyap, Stein, and Wilcox (1993) have postulated that the CP/TB spread may change with Fed monetary strategy. They reason that "tight money" policies shift down the supply of corporate loans by banks, inducing some borrowers to substitute into commercial paper. The increased volume of commercial paper in turn drives down its price relative to Treasury bills. This model also does not generate high-frequency, annual spread changes. To the extent that there is a special Fed policy for the year-end, it is to enhance liquidity, not constrict it.

4.2.4 Default Risk

Perhaps the most familiar interpretation of spread variation is that it tracks perceived default risk. The rarity of money market defaults makes this intuitive reading impossible to verify statistically but if we plot a time series of the three-month CP/TB spread, presented before and after a 10% tax on CP income in Figure 5, we see a correspondence between high spreads and the recessionary periods associated with defaults. This model can therefore explain a portion of the private-issue/TB spread to the extent that low-frequency business cycles are observable, but it is not feasible to observe real business risk at high enough frequency to analyze the week-long fluctuation in question.

4.2.5 Summary of Spread Models

Existing models of spread variation account for some significant patterns in money market prices, but they do not account for the price shifts across the year-end. The upward shift of private-issue prices is beyond the scope of tax differences, Treasury supply, monetary policy, and observable business risk. This suggests the operation of an undocumented force related directly to the peculiar economics of the turn of the year.

4.3 Implications for Turn-of-the-Year Models

We can begin documenting this force by relating the money market price shifts to the models of Section 3. For the most part, the models can be distinguished by their predictions for the money market, or lack thereof.

4.3.1 Tax-Loss and Liquidity Supply Models

The reliance of the Tax Loss model on the cross section of realizable capital losses or gains rules it out as an explanation of the money market price shifts. This often-cited explanation for small-stock, turn-of-the-year returns is irrelevant to the same pattern occurring in the money market on the same days. The Liquidity Supply model does not offer a prediction for the Money Market, so it too does not apply.

4.3.2 Liquidity Demand Model

Since the days on which private-issue prices rise could match the days on which the demand for money eases, the average price shifts are consistent with the Liquidity Demand model. However, the time series of price shifts does not bear out the prediction that larger shifts coincide with greater economic activity. The big shifts in the early 1970s, 1980, and 1990 coincide with below-average economic activity and, especially in the case of 1990, below-average holiday sales. If anything, the time series is anticyclical, not procyclical.

4.3.3 Windowdressing Model

The Windowdressing model predicts the observed effect of the year-end on money market prices. In addition, an anticyclical pattern across years is consistent with the Windowdressing model's prediction that larger price shifts coincide with a higher contrast between high and low risk, since the risk of Treasury bills is always essentially zero, whereas the risk of private-issue investments is always positive and likely to be higher in recession.

4.3.4 Big Risk Model

Most patterns, including this one, are consistent with some pattern in unobservable risk. The Big Risk model is therefore effectively not rejectable, but in back-of-the-envelope fashion, we can estimate the necessary magnitude of the imputed risk fluctuation and gauge its plausibility.

In the averages across year-ends, we measure a 21.30bp drop in the six-month CP/TB spread from day 0 to day 4. This translates to roughly 10.65bp earned for holding CP6 rather than TB6 over about six days. The 59.38bp mean CP6/TB6 spread (from Table 2) indicates that the average payment for holding CP6 rather than TB6 for six days is 59.38 x (6/365) = 0.98bp, or only about 9% as much. Similarly, the 10.20bp drop in the first trading day (say two calendar days) implies 5.60bp earned over a period that typically pays 59.38 x (2/365) = 0.33bp, or 6% as much. If we estimate the payoff for default risk to be linear in the probability of default, these opportunity costs imply a probability 10 to 15 times higher in the first days of January than in the rest of the year. The figures from Table 2 promise comparable results for the other instruments and maturities.

Keim and Stambaugh (1986) proposed the Big Risk model to account for the change in default spreads over all of January. This requires a much milder and lower frequency variation in risk than the change in the first few days. The Big Risk model requires not just an unexplained surge in risk, but actually a very large unexplained surge in risk.

4.3.5 Summary of Turn-of-the-Year Models

Of the five turn-of-the-year models, three are consistent with money market price shifts across the turn of the year. The Tax-Loss and Liquidity Supply models do not apply, but the others do, with varying degrees of success. We can discriminate further between the surviving models with experiments designed to isolate more precisely their cross-sectional predictions.

The Liquidity Demand model and the other two models can be distinguished by their predictions for the cross section of risk. The Windowdressing and Big Risk models predict a direct connection between the cross section of risk and the cross section of turn-of-the-year returns, while the Liquidity Demand model predicts a direct connection between the cross section of liquidity and the cross section of turn-of-the-year returns.

These predictions are difficult to separate in markets in which liquidity declines as risk increases. But in a market without cross-sectional variation of liquidity, a connection between measures of risk and turn-of-the-year returns is predicted only by the Windowdressing and Big Risk models.

4.4 Evidence from the Cross Section of Risk

A market with no cross-sectional variation in liquidity is the market for Dutch auction-rate preferred shares (DARPs). DARPs are equity securities which trade every 49 days at par in single-price auctions (a detailed description of DARPs and the database is given as an appendix). This design mimics the contingent-claim structure of short-term debt while qualifying corporate investors for a tax deduction on dividends (the dividends received deduction, or DRD; see Grundy (1992) for a detailed exposition) that requires a holding period of at least 46 days. Since most trades between auctions would result in a deadweight tax liability, there is practically no liquidity between auctions. As a result, the cross-sectional variation in liquidity is trivially different from zero.

The experiment is to estimate the cross section of bonus turn-of-the-year returns and compare it to the cross-section of risk. For this purpose I have two measures of risk. The first is the Standard and Poors' (S&P) rating current on the auction date, which is converted to a scalar (AAA=1, AA+=2, AA=3, etc.); the second is a 1/0 dummy indicating whether (1) or not (0) the issue is a special purpose corporation (SPC) spawned by an unprofitable thrift to issue DARPs (Grundy (1992) explains why this happened). Almost all of the AAA ratings went to the SPCs on the basis of their substantial overcollateralization (as it turns out, none of the SPCs has ever missed a dividend), but the market has never priced them as low-risk, so they constitute a special case.

Bonus turn-of-the-year returns are calculated three ways: the dividend set for the holding period including 12/31 minus (1) the dividend for the previous holding period, (2) the dividend for the following holding period, and (3) the average of the previous and following dividends. Since our risk measures increase with risk, the windowdressing model predicts a positive relationship between the risk measures and each measure of the bonus return.

The experiment is run by identifying dividends set for holding periods including 12/31 and using those that are not the first or last holding-period for the issue (so we have previous and following dividends with which to compare them) and that have the same S&P rating for all three auction dates (to make interpretation simpler). So for observation i, we have $\mathbf{DIV1231}_i$, the dividend for the holding period across 12/31; $\mathbf{DIVP}_i$, the previous dividend; $\mathbf{DIVF}_i$, the following dividend; $\mathbf{DAVG}_i$, the average of **DIVF** and **DIVP**; $\mathbf{LOGRATE}_i$, the natural log of the current S&P rating, and $\mathbf{DUMSPC}_i$, which is 1 for SPCs, 0 otherwise. This procedure nets us 613 observations on which we can run our tests:

$$(\mathbf{DIV1231}_i - \mathbf{DIVP}_i) = \underset{(-0.86)}{-0.0003} + \underset{(8.25)}{0.0109}\mathbf{DUMSPC}_i + \underset{(5.50)}{0.0040}\mathbf{LOGRATE}_i \quad R^2 = 11.04\%, \; N=613$$

$$(\mathbf{DIV1231}_i - \mathbf{DIVF}_i) = \underset{(3.73)}{0.0046} + \underset{(4.48)}{0.0062}\mathbf{DUMSPC}_i + \underset{(4.14)}{0.0032}\mathbf{LOGRATE}_i \quad R^2 = 3.25\%, \; N=613$$

$$(\mathbf{DIV1231}_i - \mathbf{DAVG}_i) = \underset{(2.01)}{0.0021} + \underset{(7.07)}{0.0086}\mathbf{DUMSPC}_i + \underset{(5.38)}{0.0036}\mathbf{LOGRATE}_i \quad R^2 = 7.75\%, \; N=613$$

The coefficients reveal that the cross-sectional relationship is significant and is in the predicted direction. This is *prima facie* evidence of year-end behavior driven directly by the cross section of risk, a prediction only of the Big Risk and Windowdressing models.

4.5 Comparison of Money Market and Small-Stock Patterns

The observation that small-stock prices and private-issue money market prices increase significantly on the same days of the year invites closer scrutiny of the relationship between the two patterns. A low correlation across years would suggest this timing to be a coincidence, whereas a high correlation would indicate the existence of a common turn-of-the-year force on both markets.

We can compare the effects in the two markets by letting $\mathbf{DELCP6}_{m,y}$ and $\mathbf{DELSPR6}_{m,y}$ be the changes in CP6 and CP6-TB6, respectively, over month m of year y, and $\mathbf{DEC1}_{m,y}$ be the return on the smallest NYSE size decile in month m of year y, and regressing the January stock returns on the simultaneous yield and spread changes:

$$\mathbf{DEC1}_{m,y} = 0.0718 - 0.2064\mathbf{DELCP6}_{m,y} \quad m=1,\ y=74\text{-}93 \quad R^2 = 80.54\%$$
$$(4.70) \quad (-8.63) \quad N = 20$$

$$\mathbf{DEC1}_{m,y} = 0.0411 - 0.4029\mathbf{DELSPR6}_{m,y} \quad m=1, y=74\text{-}93 \quad R^2 = 65.39\%$$
$$(1.77) \quad (-5.83) \quad N = 20$$

Both the absolute and relative price changes of private-issue money market instruments show a very close and significant relationship to small-stock prices. This is far from the normal relationship between CP yields and small-stock returns, as we can see if we repeat the regression with all months but January:

$$\mathbf{DEC1}_{m,y} = 0.0079 - 0.0148\mathbf{DELCP6}_{m,y} \quad m=2\text{-}12, y=74\text{-}93 \quad R^2 = 3.86\%$$
$$(1.93) \quad (-2.94) \quad N = 217$$

$$\mathbf{DEC1}_{m,y} = 0.0084 - 0.0432\mathbf{DELSPR6}_{m,y} \quad m=2\text{-}12, y=74\text{-}93 \quad R^2 = 6.82\%$$
$$(2.09) \quad (-3.97) \quad N = 217$$

The relationship almost completely disappears. The difference between the January and non-January results indicates that a single force peculiar to the turn of the year could explain much about the patterns in both markets.

4.6 Time-Series Variation in Year-End Forces

The two models consistent with all the Money-Market results both predict cosynchronous and similar patterns in small stocks. While the Big Risk model does not mention how or why turn-of-the-year price changes would vary across years, the high correlation between the two markets is a natural consequence of spikes in the level of underlying risk. The Windowdressing model does predict the variation across years of price shifts in the two markets but does not require that they be correlated. In the model, intermediaries observe the marginal benefit per dollar of windowdressing and then substitute out of the riskier assets until the marginal cost, which we observe as *ex post* price shifts, is pushed up to the marginal benefit. Consequently, the variation across years in price shifts reflects the variation across years in the marginal benefit, so price shifts are correlated across markets if the marginal benefits to windowdressing are correlated across markets.

In the Windowdressing model, the marginal benefit to an intermediary from moving a dollar in his reported portfolio from security A to security B increases with the difference perceived by the public between the risk of A and the risk of B, whereas the marginal cost is the forgone excess return. As the intermediating community moves more and more dollars from A to B, this marginal cost rises until further windowdressing is unprofitable. In other words, if we know the marginal benefit of windowdressing as of 12/31, we know the marginal cost, which we observe as turn-of-the-year small-stock returns or private-issue yield changes. The January price shifts have to be predictable because they derive from public perceptions of relative risk.

The natural estimator of the marginal benefit of windowdressing in both markets is the spread of commercial paper over Treasury bills. For the Money Market this follows directly from its popularity as an estimate of the current price of CP default risk, as discussed above. If we factor out the portion of the spread due to differential taxation, the remainder should vary with the level of risk perceived in CP investments, which is what we need. As for the equity market, Whitelaw (1994) concludes that the spread between six-month CP and TB is "the major predictor of stock market volatility." Combined with the observation of numerous researchers that small stocks are more exposed to stock market volatility than large stocks, this implies that the risk of small stocks relative to large stocks increases with the CP/TB spread.

The Windowdressing model asserts that the end-of-the-year CP/TB spread predicts the subsequent price changes of small stocks and private-issue money market instruments. Keeping in mind Cook and Lawler's (1983) conclusion that part of the spread is simply an imputed tax, we need to find a positive relationship between $((1-\mathbf{t}_y)\mathbf{CP6}_{DEC,y}-\mathbf{TB6}_{DEC,y})$, where $\mathbf{t}_y$ is the tax rate imputed at the end of year y and $\mathbf{CP6}_{DEC,y}$ and $\mathbf{TB6}_{DEC,y}$ are the yields at the end of year y, and both $\mathbf{DEC1}_{JAN,y+1}$ and $(\mathbf{CP6}_{JAN,y+1}-\mathbf{CP6}_{DEC,y})$, the NYSE first-decile returns and CP6 yield changes in January. We can either insert a tax rate of our choosing or let it float by using **CP6-TB6** and **CP6** as separate explanatory regressors.

Regression results are reported in Panels A and B of Table 3; Panel A imposes a 10% tax rate and B lets the rate float. In both panels, we predict both the CP6 yield change and the return of **DEC1** over both the first four trading days of the year and all of January, giving eight sets of regressions in all. We fit the model over all 20 years of daily data and on two 10-year subperiods. In these regressions, the end-of-year yields are averages over 12/25-12/31. We also extend the experiment back an additional 15 years by using the weekly data. In this period, the end-of-year yields are averages over the week ending with the last Friday of the year, and the subsequent changes go from this last week to either two weeks later (in the first-four-trading-days regressions) or four weeks later (in the all-of-January regressions). We then put all 35 year-ends together for one big regression.

Every regression in Table 3 supports the hypothesis that the marginal benefit from windowdressing explains the turn-of-the-year effect. The proportion of variance explained by this simple model ranges from large to enormous. The only weak relationship occurs for the money market price shifts in the early period, when there does not appear to have been an effect anyway. It is not impossible to retrofit the Big Risk model to the results of Table 3; it could be that default risk in the first days of the year is a constant and large multiple of the risk level prevailing the week before. But the Windowdressing model has succeeded where the others have not in explaining both the patterns, their correlation, and the manner and extent of their substantial predictability.

4.7 Conclusion

The experiments of this section place money market price shifts in the middle of the debate over turn-of-the-year models. The inability of the Tax Loss model to explain this pattern so highly correlated with the pattern it is purported to explain is a serious and telling failure, and the survival of the Windowdressing model through a variety of cross-sectional and time-series tests flags it as a potentially informative angle on price variation. What our experiments have not yet accomplished is a test of this model that cannot be reinterpreted as a test of the Big Risk family of models. The next section addresses this issue directly by testing the predictions of the Windowdressing model on the portfolio decisions of intermediaries, which the representative investor does not encounter.

5. Reporting Requirements and Demand Curve Shifts

The Windowdressing model predicts a connection between disclosure events and price shifts that separates into two logical modules. The first is a connection between disclosure events and shifts in the demand for private-issue money market instruments. Testing this module is the task of this section. The second, which I address in the next section, is a connection between the demand shifts and the price shifts.

Private-issue money market instruments circulate in denominations so large that direct investment is infeasible for all but a few individuals. Accordingly, consumers hold these securities through intermediaries, some - such as money market mutual funds - organized expressly to facilitate short-term investment and others - such as nonfinancial corporations - whose cash management is ancillary to their real activity. The intermediaries select portfolios of short-duration securities, which they disclose in the required detail as of predetermined dates. The hypothesis tested here is that intermediaries respond strategically to 12/31 disclosure events by tilting their portfolios away from the riskier, private-issue instruments at the end of the year and tilting back at the beginning of the next. Disaggregating money market demand into reporting and nonreporting sectors and comparing their 12/31 portfolio adjustments, we find significant support for this cross-sectional prediction. We support the first half of our hypothesis that reporting requirements provoke substitutions that move the market by establishing the existence of the substitutions.

5.1 The Cross Section of 12/31 Disclosure Events

The flow of funds (FOF) data on aggregate industry portfolios divide the demand for open-market paper (the Fed's term for commercial paper plus bankers' acceptances, [OMP]) to 15 investor categories, listed in Table 4. This is the widest cross section reported for any money market instrument (11 categories for large domestic deposits, 9 for Fed funds and repos and 2 for foreign deposits), and so presents our best opportunity to estimate a cross section of 12/31 demand shifts to relate back to the cross section of reporting requirements and forward to the time series of yield changes.

The investor categories of Table 4 represent diverse reporting environments. At one extreme are life insurance companies, which must all report their money market holdings in complete detail as of 12/31 to state insurance commissioners. At the ends of other quarters they report only the total values of their short-term portfolios, so this is the only opportunity for the public to observe their allocations across money market instruments. Similarly, private pension funds are obliged under the Employee Retirement Income Security Act of 1974 (ERISA) to report all money market investments as of the ends of their plan years, but do not have to report prime-rated, short-term investments held in between. Plan years generally correspond to employers' fiscal year-ends, so this reporting date is 12/31 more often than not. Similar disclosure rules apply to many public pension funds (which are exempt from ERISA), but they vary somewhat across funds.

Money market mutual funds, whose market share increased enormously over the twenty-year sample period, also report their portfolio constituents as of their fiscal year-ends and typically six months later as well. Other mutual funds, which handle much less of the market, follow the same schedule. Mutual funds are free to choose the fiscal year-ends most advantageous to them, but 12/31 is by far the most popular. It is important to note that some money market mutual funds do not invest in private-issue instruments, so we do not know for sure whether the aggregate portfolio changes reported by FOF represent reallocation by individual funds. It is possible that the shareholders themselves temporarily switch between types of funds, maybe for windowdressing purposes of their own.

At the other extreme of the reporting spectrum are the major commercial banks, which report their holdings so frequently that no one date is more of a reporting event than any other. It is also unlikely that brokers and dealers have the opportunity to mislead their parent companies or customers as to the nature of their trades (recent experience at Kidder notwithstanding).

Monetary authority in Table 4 refers to the Federal Reserve System, which used to support the BA market with a modest level of purchases, buying more when prices were low. This looks like arbitrage but is actually "providing liquidity." Since 12/31 prices are low, we would expect to see larger positions then, especially since the Fed has no residual claimants to worry about risk. Government-sponsored enterprises refers to the various administered lending pools. Some of them, such as Fannie Mae, operate almost as private corporations, whereas others, such as the Federal Home Loan Bank System, do not. As a result, the behavior of the aggregate portfolio is hard to predict.

The residual category (called "households" in the FOF documentation) includes the investments of nonprofit organizations (Getty Museum, universities, etc.), personal trusts not administered by banks, and any other institution operating out of view of the Feds. There is little reason to expect the demand curves of these institutions to change for 12/31, so we may see them picking up the slack left by windowdressers.

Put together, the analyses of reporting requirements predict the 12/31 demand shifts of nine of the 15 investor categories. Five categories - life insurance, private pension funds, public pension funds, mutual funds, and money-market mutual funds, which I shall call the reporting industries - should reduce their demand for OMP; four - monetary authority, brokers and dealers, commercial banks, and residual, which I shall call the nonreporting Industries - should have the same demand on 12/31 as before or after, which should show up as an increase in consumption due to the bargain price on 12/31.

5.2 The Cross Section of Demand Shifts

Our experiment is to compare the estimated cross section of 12/31 disclosure events with the estimated cross section of 12/31 demand curve shifts. We need to compare the 12/31 OMP positions of the various industries with estimates of what they would have been in the absence of disclosure events. The Windowdressing hypothesis predicts that the positions of reporting industries will fall below the estimates, whereas the positions of nonreporting industries, in response to the enhanced risk/return trade-off, will exceed the estimates. In anticipation of combining the quantity data with the price data, we shall confine this experiment to the 20 year-ends discussed above.

To keep the analysis simple, our estimate of the amount an industry would have invested on 12/31 in a non-Windowdressing world is the average of the holdings on the preceding 9/30 and the following 3/31. With this methodology we can make two sorts of comparisons. First, we compare the dollar amount of 12/31 OMP investment of each industry i, $\mathbf{OMP_{i,y,4}}$, with the amounts from three months before and after, $\mathbf{OMPEST_{i,y,4}} = (\mathbf{OMP_{i,y,3}}+\mathbf{OMP_{i,y+1,1}})/2$.

This difference is the operative figure in the model connecting disclosure to yield changes. It does not, however, indicate directly whether the industry has moved out of OMP in particular or financial assets altogether. So our second estimate is the 12/31 fraction of total industry financial assets allocated to OMP, $\mathbf{OMPPER}_{i,y,4}$, minus the average of fractions three months before and after, $\mathbf{OMPPEREST}_{i,y,4} = (\mathbf{OMPPER}_{i,y,3}+\mathbf{OMPPER}_{i,y+1,1})/2$. For the reporting industries this is the difference that would have to be generally negative.

The experimental results are summarized two ways in Table 5. We average $(\mathbf{OMP}_{i,y,4}-\mathbf{OMPEST}_{i,y,4})$ and $(\mathbf{OMPPER}_{i,y,4}-\mathbf{OMPPEREST}_{i,y,4})$ over the years they are available for each industry and count the times they are positive. Both measures of demand shifts, summarized either way, are broadly supportive of the Windowdressing hypothesis. Reporting industries have the predicted negative signs for both estimates, and nonreporting industries are uniformly positive. The unequaled importance of 12/31 reports for the life insurance industry shows up as an exit from OMP in every year except 1989, when the return on an index of stock-life companies (calculated from the CRSP NYSEAMEX and NASDAQ tapes) was the highest (both in absolute level and relative to the market) out of all 20 years. Nonfinancial corporations show a significant increase in dollar investment but a significant decrease in percentage allocation to OMP, perhaps reflecting a combination of year-end sales and windowdressing.

To get a sense of how these OMP substitutions fit into overall portfolio adjustments, we can use the same models to back out seasonal flows between investment categories within the life insurance industry. The results given in Table 6 reveal that much of the money flowing out of OMP flows into checkable deposits and currency, suggesting that the money that would otherwise have been invested in OMP is instead parked in checking accounts for the duration. The allocation to governments increases, but not as much. The other private-issue instruments are presumably lumped into miscellaneous assets.

5.3 Summary

We have established so far that the industries with 12/31 disclosure events exit the OMP market at the same time of year in which OMP prices have historically been low. This is a necessary feature of a windowdressing world, but we can go further by comparing the year-to-year demand shifts to the year-to-year price shifts. This is the goal of the next section.

6. Flow of Funds and Price Shifts

The remaining leg of the Windowdressing hypothesis is that the 12/31 demand shifts of the reporting industries cause the turn-of-the-year private-issue money market price shifts with which they coincide. The FOF data do not provide the ammunition to prove this for any one year, but to the extent that the supply/demand structure of the money market is otherwise stable over time, we can get a sense of the relationship by comparing the time series of demand shifts with the time series of price shifts. With a simple experiment of this form, we show here that for every private-issue instrument of every maturity in the database, particularly low 12/31 prices correspond with particularly low demand of reporting industries in both halves of the sample period. This is consistent with a world in which the demand shifts directly cause the price shifts. In another experiment we consider the possibility that the price shifts result instead from supply shifts.

6.1 Demand Shifts and Price Shifts

The growth and flux of the money market over the 20-year sample period make time-series comparisons difficult. Money market instruments have grown in volume and exchanged clienteles to such an extent that it is unreasonable to assume that the effect of a demand shift of a given magnitude is constant on prices throughout the period. To allow for this, we split the 20 years into two consecutive 10-year subperiods, and determine the relationship between the demand shifts summarized in Table 5 and the yield changes summarized in Table 2 for each instrument in both periods. The Windowdressing hypothesis predicts a negative relationship, as it would indicate that relatively low 12/31 demand corresponds to relatively high opportunity costs of moving the next dollar out of private-issue instruments.

The experiment is a collection of ordinary least squares regressions in which the independent variable is the estimated aggregate 12/31 demand shift, in billions of dollars, of the reporting industries. This is the sum of $\mathbf{OMP}_{i,y,4}\text{-}\mathbf{OMPEST}_{i,y,4}$ across money market mutual funds, mutual funds, life insurance companies, public pension funds, and private pension funds, which we shall call $\mathbf{REPORT}_{y,4}$. The dependent variables are yield changes across 12/31 calculated as for Table 2 (i.e. average in last week of year minus average in first week of next year), for every private-issue instrument for every available maturity. We fit the model in both the 1973-82 and 1983-92 subperiods, which gives us 22 regressions in all. The results are reported as Panels A and B of Table 7.

Every regression picks up the negative relationship between demand shifts and price shifts predicted by the model. Only a few indicate a statistically significant difference from zero, perhaps because of idiosyncratic variance in the yield figures induced by the change across trading days of the issuers included in the yield average. We can adjust for this by replacing the 11 time series of yield shifts with an index, $\mathbf{MMAVG}_y$ that averages across instruments, adjusting for maturity (i.e. dividing one-month shifts by 12, three-month shifts by four and six-month shifts by two). Fitting the same models, we get:

$$\mathbf{MMAVG}_y = \underset{(1.40)}{0.0394} - \underset{(-1.72)}{0.0146}\mathbf{REPORT}_y \quad y = 73\text{-}82 \quad R^2 = 26.99\%, \; N = 10$$

$$\mathbf{MMAVG}_y = \underset{(0.31)}{0.0097} - \underset{(-1.57)}{0.0035}\mathbf{REPORT}_y \quad y = 83\text{-}92 \quad R^2 = 23.65\%, \; N = 10$$

The regressions pick up a stronger relationship, especially in the first period. As a robustness check, we can combine the two subperiods, adjusting for the volume growth by dividing **REPORT** by the total concurrent volume outstanding of open-market paper as a measure of the impact of the demand shifts on the market, and then regress on the entire period. Letting $\mathbf{OMPOUT}_{y,4}$ be the total supply, we get:

$$\mathbf{MMAVG}_y = \underset{(1.33)}{0.0299} - \underset{(-1.78)}{1.3904}(\mathbf{REPORT}_y/\mathbf{OMPOUT}_y) \quad y=73\text{-}92 \qquad R^2=14.96 \quad N=20$$

This shows the predicted relationship, significantly negative at the 5% level.

6.2 Supply Shifts and Price Shifts

Before we leave this topic, we should consider explicitly whether the price movements are due to supply-side effects. One way to do this is to estimate seasonals in the total volume outstanding of all private-issue money market instruments and to compare them as above to the yield changes. We would be looking for abnormally large fourth-quarter levels and positive correlations between excess fourth-quarter volume and the yield changes. Table 8 reports the mean fourth-quarter seasonal of each category of private-issue instrument covered by FOF. The value for OMP is actually negative. This suggests that the supply curves of OMP issuers stay put, leading to an equilibrium at a lower quantity. The bank deposit seasonals, however, reveal expanded quantity in a time of lower prices. This does suggest supply-curve shifts that could be driving the price changes, but since the banks presumably invest the money back out, the net effect is an empirical question. To settle this, we let $\mathbf{SUPPLY}_{y,q}$ be the total volume outstanding of commercial paper, bankers' acceptances, large domestic deposits and foreign deposits, let $\mathbf{SUPLSHFT}_{y,4} = \mathbf{SUPPLY}_{y,4} - (\mathbf{SUPPLY}_{y,3} + \mathbf{SUPPLY}_{y+1,1})/2$, and run it through the 22 regressions from Table 7. The results, given as Table 9, do not support a connection between supply shifts and the price shifts, especially in the later period. If we replace the yield changes by **MMAVG** or divide **SUPLSHFT** by **SUPPLY**, we get essentially the same result:

$$\mathbf{MMAVG}_y = \underset{(2.47)}{0.0696} + \underset{(0.26)}{0.0009}\,\mathbf{SUPLSHFT}_y \quad y = 73\text{-}82 \qquad R^2 = 0.85\%,\ N = 10$$

$$\mathbf{MMAVG}_y = \underset{(0.31)}{0.0575} - \underset{(-0.97)}{0.0017}\,\mathbf{SUPLSHFT}_y \quad y = 83\text{-}92 \qquad R^2 = 10.44\%,\ N = 10$$

$$\mathbf{MMAVG}_y = \underset{(4.06)}{0.0662} \underset{(-1.06)}{-0.4479}(\mathbf{SUPLSHFT}_y/\mathbf{SUPPLY}_y) \quad y=73\text{-}92 \qquad R^2= 0.99,\ N = 20$$

All told, the time-series results support only the conclusion that the demand shifts of reporting industries induce the turn-of-the-year behavior of money market yields.

6.3 Onset of Windowdressing

Finally, we can deploy the Windowdressing model to explain the onset, visible in Figure 3, of turn-of-the-year forces in the Money Market. The answer lies in Figure 6, which plots the market share of reporting industries. Before the 1970s, money market mutual funds didn't exist, and the other reporting industries held very little of the OMP market. The impact of their demand shifts on prices reflects the growth of their market share. There may also have been some increase in the motive to windowdress due to the 1970 default of Penn Central commercial paper, which is often credited with alerting investors to the risks of CP investment.

6.4 Summary

The experiments of Tables 7 and 9 clarify our perception of the turn-of-the-year forces in the money market. Private-issue instruments sell at discounts on 12/31 because their customers with 12/31 disclosure events have temporarily lower demand. Depository institutions simultaneously use the money market to expand assets and liabilities, to no net effect.

7 Conclusion

This paper reconsidered explanations of price shifts across the turn of the year and found an effect of year-end reporting requirements on the prices of certain assets. We made empirical observations that together favor the hypothesis that financial intermediaries move the market when they tilt away from riskier asset classes in time for disclosure events. In daily observations of average money market yields we made the following observations:

1. Private-issue money market prices increase significantly over the same days in which small-stock prices increase significantly. Treasury bill prices do not.

2. The price shifts of private-issue money market instruments do not coincide with observable shifts on variables associated with money market spreads.

3. The price shifts of an instrument with no cross-sectional variation in liquidity vary with credit risk.

4. Price shifts of private-issue money market instruments and small stocks are highly correlated in January, but not in other months.

5. Both small-stock and private-issue money market price shifts are predicted accurately by the after-tax spread of commercial paper over Treasury bills.

The first two observations identify a pattern in the money market that, like the small-stock January Effect, suggests that an attribute of the year-end has an effect on security prices that is stronger for some than for others. The story in which year-end prices are distorted by tax loss selling cannot explain this pattern, since money market instruments do not generate capital losses or gains. The pattern is consistent with a story in which investors avoid relatively illiquid instruments that mature across a period of increased transactions, but observation 3 shows that at least some of the price shift is related to risk and not to liquidity.

Two scenarios connect the small-stock and private-issue money market patterns to the cross section of risk. In one, financial intermediaries that must report year-end portfolios avoid holding riskier assets at the moment of disclosure. In the other, the turn of the year is a period of higher risk that has by chance always resolved uneventfully. Observation 4 suggests that the two patterns share a common driving force, which would seem to support the higher-risk explanation since the windowdressing of intermediaries is not necessarily correlated across markets. However, observation 5 accounts for the correlation within the windowdressing paradigm with a simple cost/benefit interpretation. The commercial paper/Treasury bill spread moves with the marginal benefit of each dollar of windowdressing in both markets and so is naturally related to the marginal cost of the last dollars of windowdressing in both markets. We observe this as turn-of-the-year returns.

Versions of the higher-risk scenario can predict many observed patterns in prices but have no implications for the flow of funds between investor categories. The Windowdressing model predicts that investors with year-end disclosure events should be net sellers at year-end, whereas those without year-end disclosure events should be net buyers. We examined quarterly aggregate portfolios of investor categories and made the following observations:

6. Investor categories with concentrations of 12/31 reporting requirements have smaller positions for commercial paper + bankers' acceptances on 12/31 than earlier or later, whereas those without the requirements buy more at the lower prices.

7. Larger declines in commercial paper + bankers' acceptance investment by the reporting categories correspond to larger turn-of-the-year price shifts.

Observation 6 is direct evidence of the implications of the windowdressing scenario, and observation 7 connects the investment shifts to the price shifts. These results are unambiguous support for the windowdressing model and a challenge to models that analyze price changes as though they reflected the decisions of a single agent.

Appendix: DARP Database

DARPs are securities that push the envelope of equity design to impersonate commercial paper. At its initial placement, a DARP issuer pays a stated dividend, but every 49 days (give or take a market holiday) thereafter the dividend is reset by auction. Shareholders and interested investors submit dividend/quantity pairs that indicate the minimum dividend at which the quantity will be purchased, and shareholders have the additional option to bid 'hold at any dividend' or 'sell at any dividend.' The auction agent discards all bids with dividends outside of a prestated 'collar' around the 60-day AA CP rate (the upper limit usually increases as the credit rating decreases) and determines the dividend at which the demand ('hold' orders plus bids with lower or equal dividends) just equals the number of shares outstanding. The shares are exchanged accordingly at par, and all receive the market-clearing dividend over the holding-period to the next auction. If there is insufficient demand at the upper limit, the dividend is reset to the upper limit, and those who bid 'sell at any dividend' are left holding some of their positions. If all holders bid 'hold at any dividend,' the dividend is reset at the lower collar.

The force of this procedure is that, barring default or auction failure, investors purchase at par and receive a predetermined dividend on a predetermined date, when they can roll over or cash out at par. This is interchangeable with the experience of a CP investor, except that the return on CP can be the discount from par at which it is purchased. The total capitalization of DARPs reached a peak of about $14 billion in late 1988 and has since declined to about $7.5 billion.

The database for this study is a computer transcription of three DARPs rate histories published by Salomon Brothers. The first, dated July 1988, contains rate histories for all auctions of all 203 series issued by June 1988, including 23 series that had been recalled. The earliest DARP issues appeared in August 1984. The second and third volumes, dated June and December 1992, each contain complete histories for all series active at their respective press times, but no data for recalled issues. As a result, the database contains no data for the 18 series issued and recalled between 7/88 and 6/92, and incomplete data for the 134 series issued before 7/88 and recalled between 7/88 and 6/92. Other sources give the sequence of issuances, recalls, and rating changes over this period, but the dividends and auction dates are not available. Private placements are not included since they are not followed by the Salomon publications.

The resulting database contains the dividends set at 5,288 successful auctions. Every dividend is reported as both an annual percentage rate and a fraction of that day's 60-day AA CP rate. So if two or more auctions occur on the same day, one can search for errors by comparing the CP rates they imply. Most disagreements found this way pointed to correctable errors, but some could not be resolved and were flagged as missing. The ratings come from Standard and Poors Creditweek, and revisions are dated by the publication dates of the volumes in which they appear.

Aside from differential tax treatment, the major distinction between DARPs and CP is the exposure of DARPs to auction failure and omitted dividends. Over the years covered by the database there appear to have been six cases in which failed auctions followed successful auctions:

Series	**Date of Failure**	**Rating on prev. auc. date**
Goldome Florida	5/21/85	AAA
MCorp series B	6/23/87	BB-
MCorp series A	6/30/87	BB-
First Arkansas	2/3/88	AAA
Tucson Elec Pwr	9/29/88	BBB-
Nevada Elec Pwr	9/27/91	BBB-

In addition, some Citicorp series would likely have failed in late 1990 had their upper collar not been waived. The Goldome Florida and First Arkansas investors got out at par plus dividends at the following auctions, whereas the investors in the other series had default-like experiences, especially the MCorp investors who have not received dividends in seven years and are still in court.

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Table 2
Summaries of Yield Changes Across the End of the Year
Calculated over 7/73 - 6/93, in basis points

Instr	spread	Δ(yld)	#pos(yld)	t(yld)	#pos(spr)	t(spr)
Panel A: One-Month Maturity						
CP	122.21	41.35	18/20	3.92		
CD	128.81	38.72	16/20	3.48		
ED	160.43	33.37	19/20	3.98		
Panel B: Three-Month Maturity						
CP	78.73	26.05	17/20	3.92	20/20	5.10
BA	70.35	21.55	17/19	3.85	18/19	4.16
CD	95.24	20.29	17/20	3.22	19/20	4.26
ED	135.90	30.13	20/20	3.37	19/20	3.35
TB		-0.55	9/20	-0.19		
Panel C: Six-Month Maturity						
CP	59.38	17.60	15/20	3.80	19/20	5.32
BA	46.96	10.67	14/17	3.25	17/17	5.14
CD	94.40	12.06	16/20	2.93	17/20	4.20
ED	138.92	26.34	18/20	3.72	18/20	3.61
TB		1.31	12/20	0.51		

spread is the average spread of the instrument over Treasury Bills of the same maturity. Average of daily observations for three- and six-month maturities, monthly observations for one-month maturity. **Δ(yld)** is the mean yield over 12/25-12/31 minus the mean yield over 1/1-1/7, averaged across the twenty year-ends. **#pos(yld)** is the number of times the mean yield over 12/25-12/31 exceeds the mean yield over 1/1-1/7 (there are 19 observations for 3-month BAs, 17 observations for 6-month BAs). **t(yld)** is the t-statistic for difference from zero for Δ(yld). **#pos(spr)** is the number of times the mean spread over 12/25-12/31 exceeds the mean spread over 1/1-1/7. **t(spr)** is the t-statistic for difference from zero for the spread change from 12/25-12/31 to 1/1-1/7.

Table 3

Regressions of January Price Changes on December Spreads

Panel A

Model is $Y_y = b_0 + b_1(0.9CP6_{y-1} - TB6_{y-1}) + e_y$

Dependent variable is January Return of DEC1:

period	b_0	b_1	R^2	N
1973-92	0.1535	0.2387	59.23%	20
	(7.10)	(5.11)		
1973-82	0.1747	0.2716	74.93%	10
	(5.70)	(4.89)		
1983-92	0.1122	0.1135	17.21%	10
	(3.60)	(1.29)		
1958-72	0.0790	0.1236	39.70%	15
	(5.58)	(2.93)		
1958-92	0.1195	0.1951	46.80%	35
	(7.99)	(5.39)		

Dependent variable is return of DEC1 in first four trading days:

period	b_0	b_1	R^2	N
1973-92	0.0975	0.1108	68.07%	20
	(11.78)	(6.19)		
1973-82	0.0996	0.1251	78.28%	10
	(7.75)	(5.37)		
1983-92	0.0881	0.0634	34.30%	10
	(8.03)	(2.04)		
1962-72	0.0775	0.0927	60.40%	11
	(9.27)	(3.70)		
1972-92	0.0902	0.1047	63.82%	31
	(14.60)	(7.15)		

Dependent variable is change in CP6 over January:

period	b_0	b_1	R^2	N
1973-92	-0.3927	-1.1340	70.69%	20
	(-4.93)	(-6.59)		
1973-82	-0.4352	-1.3914	85.41%	10
	(-3.88)	(-6.84)		
1983-92	-0.2155	-0.2767	22.81%	10
	(-3.39)	(-1.54)		
1958-72	-0.1678	-0.6287	47.34%	15
	(-2.72)	(-3.42)		
1958-92	-0.2888	-0.9570	60.27%	35
	(-5.17)	(-7.08)		

Dependent variable is change in CP6 in first week of year:

period	b_0	b_1	R^2	N
1973-92	-0.2204	-0.3130	49.33%	20
	(-6.36)	(-4.19)		
1973-82	-0.2307	-0.3060	49.81%	10
	(-3.85)	(-2.82)		
1983-92	-0.2115	-0.3250	46.28%	10
	(-4.83)	(-2.63)		
1958-72	-0.0016	-0.0134	1.02%	15
	(-0.10)	(-0.37)		
1958-92	-0.1238	-0.2202	25.08%	35
	(-4.52)	(-3.32)		

Panel B

Model is $Y_y = b_0 + b_1(CP6_{y-1} - TB6_{y-1}) + b_2 CP6_{y-1} + e_y$

Dependent variable is return of NYSE DEC1 in January:

period	b_0	b_1	b_2	R^2	N
1973-92	0.1219	0.1088	-0.0139	70.06%	20
	(5.01)	(6.08)	(-4.39)		
1973-82	0.1469	0.1227	-0.0173	82.47%	10
	(3.80)	(5.47)	(-4.00)		
1983-92	0.1071	0.0564	-0.0085	36.45%	10
	(2.63)	(1.58)	(-1.54)		
1962-72	0.0542	0.0898	-0.0047	62.88%	11
	(1.64)	(3.45)	(-0.69)		
1962-92	0.0908	0.1046	-0.0105	63.82%	31
	(5.41)	(6.99)	(-4.19)		

Dependent variable is return of DEC1 in first four trading days:

period	b_0	b_1	b_2	R^2	N
1973-92	0.1219	0.1088	-0.0139	70.06%	20
	(5.01)	(6.08)	(-4.39)		
1973-82	0.1469	0.1227	-0.0173	82.47%	10
	(3.80)	(5.47)	(-4.00)		
1983-92	0.1071	0.0564	-0.0085	36.45%	10
	(2.63)	(1.58)	(-1.54)		
1962-72	0.0542	0.0898	-0.0047	62.88%	11
	(1.64)	(3.45)	(-0.69)		
1962-92	0.0908	0.1046	-0.0105	63.82%	31
	(5.41)	(6.99)	(-4.19)		

Dependent variable is change in CP6 over January:

period	b_0	b_1	b_2	R^2	N
1973-92	-0.4207	-1.1317	0.1166	70.72%	20
	(-1.74)	(-6.36)	(3.72)		
1973-82	-0.6955	-1.3784	0.1654	86.53%	10
	(-1.93)	(-6.58)	(4.10)		
1983-92	-0.1685	-0.2941	0.0223	23.27%	10
	(-0.70)	(-1.40)	(0.69)		
1958-72	0.0404	-0.6406	0.0217	51.74%	15
	(0.19)	(-3.49)	(0.50)		
1958-92	-0.1494	-0.9780	0.0771	61.70%	35
	(-1.07)	(-7.18)	(3.56)		

Dependent variable is change in CP6 in first week of year:

period	b_0	b_1	b_2	R^2	N
1973-92	-0.1153	-0.3214	0.0193	52.70%	20
	(-1.14)	(-4.30)	(1.47)		
1973-82	-0.0773	-0.3136	0.0151	54.49%	10
	(-0.41)	(-2.83)	(0.71)		
1983-92	-0.1656	-0.3421	0.0273	46.92%	10
	(-1.01)	(-2.38)	(1.23)		
1958-72	-0.0818	-0.0913	0.0244	43.28%	15
	(-1.85)	(-2.34)	(2.64)		
1958-92	0.0404	-0.2449	0.0001	40.67%	35
	(0.65)	(-4.05)	(0.01)		

Table 4

Open-Market Paper Investor Category Positions, in $billion

Industry	9/30/53	9/30/63	9/30/73	9/30/83	9/30/93
Residual	1.51	5.13	5.08	34.00	142.08
Nonfinancial Corp	0.21	0.45	13.63	42.26	55.72
Foreign	0.36	1.57	5.26	6.96	19.34
Govt Spons Enterprise	0.00	0.00	0.09	0.52	13.36
Monetary Authority	0.00	0.02	0.06	0.00	0.00
Commercial Banks	0.50	1.95	4.70	14.62	6.47
Savings & Loans	0.00	0.00	0.00	5.85	0.22
Credit Unions	0.00	0.00	0.00	0.00	2.39
Life Insurance	0.00	0.62	4.10	21.76	24.17
Private Pension Funds	0.00	0.00	2.68	17.00	19.43
Public Pension Funds	0.00	0.00	0.00	0.00	30.02
Mutual Funds	0.00	0.20	3.16	4.20	52.47
Money-Market MF	0.00	0.00	0.00	68.79	166.96
Brokers & Dealers	0.00	0.00	1.75	10.21	15.00
Bank Personal Trust	0.00	0.00	5.38	16.23	20.17
Total Supply of OMP	2.58	9.92	45.89	242.38	567.79

Table 5

Summary Statistics for Estimated 12/31 Demand Shifts

	OMP-OMPEST			**OMPPER-OMPPEREST**		
Industry	**mean**	**t(mean)**	**#pos**	**mean**	**t(mean)**	**#pos**
Residual	2.868	1.38	13/20	0.050	0.81	13/20
Nonfinancial Corp	0.864	3.86	16/20	-0.358	-3.65	6/20
Foreign	-0.167	-1.25	7/20	-0.063	-3.42	4/20
Govt Spons Enterp	0.444	2.02	12/20	0.082	1.76	11/20
Monetary Auth	0.143	2.81	4/ 4	0.024	1.83	4/ 4
Commercial Banks	0.932	3.65	17/20	0.052	2.51	16/20
Savings & Loans	0.163	0.74	10/18	0.007	0.53	11/18
Credit Unions	0.015	0.13	5/ 9	0.008	0.33	5/ 9
Life Insurance	-1.965	-4.53	1/20	-0.307	-6.01	1/20
Private Pens Fund	-0.576	-1.83	6/20	-0.022	-0.88	7/20
Public Pens Funds	-0.374	-0.95	2/ 6	-0.084	-0.95	1/ 6
Mutual Funds	-1.528	-2.45	5/20	-0.277	-1.33	6/20
Money-Market MF	-2.792	-3.02	3/19	-0.763	-1.33	8/19
Brokers & Dealers	1.092	2.38	15/20	1.147	1.94	11/20
Bank Pers Trust	-0.001	-0.02	9/20	0.008	0.44	10/20

For each industry in each year, we calculate the average investment in Bankers Acceptances and Commercial Paper on 9/30 of a year and 3/31 of the next (**OMPEST**), and subract this figure from the investment on 12/31 (**OMP**). The columns on the left report the mean, t-statistic for difference from zero for the mean, and the number of times positive out of total number of observations for **OMP-OMPEST.** We also calculate the average allocation to Bankers Acceptances and Commercial Paper of each industry on 9/30 and 3/31 (**OMPPEREST**), subtract this figure from the allocation on 12/31 (**OMPPER**), and calculate the same summary statistics for **OMPPER-OMPPEREST.**

Table 6

Seasonals in Investments of Life Insurance Companies

Investment	level - E(level) mean	level - E(level) t(mean)	weight - E(weight) mean	weight - E(weight) t(mean)
Total	-2.482	-1.54		
Check. dep. & curr	0.878	6.25	0.168	6.52
MMF shares	0.023	0.29	0.007	0.87
Mutual Fund Shares	0.025	0.14	0.005	0.24
Corp. Equities	-1.174	-1.00	-0.096	-0.79
Treasury	-0.079	-0.24	0.014	0.41
Agency	0.107	0.40	0.025	1.00
Tax-exempt	0.036	0.48	0.014	1.61
Corp. & Frgn Bonds	-1.046	-1.96	-0.036	-0.51
Mortgages	0.618	2.14	0.152	3.23
OMP	-1.965	-4.53	-0.307	-6.01
Policy Loans	-0.117	-1.01	-0.002	-0.14
Misc. Assets	0.228	0.89	0.046	2.16

The columns on the left are the mean and associated t-statistic of the difference between the 12/31 investment level and the average investment levels on the preceding 9/30 and the following 3/31. The columns on the right are the mean and t-stat of the difference between the fraction of the total assets of the Life Insurance industry allocated to that investment and the average fraction on 9/30 and 3/31.

Table 7
Regressions of Spread Changes on Demand Shifts
T-statistics underneath coefficients, R^2 in percent
Model is $Y_y = \mathbf{b}_0 + \mathbf{b}_1 REPORT_y + e_y$

Panel A: 1973-82

	One Month			Three Months			Six Months		
	$\mathbf{b}_0$	$\mathbf{b}_1$	$\mathbf{R}^2$	$\mathbf{b}_0$	$\mathbf{b}_1$	$\mathbf{R}^2$	$\mathbf{b}_0$	$\mathbf{b}_1$	$\mathbf{R}^2$
CP	0.138	-0.051	18.30	0.079	-0.076	29.14	0.136	-0.028	7.28
	(1.09)	(-1.34)		(0.57)	(-1.81)		(1.18)	(-0.79)	
BA				0.037	-0.074	44.45	-0.045	-0.047	69.01
				(0.35)	(-2.37)		(-0.81)	(-3.34)	
CD	0.057	-0.064	22.22	0.036	-0.073	27.12	0.062	-0.034	15.60
	(0.40)	(-1.51)		(0.26)	(-1.73)		(0.67)	(-1.22)	
ED	0.179	-0.038	7.27	0.360	-0.037	3.33	0.256	-0.078	30.59
	(1.13)	(-0.79)		(1.56)	(-0.52)		(1.87)	(1.88)	

Panel B: 1983-92

	One Month			Three Months			Six Months		
	$\mathbf{b}_0$	$\mathbf{b}_1$	$\mathbf{R}^2$	$\mathbf{b}_0$	$\mathbf{b}_1$	$\mathbf{R}^2$	$\mathbf{b}_0$	$\mathbf{b}_1$	$\mathbf{R}^2$
CP	0.216	-0.031	15.12	0.070	-0.017	22.80	0.011	-0.013	32.42
	(0.63)	(-1.19)		(0.48)	(-1.54)		(0.13)	(-1.96)	
BA				0.077	-0.012	17.16	0.021	-0.008	22.85
				(0.62)	(-1.29)		(0.29)	(-1.54)	
CD	0.273	-0.026	10.08	0.053	-0.013	17.77	-0.028	-0.011	26.47
	(0.77)	(-0.95)		(0.42)	(-1.31)		(-0.32)	(-1.70)	
ED	0.181	-0.019	11.41	0.035	-0.011	15.10	-0.022	-0.010	29.33
	(0.73)	(-1.02)		(0.30)	(-1.19)		(-0.32)	(-1.82)	

In each regression, the dependent variable is the average yield over 12/25-12/31 minus the average yield over 1/1-1/7 of the indicated instrument with the indicated maturity. The independent variable is the total investment in Bankers Acceptances and Commercial Paper of the Reporting Industries on the same 12/31, minus their average total investment on the preceding 9/30 and following 3/31. All regressions are on ten observations, except three-month and six-month BAs in Panel A, which are on nine and seven observations, repsectively.

Table 8

Seasonal Change is Volume Outstanding, in $billion

Instrument	mean	t(mean)	#pos
Open-Market Paper	-0.8085	-0.97	7/20
Large Domestic Deposits	2.6705	1.57	15/20
Foreign Deposits	2.5323	2.38	13/20
TOTAL	4.3943	2.21	14/20

The mean seasonal for each category is the volume outstanding on 12/31 minus the average of the volume on the previous 9/30 and the followng 3/31, averaged across 1973 to 1992.

Table 9

Regressions of Yield Changes on Money-Market Volume Seasonal

Model is $Y_y = \mathbf{b}_0 + \mathbf{b}_1 SUPPLY_y + e_y$

T-statistics underneath coefficients

Panel A: 1973-82

	One Month			**Three Months**			**Six Months**		
	$\mathbf{b}_0$	$\mathbf{b}_1$	R^2	$\mathbf{b}_0$	$\mathbf{b}_1$	R^2	$\mathbf{b}_0$	$\mathbf{b}_1$	R^2
CP	0.223	0.007	3.25	0.217	0.008	2.97	0.168	0.007	3.69
	(1.88)	(0.52)		(1.56)	(0.50)		(1.66)	(0.55)	
BA				0.146	0.012	8.79	0.009	0.014	49.17
				(1.12)	(0.82)		(0.15)	(2.20)	
CD	0.149	0.012	6.95	0.181	0.140	1.30	0.100	0.009	8.87
	(1.12)	(0.77)		(1.30)	(0.33)		(1.20)	(0.88)	
ED	0.308	-0.008	2.53	0.555	-0.023	10.26	0.454	-0.003	0.34
	(2.18)	(-0.46)		(2.90)	(-0.96)		(3.21)	(-0.17)	

Panel B: 1983-92

	One Month			**Three Months**			**Six Months**		
	$\mathbf{b}_0$	$\mathbf{b}_1$	R^2	$\mathbf{b}_0$	$\mathbf{b}_1$	R^2	$\mathbf{b}_0$	$\mathbf{b}_1$	R^2
CP	0.659	-0.023	19.12	0.298	-0.009	14.02	0.168	-0.004	8.89
	(3.65)	(-1.38)		(3.58)	(-1.14)		(3.22)	(-0.88)	
BA				0.237	-0.006	8.97	0.127	-0.003	6.29
				(3.39)	(-0.89)		(2.99)	(-0.73)	
CD	0.640	-0.019	12.89	0.221	-0.006	8.79	0.115	-0.005	9.83
	(3.38)	(-1.09)		(3.05)	(-0.88)		(2.25)	(-0.93)	
ED	0.456	-0.015	15.57	0.172	-0.004	5.04	0.097	-0.003	5.05
	(3.50)	(-1.21)		(2.57)	(-0.65)		(2.24)	(-0.65)	

In each regression, the dependent variable is the average yield over 12/25-12/31 minus the average yield over 1/1-1/7 of the indicated instrument with the indicated maturity. The independent variable is the total volume outstanding of Bankers Acceptances, Commercial Paper, Large Domestic Deposits and Foreign Deposits on the same 12/31, minus their average total volume on the preceding 9/30 and following 3/31. All regressions are on ten observations, except three-month and six-month BAs in Panel A, which are on nine and seven observations, repsectively.

Figure 1

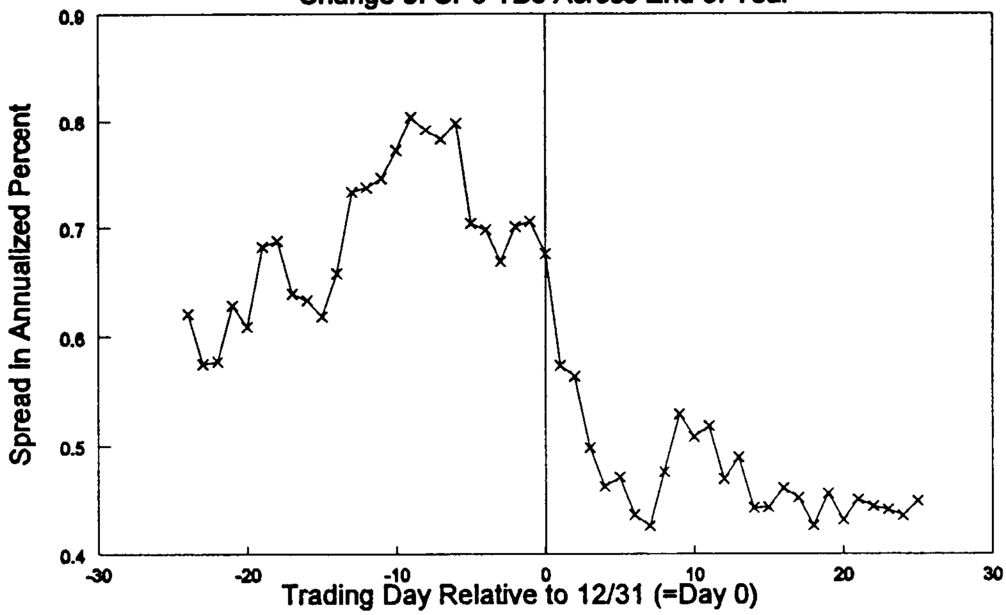

Figure 2A

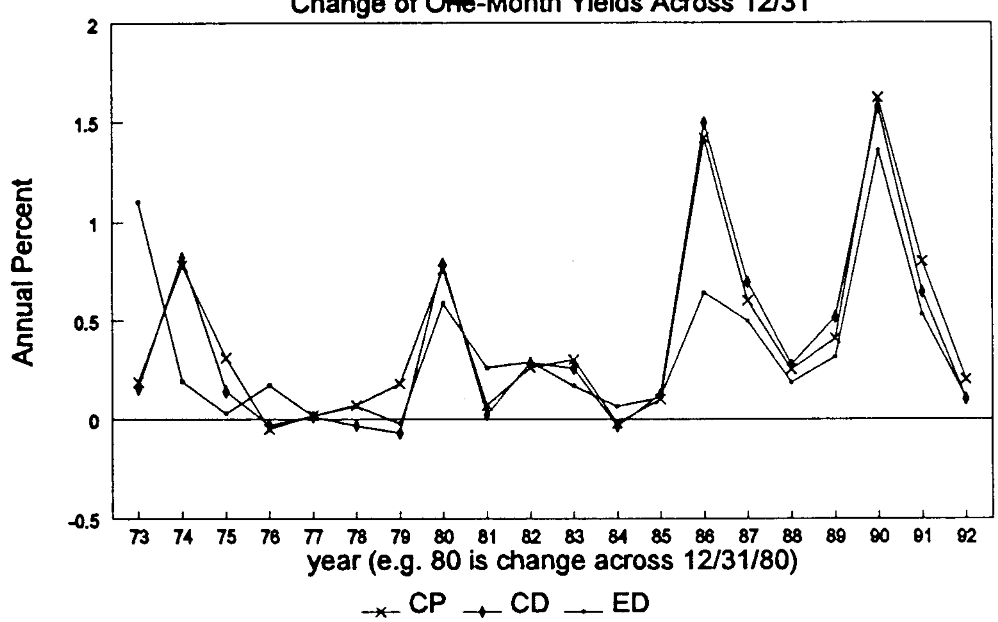

Figure 2B

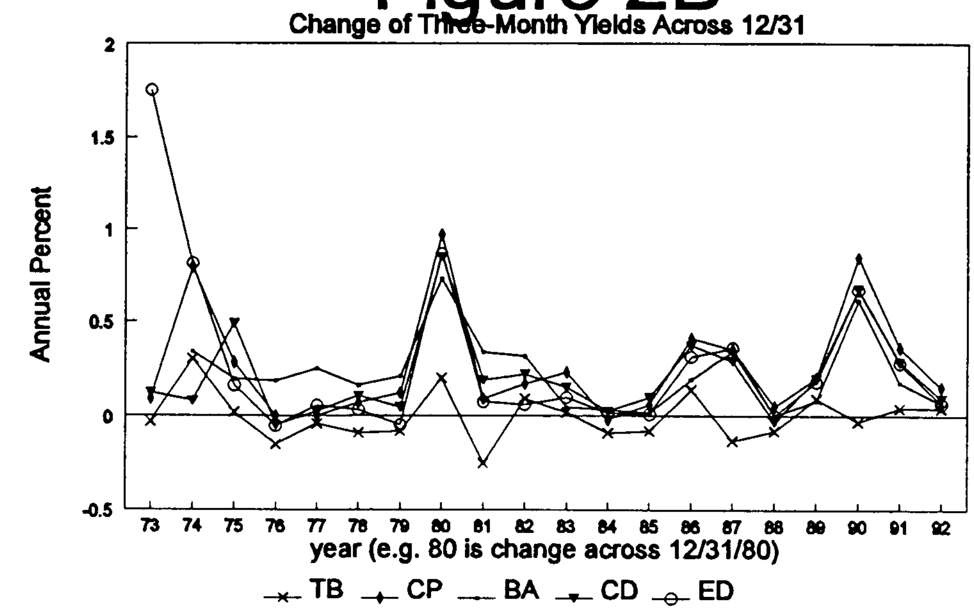

Figure 2C

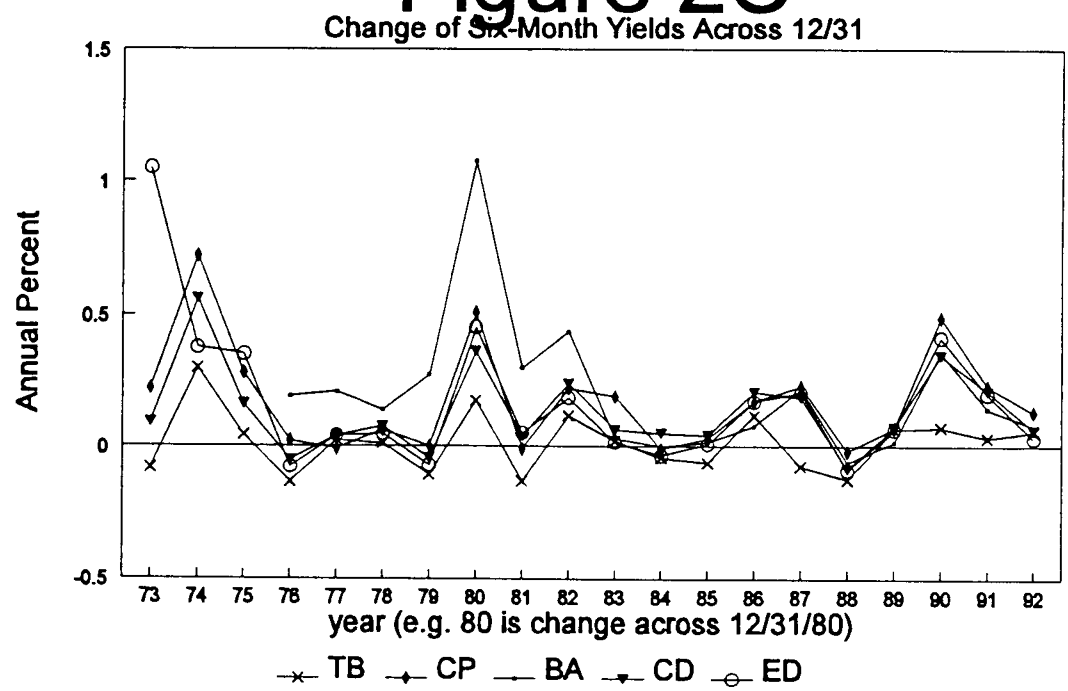

Figure 3

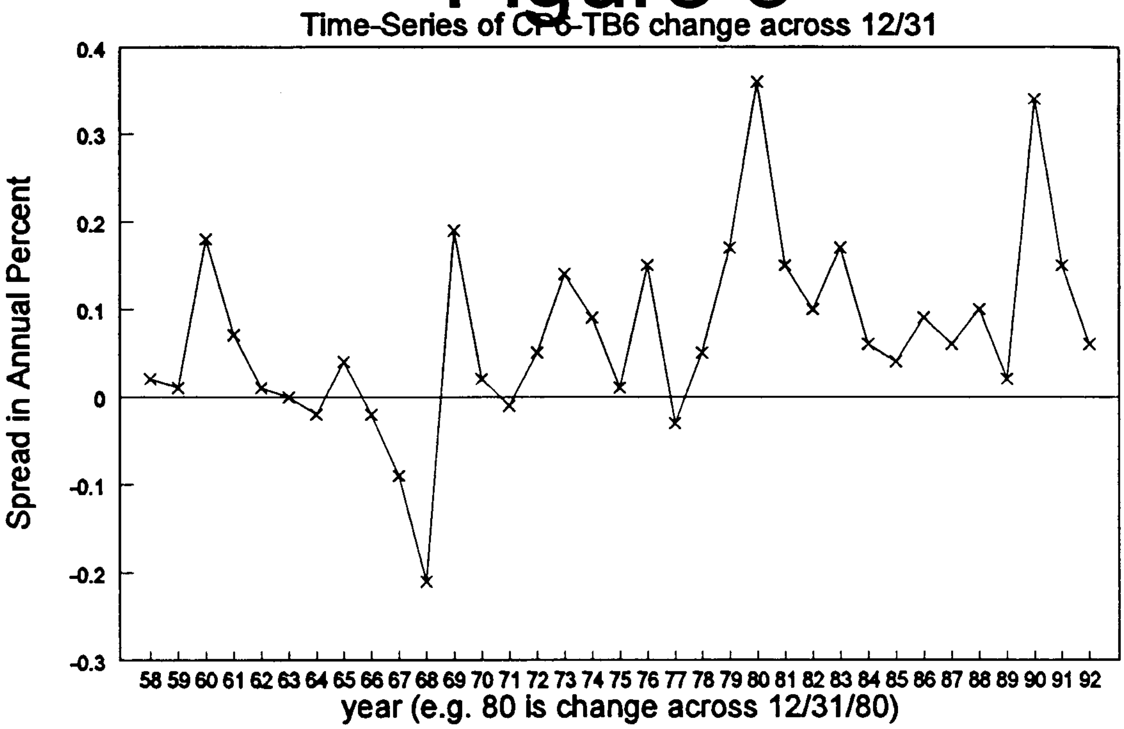

Figure 4

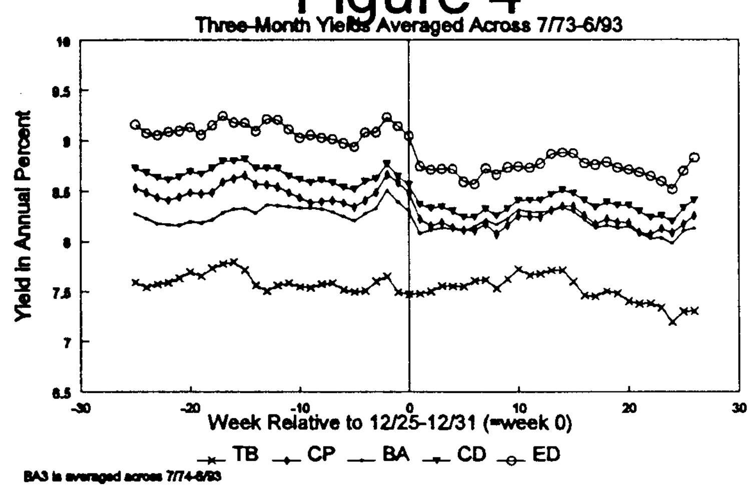

Figure 5

Time-Series of CP6-TB6 before and after 10% tax on CP6

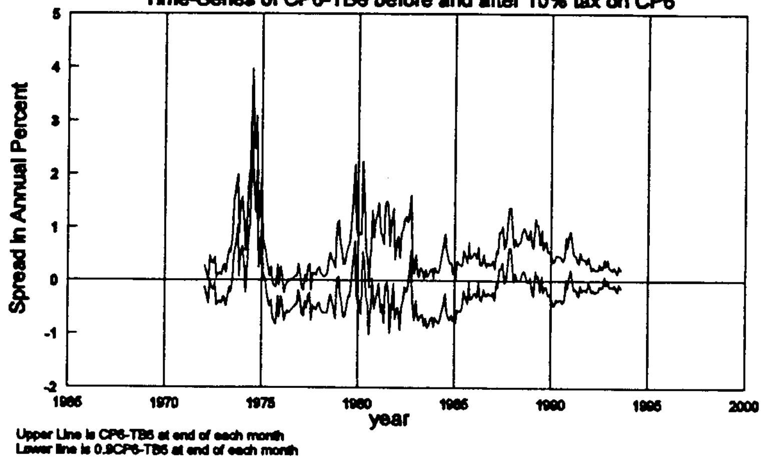

Figure 6

Fraction of CP+BA Held by Reporting Industries