On The Incidence of Deposit Taxes

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Introduction

In the United States, commercial banks are legally required to hold a portion of their assets as reserves against certain deposit liabilities, either as vault cash or as deposits at Federal Reserve banks. Since required reserves bear no interest for the banks and play no essential role in monetary policy, they function only as a tax on deposits. The size of this tax is the amount of reserves held involuntarily--the difference (if positive) between required reserves and the amount of reserves that would be held voluntarily by a wealth-maximizing bank. The annual cost of involuntarily held reserves is the interest income that could be earned on them. The deposit tax is the present value of this perpetual annual cost discounted at the earning rate, so it equals the amount of involuntarily held reserves.

The deposit tax can be avoided by creating financial instruments exempt from reserve requirements, but avoidance is costly and therefore not likely to be complete. Circumstantial evidence for incomplete avoidance is the near absence of "excess" reserves in the United States during the past fifty years, which suggests the requirements have been binding. Somebody, therefore, is bearing deposit taxes. The main candidates are bank depositors, through reduced deposit rates or increased service charges; bank borrowers, through enhanced loan rates; and bank shareholders, through reductions in share values when the taxes are unexpectedly imposed or increased. Similarly, somebody must benefit when deposit taxes are reduced: deposit rates rise or service charges fall, loan rates fall, or shareholders receive positive abnormal returns. All three things might happen, and there are more general public benefits insofar as a tax reduction lessens the incentive to create financial instruments whose only purpose is to avoid the tax.

The incidence of deposit taxes has been connected to interesting questions in the theory of financial intermediation. Fama (1985) and James (1987) found evidence that holders of negotiable certificates of deposits do not bear the tax, from which they concluded that the tax is borne by bank borrowers and that; therefore, bank loans are "unique." Fama and James and others have presented cogent arguments that the extension of credit by banks conveys favorable information about the borrowers' prospects. Insofar as credit from other sources does not convey such information, bank loans are indeed unique. It does not follow that bank borrowers can be induced to bear the entire deposit tax in return for the dissemination of this information. On the other hand, it would be very strange if the borrowers did not bear some of the tax. An increase in required-reserve ratios on time deposits raises banks' funding costs; an increase in such ratios on demand deposits increases a lending bank's required reserves on the

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deposits thus created; either effect will shift the loan-supply curve to the left, *ceteris paribus,* thus raising loan rates. The share of deposit taxes borne by borrowers is an open question; based on research findings to date, this share is unlikely to be 100%.

Studies by Kolari, Mahajan, and Saunders (1988), Slovin, Sushka, and Bendeck (1990), and Osborne and Zaher (1992) indicate that bank shareholders bear at least some deposit taxes. Specifically, Osborne and Zaher found that bank share prices react to announced changes in required-reserve ratios, experiencing abnormal returns in the opposite direction to the tax change. This experience is not consistent with the hypothesis that bank borrowers bear all deposit taxes.

An interesting discovery in the Osborne-Zaher study is that abnormal returns to bank stocks were larger following changes in time-deposit taxes than following changes in demand-deposit taxes, even when the former change is smaller than the latter. This behavior suggests the hypothesis that shareholders bear a larger part of a given-sized tax on time deposits than on demand deposits. This hypothesis could not be tested in that study because it was discovered after all the data were used. It is a plausible hypothesis because (a) time deposits have near-perfect substitutes that are exempt from reserve requirements, so that any decrease in time-deposit rates consequent upon a tax increase would drive investors to the substitute instruments, and (b) demand deposits provide liquidity and transaction services for which substitutes are few, so that they have relatively inelastic demands (Flannery and James, 1984).

Specifically, the hypothesis suggested by previous research is that AR(TD)/AR(DD) is significantly greater than $\Delta t(TD)/\Delta t(DD)$, where AR denotes abnormal return to bank shareholders, TD denotes time deposits, DD denotes demand deposits, Δt is a change in the deposit tax, and the sign of AR is opposite to the sign of Δt. This "Differential Effects," or D-E hypothesis, is meaningful only if at least one of the abnormal returns is statistically different from zero.

After completion of the studies cited above, the Federal Reserve presented an ideal experiment with which to test the D-E hypothesis. On December 4, 1990, the Fed abolished the 3 percent reserve requirement on large time deposits (those exceeding $100,000) with initial maturities less than eighteen months, and on February 18, 1992, it reduced the reserve requirement on demand deposits from 12 percent to 10 percent. (To date, there have been no further changes in reserve-requirement ratios.) As explained below, these tax reductions were approximately the same size. On the D-E hypothesis, bank shareholders were bearing a larger part of the tax that was reduced in the TD-event than of the tax that was reduced in the DD-event. Therefore, the shareholders should have enjoyed a much larger positive abnormal return after the first event than after the second. We will see that this is actually what happened.

Data and Analysis

Table 1 summarizes the two events constituting the experiment. As shown in the table, the Fed estimated the tax reduction to be $11.7 billion in the TD-

event and $8 billion in the DD-event, implying a value of 1.46. For $\Delta t(TD)/\Delta t(DD)$. But these estimates are for the whole banking system, while our sample contains only the sixty-four large banks for which data are available on the CRSP (NYSE-AMEX) Daily Tape and the Compustat Tape. The abnormal returns we compute for these large banks are unlikely to represent abnormal returns for all banks. The great majority of banks are small, with liability structures markedly different from those of our sample banks. In particular, the small banks have a much higher ratio of time to demand deposits; for them, the ratio of tax reductions, $\Delta t(TD)/\Delta t(DD)$, is much higher than for the sample banks, so the abnormal-return ratios of the small banks are unlikely to be well-estimated by the abnormal-return ratios of the sample banks. The banks in our sample are better represented by the "Large Weekly Reporting Banks," where the ratio of demand to large time deposits is much higher than in the whole system. We believe that the abnormal-return ratios computed from our sample are unbiased estimates of the abnormal-return ratios experienced by the set of weekly-reporting banks, but a poor estimate of abnormal-return ratios for all banks. Therefore, instead of comparing our computed abnormal-return ratios to the tax-cut ratio estimated by the Fed for the banking system, we prefer comparisons for the weekly reporters. For completeness, however, we report both sets of comparisons while emphasizing those for the weekly reporters.

On December 5, 1990 (one day after the TD event), the weekly reporters had $205.5 billion of large CDs (see the *Federal Reserve Bulletin*, March 1991, p. A19). Not all these CDs had original maturities of less than 18months; but if they had, the freed reserves would have been roughly[2] 3 percent of this figure, or $6.165 billion.

On February 19, 1992 (one day after the DD event), the weekly reporters had $351.9 billion of demand and other transaction deposits (see the *Federal Reserve Bulletin*, April 1992, p. A21). On that day, each bank's first $42 million of such deposits faced required reserves of 3% and so were not affected by the reserve-requirement reduction. The deposits affected by the reduction equaled D_a = $[351.9 - .042N] billions, where N was the number of weekly reporting banks. The DD event reduced reserve requirements against these deposits by two percent, thus freeing

$$.02D_a = .02[351.9 - .042N]$$
$$= \$7.038 - .00084N$$

Billion in reserves. We have not been able to learn the value of N in February 1992; until we do, we will assume that N is such that the ratio, of reserves freed by the TD event to reserves freed by the DD event, is at most 1. This implies a value of N no larger than 1,039, which is very plausible. Thus we believe $6.165 billion to be a lower bound on the reserves freed by the DD event, and therefore, that the ratio of freed reserves is at most 1.

We also have to consider whether or not any of the freed reserves had been held voluntarily. The two extreme possibilities are: (1) none of the newly freed reserves had been held voluntarily so that their ratio is an upper bound on Δt

[2] Not exactly, because it is undoubtedly optimal to keep some reserve against large CDs nearing maturity even if not required to do so.

(TD)/ Δt (DD), and (2) all of the freed reserves had been held voluntarily so the actual tax cuts were zero. The Appendix presents data helpful for this consideration and an analysis that concludes the following: The evidence is strong that none of the newly freed reserves against demand deposits had been held voluntarily, while it is far from clear that the same is true of the newly freed reserves against time deposits.

Therefore, we may take the ratio of newly freed time-deposit reserves to newly freed demand-deposit reserves as an upper bound to the ratio, Δt (TD)/Δt (DD), of tax reductions. Thus for the weekly reporters, Δt (TD)/ Δt (DD) is at most 1. This ratio may reasonably be applied to our sample banks because they have similar liability structures.

In order to estimate the abnormal returns for the weekly reporters, we compute abnormal returns for the sample banks, which require estimation of normal returns. We used the market model to obtain normal-return estimates, which requires filtering the sample (64 banks) to eliminate banks that experienced unusual developments that would contaminate estimates of their normal returns. For each event, the initial sample of 64 banks was purged by eliminating all banks that (a) were targets for mergers or acquisitions, or submitted multiple bids for other banks (if the sum of such bids exceeded one-third of the bidder's assets); or (b) announced major recapitalizations or bankruptcies during the year of the event; or (c) announced new issues, dividends, earnings, redemptions, or repurchases of securities within one week of the event. This purge reduced the sample to 26 banks for the TD event and 29 for the DD event.

As in Osborne and Zaher (1992) we constructed a portfolio of the sample banks in each event and estimated a market model for each portfolio, where the "market" is the CRSP equally-weighted market portfolio (see Table 2). The estimation period spans the 80 business days from day -85 to day -6 relative to the announcement date, which is day 0. As a check for alterations in the risk structure possibly caused by changes in reserve requirements, we also estimated a market model for a post-event period (days 6 through 85). A Chow test for equality of the betas in the pre-and post-event estimation periods indicates no change; the F (2,176) statistic is 2.01 for event 1 and 1.93 for event 2, while the 5% critical value is 3.00.

Next, we computed daily abnormal returns for each of the eleven days in the event period, and cumulative abnormal returns for three sub periods [(day -5, day -1), (day 0, day 1), and (day 2, day 5)] and the whole event period (day -5, day 5). The results are shown in Tables 3 and 4. We tested the statistical significance of daily abnormal returns with the Dann and James (1982) T statistic and the cumulative abnormal returns with the Dodd and Warner (1983) Z statistic.[3]

Empirical Results

The results in Table 3 indicate that the daily abnormal returns are insignificant on day 0 for both events; this is as expected, because the

[3] For more details on the T and Z statistics see Dann and James (1982), Dodd and Warner 1983), and Osborne and Zaher (1992).

announcements came after the markets closed. But abnormal returns are larger and statistically significant on day 1, being 3.84% for the TD event and 0.76% for the DD event. On the remaining days in the event period, the daily abnormal returns are mostly positive but statistically insignificant. On each day from 0 to 5, abnormal return is larger in the TD event than in the DD event.

From Table 4, we see that the cumulative abnormal returns for the TD event are statistically significant in the periods (0 to 1), (2 to 5) and (-5 to 5) but insignificant in the period (-5 to -1). For the DD event the cumulative abnormal returns are insignificant in all periods.

The significant abnormal returns on day 1 indicate that the reductions in reserve requirements benefited bank shareholders relative to holders of the market portfolio. The interpretation is that holders of bank shares at the time reserve requirements were imposed or increased had experienced a loss of wealth because the deposit tax could not be completely shifted to other parties, so that other parties did not receive all the benefits when the tax was decreased. The benefits realized by bank shareholders were largely windfalls, of course, if the holders acquired their shares after the most recent tax increase.[4] But the point is that the statistically significant abnormal returns on day 1 support the hypothesis that bank shareholders bear at least part of the deposit tax. These results agree with those of Kolari, *et al.* (1988), Slovin, *et al.* (1990), and Osborne and Zaher (1992).

Table 5 summarizes our findings of particular interest to the D-E hypothesis, that bank shareholders bear a larger part of the tax on time deposits than on demand deposits. According to the D-E hypothesis, the ratio (RAR) of day-1 abnormal returns is larger than the ratio (RTR) of the tax reductions. Using alternately the Fed's estimates of the tax reductions (ΔT_F, shown in Table 5) to produce the ratio RTR_F, and the estimated tax reductions for the weekly-reporting banks (ΔT_W, also shown in the table) to produce RTR_W, we find:

$$RAR = AR(TD) / AR(DD) = .0384/.0076 = 5.05,$$
$$RTR_F = [\Delta t(TD) / \Delta t(DD)]_F = 1.46,$$
$$RTR_W = [\Delta t(TD) / \Delta t(DD)]_W = 1.00,$$

Clearly, RAR is much greater than RTR_F (3.5 times) or RTR_W (5 times). As explained above, the estimate RTR_W of the relative tax reductions is the more reasonable of the two, so, in strong agreement with the D-E hypothesis, the ratio of abnormal returns is more than 5 times the ratio of tax reductions.

Since RAR is the ratio of two point estimates of abnormal returns (i.e. it has no distribution), we cannot assign statistical significance to the difference between its size and the size of RTR_F or RTR_W. In view of the approximate equality between the sizes of the two tax reductions, however, it is appropriate to test the implication of the D-E hypothesis that abnormal returns are greater for the TD event than for the DD event over the event period. In particular, we compute the daily differences, d(AR), in abnormal returns between the TD and DD events for each of the 11 days in the event period (shown in the last column of Table 3) and then test the hypothesis that the mean, $\delta(AR)$, of these daily differences in

[4] The benefits were not exclusively windfalls even for these holders, because they were in part a reward for bearing the risk of possible increases in reserve requirements.

abnormal returns is significantly greater than zero. The test statistic, T_d is the ratio of $\delta(AR)$ to its standard deviation (S_d):

$$T_d = \frac{\delta(AR)}{S_d\sqrt{11}}$$

where

$$\delta(AR) = \frac{\sum_{t=1}^{11} d(AR_t)}{11}$$

$$S_d = \frac{\sqrt{\sum_{t=1}^{11} [d(AR_t) - \delta(AR)]^2}}{10}$$

The computed value of 2.39 for T_d rejects the null hypothesis at the 5% significance level. (For a one-tailed test with 10 degrees of freedom the critical region is $T_d = 1.812$). Thus the abnormal returns for the TD event are significantly greater than those for the DD event.

Conclusion

Our results indicate that reserve- requirement changes have strong effects on large banks' stock returns, confirming the findings of Kolari, et. al. (1988), Slovin, et. al. (1990), and Osborne and Zaher (1992), that bank stock-holders bear part of the reserve tax. The results also indicate that cuts in reserve requirements against time deposits induce proportionally higher abnormal returns than cuts in reserve requirements against demand deposits. For example, the day-1 abnormal return is 3.84% for the TD event but only 0.76% for the DD event. Smaller, but still positive, differences are observed between the abnormal returns on day 0 and the cumulative abnormal returns over the remaining sub periods for the two events. We conclude that banks' shareholders bear less of the demand-deposit tax than of the time-deposit tax. Evidently, a larger part of the demand-deposit tax falls on other parties--either borrowers, as Fama (1985) hypothesized, or demand depositors, as the findings of Flannery and James (1984) lead us to expect.

Table 1

Reserve-Requirement Changes, 1990 and 1992

Event Type	Announcement Date[a]	Announcement Content[b]
TD	Dec 4, 1990	Removed the 3% reserve requirement on nonpersonal time deposits with an original maturity of less than 18 months and on net Eurocurrency liabilities. For weekly reporting banks, the requirement becomes 1.5% on Dec. 13 and 0 on Dec. 27. This change will reduce the required reserves of the banking system by $11.7 billion.
DD	Feb 18, 1992	Reduced the reserve-requirement on demand deposits from 12 % to 10 %. The reduction becomes effective April 2 for weekly reporting banks and April 16 for other banks. This change would reduce the required reserves for the banking system by an estimated $8 billion.

[a] Announcement date is the day before the announcement was reported in the *Wall Street Journal.*

[b] Announcement contents are extracted from the next *Federal Reserve Bulletin* following the announcement date.

Table 2

Market Model Estimates

Event Type	Announcement Date	β	α	R^2	F	DW[a]
TD	Dec 4, 1990	0.875* (14.0)[b]	0.0001 (0.18)	0.78	127.5	1.96
DD	Feb 18, 1992	0.979* (12.5)	0.0003 (0.68)	0.67	123.4	1.87

[a]The Durbin Watson statistics suggest that the residuals for the two regressions are free of first order serial correlation.
[b]t-statistics are in parentheses.
*Significantly different from zero at the 0.0001 level.

Table 3

Daily Abnormal Returns[a] Associated with Reserve-Requirement Changes (and Corresponding t statistics)

Days Relative to event Day	TD Event		DD Event		Difference[b] in Abnormal Returns
	Abnormal Returns	t-value	Abnormal Returns	t-value	
-5	-0.0005	-0.21	-0.0018	-0.42	0.0023
-4	0.0042	0.98	0.0012	0.38	0.0036
-3	0.0051	1.52	-0.0016	-0.42	0.0067
-2	0.0024	0.55	0.0023	0.51	0.0001
-1	0.0047	1.21	0.0021	0.46	0.0026
0	0.0061	1.49	0.0010	0.21	0.0051
1	0.0384**	4.13	0.0076*	2.05	0.0308
2	0.0060	1.63	0.0025	0.86	0.0035
3	0.0068	1.89	0.0041	0.97	0.0027
4	0.0041	0.86	0.0012	0.28	0.0029
5	0.0044	0.91	-0.0016	-0.38	0.0060

[a] Abnormal returns are in percentage points.
[b] Calculated as TD-Event abnormal return minus DD-Event abnormal return.
*Significant at the 0.05 level.
*Significant at the 0.01 level.

Table 4

Cumulative Abnormal Returns[a] Associated with Reserve-Requirement Changes (and Corresponding Z Statistics)

Event Type	Announce-ment Date	Days(-5,-1)	Days(0,1)	Days(2,5)	Days(-5,5)	Sample Size
TD	Dec. 4, 1990	0.0158 (1.61)	0.0445** (3.69)	0.0213* (2.89)	0.0816** (3.12)	26
DD	Feb. 18,1992	0.0023 (0.71)	0.0086 (1.16)	0.0062 (0.69)	0.0171 (0.72)	29

[a]Cumulative abnormal returns are in percentage points.
*Rejects null hypothesis at 0.05 levels.
**Rejects null hypothesis at 0.01 levels.

Table 5

Abnormal Returns in Relation to Event Size

Event Type	Announcement Date	Size ΔT_F[a] (Billions)	Size ΔT_W[b] (Billions)	Abnormal Returns (Day 1)
TD	Dec. 4, 1990	11.7	< 6.17	0.0384**
DD	Feb.18,1992	8.0	≥ 7.04	0.0076*

[a] Reserves freed for the banking system as estimated by the Federal Reserve System.
[b]Reserves freed for the large weekly reporting banks.
*Significantly different from zero at 0.05 level.
**Significantly different from zero at 0.01 level.

Appendix. What Happened to the Newly Freed Reserves

Case 1. Suppose that none of the newly freed reserves had been held voluntarily, so that the reserve requirement remains binding. Then these reserves immediately enter the Fed funds market, and the Fed must take them into account when aiming at a Fed-funds rate target. If its target is unchanged, the Fed will mop up all the newly-freed reserves by open-market sales in order to preserve the Fed-funds rate; required and total reserves will promptly fall by the same amount and excess reserves will not change However, if the target is being lowered at the same time that the reserves are freed (as was true in both events), not all the freed reserves will be mopped up. Excess reserves will increase, rising the more and the longer, the larger the reduction in the Fed funds target. They will stop rising, and start decreasing, when an increase in reservable liabilities raises required reserves. *Ceteris paribus*, they will return to their pre-tax-cut level when the Fed funds target steadies. Thus we expect to see a brief small increase in excess reserves and the ratio of excess to total reserves.

Case 2. Suppose, on the contrary, that *all* newly-freed reserves were held voluntarily. Then these reserves do not enter the Fed funds market and thus do not affect the Fed funds rate. For any given amount of freed reserves and any given Fed funds target, fewer of the freed reserves have to be mopped up in the interest of the Fed funds target. These developments will also ensue, though less markedly, if only some of the freed reserves had been held voluntarily. Therefore, all else equal, excess reserves will be higher, and the increment will last longer, than in Case 1.

In summary, if a large portion—perhaps all--of freed reserves had been held only to meet legal requirements, we should see only a brief small increase in excess reserves when the requirements are cut, and approximate equality between the changes in total and required reserves. This is what we see from the Appendix Table, lower panel, which applies to the DD cut. The table shows approximate equality between the changes in total and required reserves, and hence a very small brief increase in excess reserves, in April 1992, the first full month in which the new requirements were in effect. The data shown in this panel are fully consistent with the hypothesis that the required-reserve ratio against demand deposits was binding before and after the cut.

We do not see this anywhere so clearly in the upper panel of the table. The comparison is made complicated by the fact that, compared to the DD cut, the TD cut took effect in two steps over a two week period, the second step coming at the end of the month so that the first full month of the new requirements was January 1991. Also complicating the comparison is the fact that the Fed funds target was being cut more (about 75 basis points) during the three months centered on January, compared to a 25 basis point cut in the three months centered on April 1992. Nevertheless, the markedly larger and longer-lasting rise in excess reserves in December and January 1991are hard to reconcile with a hypothesis that none of the reserves freed by the TD cuts had been held voluntarily. We conclude that the evidence for equality between freed reserves and tax reduction is stronger for the DD event than the TD event.

Appendix Table. Total, required, and Excess Reserves in the Months Surrounding Reserve-Requirement Cuts (averages of daily figures, not seasonally adjusted, $billions)

Month	**Total Reserves**		**Required Reserves**		**Excess Reserves**		**Excess/Total Reserves (%)**
	Level	*Increase*	*Level*	*Increase*	*Level*	*Increase*	
Oct. 1990	61.05	-0.40	60.21	-0.33	0.84	-0.07	1.38%
Nov.	62.05	1.00	61.10	0.89	0.95	0.09	1.53%
Dec.*	59.12	-2.93	57.46	-3.64	1.66	0.71	2.81%
Jan. 1991**	50.99	-8.13	48.82	-9.04	2.17	0.51	4.26%
Feb.	48.55	-2.44	46.74	-2.08	1.81	-0.36	3.73%
March	48.59	0.04	47.41	0.67	1.18	-0.63	2.43%
Jan. 1992	55.81	0.28	54.81	0.26	1.00	0.02	1.79%
Feb.	55.24	-0.57	54.17	-0.64	1.07	0.07	1.94%
March	56.28	1.04	55.25	1.08	1.03	-0.04	1.83%
April***	50.46	-5.82	49.32	-5.93	1.14	0.11	2.26%
May	48.82	-1.64	47.82	-1.50	1.00	-0.14	2.05%
June	49.50	0.68	48.58	0.76	0.92	-0.08	1.86%

Upper panel applies to the TD event, lower panel to DD event. "Increase" is from the preceding month.

*Half the cut took effect. Dec. 13, the rest Dec. 27.

**First full month cut was in effect.

***Cut took effect April 2.

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