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Bank Imputed Interest Rates: Unbiased Estimates of Offered Rates?

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Abstract

We examine whether "imputed" interest rates obtained from bank financial statements are unbiased estimates of "offered" interest rates that the same banks report in surveys. We find evidence of a statistically significant amount of bias. However, the statistical bias that we document does not appear to be economically significant. When used as dependent variables in regression analysis, imputed rates and offered rates lead to the same policy conclusions. Our work has important methodological implications for empirical research that examines the product market competition among depository institutions.

Key words: deposit rates, transactional rates, imputed prices, product market, competition

JEL codes: G21, L11

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1. Introduction

The examination of product market competition is an important element in the banking and finance literature (and more generally, in the industrial organization literature). Theory models refer to prices that the banking firm offers to its customers given the structure of the market it faces; while the empirical literature finds a statistical relationship between the banking product prices and market concentration. This research uses deposit and loan interest rates as dependent or explanatory variables. How those prices are measured, however, is a topic of contention. Prices, in fact, are difficult to measure; in most fields of economic research, as explicit prices are not easy to obtain. Moreover, imputed prices, or prices calculated from interest expenses (revenue) over the stock of deposits (loans) are noisy measures of the true prices offered by firms.

In this paper, we examine whether "imputed" (calculated) interest rates are unbiased estimates of "offered" (transaction) interest rates using a set of U.S. banks for which both rates are observable. What we term as "offered" rates are those explicitly stated by banks in surveys, and we assume that the offered rates are indeed the "true" interest rates that the theory models call for. Many researchers, however, rely on interest rates that are imputed from the financial statements because offered rates are either only observable for a limited sample of banks or simply not observable. Even when observed, offered rates may not be readily accessible because they are collected through surveys that are either confidential or sold by private data providers.[1] This contrasts with imputed interest rates which are calculated by dividing the deposit interest expense (or alternatively, loan interest revenue) from the income statement by the stock of that particular category of deposits (loans) in the balance sheet. While financial statements, and as a result, imputed interest rates, are available at no cost for the population of U.S. banks,

[1] In the U.S. interest rate survey data collected by the Federal Reserve System, such as the Monthly Survey of Selected Deposits or the Survey of the Terms of Lending, remain confidential. Access is limited to economists working for one of the federal banking regulators. Data from private data providers, such as Bank Rate Monitor, are available at a non-trivial cost.

these constructed variables may involve significant measurement error that could lead to systematic bias.[2] Whether such bias exists and, if it exists, whether it affects empirical model estimates are questions that have not yet been systematically explored. In this paper, our goal is to determine whether using imputed, rather than offered, interest rates leads to any bias that is statistically and economically significant. We focus on deposit accounts, rather than loans, because the former have more standard product characteristics than the latter.[3]

Our work has important methodological implications for large strands of empirical research on depository financial institutions. Our results provide evidence of statistically significant bias: imputed deposit rates are not good estimates of the true transaction interest rates that banks offer to their customers. However, the observed bias decreases when imputed rates are winsorized or truncated, with the latter being more effective than the former. Moreover, the observed statistical bias is not economically significant. We show that the coefficient estimates that are obtained when either imputed or offered rates are used as dependent variables have the same sign, same order of magnitide and the same order of statistical significance. The important implication of our work is that, when properly adjusted for measurement errors, imputed interest rates lead to the same policy conclusions as offered rates. The paper proceeds as follows: section 2 presents the data, section 3 provides a short survey of the relevant literature, section 4 presents the empirical analysis that we conduct, section 5 concludes.

2. Data

For our analysis we combine data from four different sources. Imputed explicit deposit interest rates are calculated using data from the Consolidated Reports of Condition and Income (the Call Reports), the publicly available quarterly financial statements that all U.S. commercial banks have to file with their

[2] In the U.S., the financial statements that banks have to file with their regulators, known as Call Reports, are publicly available.

[3] Loans are significantly more heterogeneous intermediation products than deposits. This holds true even for more standardized lending contracts, such as mortgages. Although it is possible to observe and control for some of the price and non-price loan characteristics in the survey data that are available (such as the Survey of the Terms of Lending), it is not possible to create imputed rates for homogeneous loan categories using Call Reports. Moreover, loans' differing maturities makes it difficult to compare imputed loan rates with lending rates offered to customers.

federal regulators.[4] We impute rates for three types of deposit accounts for which information is available in the Call Reports: Negotiable Order of Withdrawal (NOW) accounts, Money Market Deposit Accounts (MMDA), and passbook savings accounts. NOW accounts, first introduced in 1980, are interest paying checking accounts that are withdrawal-upon-demand accounts with minimum balance requirements. MMDA accounts, first introduced in 1982 by banks to compete with the Money Market Mutual Funds, pay higher interest rates than NOW accounts but have more restrictive check-writing privileges and often require higher minimum balances than NOW accounts.[5] Passbook savings accounts are traditional household saving instruments without check-writing privileges.[6]

We impute rates for each of these account types by using the quarterly interest expense in the Call Reports for a given deposit account type by the stock of deposits for that quarter. It should be noted that the Call Report deposit expense items do not include any other fees or expenses related to deposit account management. The stock of deposits is measured in two different ways: (i) the latest stock at the current quarter's end, or (ii) the average of deposits as they are reported in Schedule K of the Call Reports. We, annualize the rate by compounding it so that the imputed rates are comparable with the offered rates (which are stated in a per-year basis).

NOW, MMDA and savings accounts interest rates that were offered by banks are collected from two different surveys: the Federal Reserve System's Monthly Survey of Selected Deposits (MSSD), available to us starting with January 1987, and the Bank Rate Monitor (BRM), available to us starting with January 1998. Data limitations exist with both datasets.

[4] Our focus, similar to most of the empirical banking literature, is on explicit interest rates. Implicit rates paid on deposits (in the form of service flows, such as the number checks or transfers allowed per month) and fees that depositors get charged are excluded from our analysis. Note that, since we match imputed rates that we calculate for a particular bank with the offered rates by the same institution, differences in implicit interests or fees charged across banks do not affect our analysis.

[5] Prior to the introduction of NOW and MMDA accounts, checking accounts did not pay explicit interest in the U.S. By 1984, the start of our sample period, both types of accounts were among the standard banking products.

[6] We exclude certificates of deposits (CDs) and negotiable certificates of deposits (NCDs), which are non-checkable savings accounts with specific maturities, from our analysis. Although interest rates on these instruments are included in the MSSD and BRM surveys, there are no corresponding interest expense items in the Call Reports that are detailed enough to impute maturity-specific CD rates.

The MSSD stopped collecting offered interest rate information in September 1994 and then discontinued the survey in 1997. The survey respondents were asked to provide the most commonly offered interest rate on the largest volume of deposits per deposit type during the last week of each month.[7] The MSSD provided offered rate data at the bank rather than at the bank and market (or branch) level. Since the MSSD sampling frequency is higher than the reporting frequency of the Call Reports, we use in our analysis the survey rate from the last month of the quarter as well as the average of monthly survey rates for the quarter.

The BRM survey is provided by a private data vendor that collects bank *and* market level data on a weekly basis. Although BRM surveys date back to 1984, we only have access to these data starting with 1998. To be able to match weekly BRM offered rates with the quarterly Call Report imputed rates, we use the offered rate from the last week of the quarter as well as the average of all offered rates collected throughout the quarter. To facilitate data collection, we restrict our BRM sample to single-market banks, that is, to banks that report in the BRM the rate in just one market. We collect market structure variables from the Federal Deposit Insurance Corporation's (FDIC) annual Summary of Deposits datasets, and market level personal income data from the Bureau of Economic Analysis' Regional Economic Information database.

3. Literature Survey

Given the methodological focus of this paper, we limit our literature survey to the Structure-Conduct-Performance (SCP) research where either the offered or the imputed interest rates have been used as dependent variables. In section 4.3, we use SCP regressions to test whether using imputed versus offered rates leads to economically different results. The SCP paradigm implies a relationship between

[7] Until end of June 1989, MSSD collected the most commonly offered rate per account type. Starting with July 1989, MSSD surveys collected more detailed NOW and MMDA information that accounted for the possibility that the bank may offer higher rates for larger maintained-balances. For consistency in our data series, we filtered these data to collect only the most commonly observed offered rate per account type. Samples available to us end in September 1994, because after that date MSSD started to collect interest *expense* information, instead of interest *rate* information.

market concentration and firm conduct (in terms of profit or performance); such that noncompetitive behavior in more concentrated markets results in a positive (negative) relationship between market concentration and profitability (deposit prices).

While early studies examined the relationship between market concentration (as measured by the Hirschman Herfindahl Index) and profitability, Berger and Hannan (1989) was the first to test the price-market concentration relationship using MSSD offered deposit rates rather than testing the profit-concentration relationship. The authors' results strongly support the SCP hypothesis when MMDA, NOW and short-term CD rates are used as measure of deposit account prices. Most of the studies that followed using the MSSD data confirm this negative relation between deposit rates and market concentration (Calem and Carlino (1991), Berger and Hannan (1991)), though not without exceptions (for example, Jackson (1992)). Other studies using MSSD data examine how banks change the rates they offer depositors (Neumark and Sharpe (1992)), whether the SCP relationship holds when concentration changes due to mergers (Prager and Hannan (1998)) or bank branching restrictions (Calem and Nakamura (1998)). A recent study by Brewer and Jackson (2004) considers the effects of including bank-specific risk variables (which capture nonperforming loans, capital and the interest-rate sensitivity of assets and liabilities) in the SCP analysis.

Another set of studies use imputed deposit rates obtained from the Call Report data (Heitfield and Prager (2002), Rosen (2003), Adams, Roeller, and Sickles (2002), Dick (2002), Hannan and Prager (2004) and Hannan and Prager (forthcoming)) and find results generally consistent with studies using MSSD data. These more recent studies add to the literature by testing additional aspects of the SCP paradigm. Rosen (2003) for example, examines whether the size distribution of banks in a market (in addition to market concentration) affects the deposit rates. Heitfield and Prager (1998) test the price-concentration relationship using alternative measures of markets (defined at the Metropolitan Statistical Area or MSA and state-level) and find that while local market concentration measures are useful, broader concentration measures are also appropriate. Several of the studies comment on the advantage of using the imputed Call Report prices given the extended time period for which these data are available (e.g.,

Rosen (2003), Heitfield and Prager (1998)).[8] However, since sample periods and specifications are not necessarily similar, it is hard to compare the findings of MSSD-based studies of SCP with those using imputed rates from the Call Reports.

What differs among these studies is the particular interest rate that is found to have the strongest relationship (in terms of statistical significance), and the economic implications of the results. Berger and Hannan (1989) find that MMDA rates are 25 to 100 basis points less in the most concentrated markets than in the least concentrated markets. They find similar results for NOW and savings account rates, but not for longer-term CD rates. Calim and Carlino (1991) use MMDA and short-term CD rates (3 and 6 months) and find similar results, though they do not interpret the economic effects of their findings. Berger and Hannan (1991) focus solely on MMDA rates and find an asymmetric relationship between rate increases and decreases: a 29 basis point decrease in the rate of market treasuries leads to 62 percent probability that a bank will reduce its MMDA rate. The same increase in market rates leads to a 39 percent probability that a bank will increase its MMDA rates.

Heitfield and Prager (2002) examine MMDA and NOW account rates, but do not interpret the results economically. Neumark and Sharpe (1992) use MMDA and 6 month CD rates and find that the rates, on average, drop 60 basis points between the least to most concentrated markets. Rosen (2003) includes MMDA and NOW account also, and finds a small 4 to 7 basis point change in rates with a one standard deviation change in the market concentration. He attributes a larger change in deposit rates to market size. Brewer and Jackson (2004) find that the magnitude of the relationship between deposit rates and market concentration decreases by 50 percent when bank-specific risk variables are included in the SCP analysis.

The only study that examines whether using MSSD offered rates versus Call Report imputed rates may lead to different inferences is Prager and Hannan (1999). In an earlier paper (Prager and Hannan,

[8] To date, only a few studies to date have used the Bank Rate Monitor data, partly due to its inaccessibility to researchers and academics until recently. These studies, however, have not been direct tests of the SCP hypothesis. Radecki (1998) and Heitfield (1999) examine the appropriate size of the 'local-market'; Rosen (2002) presents a model of price setting in the presence of heterogeneous customers; and Kiser (2003) studies whether conditions in the bank loan market affect the pricing of retail deposits.

(1998)) the authors had used MSSD offered rates and found that substantial horizontal mergers lead to statistically significant decreases in NOW and MMDA rates (24 and 32 basis points decrease, respectively). When revisiting this evidence using Call Report imputed rates (which results in significantly larger samples), Prager and Hannan (1999) find that large horizontal mergers have no effect on NOW and MMDA accounts, whereas such mergers lead to a small decrease in savings account rates (9 basis points).[9] Prager and Hannan (1999) then investigate whether this discrepancy may be due to the fact that their 1998 paper relies on MSSD offered rates whereas their 1999 paper uses Call Report imputed rates. They repeat their analysis for a subsample of banks for which both offered and imputed rates are available, and find that coefficient estimates differ significantly depending on whether *monthly* MSSD offered rates or *quarterly* Call Report imputed rates are used. The authors note that the coefficient estimates have the same sign but they do not necessarily have the same statistical significance. Further, the authors find that the coefficients of correlation between offered and imputed series range between 0.731 and 0.933 for NOW accounts and 0.515 and 0.689 for MMDA accounts. The authors conclude Call Report imputed prices are "noisy" and "should be used with caution".

In summary, most studies use MMDA or NOW accounts, find strong statistical significance using MMDA accounts, less so using NOW accounts and find vastly different economic implications for the results. What is not evident is whether the different economic results found using different rates depend on the additional elements included in later studies (i.e., market size, megamergers) or the dataset and specific rates used. We examine this issue in tests of the SCP hypothesis below.

4. Empirical Analysis

We conduct three sets of tests to examine whether imputed deposit rates are representative of the deposit rates that banks offer for a set of banks for which both types of rates are available in the same quarters. First, we examine the distributions for the imputed and offered rates for different types of deposit accounts. Second, we test the null hypothesis that imputed interest rates are unbiased estimates of

[9] Savings accounts were not analyzed in Prager and Hannan (1998).

rates that banks offer by regressing offered deposit rates on their imputed counterparts in cross-sectional OLS regressions. In this step, we also examine whether winsorizing or truncating helps reduce any statistical bias that may exist. Finally, to examine whether observed statistical differences have any impact on empirical estimations, we estimate separate SCP regressions where the dependent variable is first the offered deposit rate and then the imputed deposit rate.

4.1. Descriptive Statistics and Univariate Tests

We first examine the descriptive statistics for offered and imputed interest rates and conduct univariate tests. From the MSSD dataset, offered interest rates are available between 1987 and 1994 for three types of accounts: NOW, MMDA and savings accounts. Since the MSSD is a monthly survey, we use (as discussed above) both the offered rates from last survey of the quarter as well as an average of the surveyed deposit rates during the quarter. Similarly, because the BRM is a weekly survey we use the offered rate from the last survey of the quarter as well as the average of offered rates surveyed during the quarter. From the BRM dataset, we have NOW and MMDA offered rates between 1998 and 2000. We compare each of these offered rates with the corresponding Call Report-imputed rate for the same period for the same bank. Since imputed rates are the ratio of the quarter's deposit expense item from the income statement divided by the stock of deposits for the corresponding account type and quarter, they contain extreme outliers. For this reason, we use both winsorized and truncated versions of the imputed rates.

The descriptive statistics provided in Table 1 make use to two sets of deposit rate series. In the first set, we compare offered rates obtained from the last survey of the quarter (column A) with the imputed rates obtained by using the stock of deposits at the end of the same quarter (column B). In the second set, we compare the average of offered rates surveyed during the quarter (column D) with imputed rates calculated using the average stock of deposits (either on a weekly or daily basis) as reported in Schedule K of the Call Reports (column E). In both sets, the imputed rates in Table 1 have been winsorized at the 1st and 99th percentile of their distributions.

Panel 1A suggests that even though tests of equality of the means or variances are rejected statistically, MSSD offered rates are economically close to Call Report imputed rates. For NOW accounts, the average offered rate based on the last survey of each quarter (column A) is 4.05% whereas the corresponding imputed rate is 4.15% (column B), indicating a 10 basis point difference. For MMDA accounts, the average offered rate is 5.71% whereas the corresponding imputed rate is 6.01% (30 basis points difference), and for savings accounts, the average offered rate is 5.21% and the corresponding imputed rate is 5.38% (17 basis points difference). The null hypothesis for the equality of the means (H_0: $mean_X - mean_Y = 0$) is rejected at 1% level for all three account types. Not surprisingly, the Call Report imputed rates have higher standard deviations than the corresponding MSSD offered rates: calculated as a ratio, the imputed rates inevitably incorporate measurement error which leads to higher variances. The null hypothesis of the equality of the variances of offered and the corresponding imputed deposit rates (H_0: $var_X / var_Y = 1$) is also rejected at the 1% level (reported in column C). The coefficient of correlation (ρ) between MSSD offered rates and Call Report imputed rates range from a high of 0.78 for NOW accounts, to 0.46 for MMDA accounts, and to 0.27 for savings accounts (all statistically significant at the 1% level). Note that these correlations are within the same range as those observed between offered and imputed rates by Prager and Hannan (1999).

We also compare (in columns D and E of Table 1) the average of the surveyed offered rates during the quarter with the imputed rate calculated using the average of the stock of deposits during the quarter (as reported in Schedule K of the Call Report). For the NOW account series, the mean of the averaged quarterly MSSD survey rates and the imputed rates based on average quarterly deposits are not statistically different from each other (the t-statistic listed in column F is 1.42). Although the ratio of the variances of the two series is close to 1 (0.86 in column F), the equality of the variances is rejected at the 1% level. The coefficient of correlation of 0.87 indicates that for NOW accounts, imputed rates that are winsorized at the 1% at either tail of their distribution have the potential to be a good substitute for the survey collected offered rates. The results in columns D through F for MMDA and savings accounts

indicate that for other account types the null hypothesis of equality of the means and variances of offered and imputed rates is rejected.

In Panel 1B we repeat the analysis using the offered rates collected by the BRM survey. For both NOW and MMDA accounts (savings accounts data were not available in the BRM), the Call Report imputed rates are higher (statistically significant at 1%) than the corresponding BRM survey rates for both the rate from the last survey and the average of weekly survey rates through the quarter. The differences observed between BRM and Call Report rates are much larger than those observed between MSSD and Call Report rates, ranging between 81 to 113 basis points. The NOW and MMDA series also show lower correlation than the corresponding MSSD series. One possible explanation for the observed discrepancy is differences in MSSD and BRM surveys. The former asked banks to report the most commonly offered (in dollar terms) interest rate during the last week of each quarter. BRM, on the other hand, collects weekly bank and branch level data. Since we cannot weight rates offered at different branches because we cannot observe NOW or MMDA deposit stocks at the branch level, we limit BRM sample to single-market banks. It is not clear, however, why that would lead to a difference such as the one that we observe in the data.

The results of Table 1 provide evidence of statistically significant differences between the offered rates obtained from surveys such as MSSD or BRM and the corresponding imputed rates obtained from the Call Reports (for the same set of banks in the same quarters). In section 4.3, we examine whether these observed differences generate biases that researchers should be aware of. Before we get to that point, however, we would like to investigate to what degree researchers of financial institutions should consider to winsorize or truncate imputed rates obtained from bank financial statements.

4.2. Winsorization versus Truncation of the Imputed Deposit Rates

Imputed interest rates contain extreme outliers. For example, while the MSSD based MMDA offered rates ranged between 0.0001 and 0.1548 (i.e., between 0.01% and 15.48%) the corresponding raw imputed rates ranged between –0.6053 and 2.1605 (i.e., between –60.53% and 216.05%). Similar outliers

are observed for all of the imputed deposit rate series in our samples (not reported to conserve space). One method to minimize the effect of such extreme observations on the empirical analysis is to *winsorize* the variable in question by assigning observations that are lower or higher than a certain threshold to the values that are associated with that threshold in question (for example, asssign the observed values below the 1st and above 99th percentiles of the distribution, to the values of the 1st and 99th percentiles, respectively). Alternatively, one could *truncate* the series by dropping observations that are lower or higher than a given threshold at either end of the distribution. However, each of these methods has its weaknesses. While both methods preserve the central tendency of the distribution for the variable in question, truncation throws out valuable observations whereas winsorization assigns arbitrary values to observations that fall outside of the set threshold.

To examine the effects of winsorization and truncation we regress the same offered rate series on imputed rates with different levels of winsorization or truncation:

$$R_{i,t}^{Offered} = \alpha + \beta R_{i,t}^{Imputed} + \varepsilon_i \qquad (1)$$

where, $R_{i,t}^{Offered}$ is the offered NOW account rate collected during the last MSSD or BRM survey of the quarter, and $R_{i,t}^{Imputed}$ is the corresponding NOW account Call Report imputed interest rate that was either winsorized or truncated. We use 1st-99th and 5th-95th percentile thresholds when winsorizing or truncating. In regression (1), if imputed rates are unbiased estimates of the offered rates the null hypothesis would require that $\alpha=0$ and $\beta=1$ (it should be noted that this null hypothesis is in fact a joint-hypothesis since it presumes that offered transaction rates are the "true" interest rates that researchers are interested in).

The OLS regression estimates of equation (1) for NOW accounts are presented in Table 2.[10] Panel 2A presents the results obtained from the MSSD samples and Panel 2B presents the results obtained from the BRM samples. The null hypothesis (H_0: $\alpha=0$ and $\beta=1$) is rejected in both panels of Table 2 (the F-test results are provided in the table). When using the imputed rates winsorized at 1st-99th percentile of

[10] We repeat the analysis using MMDA and savings account rates, but we do not to report them to conserve space.

their distribution, we obtain estimates of $\hat{\alpha}$ =0.0140 and $\hat{\beta}$ =0.6383. Truncating at the same threshold level we obtain estimates of $\hat{\alpha}$ =0.0098 and $\hat{\beta}$ =0.7460. Moving the threshold to 5th-95th percentiles and winsorizing the series yields $\hat{\alpha}$ =0.0061 and $\hat{\beta}$ =0.8443, whereas truncating at the latter level yields $\hat{\alpha}$ =0.0043 and $\hat{\beta}$ =0.9020. The regression R^2s systematically increase from 0.60 to 0.76. These results clearly indicate that truncation works better than winsorization, and higher thresholds (5th-95th percentiles of the imputed rate distribution) work better than lower thresholds (1st-99th percentile).

We repeat the analysis using the sample of single-market banks. MSSD collects data at the bank level (rather than the bank-and-market level as the BRM survey does). It is possible that averaging of rates at this level may lead to a poor correlation between the MSSD survey rate and the Call Report imputed rate for multi-market banks. To the contrary, however, we find no improvement in the results when we confine the sample to single market banks in the MSSD (results not reported to conserve space). This is consistent with Radecki (1998) and Heitfield (1999) who find that many large banks set uniform rates across large geographic spaces, such as a state.

Results in Panel 2B from the BRM sample lead to a similar conclusion, even though the coefficient estimates are further away from the values suggested by the null hypothesis. We see the same progression with the estimate of α decreasing from 0.0116 when using imputed rates that are winsorized at the 1st-99th threshold, to 0.0099 when using imputed rates that are trnucated at the 5st-95th percentiles. Similarly, the estimate for β increases from 0.0294 when winsorized at 1st-99th level to 0.1317 when truncated at the 5th-95th level. In Panel 2B, the regression R^2s also increase, but they are much lower than those observed in Panel 2A, increasing from 0.03 to 0.08. BRM results are clearly poorer than those obtained from MSSD results.

After having established that imputed rates that are truncated at the 5th and 95th percentiles of their distribution show the least amount of statistical bias, in the next section we evaluate the statistical bias for different interest rate measures.

4.3. Tests of Statistical Bias

In this section, we examine whether our empirical set-up in the previous section might have favored the rejection of the null hypothesis (that is, H_0: $\alpha=0$ and $\beta=1$). To do this, we use the imputed rates that have been truncated at the 5^{th}-95^{th} percentiles of their distributions. The first column of Table 3 panel 3A (panel 3B), repeats the same regression as in the last column of Table 2 Panel 2A (panel 2B): the offered NOW account rate from the last survey of the quarter is regressed on the imputed rate based on the quarter-end NOW account deposit stock.[11] In columns 4 and 7 of Table 3, we observe the tests of bias conducted for MMDA and savings accounts. In both of the latter cases, the null hypothesis of no bias is rejected at the 1% level. For the MMDA and savings accounts the estimates of α are higher, estimates of β are lower, and the regression R^2 are lower than their counterparts for NOW accounts. These results suggest that the bias is higher for MMDA and even higher for savings accounts.

In the above tests, we regress the offered rate from the last survey of the quarter on the imputed rate. Since the Call Report rates is a dollar-weighted quarterly average of the rate paid over the quarter, while the last reported rate is a rate observed at one point-in-time, our choice may weaken our tests and lead to us to reject the null more often than we should. To examine this possibility, we regress the average of rates offered by the bank during a given quarter on the imputed rate for the same quarter. The results for MSSD data are reported columns 2, 5, and 8 of Table 2. Even though regression R^2 increase by a small amount (compared to columns 1, 4 and 7, respectively) the coefficient estimates are practically the same. It appears that imputed rates, even though they are dollar-weighted averages, are reasonably good proxies for rates that banks offer, and this even when the latter is obtained from the last survey of the quarter in question.

Up to this point our imputed rate was calculated using the stock of deposits at the end of the quarter as they are reported in the Call Reports. A related question is whether using the average of stock of deposits over the quarter, as opposed to the stock of deposits from the end of the quarter, may reduce

[11] This set of regressions has a lower number of observations due to the fact that we constrained Table 3 regressions to the same subsample per deposit account type.

the bias that imputed rates show in replicating the offered rates. To examine this, we use the average quarterly deposit amounts that are reported in Schedule K of Call Reports to calculate a new "average" imputed rate (which is then truncated at the 5th and 95th percentile of its distribution).[12] The results are provided in columns 3, 6, and 9 of Table 3. The results show an improvement over the imputed rates calculated based on the stock of deposits reported at the end of the quarter: for NOW accounts $\hat{\alpha}$ decreases from 0.0048 to 0.0030, $\hat{\beta}$ increases from 0.8981 to 0.9462, and the R^2 increases from 0.77 to 0.83. Similar improvements are observed for regressions of MSSD-based MMDA and savings account rates. However, despite these improvements, the null hypothesis (H_0: $\alpha=0$ and $\beta=1$) is still rejected across the board.

We repeat the analysis using single-market banks in the MSSD dataset. Our results, reported in Panel 3A, do not improve.[13] As noted above, these results are in line with the findings of Radecki (1998) and Heitfield (1999): multi-market banks setting the same deposit rate over large geographical areas would result in little variation in the imputed rates of such banks.

Results in panel 3B, which repeats this analysis with the BRM survey data, finds similar results, except that results are weaker across the board when compared to their counterparts in Panel 3A. For example, in columns 1, 2, 3 of Panel 3B, for the BRM based NOW rate $\hat{\alpha}$ decreases from 0.0096 to 0.0082, $\hat{\beta}$ increases from 0.15 to 0.24, and R^2 increases from 0.09 to 0.13. The results for the MMDA accounts are weaker. The null hypothesis (H_0: $\alpha=0$ and $\beta=1$) is rejected in all cases.

These results indicate that the Call Report imputed deposit rates for NOW, MMDA and savings accounts are biased estimates of the rates that banks offer to their customers and report in the MSSD and BRM surveys. However, the existence of statistical bias need not result in economically different inferences when imputed rates are used instead of offered rates. We test this conjecture next.

[12] In Schedule K, banks are required to report either daily averages, or weekly averages based on a single day of the week.

[13] In order to conserve space, we do not report all of these results. They are available upon request.

4.4. Imputed Deposit Rates versus Offered Deposit Rates in SCP Analysis

In this section, we compare the results of deposit price-market concentration regressions to determine whether using imputed interest rates instead of the offered interest rates leads to different conclusions in tests of SCP Hypothesis. While the scope of this test is limited to a specific case, it is relevant because deposit price information has been commonly used in SCP analyses in the literature. We conduct regressions based on equation (2) below and present the results in Table 4:

$$R_{i,t} = a + b_1 HHI_{i,t} + b_2 MSA_{i,t} + b_3 PIPC_{i,t} + \sum_{quarter} b_4 T_t + e_{i,t} \quad (2)$$

where $R_{i,t}$ is the deposit-account specific (offered or imputed) interest rate; HHI is the Herfindahl-Hirshman Index of market concentration (calculated for each market once a year due to the availability of Summary of Deposits data), and MSA is dummy variable that equals to 1 for metropolitan markets and 0 otherwise; and PIPC is the personal income per capita in the market in question (in constant beginning-of-the-sample-period-dollars, this variable was scaled by $10,000. Deposit markets are defined as the largest of a county, a Metropolitan Statistica Area (MSA) or a Consolidated-MSA (CMSA). Equation (2) is estimated for the entire sample, but we account for time variation in deposit rates by including time "dummy" variables (T) for different quarters with the exception of the first quarter.[14]

We present results first with the series that exhibited the highest bias in Table 2, the offered rates from the last survey of the quarter and the corresponding imputed rate winsorized at the 1st and 99th percentiles of its distribution. For MSSD data, the results of the SCP regressions are presented in Panel 4A. The coefficient estimate for HHI is equal to –0.0065 (significant at 1% level) when NOW account offer rate is used as the dependent variable and equal to –0.0053 (significant at 1% level) when the NOW account imputed rate is used. Results are similar for the MMDA accounts (columns 3 and 4). For savings accounts results (last two columns of Panel 4A) are not statistically significant for the imputed rates, whereas they are for offered rates. Except for the savings account rates, these results imply that the same policy implications would be drawn irrespective of whether MSSD-offered or Call Report-imputed

[14] These quarter indicator variables are not reported in our tables to conserve space.

rates are used. For example, a 0.0200 point increase in deposit market concentration (200 if HHI were on a scale of 0 to 10,000) suggests to a 1.3 basis points decrease in NOW account rates if offer rates were used, and 1.1 basis points decrease in NOW account rates if imputed rates were used. For MMDA accounts, the suggested decreases in rates following a 0.0200 increase in HHI are 0.5 and 0.6 basis points for offered and imputed rates, respectively.

Results of SCP regressions for the series that exhibit the least amount of bias (the average of rates surveyed over the quarter versus imputed rates based on average deposits during the quarter and truncated at the 5th and 95th percentiles of their distributions) are presented in Panel B of Table 4. As expected, the coefficient estimates in SCP regressions for offered and imputed rates are very close to each other and exhibit the same signs and significance levels. As in Panel 4A, for the periods covered by the MSSD survey data, offered rates and the truncated-imputed rates yield highly similar results that would lead to similar policy conclusions. We also repeated the SCP regressions using single-market MSSD banks (not reported to conserve space). The results reported in Panels 4A and 4B did not improve.

In Panels 4C and 4D, we repeat the analysis above with the BRM data using NOW and MMDA rates. The coefficient estimates for NOW accounts in either panel are not significantly different from zero, irrespective of the offered and imputed rate that was used in the regressions. In Panel 4C, the coefficient estimates for MMDA rates are -0.1040 for the quarter's last offer rate and -0.0090 for the imputed rate winsorized at 1st and 99th percentiles of its distribution (using MMDA deposit stock from the end of the quarter). In Panel 4D, the coefficient estimates for MMDA rates are –0.0102 for the average of quarter's offer rates and –0.0077 for the imputed rate truncated at 5st and 95th percentiles of its distribution (using the average of MMDA deposits during the quarter). For the latter, a 0.0200 increase in HHI would suggest 2 basis points decrease in MMDA rates if offered rates were used, and a 1.5 decrease in MMDA rates if imputed rates were used. The results clearly indicate that imputed rates, if winsorized or truncated, lead to similar policy conclusions as offered rates at which customers conduct their deposit banking transactions.

It should be noted that our interpretation of these results is in contrast to the conclusion that Prager and Hannan (1999) come to. Observing important differences in coefficient estimates when Call Report imputed rates and MSSD offered rates are to estimate the very same model, they conclude that the observed differences are due to differences in the data. They note that imputed rates are "noisy" and should be used with caution.

There are however a number of differences between Prager and Hannan (1999) and our work that should be noted. First, Prager and Hannan (1999) estimate a model of price *changes* that compares pre- and post-merger prices whereas we estimate a SCP model in the price *levels*. Second, and more importantly, Prager and Hannan (1999) estimate the same model using *monthly* MSSD offered rates and *quarterly* Call Report imputed rates for the same time horizons. This would suggest that their offered rate regressions have higher number of observations, hence lower standard errors, than the regressions in which quarterly Call Report imputed rates are used. In that sense, our comparisons of offered versus imputed rates are "fairer" in the sense that we use the same number of observations in each of these regressions.

Nevertheless, the fact remains that Table 4 results suggest similar coefficient estimates for a *specific* model estimate. As Prager and Hannan (1999) note, imputed interest rates are noisy estimates of offered (transaction) deposit rates. Our work shows the importance of proper truncation and suggests that higher levels of truncation (say, at the 10^{th} and 90^{th} percentiles of the imputed rate distribution) may be needed to further reduce the noise.

5. Summary and Conclusions

In this paper, we provide a systematic analysis of the bias that imputed interest rates may introduce when used as estimates of offered interest rates. Our results provide strong evidence of statistical bias: imputed interest rates tend to underestimate the true interest rates offered to customers for the same account type at the same bank. We further examine whether this observed bias leads to economically different results in analyses that researchers may conduct. Reassuringly, we find that this is

not the case: typically the coefficient estimates have the same signs, same levels of statistical significance, and are of the same order of magnitude irrespective of whether imputed or offered rates are used. This suggests that imputed rates can be used as good substitutes of offered (transaction) rates when conducting empirical research. An important implication of our research is that empirical analyses of bank price data need not remain limited to survey data as imputed rates from the Call Reports are available for the population of U.S. banks.

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Table 1. Summary Statistics and Univariate Tests

The statistics are provided for subsamples for which all four variables of interest are available in the Call Report (CR), Monthly Survey of Selected Deposits (MSSD) or Bank Rate Monitor (BRM) datasets. Call Report imputed rates have been winsorized at 1% and 99% of their distributions. **Column A** offered rate is based on the **last** survey of the quarter. **Column B** imputed rate is based on the stock of deposits reported at the **end** of the quarter. **Column C** is an **average** of survey offer rates made during the quarter. **Column D** imputed rate is based on the average stock of deposits over the quarter as reported in Schedule K of the Call Report. Equality of the means is tested with a t-test (H_0: $mean_X - mean_Y = 0$), equality of the variances is tested with an F test (H_0: $var_X \div var_Y = 1$). **ρ** is the coefficient of correlation between the two series. * and ** denote statistical significance at the 5% and 1% levels, respectively.

Panel 1A **Monthly Survey of Selected Deposits (MSSD) versus Call Report (CR) Rates**

		A MSSD (Last)	B CR (End)	C Tests (A vs. B)		D MSSD (Average)	E CR (Average)	F Tests (D vs. E)	
NOW	**Mean**	0.0405	0.0415	-5.84	**	0.0408	0.0406	1.42	
	Standard Deviation	0.0137	0.0167	0.68	**	0.0135	0.0145	0.86	**
	Minimum	0.0001	0.0098	**ρ**=0.78	**	0.0014	0.0096	**ρ**=0.87	**
	Median	0.0470	0.0447			0.0470	0.0450		
	Maximum	0.1548	0.1073			0.1528	0.0820		
	Bank-quarter Obs.	14,445	14,445			14,445	14,445		
	Sample Period	1987Q1-1994Q2	1987Q1-1994Q2			1987Q1-1994Q2	1987Q1-1994Q2		
MMDA	**Mean**	0.0571	0.0601	-22.06	**	0.0571	0.0595	-19.00	**
	Standard Deviation	0.0070	0.0104	0.46	**	0.0068	0.0096	0.50	**
	Minimum	0.0350	0.0213	**ρ**=0.46	**	0.0350	0.0112	**ρ**=0.54	**
	Median	0.0550	0.0589			0.0553	0.0582		
	Maximum	0.1150	0.1012			0.1050	0.0869		
	Bank-quarter Obs.	8,339	8,339			8,339	8,339		
	Sample Period	1987Q1-1991Q2	1987Q1-1991Q2			1987Q1-1991Q2	1987Q1-1991Q2		
Savings	**Mean**	0.0521	0.0538	-12.83	**	0.0521	0.0540	-14.56	**
Accounts	**Standard Deviation**	0.0048	0.0119	0.16	**	0.0047	0.0109	0.19	**
	Minimum	0.0400	0.0196	**ρ**= 0.27	**	0.0386	0.0093	**ρ**=0.33	**
	Median	0.0510	0.0522			0.0516	0.0524		
	Maximum	0.0895	0.1216			0.0892	0.1041		
	Bank-quarter Obs.	8,442	8,442			8,442	8,442		
	Sample Period	1987Q1-1991Q2	1987Q1-1991Q2			1987Q1-1991Q2	1987Q1-1991Q2		

Table 1. Summary Statistics and Univariate Tests (continued)

Panel 1B — **Bank Rate Monitor (BRM) versus Call Report (CR) Rates**

		A BRM (Last)	B CR (End)	C Tests (A vs. B)		D BRM (Average)	E CR (Average)	F Tests (D vs. E)	
NOW	**Mean**	0.0123	0.0256	-18.95	**	0.0125	0.0206	-26.80	**
	Standard Deviation	0.0057	0.0339	0.03	**	0.0057	0.0138	0.17	**
	Minimum	0.0025	0.0008	**ρ**=0.17	**	0.0004	0.0015	**ρ**=0.31	**
	Median	0.0101	0.0164			0.0106	0.0176		
	Maximum	0.0350	0.2413			0.0350	0.0861		
	Bank-quarter Obs.	2,415	2,415			2,415	2,415		
	Sample Period	1998Q1-2000Q4	1998Q1-2000Q4			1998Q1-2000Q4	1998Q1-2000Q4		
MMDA	**Mean**	0.0229	0.0314	-32.51	**	0.0230	0.0319	-34.53	**
	Standard Deviation	0.0071	0.0105	0.44	**	0.0069	0.0105	0.43	**
	Minimum	0.0035	0.0035	**ρ**= 0.33	**	0.0035	0.0050	**ρ**=0.34	
	Median	0.0225	0.0314			0.0225	0.0318		
	Maximum	0.0500	0.0613			0.0500	0.0597		
	Bank-quarter Obs.	2,373	2,373			2,373	2,373		
	Sample Period	1998Q1-2000Q4	1998Q1-2000Q4			1998Q1-2000Q4	1998Q1-2000Q4		

Table 2. Winsorize or Truncate the Imputed Deposit Rate?

This table presents the results of the following OLS regression for unbalanced panels of U.S. commercial banks:

$$R_{i,t}^{Offered} = \alpha + \beta R_{i,t}^{Imputed} + \varepsilon_{i,t} \quad (1)$$

The dependent variable is the interest rate that the bank has most commonly offered for NOW accounts and reported in the last survey of the quarter. The explanatory variable is the imputed interest rate for NOW accounts obtained from the Call Reports for the same bank. The imputed rate is obtained by dividing the deposit interest expense item by the stock of deposit at the end of the quarter. All equations are estimated using ordinary least squares (OLS) techniques. F-statistics are reported for the joint-null hypothesis that α=0 and β=1. t-statistics appear in parentheses below the estimated coefficients. * and ** denote statistical significance at the 5% and 1% levels, respectively.

Panel 2A	**MSSD Offered-Deposit Rates Regressed on Call Report Imputed Rates**							
	NOW Accounts							
Constant	0.0140	**	0.0098	**	0.0061	**	0.0043	**
	(72.01)		(51.96)		(33.85)		(22.22)	
$R^{Imputed}$ (winsorized at 1%)	0.6383	**						
	(147.20)							
$R^{Imputed}$ (truncated at 1%)			0.7460	**				
			(174.10)					
$R^{Imputed}$ (winsorized at 5%)					0.8443	**		
					(201.27)			
$R^{Imputed}$ (truncated at 5%)							0.9020	**
							(200.65)	
H_0: α = 0 & β = 1	3582.7	**	1813.6	**	696.7	**	248.6	**
N	14446		14159		14446		13005	
Adjusted-R^2	0.6000		0.6816		0.7371		0.7559	
Regression F-stat	21666.6	**	30310.3	**	40510.0	**	40261.6	**

Table 2. Winsorize or Truncate the Imputed Deposit Rate? (continued)

Panel 2B	**BRM Offered-Deposit Rates Regressed on Call Report Imputed Rates**							
	NOW Accounts							
Constant	0.0116	**	0.0112	**	0.0104	**	0.0099	**
	(80.52)		(72.45)		(56.71)		(44.98)	
$R^{Imputed}$ (winsorized at 1%)	0.0294	**						
	(8.67)							
$R^{Imputed}$ (truncated at 1%)			0.0469	**				
			(10.68)					
$R^{Imputed}$ (winsorized at 5%)					0.0897	**		
					(13.55)			
$R^{Imputed}$ (truncated at 5%)							0.1317	**
							(14.15)	
H_0: $\alpha = 0$ & $\beta = 1$	47732.8	**	28398.6	**	13010.3	**	6347.6	**
N	2415		2368		2415		2171	
Adjusted-R^2	0.0298		0.0456		0.0703		0.0840	
Regression F-stat	75.2	**	114.0	**	183.6	**	200.1	**

Table 3. Tests of Statistical Bias

This table presents the results of the following OLS regression for unbalanced panels of U.S. commercial banks:

$$R_{i,t}^{Offered} = \alpha + \beta R_{i,t}^{Imputed} + \varepsilon_{i,t} \quad (1)$$

The dependent variable is the interest rate that the bank has most commonly offered for a particular type of deposit account. We use either the rate from the last survey of the quarter or the average of rates in all surveys of the quarter. The explanatory variable is the imputed interest rate obtained from the Call Reports. We use either the stock of deposits as reported at the end of the quarter or the average stock of deposits through the quarter (as reported in Schedule K of Call Reports). All imputed rates are truncated at 5% of either side of their distributions. All equations are estimated using ordinary least squares (OLS). t-statistics appear in parentheses below the estimated coefficients. * and ** denote statistical significance at the 5% and 1% levels, respectively.

Panel 3A **MSSD Offered Deposit Rates Regressed on CR Imputed Deposit Rates (Truncated at 5%)**

	NOW						MMDA						Savings Accounts					
	$R^{Offered}$ (Last)		$R^{Offered}$ (Average)				$R^{Offered}$ (Last)		$R^{Offered}$ (Average)				$R^{Offered}$ (Last)		$R^{Offered}$ (Average)			
Constant	0.0040	**	0.0048	**	0.0030	**	0.0237	**	0.0238	**	0.0183	**	0.0306	**	0.0306	**	0.0288	**
	(20.42)		(26.25)		(18.55)		(41.74)		(44.66)		(36.33)		(63.85)		(65.57)		(62.26)	
$R^{Imputed}$ (End)	0.9106	**	0.8981	**			0.5516	**	0.5481	**			0.4034	**	0.4044	**		
	(197.68)		(207.76)				(57.89)		(61.11)				(44.21)		(45.53)			
$R^{Imputed}$ (Average)					0.9462	**					0.6473	**					0.4375	**
					(249.77)						(75.54)						(49.76)	
H_0: α=0 & β=1	208.6	**	358.8	**	250.3	**	2380.1	**	2746.4	**	1957.1	**	2258.3	**	2358.8	**	2210.4	**
N	12607		12607		12607		7128		7128		7128		7280		7280		7280	
Adjusted-R^2	0.7561		0.7740		0.8319		0.3198		0.3438		0.4446		0.2116		0.2216		0.2538	
Regression F-stat	39077.3	**	43165.3	**	62386.1	**	3351.7	**	3734.8	**	5706.0	**	1954.2	**	2073.0	**	2476.2	**

Table 3. Tests of Statistical Bias (continued)

Panel 3B **BRM Offered Deposit Rates Regressed on CR Imputed Deposit Rates (Truncated at 5%)**

	NOW			MMDA		
	$R^{Offered}$ (Last)	$R^{Offered}$ (Average)		$R^{Offered}$ (Last)	$R^{Offered}$ (Average)	
Constant	0.0096 **	0.0099 **	0.0082 **	0.0149 **	0.0151 **	0.0144 **
	(40.57)	(41.79)	(28.76)	(26.23)	(27.58)	(26.73)
$R^{Imputed}$ **(End)**	0.1534 **	0.1472 **		0.2546 **	0.2484 **	
	(14.08)	(13.54)		(14.49)	(14.58)	
$R^{Imputed}$ **(Average)**			0.2366 **			0.2676 **
			(17.51)			(16.24)
H_0: $\alpha=0$ & $\beta=1$	4430.1 **	4421.0 **	3152.8 **	2682.2 **	2827.4 **	3097.4 **
N	2022	2022	2022	2089	2089	2089
Adjusted-R^2	0.0889	0.0828	0.1314	0.0910	0.0920	0.1117
Regression F-stat	198.3	183.3	306.7	210.0	212.6	263.6

Table 4. Imputed Vs. Offered Rates in Structure Conduct Performance Analysis

$$R_{i,t} = a + b_1 HHI_{i,t} + b_2 MSA_{i,t} + b_3 PIPC_{i,t} + \sum_{quarter} b_4 T_t + e_{i,t} \quad (2)$$

The dependent variable is either (i) the offered interest rate that the bank reported in the MSSD or BRM surveys, or (ii) the imputed interest rate obtained from the Call Report (CR). All equations are estimated using ordinary least squares on unbalanced pooled-data. HHI is the Herfindahl-Hirshman Index of market concentration. MSA is a "dummy" variable for metropolitan markets. PIPC is the personal income per capita (in constant-beginning-of-sample-year dollars). t-statistics appear in parentheses below the estimated coefficients. * and ** denote statistical significance at the 5% and 1% levels, respectively.

Panel 4A **MSSD Offered Rates versus CR Imputed Rates in SCP Regressions**

(with imputed rates winsorized at 1st percentile on either end of their distributions)

	NOW				MMDA				Savings Accounts			
	MSSD Offered Rate (Last)		CR Imputed Rate (End)		MSSD Offered Rate (Last)		CR Imputed Rate (End)		MSSD Offered Rate (Last)		CR Imputed Rate (End)	
Constant	0.0553	**	0.0551	**	0.0484	**	0.0534	**	0.0484	**	0.0471	**
	(119.11)		(72.04)		(69.11)		(49.46)		(89.58)		(34.54)	
HHI	-0.0065	**	-0.0053	**	-0.0027	**	-0.0031	**	-0.0031	**	0.0005	
	(11.56)		(5.67)		(3.77)		(2.81)		(5.58)		(0.37)	
MSA	-0.0039	**	-0.0047	**	-0.0020	**	-0.0017	**	-0.0019	**	-0.0022	**
	(19.46)		(14.42)		(7.94)		(4.39)		(10.10)		(4.54)	
PIPC (in $10,000)	-0.0007	**	0.0004		0.0032	**	0.0019	**	0.0019	**	0.0017	**
	(4.06)		(1.52)		(13.45)		(5.37)		(10.73)		(3.78)	
Quarter "dummies"	yes		yes		yes		yes		yes		yes	
N	10,956		10,956		6,348		6,348		6,343		6,343	
Adjusted-R^2	0.8062		0.6138		0.2480		0.1711		0.0509		0.0218	
Regression F-stat	1471.15	**	562.61	**	111.17	**	69.96	**	18.91	**	8.45	**

Table 4. Imputed Vs. Offered Rates in Structure Conduct Performance Analysis (continued)

Panel 4B **MSSD Offered Rates versus CR Imputed Rates in SCP Regressions**

(with imputed rates truncated at 5th percentile on either end of their distributions)

	NOW				MMDA				Savings Accounts			
	MSSD Offered Rate (Ave)		CR Imputed Rate (Ave)		MSSD Offered Rate (Ave)		CR Imputed Rate (Ave)		MSSD Offered Rate (Ave)		CR Imputed Rate (Ave)	
Constant	0.0267	**	0.0254	**	0.0455	**	0.0484	**	0.0472	**	0.0503	**
	(43.97)		(46.63)		(77.34)		(73.73)		(106.65)		(84.54)	
HHI	-0.0056	**	-0.0042	**	-0.0010		-0.0000		-0.0025	**	-0.0028	**
	(10.37)		(8.59)		(1.75)		(0.02)		(5.38)		(4.48)	
MSA	-0.0035	**	-0.0037	**	-0.0015	**	-0.0009	**	-0.0018	**	-0.0025	**
	(18.00)		(21.10)		(7.15)		(3.85)		(11.88)		(12.21)	
PIPC (in $10,000)	-0.0003		0.0001		0.0028	**	0.0021	**	0.0017	**	0.0011	**
	(1.87)		(0.73)		(13.99)		(9.71)		(11.19)		(5.72)	
Quarter "dummies"	yes		yes		yes		yes		yes		yes	
N	10,314		10,314		6,245		6,245		6,221		6,221	
Adjusted-R^2	0.8022		0.8236		0.2690		0.2725		0.0633		0.0362	
Regression F-stat	1307.83		1505.48		115.87		117.91		22.01		12.69	

Table 4. Imputed Vs. Offered Rates in Structure Conduct Performance Analysis (continued)

Panel 4C **BRM Offered Rates versus CR Imputed Rates in SCP Regressions**

(with imputed rates winsorized at 1st percentile on either end of their distributions)

	NOW				MMDA			
	BRM Offered Rate (Last)		**CR Imputed Rate (End)**		**BRM Offered Rate (Last)**		**CR Imputed Rate (End)**	
Constant	0.0214	**	0.0269	**	0.0288	**	0.0330	**
	(14.91)		(3.05)		(15.45)		(12.31)	
HHI	-0.0002		-0.0013		-0.0104	**	-0.0090	*
	(0.11)		(0.12)		(4.28)		(2.57)	
MSA	-0.0010		0.0086		-0.0003		-0.0019	
	(0.94)		(1.31)		(0.23)		(0.93)	
PIPC (in $10,000)	-0.0021	**	-0.0031		-0.0007	*	0.0002	
	(7.67)		(1.84)		(2.05)		(0.35)	
Quarter "dummies"	yes		yes		yes		yes	
N	2,085		2,085		2,050		2,050	
Adjusted-R^2	0.0594		0.0036		0.0289		0.0185	
Regression F-stat	10.41	**	1.54	**	5.36	**	3.76	**

Table 4. Imputed Vs. Offered Rates in Structure Conduct Performance Analysis (continued)

Panel 4D **BRM Offered Rates versus CR Imputed Rates in SCP Regressions**

(with imputed rates winsorized at 1st percentile on either end of their distributions)

	NOW				MMDA			
	BRM Offered Rate (Last)		**CR Imputed Rate (End)**		**BRM Offered Rate (Last)**		**CR Imputed Rate (End)**	
Constant	0.0214	**	0.0254	**	0.0293	**	0.0324	**
	(14.85)		(11.33)		(16.39)		(14.67)	
HHI	-0.0000		-0.0038		-0.0102	**	-0.0077	**
	(0.00)		(1.30)		(4.31)		(2.65)	
MSA	-0.0016		-0.0051	**	-0.0012		0.0003	
	(1.48)		(3.10)		(0.88)		(0.20)	
PIPC (in $10,000)	-0.0018	**	-0.0001		-0.0006		0.0000	
	(6.52)		(0.21)		(1.87)		(0.03)	
Quarter "dummies"	yes		yes		yes		yes	
N	1,904		1,904		1,872		1,872	
Adjusted-R^2	0.0527		0.0101		0.0358		0.0143	
Regression F-stat	8.57	**	2.38	**	5.96	**	2.94	**