The value of risk

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THE VALUE OF RISK: MEASURING THE SERVICE OUTPUT OF U.S. COMMERCIAL BANKS

SUSANTO BASU, ROBERT INKLAAR and J. CHRISTINA WANG*

Banks often charge implicitly for their services via interest spreads, instead of explicit fees. Much of bank output thus has to be estimated indirectly. In contrast to current statistical practice, dynamic optimizing models of banks argue that compensation for bearing systematic risk is not part of bank output. We apply these models and find that in the U.S. National Accounts between 1997 and 2007, bank output was overestimated by 21% and gross domestic product (GDP) by 0.3%. Compared with current methods, our new estimates imply more plausible estimates of the income share of capital and the return on fixed capital of the banking industry. (*JEL* E01, E44, O47)

I. INTRODUCTION

Services are an increasingly important part of modern economies, both in terms of size and for their contribution to economic growth. However, the output data for many of these services is notoriously weak, and this is particularly the case for banking.[1] This makes it hard to determine the sources of economic growth and even the size of the economy. A major barrier to progress in this area has been the inadequacy of production models for banks. Wang, Basu, and Fernald (2009, WBF henceforth) propose a general-equilibrium model of interactions between banks, firms, and consumers to remedy this problem. In this paper, we estimate the value of output of U.S. banks following the prescriptions of the WBF model for the period 1997–2007. We find that these new estimates differ considerably from those based on current National Accounts methods: bank output is reduced by 21% and gross domestic product (GDP) is reduced by 0.3%. We argue that compared to current National Accounts, these new output estimates imply a more plausible capital share in income and internal rate of return (IRR) on fixed capital.

Measuring the value of bank output is challenging, as much of bank service output is not explicitly priced. Instead, the implicit charges for financial services are bundled with interest flows between banks and their customers, chiefly borrowers and depositors. WBF show

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1. See, for example, Diewert (2008); Griliches (1992, 1994); Inklaar, Timmer, and van Ark (2008); Triplett and Bosworth (2004).

ABBREVIATIONS

ABCP: Asset-Backed Commercial Paper
ABS: Asset-Backed Securities
C&I: Commercial and Industrial
CP: Commercial Paper
GDP: Gross Domestic Product
GSEs: Government-Sponsored Enterprises
IRR: Internal Rate of Return
IT: Information Technology
MBS: Mortgage-Backed Securities
ML: Merrill Lynch
MM: Modigliani and Miller
NIPA: National Income and Product Accounts
NP: Not Prime
PD: Probability of Default
SNA: System of National Accounts
STBL: Survey of Terms of Business Lending
WBF: Wang, Basu, and Fernald

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how implicit service revenue can be unbundled from gross interest flows by applying the idea from financial intermediation theory that the main service provided by banks in making loans is reducing asymmetric information between borrowers and lenders through screening and monitoring. Instead of receiving an upfront fee for these services, an optimizing bank can charge a higher interest rate than the rate available on a market security with otherwise the same risk attributes.

This procedure contrasts with the typical statistical practice in Organization for Economic Cooperation and Development countries.[2] According to current national accounts guidelines, banks' implicit revenue from lending services (per unit of loan balance) equals the spread between the gross loan interest rate and a risk-free rate.[3] This in effect treats loan risk premia (i.e., the return differential between a risk-free and the equally risky fixed-income security) as part of banks' value added. A producing firm's measured output will thus fall if it switches from market debt to bank loans, or will appear to rise if it starts issuing bonds rather than borrowing from banks, even if the underlying risk of the firm remains the same.

According to the WBF model, the implicit revenue from screening and monitoring services should equal the spread of the gross loan interest rate over the yield on an equally risky fixed-income security, *not* a risk-free security such as a Treasury bill or bond. This accounting method treats the risk premium as part of the borrowing firms' cost of capital and hence as part of households' capital income, their compensation for bearing risk. A key advantage of this method is that it leads to a uniform treatment of risk premia on all debt instruments, so that nonfinancial firms' output is invariant to their source of debt finance—markets or banks.

In this paper, we implement a new model-implied measure of bank output for U.S. commercial banks. To highlight the role of risk, this paper focuses on new estimates of the nominal value of services associated with loans, where our risk-based user-cost approach differs substantially from current practice. Despite our conservative estimate of risk premia, we show that imputed bank output is overstated by 45% on average in the U.S. National Income and Product Accounts (NIPA). This translates into an overstatement of total bank output, which includes explicit fees and commissions, of 21%. Netting out the lending services to nonfinancial firms, which are counted as an intermediate input, this finding implies that U.S. GDP would have been 0.3% lower on average over our sample period of 1997–2007.

A number of plausibility checks also argue in favor of our output measure. First, we compare the share of capital in banks' value added with the share of capital in the total private economy and other industries. Under current practice, banks show up as more (fixed) capital-intensive than petroleum refining, whereas our estimates suggest a capital share closer to the share of capital in the overall private sector. In addition, current practice implies an IRR on fixed assets that is 8 percentage points higher than the rate in the private sector as a whole.[4] Our new estimates imply an internal rate that is, on average, slightly lower than the rate in the overall private sector. This is more consistent with the basic principle that the IRR on fixed assets should not vary much across industries as long as capital is mobile.

The rest of this paper proceeds as follows. We begin with a brief review of the theory-implied new output measure, focusing on the role of risk. We then discuss data and present our results. We conclude with a summary, and discuss directions for future research.

II. THE MODEL FOR IMPLICIT BANK SERVICE OUTPUT

This section reviews briefly the dynamic stochastic optimizing models of banks in Wang (2003) and WBF (2009), focusing on their implications for imputing the value of bank services that are not explicitly charged for.[5] The key conclusion of these studies regarding output measurement is that implicit compensation for bank services can be inferred from a bank's total income by netting out the pure risk-based returns (i.e., costs of funds) on assets and liabilities held by the bank. To impute the cost of funds on any such risky financial instrument, one should

2. For a discussion of the current method used in the United States, see Fixler, Reinsdorf and Smith (2003).

3. See SNA (1993, 6.128).

4. Differences in systematic risk between industries can explain differences in the internal rate of return; see Section II. However, our loan risk premium estimates and stock market betas suggest that an 8% risk premium is excessive.

5. WBF (2009) extend Wang's partial equilibrium model to a general equilibrium setting, and demonstrate that all the qualitative results in the study of Wang (2003) continue to hold. Interested readers who wish to pursue the theoretical issues in greater detail are referred to those studies.

FIGURE 1

Decomposition of a Bank's Interest Flows
(Simplified Version)

Loan balance (A)

r^A

Y^A

r^M

risk premium

r^F

Y^D

r^D

interest expense

0

Deposit balance (D)
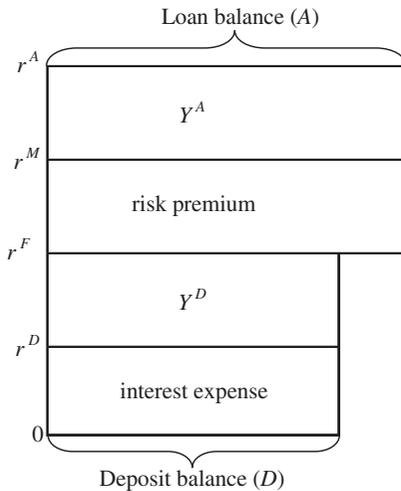
Notes:
r^A: (Average) interest rate received on loans
r^M: Expected rate of return required on market securities
     with the same (systematic) risk characteristics as
     the loans
r^F: Risk-free rate
r^D: Interest rate paid on deposits
Y^A: Nominal output of bank services to borrowers
Y^D: Nominal output of bank services to depositors
For a more detailed decomposition, see Wang (2003).

use the rate of return on (debt) securities subject to the same risk, but without any services attached. Total income net of the pure costs of funds then measures the true value of bank services implicitly charged for. This conclusion is summarized in Figure 1, which shows graphically how we impute the value of bank services related to loans (Y^A) and deposits (Y^D) using data on the interest rate paid on deposits (r^D), the interest rate charged on loans (r^A), and market interest rates on risk-free securities (r^F) and risky securities (r^M). This section outlines the theoretical arguments for choosing these particular interest rates while the next section discusses our empirical implementation.

A. Implicit Bank Services—The Case of Lending[6]

Before any attempt to measure, one must first define a concept. So, what is the output of

banks? Wang (2003) and WBF (2009) answer this question through models that embed optimal bank operations within the context of competitive financial markets. These papers recognize that the value added of banks lies in resolving information problems and processing transactions, not in generating returns on the resulting financial instruments. These returns are determined entirely by the instruments' risk characteristics and market interest rates. In particular, in these models the value added of bank lending consists of screening and monitoring activities to mitigate asymmetric information problems with regard to borrowers' creditworthiness.[7] Bank services are analogous to other professional business services, such as legal, accounting and consulting services, and indeed analogous to all production in the economy: output is generated through a production process that uses primary inputs of labor and capital, as well as intermediate inputs (such as office supplies and utilities).

In contrast, the purely risk-based returns that accrue to the stock of financial instruments held by banks are what investors would demand on any contingent claims with the same risk profiles, regardless of how they are created. These pure returns also correspond to the concept of the "user cost of funds," defined as the (risky) future payoff from investment that compensates suppliers of funds for their forgone current consumption and for bearing risk, but *not* for any attached services.[8] The costs of funds are part of the overall user cost of capital faced by the ultimate users of funds, such as nonfinancial firms. These are therefore part of those firms' value added, not the value added of the banks that provide the funds.

bundled with risk-based asset (i.e., loan) returns. See Wang (2003) for detailed accounting of services to depositors. In the empirical application, we also measure services to depositors.
    7. Banks' role in resolving information asymmetry is well recognized in the financial intermediation literature (e.g., see the survey by Bhattacharya and Thakor 1993). More recently, Allen and Santomero (2001) broaden the scope to recognize intermediaries' role as providers of specialized financial expertise. This can be interpreted as a form of transaction facilitation and thus encompassed in our definition of bank value added.
    8. This can be viewed as an extension to what is often referred to as the "user-cost" framework. Diewert (1974) was one of the first to introduce this framework and Barnett (1978) first applies it to financial assets, introducing the concept of "user cost of money." The key element of our extension is that it takes account of risk, that is, in the real world where the reward to essentially all investment is uncertain, the so-called "opportunity cost of money" is comparable across securities only after adjusting for risk.

6. For exposition of the theory, we focus on bank lending services because the measurement problem is made harder by the fact that the implicit revenue from services is

This paper concentrates on the measurement of nominal bank output, but to understand the models of Wang (2003) and WBF (2009), it is useful to consider briefly the concept of real output implied by these models. Real bank (lending) output consists of intermediation services that certify borrowers as credit-worthy at loan origination (screening) and on an on-going basis (monitoring). Thus, a natural measure of real bank output is the number of loans originated and monitored, just as a natural measure of the output of a "normal" service provider, like a barbershop, is the number of haircuts it provides. In principle, certain types of loans (e.g., small business loans) may require more information processing than others (such as conforming mortgages). Thus, a refined measure of real output would augment the raw transactions count with some notion of "quantity of service," just as a high-quality coiffure by Christophe of Los Angeles[9] should be counted as being "more haircut output" than a haircut from the local barber shop. But in any measure of real bank output, the natural starting point is the number of transactions of each type performed.

Inklaar and Wang (2007) count these transactions and aggregate them into an index of real bank output. The object of this paper, of course, is to measure nominal bank output accurately. In conjunction, these two papers imply a complete set of national income measures for banking—nominal output, real output, and an implicit price index for banking services.

B. Loan-Interest-Rate Spread—Risk versus Implicit Bank Services

The key measurement implication of Wang (2003) and WBF (2009) is that the nominal value of bank services that are not explicitly charged for can be imputed as total income net of the purely risk-based returns on the financial claims created by those services and held on the bank's book. In the case of lending services, the pure cost of funds of a loan should be inferred using the rate of return on a market debt security with the same risk characteristics (but without any services attached).

This method of matching risk is of the same nature as a common application of asset-pricing theory to corporate finance—the cost of capital for a specific investment project is set to equal the rate of return on "like" market securities. Both of these applications follow the same principle as the Arbitrage Pricing Theory in the work of Ross (1976), where the expected rate of return on a portfolio is determined given the returns on "factor" portfolios and the absence of arbitrage opportunities.[10] One obvious implication is that no firm—and no bank—would use the return on risk-free securities as the appropriate opportunity cost for an investment with risky payoff.

The logic of removing risk-adjusted returns from total bank income to impute the value of service output can be illustrated with a stylized example of "the bank that does nothing."[11] Specifically, assume frictionless financial markets, so that firms can borrow directly from households without the need for intermediaries to process information or transactions. The required (net) rate of return on any investment between periods t and $t + 1$, denoted $\tilde{r}_{t+1}$ (with the tilde emphasizing the random nature of the return), is determined by a stochastic discount factor, denoted m_{t+1}, as follows:

$$(1) \qquad E_t[(1 + \tilde{r}_{t+1})m_{t+1}] = 1.$$

Assume entities that function solely as accounting vehicles are set up as follows[12]: households transfer their capital to these entities in exchange for claims on the entities, which then rent the capital to production firms. By design, these entities have balance sheets and income statements that look like those of banks, so they are called banks for short even though they perform no services.

For simplicity of exposition, we assume these banks are fully equity funded. However, note that the banks' capital structure is irrelevant for their cost of capital in this simple model economy as here the Modigliani and Miller (MM, 1958) theorem applies. More generally, Wang (2003) showed that the central message that the user cost of funds must take risk into account does not depend on whether the MM theorem

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9. Who famously cut Bill Clinton's hair on Air Force One at Los Angeles International Airport (LAX).

10. These are all examples of the so-called relative approach to asset pricing: the value of a specific risky investment is determined taking the value of all the other assets as given. See Cochrane and Saa-Requejo (2000) for other applications of this relative approach. One prominent example is pricing options.

11. See WBF (2009) for a more detailed illustration in a general-equilibrium framework.

12. The real-world analogy is a so-called special purpose vehicle, which is a pure financing arrangement off the balance sheet of the sponsoring institution. It involves virtually no operational activities.

holds. What remains is the practical matter of finding the market rates most commensurate with the risk of financial instruments held by banks, as we discuss later in detail.

Now look at the cash flow of a representative bank. Households recognize that a bank here is just a bookkeeping device and that they ultimately own its assets—capital used in production. So they require the same rate of return on a bank's equity as on those assets. The bank must therefore lend the funds to any firm at a rate set according to Equation (1). Consequently, production firms face the same cost of capital as they would have if they had borrowed directly from households. Let $r_t^i \equiv E_t(\tilde{r}_{t+1}^i)$ denote the expected rate of return on the loan to firm i with balance A_t^i; further denote total balance of the loan portfolio as A_t and the average rate of return on the portfolio as r_t^A. Then the expected interest income on the portfolio can be expressed as:

$$(2) \quad r_t^A A_t = \sum_i A_t^i r_t^i, \quad \text{with } A_t = \sum_i A_t^i \text{ and}$$

$$r_t^A = \sum_i w_i r_t^i.$$

$w_i = A_t^i / A_t$ is the weight of loan i in the portfolio. Note that $r_t^A A_t$ is also the expected dividend payment to the households who own the bank.

The correctly imputed value of bank service output should be zero on average as by design the banks produce no real services.[13] This is exactly the result if the value of services is imputed as the bank's total income net of its risk-adjusted cost of funds, that is, $A_t(\hat{r}_{t+1}^A - r_t^A) \approx 0$, because $\hat{r}_{t+1}^A - r_t^A = \sum_i w_i(\hat{r}_{t+1}^i - r_t^i) \approx 0$, where $\hat{r}_{t+1}^i$ and $\hat{r}_{t+1}^A = \sum_i w_i \hat{r}_{t+1}^i$ are the realized rate of return on loan i and on the portfolio, respectively.

In contrast, if the value of services is imputed by subtracting risk-free returns from total income, as in the existing national income accounting practices, then on average the bank will be credited with producing positive output of services, as in general the expectation of $\hat{r}_{t+1}^A - r_t^F \approx r_t^A - r_t^F > 0$.[14] This result follows

directly from expanding Equation (1), which applies to r_t^i and hence also to r_t^A, and substituting $1 + r_t^F$ for $1/E_t(m_{t+1})$ (which is itself an application of Equation [1] to risk-free assets):

$$(3) \quad r_t^A = (1 + r_t^F)[1 + \text{cov}(\tilde{r}_{t+1}^A, -m_{t+1})] - 1,$$

where r_t^F is the yield on a debt of the same maturity but not subject to any risk (e.g., default), nor with any embedded options.[15] U.S. Treasury's are the best example.[16] r_t^F only compensates investors for sacrificing current for future consumption with certainty. A security with risky payoff that cannot be diversified away and is (negatively) correlated with the stochastic discount factor, however, must in expectation pay a return premium $\text{cov}(\tilde{r}_{t+1}, -m_{t+1})$, to make up for the risk-induced disutility.[17] This premium is positive for almost all risky assets (see any finance text, e.g., Campbell, Lo and MacKinlay 1997).

This stylized example serves to intuitively highlight the conceptual problem of using the risk-free rate to impute bank output. Wang (2003) and WBF (2009) show that similar overestimation of bank output arises in the realistic case where banks provide actual services—processing information and transactions—for which no explicit fees are charged but implicit compensation is earned via an interest-rate spread.

To infer the value of such implicitly priced services as part of banks' net interest income, Wang (2003) solves for the optimal interest rate charged by a value-maximizing bank when making loans with the same (systematic) risk profile as a type of existing market debt. The usual first-order condition gives rise to the following expression for the rate of return (denoted r_t^A) the bank should expect to earn on a loan portfolio:

$$(4) \qquad\qquad r_t^A = r_t^M + r_t^S.$$

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13. To the extent the portfolio is sufficiently diversified and the persistence in aggregate shocks is accounted for, realized returns averaged across firms should basically equal the conditional expectation.

14. The mirror image of this over-counting of bank output is the under-counting of borrowing firms' output—reduced on average by $(r_t^A - r_t^F)$ simply because of the change in accounting method.

15. Yields on bonds must be adjusted for the embedded option to be comparable with those on option-free debt instruments. Bonds that allow prepayment, such as MBS, essentially have an embedded call option.

16. They are typically considered risk-free in that they earn a guaranteed return, r_t^F, if the debt is held until maturity. Note that even for this type of debt there is still interest rate risk, that is, the holding-period return is almost surely uncertain if one sells it prior to the maturity date.

17. In the consumption-capital asset pricing model, which can be expressed as a specific case of Equation (1), this means assets with payoff positively correlated with consumption growth have to pay a positive return premium.

$r_t^M \equiv E_t(\tilde{r}_{t+1}^M)$ is the expected rate of return demanded by investors on the market debt with the same risk. The r_t^S represents what we shall call the service spread, which generates the extra interest that compensates the bank implicitly for processing the loan. The optimal service spread r_t^S in Equation (4) satisfies the condition that the extra interest receipt, $r_t^S A_t$, equals the (weighted average) marginal cost of processing a loan multiplied by the optimal markup.[18] This markup is determined by competition in the loan market.

In the nomenclature of the 1993 System of National Accounts (SNA 1993), r_t^M in Equation (4) is called the reference rate—serving as reference for the cost of funds on the loan. For a market rate to be the proper reference, the security should not only have similar risk, but banks should also face the same marginal tax rate and transaction costs faced by typical investors in the reference market debt.[19] We argue that this is likely a reasonable assumption for the reference rates used in our empirical exercise, as most of the market securities chosen as references for bank loans are backed by securitized pools of loans, such as mortgage-backed securities (MBS), and the securities are routinely held on bank balance sheet along with those same categories of loans. That is, by revealed choices of asset allocation, banks appear to consider these securities as offering similar rates of return as the corresponding categories of loans. The reference rate for a portfolio of loans (of varying types, maturities and rate-reset dates) is then a weighted average of rates on the individual loans.

C. Imputing the Value of Implicit Bank Services

Derivations in the previous section imply that, on average, a bank's nominal output of implicit lending services to borrowers should equal $r_t^S A_t = (r_t^A - r_t^M) A_t$. But neither of the expected rates of return, r_t^A and r_t^M, is observed. So, for empirical estimations, we make use of the relationship that the expected rate of return

on a defaultable debt equals its promised yield to maturity (i.e., the contractual interest rate, denoted by R_t^k) corrected for its expected loss rate due to default (denoted by d_t^k)[20]:

$$(5) \qquad r_t^k = R_t^k - d_t^k, \quad k = M, A.$$

$d_t^k \equiv E_t(\tilde{d}_{t+1}^k)$, where d_t^k is the (random) default loss rate. For market securities, R_t^M's are generally observed while d_t^M's can be estimated using time series data.[21] For loans, d_t^A's can be estimated as well, although R_t^A's are less often observed. Substitute Equation (5) into Equation (4) and we can impute the output of lending services as[22]:

(6)
$$Y_t^A = r_t^S A_t = [(R_t^A - d_t^A) - (R_t^M - d_t^M)]A_t.$$

Previous discussions make it clear why the reference rate ($r_t^M = R_t^M - d_t^M$) should be risk-adjusted. Therefore, the reference rate varies across loan types, depending on risk characteristics of the loan or portfolio of loans associated with the services considered.

In contrast, the U.S. NIPA currently impute bank services to borrowers using a nearly risk-free rate as the reference rate:

(7)
$$(r_t^A - r_t^F)A_t = (r_t^S + r_t^P)A_t = Y_t^A + r_t^P A_t,$$

where $r_t^P = r_t^M - r_t^F$ is the return premium of the reference risky market securities over (maturity-matched) risk-free securities; it equals $(1 + r_t^F)\text{cov}(\tilde{r}_{t+1}^M, -m_{t+1})$ (see Equation [3] above).

The value of output imputed according to Equation (7) will overstate the actual value of service output. According to some, the informal justification for Equation (7) is that $r_t^P A_t$ is regarded as compensation for rendering a so-called "risk-bearing" service. Wang and Basu (2007, Section 3.4) discuss at length why risk-bearing is not a productive service according to the conceptual framework of SNA 1993.

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18. That is, the bank charges an implicit price for its intermediation service, equal to a markup on the marginal cost of producing that service. The cost is determined by a loan officer's labor input in processing a loan, plus the amount of physical capital and supplies used for that task.

19. For banks, additional distortions are introduced if deposit insurance is not fully risk sensitive (see Wang 2003 for a detailed treatment). Here, we assume that deposit insurance is fairly priced for the banking industry as a whole, and ignore distributional effects.

20. The d_t^k equals the product of the probability of default (PD) and the expected loss rate given default. If the latter is near 100%, then d_t^k is close to the PD. Wang (2003) details the distinction between promised yield and expected rate of return. The equation here is exact only for instantaneous returns, and is used as an approximation in discrete-time cases. See Duffie and Singleton (2003) for continuous-time models of defaultable debt pricing.

21. The conditional estimate of d_t^M, such as KMV's expected default frequency, is procyclical.

22. See WBF (2009) for a detailed discussion of how the actual value in each period still deviates from this average.

More importantly, they show that the NIPA's imputation results in inconsistent accounting of the output of *borrowing* firms, by making firms' measured value added depend on their sources of funding. Suppose two firms are identical, but one borrows from banks and the other from the bond market. Then the firm relying on banks is credited with producing lower value added than the one issuing bonds, even if their actual productive activities are identical.

The value of implicit depositor services can be imputed in a similar manner to the new way we imputed the value of implicit lending services. Let D_t denote the deposit balance, and r_t^D the interest rate paid; R_t^M and d_t^M are defined as above (but the values almost certainly differ), then nominal output of depositor services can be imputed as:

$$(8) \qquad Y_t^D = [(R_t^M - d_t^M) - r_t^D]D_t.$$

For insured deposits in the United States, the relevant reference rate should be the risk-free (Treasury) rate, that is, $R_t^M = r_t^M = r_t^F$, as $d_t^M = 0$. For the remaining, uninsured, deposits, $R_t^M - d_t^M > r_t^F$, because the deposit holders are exposed to some (default) risk in bank asset portfolios. In our empirical application, we abstract from this issue and effectively assume that all deposits are insured, and hence risk-free.

Note that Equation (6) implies that if a bank passively holds market securities in its investment portfolio, there are no services provided to the asset issuers (i.e., $Y^A = 0$), as $R^A = R^M$ and $d^A = d^M$. Likewise, Equation (8) implies zero implicit services (i.e., $Y^D = 0$) provided to holders of bank term liabilities (commercial paper, market bonds, and privately placed bonds), as the interest rate paid equals the reference rate ($R^D = R^M$ and $d^D = d^M$). Also note that under virtually all circumstances (i.e., whenever there are equity holders), $(r^M - d^M)$ in Equation (6) is greater than its counterpart in Equation (8), because bank assets are typically riskier than bank liabilities. In other words, the reference rates for imputing lending and depositor services almost always differ by a positive margin.

So again, recall that Figure 1 illustrates the imputed nominal output value of implicit bank services. Note that only part of a bank's net interest income constitutes nominal output of bank services; the remainder—corresponding to the risk premium, $(r^M - r^F)A$—is excluded.[23]

This is precisely because the reference rate for lending services generally exceeds that for depositor services. The risk premium, along with actual interest expenses on bank liabilities, constitutes a pure transfer of capital income. It is part of the factor income generated by the capital used in the borrowing firms' production or in the consumption of consumers. This factor income is then transferred from the end users of funds to the ultimate suppliers of funds—the bank shareholders. Only when all investors are risk neutral or all risk is idiosyncratic will this risk premium disappear. Figure 1 illuminates how our model-based output measure differs from the NIPA's current measure, which uses a (nearly) risk-free rate as the single reference rate (see Fixler, Reinsdorf, and Smith 2003).[24] As we have argued, the NIPA's measure overstates bank output by the amount of the risk premium. In the remainder of this paper, we discuss how to estimate the risk premium and its quantitative impact on the measured output of the U.S. commercial banking industry.

III. DATA AND EMPIRICAL ESTIMATES OF BANK SERVICE INCOME

A. Data Sources

Accounting data for individual commercial banks come from the Consolidated Reports of Condition and Income (the Call Reports).[25] These are quarterly financial statements filed by banks to their regulators and made available by the Federal Reserve Bank of Chicago. Our empirical estimates use data from the second quarter of 1997 to the fourth quarter of 2007, mostly because some of the necessary variables are not available for earlier years.

The Call Reports data are used to estimate the average interest rate earned by banks on each category of loans and deposits. The Call Reports also provide data on the repricing period of various categories of loans. Yields on U.S. Treasury

23. As is shown, the balance of loans exceeds that of deposits, with bank equity making up the difference. This

figure is a simplified version of Figure 1 in Wang (2003), as it ignores risk premia on deposits because of uninsured deposits. That is, for deposits it sets $r^M = r^F$, and overstates depositor services.

24. Specifically, it is a weighted average rate of return on all U.S. Treasury securities held on banks' book. So it generally exceeds what is commonly viewed as the risk-free rate—the 90-d Treasury bill rate—as banks also hold longer term Treasury notes and bonds.

25. These correspond to the forms FFIEC 031-041; see www.ffiec.gov for details.

securities of varying maturities are from the Federal Reserve Board,[26] as are yields on commercial paper of the top two tiers of ratings; yields on the remaining tiers are from Bloomberg. Yields on mortgage- and asset-backed securities are based on indices constructed by Citigroup Global Markets and Merrill Lynch (ML). Finally, interest rates charged on commercial and industrial (C&I) loans for clients with various risk profiles come from the Federal Reserve Survey of Terms of Business Lending (STBL).[27]

B. Implementation—Overview

The Call Reports afford no direct observation of either the promised yield (R_t^A) or the expected default rate (d_t^A). Instead, what is reported is the average interest rate actually received by banks on each individual category of loans and securities, that is, $R_t^A - \hat{d}_{t+1}^A$, where $\hat{d}_{t+1}^A$ is the realized default loss rate (indexed $t+1$ because it becomes known only at the end of period t). Plug this into Equation (6) and we can express the service spread r_t^S as

$$(9) \quad r_t^S = [(R_t^A - \hat{d}_{t+1}^A) - (R_t^M - d_t^M)]$$
$$+ (\hat{d}_{t+1}^A - d_t^A) \approx (R_t^A - \hat{d}_{t+1}^A) - R_t^M$$
$$+ (\hat{d}_{t+1}^A - d_t^A).$$

This is our basic formula for imputing the value of implicitly priced services to borrowers. As will be shown in the following text, the expected default rate d_t^M is often considerably lower than 1% for the market securities we use for reference rates. Therefore, the service spread can be inferred from the realized loan interest rate and the matched market yield R_t^M, after correcting for the deviation of the actual from the expected rate of loan default. The empirical estimate of each term will be detailed in turn.

The Call Reports data dictate that we can match loans with market securities in only a few broad categories: real estate loans with MBS, consumer loans with asset-backed securities (ABS), and C&I loans with commercial paper. So, the reference rate ($r_t^M = R_t^M - d_t^M$) used for each category is a (noisy) proxy for the true risk-matched reference rate, as we observe

little of the risk composition and only limited information about the maturity of the loans and thus cannot assess the accuracy of the match. Nevertheless, using market debt returns almost surely underestimate the true risk premium on loans, as market securities on average have much lower realized default rates and are therefore likely to command lower risk premia as well.[28]

Another issue is that in each period we observe only the average interest rate earned by a bank on its portfolio of a given type of loans, regardless of when the loans were priced. In particular, for loans with long periods of fixed rates, like mortgages, this loan portfolio will also include loans that were priced years ago. Comparing this average rate with current market rates to impute the service spread is obviously not correct. Unfortunately, the data necessary for a proper matching—gross flows of new loans originated and old loans paid off or reset at a new interest rate in each period—are not available. So, rather than trying to make rough assumptions about the composition of the loan portfolios, we compare the average interest rate to the current market reference rates in our baseline estimates.[29]

The one exception is C&I loans where we use data from the STBL, which provides data on the interest rate charged on new C&I loans originated by commercial banks in the survey week. In this case, we can match the timing of bank loan interest rates and the market rate. While still not perfect, this matching likely provides a more accurate estimate of actual service spreads than could be obtained by using the difference between average bank loan rates earned and current market reference rates.

Estimating depositor services according to Equation (8) is straightforward, especially once we assume $r^M = r^F$. This assumption is necessary, because the Call Reports do not provide adequate data for estimating the risk premium on uninsured deposits, whose share is, fortunately, modest.

To further implement Equation (8), the difference between the realized and expected default rate should be added as part of the service spread. We estimate these terms by using data

from the Call Reports on charge-offs of the different loan categories. The expected default rate is proxied by the period-average charge-off rate. The only remaining piece of information is then the risk premium of each loan category.

C. Estimates of Risk Premia

To facilitate comparison with the NIPAs' current measure of bank output, we estimate separately the two components—the risk-free rate and the risk premium—of the reference rate for each category of loans. The risk premium on a reference security is[30]:

$$(10) \qquad r_t^P = r_t^M - r_t^F = R_t^M - r_t^F - d_t^M.$$

Data indicate that the unconditional estimate of d_t^M, equal to the long-term average of realized defaults, is extremely low for certain categories of market debt, such as commercial paper. For example, according to Moody's, the historical average default rates of commercial paper with the top two rating grades (P-1 and P-2) are basically nil.[31] So, for certain categories of loans, when such corporate debt is used as the reference securities, a reasonable estimate of r_t^P is simply the yield spread between such debt and the maturity-matched Treasury securities (i.e., $R_t^M - r_t^F$); the upward bias from ignoring d_t^M should be negligible.

To compute the respective risk premium on C&I loans, we rely on the Federal Reserve's STBL to gauge the default risk and maturity composition of C&I loans and find the best matched market securities.[32] Data from this survey indicate that about 70% of C&I loans are repriced in less than a month and over 90% in less than a year. This suggests that commercial paper is a more appropriate type of reference security than corporate bonds. On the other hand, using the yields on commercial paper likely results in conservative estimates of the risk premium on C&I loans, as C&I loans

tend to have both longer average maturities and greater default risk than commercial paper.[33]

Among the four risk categories reported in the STBL, two have readily available reference market securities. First, according to the filing instructions, the "minimal-risk" classification explicitly requires that the loans be to customers with a bond rating of AA or higher; such firms generally also carry a P-1 short-term rating by Moody's. Second, the "low-risk" category requires customers to have a BBB bond rating, which maps into a P-2 rating by Moody's.[34] However, the reference securities for the other two, higher, risk categories, "moderate risk" and "other," are not as clear. So we assume that the higher interest rate related to the "low-risk" category is entirely as a result of greater risk but not to extra implicit service revenue.

Over the sample period, the risk premia of loans in the minimal-risk and low-risk categories average 0.2 and 0.5 percentage points, corresponding to the risk premia on P-1 and P-2 commercial paper, respectively. By comparison, loans in the moderate-risk and the other-risk categories carry considerably higher average risk premia: 1.4 and 2.3 percentage points, respectively.[35] As the latter two categories on average account for 60% of the volume of new C&I loans reported in the STBL, the weighted average risk premium for all C&I loans is 1.3 percentage points in our time series. This weighted average is computed using the volume of new loans in each category as weights.

Instead of assuming that higher interest rates on moderate risk and other C&I loans are fully because of higher risk premia, we could also assume they are fully because of higher information processing costs. This would imply using the commercial paper spread for low-risk C&I loans as the market reference rate for the moderate-risk and other categories. Doing so would reduce the overall risk premium from 1.3 to 0.5 percentage points and almost double the average service spread from 0.9

30. For coupon bonds, r^M and r^F should in fact be matched by duration, not maturity. However, because we have no data on the durations of private-sector market debt, we assume that the flow of their coupon payments is such that each debt's duration is similar to that of the maturity-matched Treasury.

31. "For a 180-d period, these risks are estimated to be 0.00% for P-1, 0.02% for P-2, 0.12% for P-3, and 0.43% for not prime (NP)." www.moodyskmv.com/research/whitepaper/60917.pdf.

32. It is possible that the loans covered in the survey are still not representative of the banking industry as a whole, or at all times. But this is the best micro data source available, and there is no reason to suspect systematic bias.

33. The match is not improved by using asset-backed commercial-paper (ABCP) which some would argue is a better reference for secured bank loans. The yields on ABCP and on regular nonfinancial CP are virtually the same until July, 2007, when the subprime-induced financial turmoil broke out in the United States.

34. AA and BBB are bond ratings by S&P, equivalent to ratings of Aa2 and Baa2 by Moody's. The mapping between long- and short-term ratings can be found at http://federalreserve.gov/releases/cp/about.htm.

35. For reference, the risk premium time series for each loan category is reported separately in Figure A1.

to 1.7 percentage points on average over the period. However, total imputed bank output would only increase by 6% on average, which does not materially affect our main results.

The risk premia of consumer installment and credit card loans are estimated using ML's ABS indices for fixed-rate auto and credit card loans, respectively. A weighted average yield is computed based on the share of credit cards versus all other loans in the portfolio. The average rating of the ABS underlying the two indices is between BBB and AA, as both these indices are components of ML's ABS master index.[36] Following this procedure almost certainly yields a rather conservative estimate of the average risk premium on the consumer loans held on the books of banks because to receive investment-grade ratings, the ABS invariably must obtain credit enhancement to ensure that their holders will be subject to minimal credit risk.[37] Moreover, even at the original loan level, the loans kept on banks' books may be riskier than the ones that are securitized.[38] In terms of maturity, however, no data are available to gauge how well on average the indices' constituent bonds match consumer loans held by banks.[39] The average duration of these ABS indices is fairly short, so we compare the average ABS rate to an average of 1- and 2-yr Treasuries.

We thus obtain an average risk premium of 0.7 percentage points. This is likely a conservative estimate as this is lower than the average C&I premium of 1.3 percentage points, whereas contractual rates on consumer loans are on average much higher than the rates charged on C&I loans. As a sensitivity check, we also estimated the risk premium based on a BBB-rated corporate bond index, which covers the most risky investment-grade securities.[40] This would increase the average risk premium from 0.7 to 1.8 percentage points and reduce the financial service output associated with these loans by 20% and total bank output by 7%. Because the impact on total output is quite modest, we stick to the risk premium estimate based on the ABS index as our baseline case. Besides, there is no concrete information to substantiate that the BBB-rated corporate bond index is more appropriate as the market reference for consumer loans.

To estimate the risk premium on real estate loans, we use the maturity-weighted redemption yields on MBS issued by government-sponsored enterprises (GSEs, such as Fannie Mae and Freddy Mac) as the reference rate. The maturity data are available in the Call Reports (schedule RC-C) since the second quarter of 1997. Again, this reference rate likely gives a conservative estimate of the risk premium on these loans as agency MBS are not subject to default risk but only to prepayment risk: mortgage holders may repay their loans in part or in full ahead of schedule.[41]

The real estate loans in bank portfolios have a repricing period or remaining maturity between 6 and 10 yr in the sample period, so we compare an MBS index with a long remaining maturity (7–10 yr) to a maturity-matched average of Treasury yields. The resulting risk premium is 1.2 percentage points over this period, as a sensitivity check we again applied the 1.8 percentage points risk premium based on BBB-rated corporate bonds. This reduced service output associated with these loans by almost 80% and in fact led to negative service output in one-third of the quarters. This makes it highly unlikely that banks would use such a BBB corporate rate as the reference when setting interest rates on real estate loans.

For the yield on the MBS index to be a good proxy for the pure (risky) return in the loan rates, a substantial fraction of the mortgage

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36. We choose not to use a general index for the ABS market because, between 2003 and the first half of 2007, a rapidly growing share of the market comprised securities backed by subprime and Alt-A mortgage loans—from less than 20% in 2003 to over 30% in 2006, according to the Securities Industry and Financial Markets Association.

37. Credit enhancement can be obtained in a variety of ways. It can be purchased from third parties such as insurance companies, or created "internally" by forming a sufficient loss-absorbing cushion of junior claims within the tranche structure "wrapped" around a pool of assets in a manner that enables the issued ABS can obtain senior ratings.

38. Using securitization to save on capital requirements is a form of regulatory arbitrage. This may not be a major concern; for example, Calomiris and Mason (2004) find little evidence of this motivation in banks that securitize credit card loans.

39. As these are indices for fixed-rate ABS, their average maturity may exceed that of the underlying consumer loans, some of which carry floating rates.

40. Non-investment-grade bond indices have yields much higher than the average rate received on consumer loans, most likely because of the high default premium (i.e., d_t^M above).

41. None of the conforming residential mortgages that back the agency MBS carry prepayment penalties; this amounts to an implicit call option. The option is most likely to be exercised when the current period mortgage rate falls below the loan's contractual interest rate. See, for example, Dunn and McConnell (1981) or Kau et al. (1992) for the magnitude and determinants of prepayment risk.

portfolio must be repriced in the period of consideration. This timing requirement is made clear in Equation (9): the reference rate should be for the period when a loan's interest rate was set or *last* reset.[42] To gauge the extent to which the above baseline estimates are affected by the interest-rate timing mismatch, a problem that we suspect is particularly acute for long-term, fixed-rate loans such as many residential mortgages, we also compute the risk premium on real estate loans using a series of moving averages of current and past (up to 5 yr) market rates. For the period 2002–2007, the average service spread on mortgage loans using current market rates is 0.80%, while that using the 5-yr moving average rates is 0.69%. Service spreads estimated using shorter moving averages lie in between. A maximum effect of 0.11 percentage points is modest compared to the average service spread of 0.80, so timing mismatch between bank loan rates and the market reference rates is not a major concern for real estate loans.

In summary, except for the two least risky (minimal- and low-risk) categories of C&I loans, we lack high-frequency data to accurately estimate the riskiness of the loan portfolios on bank balance sheet. Therefore, our choices of reference rates for the other bank loans rely on the assumption that the systematic risk of each category of loans is similar to that of the market securities based on securitized pools of that category of loans. On the other hand, our sensitivity analysis suggests that, even apart from the issue of theoretical justification, raising all the reference rates to as high as yields on the lowest investment-grade (i.e., BBB-rated) corporate bonds would not significantly alter the results reported in the remainder of this paper. So, hereafter we present only results based on the reference rates derived above using market securities structured from securitized loans.

For transaction deposits, which are short-term and largely default-risk-free debt claims, we use the 3-mo Treasury bill yield as the reference rate, which we will refer to as the risk-free rate in the empirical subsection below. The reference rate for savings and time deposits is the average yield on maturity-matched Treasuries. Its spread over the 3-mo Treasury yield is a term premium. Similarly, the term premium for each category of loans is defined as the yield spread

between the loan-maturity-matched Treasuries and 3-mo Treasury bills. We will show how much the estimate of bank service output would be affected even if we only account for the term premia in loan interest rates but not the risk premia.

D. New Estimates of the Value of Borrower and Depositor Services

Given the reference rate for each category of loans, we now estimate borrower and depositor services. Table 1 is a detailed exposition using the estimates for the fourth quarter of 2007, comparing our model-based, service-flow measure of bank output with the measure that approximates NIPA's current methodology.[43] In total, it lists five types of services—to holders of two types of deposit accounts and borrowers of three types of loans.[44] Other categories of assets and liabilities, such as investment securities and subordinated debt, are excluded because, as explained in Section II, their holders do not receive financial services created by banks.[45]

Table 1 shows that for 2007:Q4, the risk-adjusted reference rates on the three types of loans are at least one percentage point higher than the risk-free rate. Using the risk-adjusted reference rates lowers the imputed value of borrower services by $116.8 billion (from $205 to $88.2 billion). To gauge the impact on GDP, we net out the value of borrower services to businesses (i.e., services related to commercial real estate loans and C&I loans).[46] Accordingly, GDP in 2007:Q4 would be $52.9 billion, or 0.4 percentage points, lower using our risk-adjusted bank output measure. We suspect that

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42. There are, of course, timing issues regarding when the screening or monitoring is done versus when the implicit revenue is recognized. See WBF (2009) for an in-depth discussion.

43. As mentioned before, the NIPA methodology uses the return on bank Treasury portfolios as their reference rate, see Fixler et al. (2003). The comparison we make in Figure 1 is based on similar reasoning though.

44. Among the loan categories covered in the Call Reports, we consider only those for which reasonably similar reference securities can be found in the market. So, lease financing receivables are excluded. Moreover, we include only loans and deposits made in banks' domestic offices, because activities in foreign offices do not contribute to U.S. GDP. In sum, the four categories in Table 1 account for 90% of the total balance of loans and leases in 2007.

45. By excluding these, we further reduce our measure of bank output relative to the NIPA methodology, which includes other financial assets and liabilities. However, as shown by Fixler et al. (2003), these sources of imputed output are quantitatively unimportant.

46. We infer the former from total services related to real estate loans, based on the simplifying assumption that the share of services to commercial customers is proportional to the share of commercial loan balances in total real estate loans.

TABLE 1

The Effect of Risk Adjustment: Imputed Output of U.S. Commercial Banks at Current Prices in 2007:Q4 ($billions)

				Reference Rate			Imputed Output		
	Average Balance	Interest Flow	Annualized Interest Rate (%)	Risk-Free (%)	Term (%)	Default and Term (%)	Risk-Free	Term	Default and Term
Deposits in domestic offices	5,504	152	2.8	3.5	3.5	3.5	39.0	42.5	42.5
Demand deposits	486	0.0	0.0	3.5	3.5	3.5	16.9	16.9	16.9
Time and savings deposits	5,018	152.2	3.0	3.5	3.5	3.5	22.1	25.6	25.6
Loans in domestic offices	5,471	395	7.2	3.5	4.0	5.7	205.0	177.0	83.7
Real estate loans	3,545	235.3	6.6	3.5	4.3	5.8	112.2	84.3	31.5
Consumer loans	804	80.9	10.1	3.5	3.5	4.9	53.0	52.9	41.1
Commercial and industrial loans	1,123	78.8	7.0	3.5	3.5	6.0	39.8	39.8	11.1
Total	10,975	547	6.6	3.5	3.8	4.6	244.0	219.5	126.2

Notes: "Average balance" is the average of the balance reported on December 31, 2007 and September 30, 2007. "Interest flow" is the actual interest received or paid within the quarter. "Annualized interest rate" is the interest flow divided by the average balance and then annualized. The risk-free reference rate is the average 3-mo Treasury yield, the term-adjusted reference rate is the Treasury yield corresponding to the average maturity of the loans or deposits, and the default- and term-adjusted rate also includes the default-risk premium. See Tables A1 and A2 in the Appendix for details of the Call Report data items used in constructing these variables.

this figure is on the low end because, as detailed above, we have adopted conservative estimates of risk premia to adjust the reference rates for risk.

Figure 2 plots the respective average risk-adjusted reference rates for deposits and loans from 1997:Q2 to 2007:Q4. Throughout the sample period, the risk plus term premium stays positive, so the average reference rate for loans consistently exceeds that for deposits. For comparison, Figure 2 also plots the actual average interest rate paid on deposits and received on loans, respectively. The quarterly average rate is calculated as the interest received or paid during a quarter over the average balance of the corresponding instruments for the quarter.[47] It is clear that the interest rates paid on deposits are on average more inertial than the risk-free reference rate, a well-documented, stylized fact in empirical banking studies (e.g., Berger and Hannan 1989). Likewise, the interest rates received on loans are on average less volatile than the reference market rates.

Figure 2 also shows that the average loan rate consistently exceeds the average loan reference rate, implying a positive service spread on average. In contrast, the average deposit rate was higher than the deposit reference rate between late 2001 and early 2004. This does not mean that banks provided transaction services at a loss as bank customers pay explicit charges as well. To illustrate: in the years when imputed output related to deposits was negative (−$1.4 billion in 2001 and −$6.3 billion in 2002), the explicit deposit charges amounted to $29.7 billion (2001) and $31.7 billion (2002). Furthermore, Flannery (1982) explains negative margins on deposits as reflecting the quasi-fixed nature of deposit relationships. That is, depositors are to some degree "locked" into a bank account because of the costs they would incur to switch banks; in return, banks implicitly commit to smoothing deposit interest rates.[48] Also note that these negative margins are not a consequence of estimating risk-adjusted reference rates because the deposit reference rates contain no risk premia. So, negative interest margins can well be a feature of the current NIPA methodology.[49]

47. Table A1 in the Appendix lists the specific data items used in calculating the average interest rate on each category of securities, loans, and deposits. Table A2 summarizes major changes, in terms of reporting requirements and variable definitions, in the Call Reports between 1997 and 2007 and the way they are handled to arrive at harmonized time series.

48. See also Berlin and Mester (1999) on interest rate smoothing as a feature of relationship banking.

49. In practice, the BEA uses the average return on Treasuries on bank balance sheets as their overall reference

FIGURE 2

Average Interest Rates on Loans and Deposits, and Corresponding Reference Rates,
1997:Q2–2007:Q4
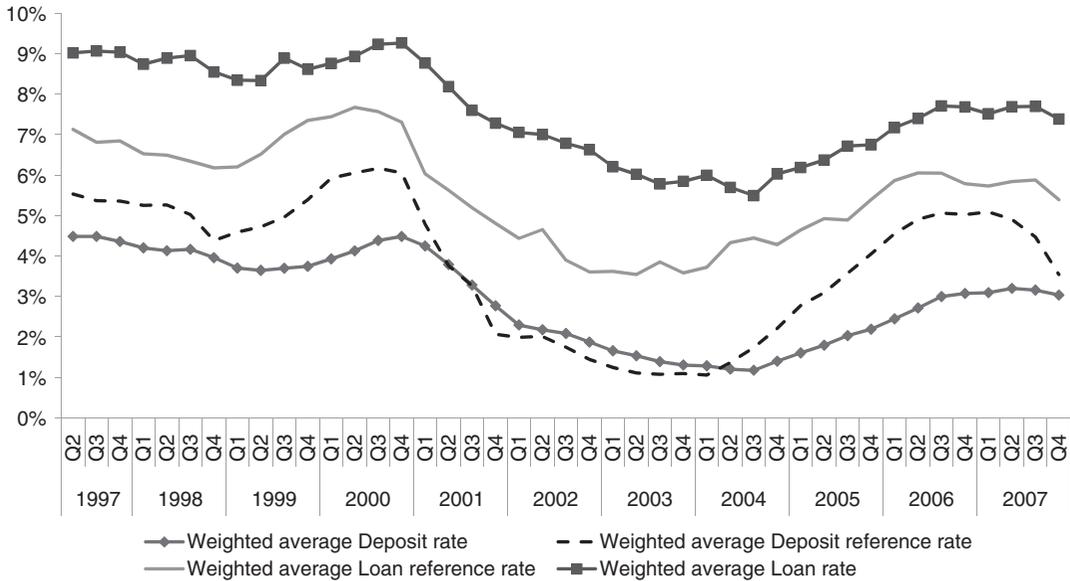
In Figure 3 we plot the service spreads for deposits and loans directly.[50] Not surprisingly, the two spreads frequently move in opposite directions, as their formulae carry negative signs (see Equations [6] and [8]), while both actual rates are more inertial than the respective reference rate. Furthermore, the spreads appear to co-move with the business cycle: the deposit-service spread narrows, while the loan-service spread widens following monetary easing in economic downturns, and vice versa. Variations in the loan-service spread can mostly be traced to C&I and consumer loans, as the service spread on real estate loans remains fairly stable throughout the period (see Figure A2). One possible explanation for this pattern is that bank C&I loans become riskier relative to commercial paper in periods of economic weakness, possibly because smaller or riskier firms are more likely to draw on their credit lines in bad times. If this is the case, then our empirical results underestimate the risk premium on C&I loans in such periods.

Figure 4 depicts the imputed bank service income and the compensation for risk.[51] Compensation for term risk and default risk represents the difference between our new model-implied measure of bank output and the NIPA's current measure. Variations over time in income from the two services echo those in the two service spreads depicted in Figure 3. The term-risk compensation too is time-varying; it rises as the yield curve steepens, and falls as the yield curve flattens. In comparison, the default-risk compensation is more stable over time. Especially worth noting are the last two quarters of 2007. Compensation for both default and term risk increased sharply because of the turmoil in financial markets and the monetary easing that followed in response.

We note that the output series of implicit bank services based on our risk-adjusted reference rates is more volatile than that based on the

rate. However, these Treasuries on average have longer maturities than deposit accounts.

50. Figure A2 shows the service spread separately for the three loan categories.

51. "Loan services" in the figure corresponds to Y^A in Equation (6), and "Deposit services" to Y^D in Equation (8). "Default risk compensation" corresponds to the term $r^A A$ in Equation (7). "Term risk compensation" denotes the return because of maturities longer than 3 mo.

FIGURE 3

Weighted Average Service Spread for Loans and Deposits, 1997:Q2−2007:Q4
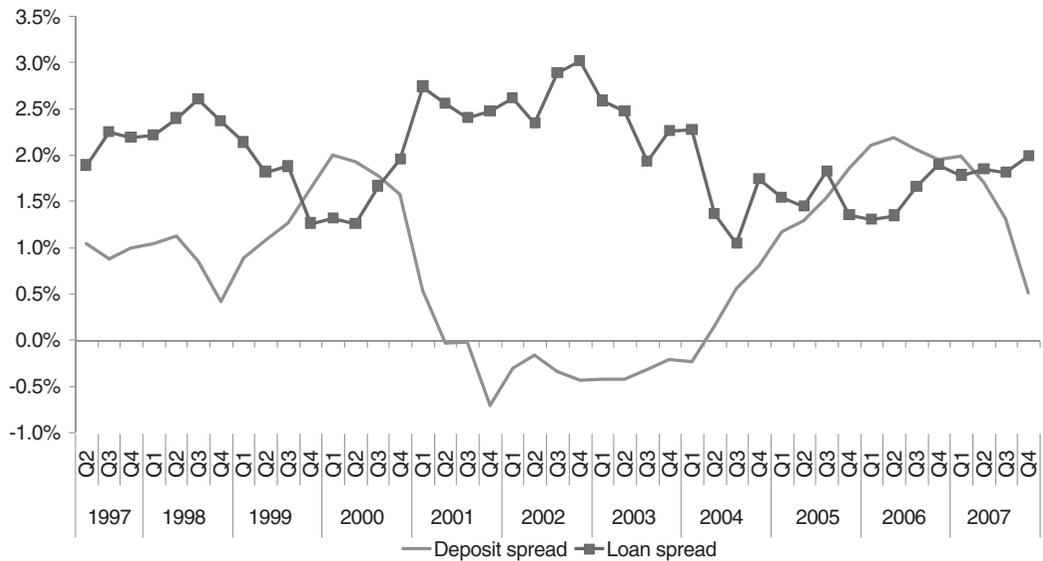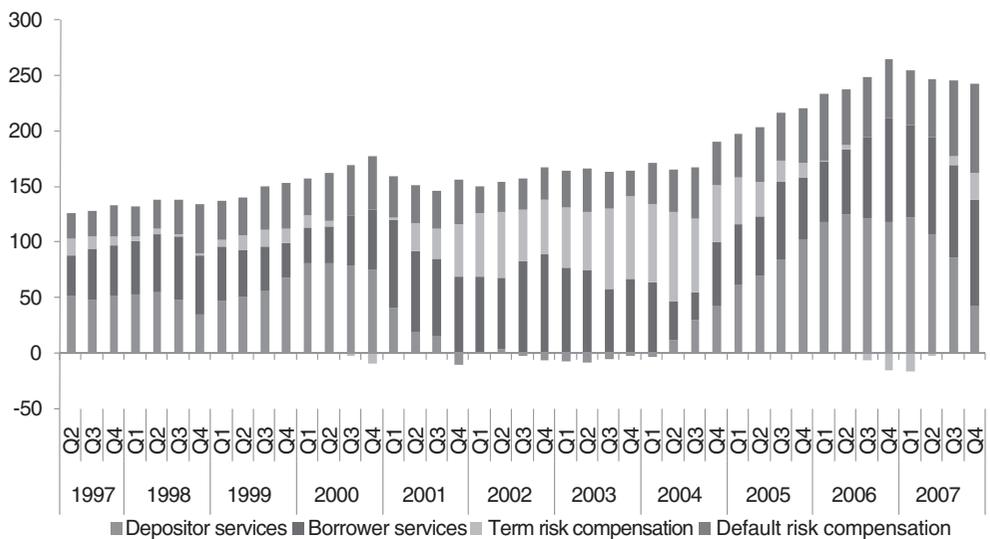

FIGURE 4

Imputed Output of U.S. Commercial Banks and Risk Compensation at Current Prices, 1997:Q2−2007:Q4 (Billions of Dollars)

Notes: "Deposit services" equals the deposit service spread (cf. Figure 3) times the quarterly average deposit balance (see equation). "Loan services" equals the loan service spread (cf. Figure 3) times the quarterly average loan balance at all banks (following equation); "Term risk compensation" denotes the value of the return on loans and deposits due to maturities longer than 3 months. "Default risk compensation" denotes the value of pure default risk-based return on loans.

risk-free reference rate.[52] Some cite this fact as basis for objecting to risk adjusting the reference rates in practice. We argue that this result per se is little ground for counting risk compensation as part of bank output, even considering the likely practical difficulty.

First of all, the volatility of growth rates of overall risk-adjusted bank output, inclusive of explicit fees, is on par as a number of other industries, including the "securities, commodity contracts, and investments" industry.[53] So, while risk-adjusted bank output is more volatile, it does not seem *too* volatile for use in the NIPAs. Second, similar comparisons of volatility based on euro area data (Colangelo and Inklaar 2009) suggest that more detailed interest rates, such as those based on surveys conducted in the euro area (e.g., rates on new business by repricing period) could markedly mitigate volatility of service spreads. While in our U.S. data the standard deviation of the overall risk-adjusted interest margin is more than twice as large as that based on a risk-free rate, the former is only 20% larger than the latter in a similar comparison based on euro area data.

E. Plausibility Checks

So far, we have made the case for using our measure of bank output on theoretical grounds, that is, we have explained why the reference rate used to impute the value of bank service output should be adjusted for the risk of the associated financial instrument. By removing the risk premium, this new measure of output reduces banks' operating surplus.[54] We now examine whether or not the lower surplus is "implausibly small" as Fixler and Reinsdorf

(2006, footnote 6) have asserted in arguing against risk-adjusted reference rates. We focus on two indicators, the capital share in value added and the IRR on fixed capital, as the range of values of each indicator in other industries can be viewed, under certain conditions, as the plausible benchmark for comparison. The capital share, defined as the share of operating surplus in industry value added, gives an indication of the capital intensity of production in that industry. The IRR is the return an industry or a firm would need to earn on its fixed capital assets, such as buildings and computers, to exactly cover the rental cost of fixed capital.

We must note the close link between the IRR and the user cost of funds. The latter is, in fact, simply the former net of depreciation (consisting of both obsolescence and physical wear and tear). The concept of a risk-adjusted user cost in the case of fixed capital has long been an integral part of investment theories. The IRR in some industries is consistently higher than in others, even after controlling for depreciation and expected changes in the price of capital goods—precisely because investing in those industries incurs greater systematic risk. Investors thus demand a higher rate of payoff on average, so long as capital is mobile and the no-arbitrage condition holds. The risk-based user-cost measure is also routinely used in industry-level growth accounting studies.[55] We calculate the IRR using the standard Jorgensonian framework (e.g., Jorgenson, Gollop, and Fraumeni 1987), and capital includes fixed reproducible assets, such as buildings and machinery, as well as land and inventories.[56]

The first step is to gauge by how much our new measure would revise downward total nominal output of all depository institutions. Total output equals the sum of explicit bank service charges (comprising the bulk of noninterest income) and implicit revenue from services (i.e., our estimate of borrower and depositor service output in Table 1 and Figure 3).[57] While imputed bank output is overstated by 45% on average, total banking output is overstated by only 21% on average over the sample period 1997:Q2–2007:Q4. Next, we obtain a new output estimate for all depository institutions (i.e.,

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52. Using our risk-adjusted reference rates, the average interest spread on loans and deposits over this period is 1.5 percentage points with a standard deviation of 0.5 percentage points, while using a risk-free reference rate the average is 2.4 percentage points with a standard deviation of 0.2 percentage points.

53. The standard deviation of the annual growth rate of bank output is compared with standard deviation of the annual growth rate of industry gross output based on the BEA "GDP by Industry" dataset, both covering the same period of 1998–2007 at an annual basis. The standard deviation of bank output growth was 14%; the standard deviation of output growth in the "securities, commodity contracts, and investments" industry was 16%.

54. Operating surplus is defined as value added net of labor compensation and indirect taxes. As explained above, part of the "excess" bank operating surplus should be reallocated to nonfinancial firms that purchase bank services, while the remainder should be reallocated to interest payments and receipts of households.

55. See, for example, Jorgenson, Gollop, and Fraumeni (1987).

56. Data are from the Bureau of Labor Statistics.

57. Note that we exclude the trading-income elements of noninterest income, as we argue that it is also not output but transfer of property income; see Inklaar and Wang (2007) for further discussion.

the credit intermediation industry as defined in the NIPA Industry Account) by assuming that output of the rest of the industry is overstated by the same percentage as that of commercial banks in each year.[58] Obviously it would be preferable to have direct estimates of the overstatement for both savings banks and credit unions, but that is beyond the scope of this paper.

Table 2 shows the results of our plausibility exercise comparing capital shares and internal rates of return according to the current NIPA measure versus our new measure of output. Under the NIPA output measure, the banking industry's capital share averages 59%, ranking it higher than the capital share of the petroleum refining industry and similar to the share of coal mining. This seems an implausibly high capital share, as the other industries with similar shares are generally regarded as intensive users of large-scale machinery. The implication is that the operating surplus may be implausibly large under the NIPA measure. The new output measure, by excluding the risk premium, decreases the capital share of the industry to 42% on average—the same as the share of private industries as a whole.[59] This is also close to the capital share of retail trade but higher than that of business services.

The IRR of the banking industry, based on the NIPA measure of output, also seems implausibly high, at 17.8%, on average, over the period. In comparison, the IRR for the private sector as a whole is only 9.3%. The premium of 8 percentage points seems unwarranted by the systematic risk of the credit intermediaries, as many of those with publicly traded shares have a beta around one. Once the new measure of bank output is used, the resulting lower operating surplus reduces the IRR of the industry to a level close to that of the overall private sector.

58. This industry (NAICS 521 and 522) comprises commercial banks, the Federal Reserve, savings banks, and credit unions. Commercial banks account for more than half of the employment. Savings banks, the second largest category, tend to have a larger share of real estate loans than commercial banks. Although the risk premium on real estate loans tends to be somewhat lower than on other loans, a robustness check that applies the same interest rate margin by loan category to savings banks leads to similar estimates of overstatement.

59. Lower bank operating surplus also means lower operating surplus for the overall private sector. But taking this into account has only a minimal effect on the values reported in Table 2 for the private sector. It is also important to note that we are in all likelihood underestimating the risk premium, and this means the true capital share of the banking industry is lower than 42%.

TABLE 2

The Impact of Risk Adjustment on Labor Share and Internal Rate of Return, 1997–2006 Average

	Capital Share in Value Added	Internal Rate of Return on Fixed Assets
Financial intermediation		
Risk-free	59	17.8
Risk-adjusted	41	6.8
Private economy	42	9.3

Notes: "Financial intermediation" refers to North American Industrial Classification System (NAICS) industries 521 and 522 in the Bureau of Economic Analysis's (BEA) GDP by Industry Account. "Risk-free" and "risk-adjusted" denote the two measures of bank output that use the risk-free and the risk-adjusted reference rates (corresponding to the "risk-free" and "default and term" output columns in Table 1), respectively. "Private economy" is as defined in the GDP by Industry Account. The "capital share in value added" includes an estimate of the labor compensation of self-employed, assuming they earn the same average wage as employees. The "internal rate of return on fixed assets" is the shadow rental rate on the gross capital stock at current prices that would generate the actual capital compensation (defined as value added minus labor compensation). All fixed assets as covered by the Bureau of Labor Statistics are included, that is, fixed reproducible assets, land and inventories. The industry-level capital and income data are available annually for the 1997–2006 period.

Mis-measured capital assets are a far less plausible reason for the observed gap between the IRR of the overall private sector and the financial intermediation industry. It may be argued that credit intermediaries have built up more intangible assets than the average private industry, for example, through business reorganization that complements the investment in information technology (IT).[60] However, the intermediation industry would need to have an investment share of intangibles nine times higher than that of the average private industry to account for the difference in the IRR. This seems unlikely, as the IT investment share of banks is only 30% higher than that of the overall private sector.[61]

The decrease in the capital share and the IRR on fixed capital toward a more reasonable level is an indirect effect of excluding the risk premium in our new measure of bank output. We therefore view the results reported in Table 2

60. The BEA counts only software and a few intangibles as capital. Corrado, Hulten, and Sichel (2006), among others, argue that the scope of capital should be expanded to cover organizational capital, brand capital, etc.

61. Specifically, 34% versus 26% of total investment.

as empirical support for the new measure, complementing the theoretical argument for risk-adjusted reference rates.

IV. CONCLUSIONS

Banks provide important services to both borrowers and depositors. They reduce the information asymmetries that impede borrowers' access to credit, and provide transaction services to depositors. However, banks generally do not charge explicit fees for these services; instead, they bundle the fees with loan and deposit interest flows. As a result, the output value of both borrower and depositor services must be imputed. In the statistical and research community, it is generally agreed that the value of such implicit bank services is most appropriately imputed as the difference between the interest paid on loans (and interest received on deposits) and the opportunity cost of the associated funds as determined by a reference rate. The choice of this reference rate, however, is more contentious. Under the current system of National Accounts (1993) and in the U.S. NIPA, this reference rate is stipulated to be a single, risk-free rate.

In contrast, Wang (2003) and WBF (2009) show that, in a world with risk-averse investors, each reference rate should take account of the nondiversifiable risk of the associated financial instrument. Specifically, the opportunity cost of a risky loan is not the return on a risk-free investment, but rather the return on an investment of comparable risk. The model in the work of WBF (2009) is an abstract representation of reality, assuming, for example, (nearly) complete and efficient financial markets. Relaxing these assumptions would likely affect the exact risk premium concept that should be incorporated into the reference rates, but the core message of the model should continue to hold: passively bearing risk that is priced in the market is not a productive activity.

In this paper, we show that the output measure implied by the banking model of WBF (2009) can be implemented for U.S. commercial banks from 1997 onward. In particular, financial markets provide data on yields of debt instruments comparable to those held on banks' balance sheets, enabling us to derive risk-adjusted reference rates. We show that removing the risk premium, the difference between the risk-adjusted reference rate and the risk-free rate, is quantitatively important. Comparing bank output calculated using our risk-adjusted reference rate with output computed using the risk-free reference rate according to the current NIPA method, we show that the latter overstates, on average, imputed bank output by 45%, total bank output by 21%, and U.S. GDP by 0.3%.

Our risk-adjusted reference rates are not perfect, as the bank loan categories for which interest rates are reported separately are quite broad. As a result, the matching of risk characteristics between bank loans and comparable publicly traded debt instruments is imprecise. Nonetheless, we would argue that we have captured some of the risk premium by using conservative estimates, and that accounting for some of the risk premium is an improvement over not accounting for it at all. Furthermore, estimates of the share of capital in banks' value added, and the IRR on fixed capital of the banking industry also suggest that our measure of bank output is more plausible than the current NIPA measure.

We conclude by drawing two important implications of our paper. First, we find no convincing theoretical or practical reasons for using risk-free reference rates in estimating bank output. Instead, we show that it is feasible to use risk-adjusted reference rates and that doing so is quantitatively significant. The fact that our risk-adjusted measure of bank output is both conceptually preferable and leads to more plausible outcomes argues strongly for changing current statistical practice to remove the compensation for risk-bearing in general from bank output. Second, information about loan risk rating and the attendant interest rates charged by U.S. commercial banks is scarce, despite the central role of risk rating in measuring bank output, as well as in studying other important banking issues such as competition in credit supply. We, therefore, urge the statistical agencies to improve data collection in this important area.

APPENDIX. DETAILS OF DATA AND ESTIMATION PROCEDURES

TABLE A1

Call report items used in calculating commercial bank interest rates

	1997Q2–2000Q4	2001Q1–2007Q4
Interest income and expenses		
Income on real estate loans	RIAD4011+RIAD4246	RIAD4011
Income on consumer loans	RIAD4013+RIAD4247+RIAD4248	RIAD4013
Income on commercial and industrial loans	RIAD4012	RIAD4012
Expenses on time and savings deposits	RIAD0093+RIADA517+RIADA518	RIAD0093+RIADA517+RIADA518
Loan/deposit balance		
Real estate loans	RCON1410	RCON1410
Credit card loans	RCON2008	RCONB538
Other consumer loans	RCON2011	RCONB539+RCON2011
Commercial and industrial loans	RCON1766	RCON1766
Time and savings deposits	RCON2385	RCON2385
Demand deposits	RCON2210	RCON2210
Maturity data		
Real estate loans (1–4 family)	RCONA564-RCONA569	RCONA564-RCONA569
Loans except 1–4 family real estate loans	RCFDA570-RCONA575	RCFDA570-RCONA575
Time deposits of less than $100 000	RCONA579-RCONA582	RCONA579-RCONA582
Time deposits of $100 000 or more	RCONA584-RCONA587	RCONA584-RCONA587

Notes: Entries refer to the mnemonics used in the Call Reports, listed under the relevant period(s). Data were downloaded from the Federal Reserve Bank of Chicago (http://www.chicagofed.org/webpages/banking/financial_institution_reports/ commercial_bank_data.cfm). Using the Entity Type Code variable (RSSD9331), only data covering commercial banks were selected. A bank is included in the loan interest rate calculation only when data on both interest income and the loan balance are available. This requirement mostly affects banks with less than $25 million in assets, because before 2001 these banks did not have to provide a breakdown of total interest income by loan category. In 2007, this category of banks represented around 0.1% of total commercial bank assets.

TABLE A2

Notes on Changes in Variable Definitions in the Call Reports, 1997–2007

Code/Item	Note
RIAD4246, RIAD4247, RIAD4248	Up to 2000, small and medium-sized banks used these variables to report their interest income for the different loan categories. RIAD4249 covers interest income on Commercial and Industrial loans, but also on all other loans, so this variable was omitted at the cost of coverage of the industry loan totals. Banks with fewer than $25 million in assets did not have to report any of these variables.
RCON2008, RCON2011	Up to 2000, banks with domestic and foreign offices only had to distinguish between credit card loans and consumer installment loans for the consolidated bank. Total loans to individuals are available for the bank's domestic offices. To increase coverage, the share of credit card loans and of consumer installment loans was calculated based on the consolidated totals (codes RCFD2008 and RCFD2011) and applied to the total for the bank's domestic offices.
RCONB538, RCONB539	From 2001 onwards, credit card loans (RCONB538) do not include other revolving loans (RCONB539) anymore.

FIGURE A1

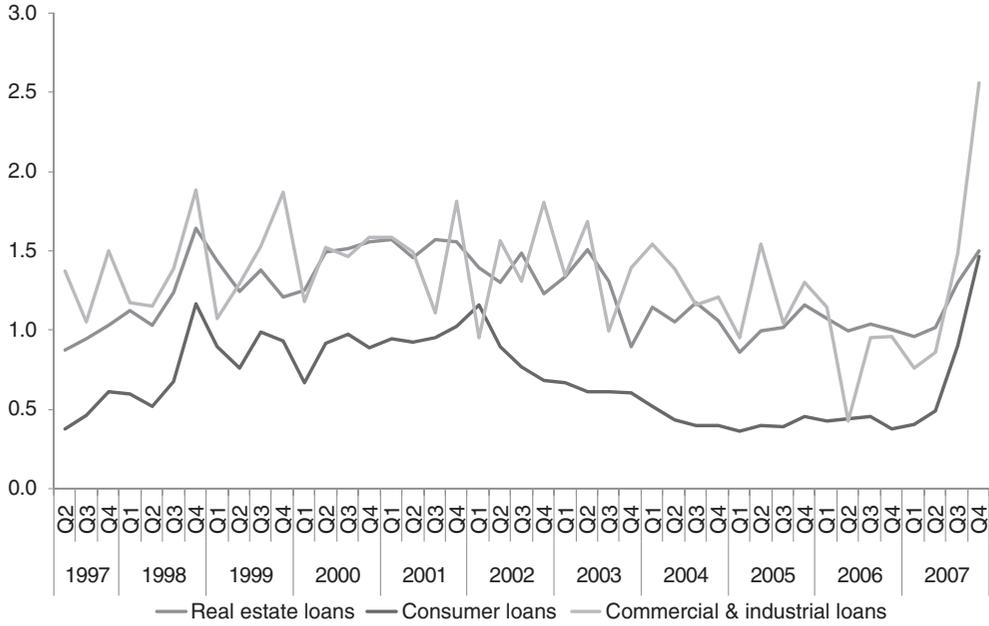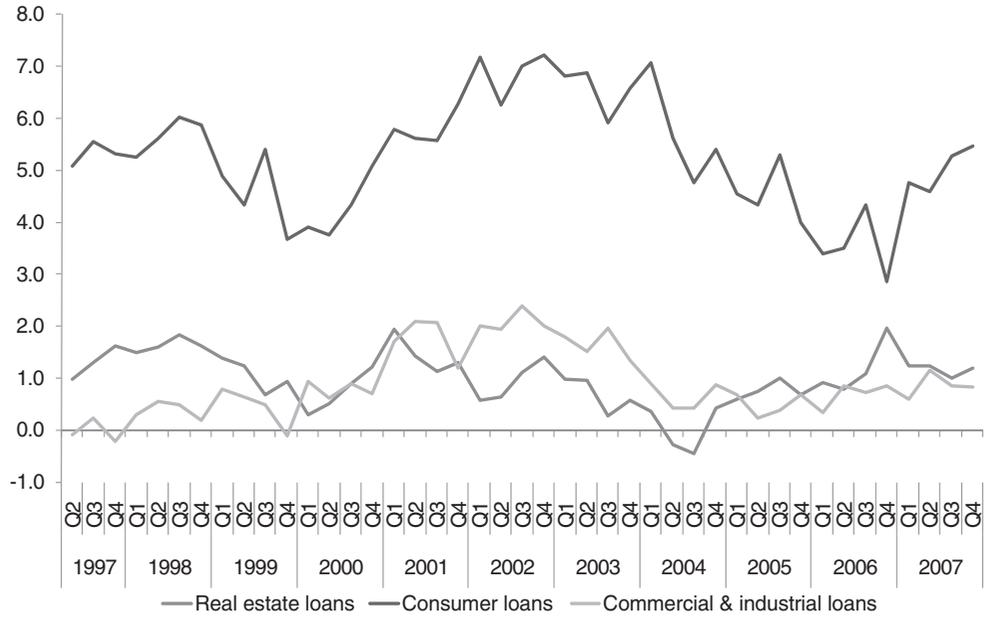Risk Premiums of Each Loan Category

FIGURE A2

Service Spread of Each Loan Category

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