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The Value of Risk:

Measuring the Services of U.S. Commercial Banks

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Abstract: Measuring financial services provided by commercial banks is difficult because many of their services are implicitly priced. To arrive at the conceptually correct value of these services, current National Accounts practice needs to be modified to account for the risky nature of most bank loans. In this paper, we show that a conservative estimate of the risk premium implies that bank output in the U.S. National Income and Product Accounts is overestimated on average by 21 percent between 1987 and 2003. Moreover, the risk premium is time varying and thus affects the measurement of bank output growth as well. We also argue that the BLS activity counts provide the best available measure of real bank output and that, instead of the current practice of using employment shares as weights for aggregation, nominal output shares should be used to estimate total real bank output.

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I. Introduction

What is the real output of a bank or other financial institution? And what is the associated price? These difficult questions have been the subjects of much debate, but no consensus has yet emerged. This area of research has been particularly contentious because different researchers have put forward a variety of proposals for measuring real bank output. Each proposal seems intuitive enough on its own, but taken together they have turned out to be inconsistent with one another.[1]

The major reason for the continued confusion is that the great majority of the services provided by banks are compensated and thus priced implicitly, not explicitly. Thus, neither nominal nor real output of such bank services can be measured directly and both have to be imputed. The imputations must be based on economic models, which in turn are dependent on assumptions. Therefore, the only way to make progress in this area is to show that a set of conventional assumptions, which are widely accepted by economists, lead to a set of clear-cut, definite conclusions regarding measurement.

In a series of recent papers, Wang and co-authors have taken up this research program, and proposed a new measure of nominal and real bank output and an implicit price deflator. This new measure is derived from complete economic models of bank production, asset pricing in financial markets and optimization under uncertainty, sometimes embedded in general-equilibrium settings. Three substantive conclusions emerge from this line of work.

First, it is important to account for risk in measuring nominal output. Wang (2003a) and Wang, Basu and Fernald (2004) show that the risk premium required on loans should be counted as part of a borrowing firm's cost of capital and not as part of the lending bank's nominal output. In the language of the measurement literature (e.g., the terminology used in SNA93), the "reference rate" needs to be adjusted for risk. This principle implies that there is not an unique reference rate; instead, there is a different reference rate for each risk category of loans. Wang (2003b) concludes that this effect can be substantial. Her preliminary calculation shows that failing to account for risk may overstate nominal bank output by about 25 percent.

[1] Triplett and Bosworth (2004, ch. 7) provide a clear summary and critique of several of the existing measures of bank output, and discuss their preferred measure.

Second, in order to measure the real output of banks, it is important to know what banks actually do. On the depositor side, this is relatively easy: Banks provide a variety of services that facilitate transactions, such as check clearing, ATM withdrawals and deposits, Internet banking, and the like. An index of these transactions, constructed along standard lines, is the real output of depositor services. On the borrower side, banks process credit information and decide whether to originate loans, and if so at what rates. They also monitor existing loans—again, processing credit and other financial information—and provide a variety of bookkeeping services. Thus, information processing is the essence of real bank lending output. However, it is difficult to observe how much information is processed per loan, and how this amount changes with the type and characteristics of the loan. We return to this issue later.

The third conclusion is that the real volume of financial services supplied is not in constant proportion to the real balance of deposits or loans. Early papers by Donovan (1977) and Barnett (1978, 1980) suggested that the real financial services provided to consumers would be proportional to the stocks of financial assets held by depositors. Furthermore, the price of these services could be measured easily as the interest rate margin foregone by the consumer to hold these assets in low-interest-bearing accounts. However, this approach has a basis in economic theory only if there exists a utility function over consumption and real balances that is stable over time.

Basu and Wang (2006) investigate the robustness of such a utility representation, using the duality approach to this problem pioneered by Feenstra (1986). They develop a general-equilibrium transactions model where bank services are needed to purchase consumption goods, and banks charge implicitly for the real services provided by paying a lower-than-market interest rate on deposit balances. Basu and Wang show that in this scenario, which is implicit or explicit in most discussions of banking output, fixed proportionality between real service output and asset balances is unlikely to hold. In particular, proportionality breaks down if there is technological progress in any of the financial industries. Given the extent of financial innovation and structural change in banking and finance in recent years, it seems highly restrictive to tie oneself to output and price measures that are valid only if TFP never changes in these industries.

Conceptually, the measurement implications of this line of research are clear. First, it implies that real output needs to be constructed as an index of the actual transactions performed by banks—clearing checks, originating and monitoring loans, and so on. Second, it implies that the nominal output of each category of financial services should be computed using risk-adjusted reference rates. With both nominal and real measures in hand, the implicit price deflator follows naturally.

Can these conceptual lessons be implemented at the industry level using existing data, which is necessary if these ideas are to serve as the basis of a program of measurement?[2] Of course, the theory can serve to guide future data collection, and to some extent more and better data will need to be collected to implement the full set of measurement concepts laid out by Wang et al. But it is fair to say that some of the variables discussed in their papers, such as *ex ante* risk premia on loans, are objects that are rarely encountered in the measurement literature. (They are, of course, staples in the finance literature.) Thus, it is important to see whether one can construct reasonable estimates of risk premia using available financial data, and whether the implied measures of real financial output and prices are sensible ones.

This paper serves as a pilot project for taking the important step from theory to data. It shows that the approach advocated by Wang et al. in the series of papers discussed above can indeed be implemented for an entire financial industry using available data. It also shows that the results differ in important ways from those that would be obtained using some of the different methods that have been proposed in the literature. In particular, accounting for risk premia matters considerably even under the most conservative estimates, and so does the choice of the weights used to aggregate the real output of individual categories of bank services. Thus, the debate over the right theoretical measure of financial output has serious practical significance.

In order to restrict this initial project to a manageable scope, we focus on measuring commercial bank output.[3] Banking is the financial industry where the debate over output measurement has been the greatest, probably because such a high fraction of bank output is implicit, and thus needs to be imputed by using an economic model. Banking is also an industry that is clearly undergoing major structural and technological changes. Thus, from either the point of view of research or of policy-making, having reliable estimates of bank output is of major importance.

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[2] Wang (2003b) has implemented the new measure of bank output at the micro level, using data on individual bank holding companies.

[3] Specifically, we focus on the output associated with 'traditional' banking activities such as originating loans and deposits. Bank output associated with fee-income, from underwriting fees to securitization income is not dealt with here.

We find that the lessons that come out of the new theory are important for measurement. First, accounting for risk lowers overall nominal bank output by about 21 percent over the period 1987-2003. This occurs despite our use of a conservative (i.e., likely low) estimate of the risk premium. Furthermore, we show that the current BEA reference rate is too high, because (due to the inclusion of mortgage-backed securities) it is not truly a risk-free rate. Since services for insured deposits should be imputed using a rate that is truly risk-free, such as U.S. Treasurys, making this correction lowers imputed depositor services by nearly 40 percent. Correcting for risk not only changes the average level of nominal output, it also changes its growth rate over time, since the risk premium shows a decidedly cyclical pattern.

Second, we find quite different patterns for real output growth, depending on the underlying concept of real output and the weights used to aggregate output components. We begin by taking disaggregated measures of real output from the BLS. These are based on counts of various categories of transactions (e.g., numbers of checks cleared). These measures are conceptually consistent with the new banking theories we are implementing, although they make the implicit assumption that the amount of service represented by each transaction does not vary with its characteristics (e.g., the bank has to do the same work to clear a check for $1 as it does to clear a check for $1,000). Ideally we would like to have measures of real output that try to adjust within each category for the characteristics of the services performed. The data to perform such "quality" adjustments are not currently available, but collecting them to improve the underlying real output measures is a high priority.

Using the same BLS output measures for the underlying real output components, we find that using our measures of nominal output as weights makes a noticeable difference in the aggregate index of real activity relative to using the weights computed using BEA's non-risk-adjusted reference rate, but only a small change relative to the employment weights currently used by the BLS.

The paper is structured as follows. Following this introduction, which is Section I, Section II gives an overview of the economic issues that are relevant for measuring real and nominal bank output. It goes into some detail on the issue of how to infer risk premia on bank loans and bonds, which is important for the risk adjustment of our nominal output measure.

Section III then discusses issues of implementation, introduces the data we use, and presents our results.[4] Section IV draws conclusions, and lays out directions for future research.

II. The Economic Model of Banks

This section reviews briefly the theory of banking output based on complete economic and financial models with risk. Interested readers who wish to pursue these issues more deeply are urged to consult Wang (2003a), WBF (2004) and Basu and Wang (2006).

II.A Bank Lending Output

One must first define a concept before attempting to measure it accurately. So, what is the output of banks corresponding to the asset side of their balance sheet? Wang (2003a) and Wang, Basu and Fernald (2004, WBF henceforth) answer this question with dynamic models of optimal bank operations under uncertainty.[5] By embedding bank operations within the backdrop of competitive financial markets, these papers show that the value added of banks lies solely in resolving information problems and processing transactions. Accordingly, Wang (2003a) and WBF (2004) formally recognize the intuitive parallel between the activities of banks—processing a wide range of information and transactions—and the activities of other professional services firms, especially those providing consulting and accounting services. For instance, one important service that banks provide to borrowers is to process their credit information through screening and monitoring, which is similar in nature to the auditing services performed by accounting firms.[6] All of these services are generated through a production process that uses primary inputs of labor and capital, as well as intermediate inputs (such as office supplies and utilities).

More importantly, Wang (2003a) demonstrates the separability between the flow of

[4] Our data and methods are described in full detail in Appendix A.

[5] WBF (2004) extend Wang's partial equilibrium model to a general equilibrium setting, and demonstrate that all the qualitative results in Wang (2003a), summarized in this paper, continue to hold.

[6] Banks' role in resolving information asymmetry is well recognized. For example, Fixler (2004, p. 223) observes that "these [financial] services have to do with overcoming the problems of asymmetric information, a view that is widely accepted in the financial economics literature. … The role of banks as a lender arises out of the private nature of the lending transaction—the bank…reduces the problem of adverse selection…[and] the problem of moral hazard. These are the financial services that Fama (1985) and others identified when they argued that banks were special."

financial services and the stock of financial instruments. By nature, financial services are typically intangible; financial instruments such as loans are often the most tangible manifestation of those services. However, Wang (2003a), WBF (2004) and Basu and Wang (2006) show that flows of bank services are not inherently tied to stocks of their securities holding.[7] Thus, there is no theoretical basis for fixed proportionality between the flow of services and the stock—be it measured by book or market value—of financial securities.

The separability between service flows and securities balances has become quite evident, as more and more banks and other firms are providing financial services without holding the associated securities, and vice versa. For instance, in securitized consumer lending, now the dominant means of supplying credit to households, finance companies (such as GMAC) and some banks specialize in providing bookkeeping and payment services to both the borrowers and the holders of asset-backed securities, without holding any of the underlying loans on their balance sheets. On the other hand, a growing number of small and medium-size banks hire specialized firms to originate and service their residential mortgage loans (Bergquist, 2002).

A significant implication of the separability between the flow of financial services and the stock of financial instruments is that the importance of an individual bank or even the banking sector as a whole is not necessarily related, let alone proportional, to the size of its asset holding. The same distinction applies to other types of financial intermediaries as well.

Theories in general offer no basis for assuming that the quantity of services produced is of a fixed ratio to the balance of the associated financial instruments, and the onus should be on those who assume a fixed proportionality to justify that assumption. Fixed proportionality is hard to defend even for the case of traditional services, especially for transaction services such as banks' payment services to depositors. The literature on payment services suggests that banks see check clearing as a basically homogeneous service, regardless of the dollar figure of the check.[8] The same is true of many other depositor services (e.g., issuing money orders, transferring funds, etc). By comparison, the fundamental separation between service flows and asset balances may seem less evident in cases where the financial firm both performs the services and holds the assets, as in traditional bank lending. However, once we identify and focus on the true underlying *services*, the detachment of service flows from asset stocks becomes equally

[7] In fact, Fischer (1983, p. 6) has already made the same argument.

intuitive. For instance, originating a $1 million mortgage likely entails productive activities much less than 10 times those needed for originating a $100,000 mortgage. (The two originations likely involve about the same amount of work nowadays given the ready availability of credit scores for individuals.)

II.B Rates of Return, User Costs and the Role of Risk

One crucial implication of the service-centric understanding of bank output in Wang (2003a) and WBF (2004) is that the flow of services is qualitatively distinct from the per-period returns that accrue to the stock of financial assets. These returns are solely to compensate suppliers of funds for foregoing current consumption in exchange for future consumption. Free of any attached services, such returns can be called "pure returns." In cases where pure returns are joint with implicit service charges, the former must be netted out of a bank's total income to impute the nominal value of the implicit services provided.

The concept of "pure returns" is a refinement of the usual idea of opportunity costs, extended to a world with risk. With risk, one must not use the rate of return on a security with no credit risk as the opportunity cost of funds for every risky security simply because one could invest in the credit-risk-free security instead. By that argument, it would be equally valid to use a junk bond rate as the opportunity cost since one also foregoes the opportunity to invest in high-risk, and thus high-yielding, junk bonds! Furthermore, even within Treasury securities, a 10-year bond yields a higher average rate of return than a 90-day bill if held over the same 90-day period, because the former is subject to the risk of time-varying (long-term) interest rates. Since risk matters for asset prices, the opportunity-cost argument alone—without reference to risk—provides little theoretical guidance in setting the "pure return" (i.e., opportunity cost) of funds, let alone justifying an arbitrary definition of the opportunity cost in terms of a "risk-free" rate. The conclusion of Wang (2003a) and WBF (2004) is that one needs to compare the rate of return on a loan to the opportunity cost of funds provided without services but *subject to the same risk*.

What determines this risk-adjusted rate of "pure return" that investors expect on a financial security? Applying standard theories of asset pricing, Wang (2003a) and WBF (2004) show that the pure return depends positively on the correlation between a security's risk and

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[8] See, e.g., Kimball and Gregor (1995) and Radecki (1999); both present industry data on the average and marginal cost of processing a payment via various means that make no reference to the size of the payment.

systematic factors (such as the business cycle). In fact, if a security's risk does not vary with systematic factors, then its expected rate of return is merely the risk-free rate, no matter how volatile its return; for example, if a loan's default risk does not vary with macroeconomic conditions, then any lender should expect to receive a return on average equal to the risk-free rate, although the interest rate the borrower must promise to pay *conditional on him remaining solvent ex post* rises with his probability of default.[9]

Since this concept may not be familiar, we explain it further. Denote contractual interest rates as *R* and *ex ante* required rates of return (which should on average equal *ex post* realized returns) as *r*. The contractual rate, sometimes also known as the yield (or yield-to-maturity), is the interest rate a borrower *promises ex ante* and is obligated to pay if solvent *ex post*. It is, for example, the 8 percent interest rate that might be written into a mortgage contract. But suppose that mortgages have a 25 percent default probability. Then the rate of return a bank expects to get *ex post* from the 8 percent mortgage is actually 6 percent on average. Thus, the bank's required rate of return, *r*, on mortgages is 6 percent.

As shown in Wang (2003a), the contractual interest rate that a bank should optimally charge on a loan is:[10]

$$R_t^A = R_t^M + r_t^S \,. \tag{1}$$

R_t^A is the period-*t* yield on a defaultable loan, which is an asset to the bank. R_t^M is the market yield on securities with the same risk characteristics, but without any services attached.[11] r_t^S is what we shall call the service-spread, that is, the extra interest rate charged to recoup the cost of processing (e.g., screening and monitoring) the loan. So the extra interest receipt (that is, r_t^S times the asset balance A_t) should equal the marginal processing cost of a loan (c_t) times the optimal markup (μ_t) determined by (perfect or imperfect) competition within the loan market:

$$r_t^S A_t = c_t \mu_t. \tag{2}$$

According to asset pricing theories, the general expression for R_t^M in (1), i.e., the yield on a debt with no services attached, is:

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[9] See Wang (2003a) for a detailed explanation of the distinction between the promised interest rate and the expected rate of return, or equivalently, the distinction between *default* and *risk* premia.

[10] To be precise, this relationship holds exactly only for instantaneous returns under continuous compounding. See Wang (2003a) for the exact equation in discrete time.

$$R_t^M = r_t^F + r_t^P + d_t^e. \tag{3}$$

r_t^F is the yield on debt with no options attached (i.e., not callable or putable), and not subject to default or prepayment risk (U.S. Treasurys are the best example). It can be considered a truly risk-free rate in that r_t^F $(= R_t^F)$ is the guaranteed return if one holds this type of debt till maturity.[12] For a defaultable debt, however, its yield also contains the risk premium, r_t^P, and the default premium, d_t^e. d_t^e is the extra return that must be *promised* to investors because it is only paid when there is no default *ex post*. If the probability of default correlates with risk factors priced in the market, investors will also demand that the *average* return received *ex post* exceed the default-free yield, and that spread is r_t^P in (3).[13] (See Wang, 2003a for more details.)

Thus, the expected or *required* rate of return on a bond in the market with yield R_t^M, which we denote r_t^M, is the rate that one receives on average from the bond. It is just expression (3) without the default premium:

$$r_t^M = r_t^F + r_t^P. \tag{4}$$

Think again about the example of mortgage origination. Suppose, conditional on two borrowers' respective incomes and credit scores, default is more likely for a $1 million loan than for a $100,000 loan. Suppose also that both loans' default risks covary fully with business cycles (i.e., both are fully explained by systematic factors). Then investors will demand a higher rate of return on the former, even in expectation.[14] Since realized returns on average equal the expected return, the $1 million loan should on average give its holder a higher rate of return. This would be true even if, as suggested above, the two kinds of loans entail the same origination services.

Using the previous arguments, the rate of return that a bank requires on a loan, inclusive of its payment for information processing services, must be

$$r_t^A = r_t^M + r_t^S = r_t^F + r_t^P + r_t^S. \tag{5}$$

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[11] We use the terms "yield" and "contractual rate" interchangeably, since a debt security's yield is computed using its promised stream of interest and principal payments.
[12] Note that even for this type of debt the return is still typically uncertain if one sells it prior to the maturity date.
[13] For the relationship between the yield on a defaultable bond and its expected return, see any finance textbook (for example, Duffie and Singleton (2003)). WBF (2004) contains a simple discrete-time version. Yields on callable and putable bonds must be adjusted for the attached option to be comparable with other debt instruments. Bonds with prepayment risk, such as mortgage-based securities, are essentially callable bonds, as prepayment is an option for borrowers to pay back sooner (i.e., call the bond before maturity).
[14] Combined with the former's higher default probability, this will lead to an even higher interest rate promised in the contract for the $1 million loan.

To compute nominal output in originating a loan, given the size of the loan *A*, equation (2) says that we need the service-compensation spread, r_t^S. By equation (5), this is the return spread on the bank loan relative to bonds of comparable riskiness ($r_t^S = r_t^A - r_t^M$). Note that subtracting only the risk-free rate from the loan rate, as is the current practice in the NIPAs, would overstate nominal lending output by the risk premium times the face value of the loan:

$$\left(r_t^A - r_t^F\right)A_t = \left(r_t^P + r_t^S\right)A_t = c_t\mu_t + r_t^P A_t . \qquad (6)$$

For an extended discussion of why risk-bearing is not a productive service as defined by the national income accounts, see Wang and Basu (2006, section 3.4).

Note that the use of a risk-adjusted market rate as the opportunity cost of funds is fully consistent with—indeed, is implied by—the user-cost approach to calculating nominal bank output. All that is necessary is to extend the concept of user costs to include risk. Conceptually, a “pure return” or interest rate has traditionally been seen as the reward for postponing consumption—giving up a sure thing today to receive a sure thing tomorrow. Now think of a different offer—give up some sure consumption today in exchange for a larger amount of consumption with some positive probability tomorrow. These are qualitatively similar offers; it is only that in the first case the probability is fixed at 1. Our concept of a risk-adjusted reference rate is no more than the user-cost return in the case where the repayment probability is not always fixed at 1.

Furthermore, the measurement community already implicitly endorses the concept of a risk-adjusted user cost in the case of the user cost of capital. That is, we see that capital in some industries systematically earns a higher rate of return year after year, even after controlling for depreciation. This essentially means the required return—the “*r*” in the usual ($r + \delta$) user-cost formula—is higher in some industries. This happens precisely because someone who gives up consumption to invest in those industries is less sure of receiving a reward for waiting just when she most needs the funds to be repaid for future consumption (i.e., those industries are riskier), and thus demands a larger reward on average. This risk-based user cost measure is routinely used in industry-level growth accounting studies.[15]

[15] See, for example, Jorgenson, Gollop and Fraumeni (1987).

II.C Total Nominal Bank Output

We now discuss how to implement the nominal bank output measure proposed in Wang (2003a) and WBF (2004). We call our new model-based measure "pure services," to distinguish it from the current measure in the NIPAs. We discuss the measurement of both borrower and depositor services.

First, consider the nominal value of implicit services that are compensated through "interest" income (e.g., bank lending services) based on a balance of assets (e.g., loans). As in the previous sub-section, let A denote the asset balance, r^A denote the required return, and r^M the rate of return investors expect on a market security with the same risk profile (e.g., the market rate on comparable commercial papers or asset-backed securities). As noted in the previous section, $r_t^A = r_t^F + r_t^P + r_t^S > r_t^M = r_t^F + r_t^P$. Nominal service output to borrowers—denoted $\mathcal{Y}^A$—is then imputed as:

$$\mathcal{Y}^A = (r^A - r^M)A = r^S A \; = c \; \mu \, . \tag{7}$$

To adapt the nomenclature of SNA93, r^M is the risk-adjusted reference rate for imputing implicit lending services. Note that (7) applies to both on- and off-balance-sheet securities. That is, A can represent not only traditional loans but also the relevant balance of loan commitments or stand-by letters of credit. (7) also implies that, if a bank just holds some market securities passively, then $r^A = r^M$ and its $\mathcal{Y}^A$ is zero.

Likewise, consider the nominal value of implicit services compensated by paying a lower interest rate (e.g., deposit services) on a balance of liabilities (e.g., deposits). Let D denote that balance, r^D denote the actual interest rate paid, and $r^{M'}$ the rate of return on a market security with the same risk. This makes $r^{M'}$ the reference rate for implicit services to holders of bank debt (e.g., depositors). Then nominal output of depositor services—denoted $\mathcal{Y}^D$ —is imputed as:

$$\mathcal{Y}^D = (r^{M'} - r^D)D \, . \tag{8}$$

Most of banks' services to holders of their liabilities are to depositors. For insured deposits in the U.S. (i.e., up to \$100,000 per individual), $r^{M'} = r^F$ (the short-term Treasury rate). For the remaining uninsured deposits, $r^{M'} > r^F$, because the holders are exposed to some of the risk in banks' asset portfolios. When the liabilities are commercial papers or bonds issued by banks in the markets, $\mathcal{Y}^D$ will be zero, since the interest rate paid is exactly the market reference rate, i.e.,

$r^{M'} = r^D$. This seems a rather intuitive result, since no services—according to the new, pure-services definition of output—are produced.

Note that, under virtually all circumstances (that is, whenever there are equityholders), r^M in (7) is greater than $r^{M'}$ in (8), because bank assets are typically more risky than their liabilities. In other words, the reference rates for imputing lending and depositor services almost always differ.

Figure 1 illustrates the imputation of nominal implicit bank service output, depicting the polar case where all bank service revenue is implicit (i.e., bundled with interest), and bank liabilities are composed entirely of deposits.[16]

Above all, note that only *part* (areas I and IV) of a bank's net interest income (gross interest income minus interest payment, equal to the sum of areas I through IV) constitutes the true nominal output of bank services.[17] This mirrors the above result that the reference rates for lending and depositor services differ. Area I, the part of interest income exceeding the (risk-adjusted) return expected on market securities with risks comparable to the given set of loans, corresponds to $\mathcal{Y}^A$ above. Area IV, the interest depositors forego, corresponds to $\mathcal{Y}^D$ above.

In contrast, the other two areas—II and III—are both merely pure interest transfers. Area II, equal to $r^M A - r^{M'} D$, is the return bank shareholders demand for bearing the (systematic) risk of the loan portfolio. This part of bank shareholders' income, however, is in fact factor income originally generated by the capital used in the borrowing firm's production. Wang and Basu (2006, section 3.4) explain why, in an accounting system consistent with standard economic principles, this income should be counted as part of the borrowing firm's value added instead of as part of the lending bank's output. Area III, equal to $[r^{M'} - (r^F + \alpha)]D$ (where α is the insurance premium charged by FDIC), is the value of (the put option embedded in) deposit insurance accruing to bank shareholders.[18] So, area II is the factor income transferred from end users of funds to ultimate suppliers of funds (the bank shareholders), while area III is a transfer

[16] Obviously, many modern banks derive revenues from a greater scope of activities. However, in many cases, accurate measurement of the output associated with those activities is more a statistical problem than a conceptual problem.

[17] As shown, the balance of loans exceeds that of deposits, with bank equity making up the difference. Also, area V'—deposit insurance premium—is part of the bank's overall explicit payment for deposit funds.

[18] Area III exists for an individual bank if the deposit insurance premium it pays to the FDIC is lower than what would be required by a private insurer given the risk of the bank's asset portfolio.

from taxpayers to bank shareholders.[19] Only when all investors are risk neutral will these two elements of interest transfer disappear.

Note that while Figure 1 depicts a situation where the expected rate of return on loans is greater than that on deposits (or liabilities in general), the opposite can and does happen, usually at the end of a boom when longer-term (loan) rates fall below short-term (deposit) rates. In this case, the logic for imputing bank value added remains the same, but banks now suffer a loss on the funds because of the inverted term structure—a loss that is analogous to a capital loss on inventories.

In practice, the reference rate on a financial security (or a portfolio) should simply be the market interest rate on market securities with the same (or the most similar) risk features. Wang (2003b) applies the pure-services output measure to individual bank holding companies, in particular detailing which market interest rates to use as reference rates for imputing the value of depositor services and multiple categories of lending services. The imputed value of bank output implicitly priced is then added to explicit fee income to yield total bank output. By comparison, this study implements the pure-services measure at the industry level, using market data of yields on various comparable market securities, aggregate data on the commercial banking industry, as well as accounting data from individual banks.

II.D Real Output and Its Price

Real financial service output can be constructed as an index of various transactions processed, such as (in the case of banks) the number of a particular type loans originated, or deposit accounts serviced. The real output index then implies the price deflator.

$$\boldsymbol{Y}^i = \mathcal{Y}^i / P^i \text{ , } i = A, D. \tag{9}$$

$\mathcal{Y}^i$ represents the nominal service output derived above, and P^i is the corresponding deflator.

In fact, this is basically how the BLS currently constructs the index of real bank output. The BLS productivity group constructs an index of aggregate bank output for an array of depositor services (such as ATM transactions and check clearing) and borrower services (such as screening and monitoring loans)—see their Technical Note (BLS, 1998).

[19] For the banking sector as a whole, area III will disappear if total deposit insurance premium is actuarially fair. But there may still be transfers within the banking sector—from low-risk to high-risk banks.

In our empirical estimates of real output by category of service we use the BLS measures, which are basically just the numbers of transactions of each type.[20] However, we emphasize that nothing in our theory requires that we use simple counting as a service output measure (for example, using the number of mortgages issued to represent real mortgage-related bank service output). One could use the same type of hedonic analysis done for durable goods, and see how the price charged for each service depends on the characteristics of the service *after correcting the price charged for risk.* Obvious candidate characteristics include the amount of the loan, the credit rating of the borrower (borrowers with poor credit ratings may require more investigation by the bank), whether the loan, if a mortgage, conforms to the standards of Fannie May/Freddie Mac, and so on. This is an area that is a high priority for future research. However, absent these detailed data and results, for now we use the BLS count-based measures of real activity.

That being said, we have noted above that independent research verifies the BLS transactions-count method in at least some cases (e.g., check clearing). And it seems likely, as we discussed above, that conforming mortgages are another example.

However, when it comes to the weights used to aggregate individual categories of real service output into an overall real output index for banking, we do not follow the existing BLS method. WBF (2004) delineate how the BLS's method should be modified to accord with the pure-services output measure. The BLS aggregates the services associated with lending and deposit-taking using as weights the shares of employment devoted to each activity. Economic theory suggests, however, that one should use the nominal output shares of the activities as the weights instead. Of course, one needs to use the risk-adjusted interest rate spreads to derive the nominal output measures. Thus, the aggregate measure of real bank output also changes with the adjustment for risk, but indirectly, through the shares needed for aggregation.[21] The empirical section below presents this new estimate of aggregate real bank output. We find that using the weights implied by economic theory causes the overall output index to change significantly.

[20] However, as discussed below. the weights we use to aggregate these service categories are quite different from the BLS weights, and this innovation causes the overall indexes to differ significantly.

[21] To be precise, the BLS actually follows a two-step procedure: It aggregates several categories of loans weighted by their respective interest rates to get lending output, and then sums up lending and depositor services weighted by their respective employment shares to obtain the index of total bank output. In our proposed scheme, everything would be symmetric: the different categories of loans would also be weighted by their nominal output shares. These revenue shares, however, are unlikely to correspond to relative interest rates of the loans, because, as we have discussed extensively, each loan interest rate must be adjusted for the risk associated with the interest flow.

More generally, the new models' most crucial implication for the measurement of banks' real output is the principle that the quantity of services is not necessarily proportional to the balance of associated financial instruments. Thus, these new theoretical results imply immediately that interest rates or rate differentials are not the prices of services. In the case of banks, this means that $\boldsymbol{Y}^A$ is not a fixed proportion of the balance of financial assets (A in (7)), nor is $\boldsymbol{Y}^D$ of the balance of deposits (D in (8)); P^i bears no fixed relation to any interest margin. This implication is the corollary of the pure-services definition of financial output: the flows of returns—including the risk premia—accrued to the funds invested in non-bank productive capital are not part of banks' output.

Our measure of real bank output is very similar conceptually to what Humphrey (2004, p. 215) calls "a direct measure of output quantities." Humphrey notes that "academics would prefer such a measure of banking output to what they now use" if it were available for individual banks. If an industry price deflator were constructed along the lines we propose, banking could follow the usual practice of constructing real output at the firm level by deflating nominal firm revenues by the industry deflator.

II.E Comparison with Existing Measures of Bank Output

We have shown that nominal bank output can be constructed using a user-cost-based approach, but the reference rates need to be adjusted for risk, and thus some of the gap between r^A and r^D does not represent implicit compensation for bank services. However, in accordance with SNA93, the U.S. NIPAs equate the *entire* interest margin to the nominal value of implicit financial services. Furthermore, since the 2003 comprehensive revision, the NIPAs also apply a single reference rate to divide the entire spread into two parts: the part of interest income above the supposedly risk-free reference rate (i.e., $(r^A - r^F)A$ in Figure 1) is counted as the nominal value of implicit borrower services, while the return foregone by depositors (i.e., $(r^F - r^D)D$ in Figure 1) is counted as depositor services. As a practical matter, however, the reference rate as defined in the NIPAs is not truly risk free in the sense that U.S. Treasury securities are risk free. We discuss this issue in greater detail later in Section III.

The resulting differences thus lie primarily in the value of (implicit) services to borrowers: the NIPAs include the risk-related returns on the funds lent by bank shareholders (i.e., areas II and III in Figure 1), whereas the new pure-services measure does not. For the same reason, the two measures differ on nominal output of services to holders of uninsured deposits: it is less by $(r^{M'} - r^F)D$ (i.e., by the risk-related returns depositors require).[22] Both measures agree on nominal output of services to holders of insured deposits, because of deposit insurance in the U.S.[23]

The distinction between the two measures is best illustrated with a special case where a bank funds its loans entirely with uninsured deposits (e.g., via jumbo CDs). Then, since investors in the bank's bond will demand $r^{M'}$, which is greater than r^F, the NIPAs will impute a value of borrower services that exceeds the whole of net interest, and a value of depositor services that is negative! This example highlights the conceptual problem in the NIPAs' choice of r^F as the reference rate.

The more crucial difference between the two measures lies in how nominal output is decomposed into quantity and price. The two measures imply different concepts of real output and in turn price deflators. The NIPAs now explicitly identify the two interest *rate differentials* as respective implicit *prices* for the implicit financial services. That is, the discounted rate differential $(r^A - r^F)/(1+r^F)$ is viewed as the supply price of implicit services to borrowers, while the rate differential $(r^F - r^D)/(1+r^F)$ is the price of implicit depositor services (see Fixler *et al*. 2003; Fixler 2005). These definitions of output prices imply that output balances of financial assets (largely loans) and deposits are the real outputs of borrower and depositor services respectively.[24]

In contrast, the pure-services measure of real output bears no definite relation to balances of financial assets or liabilities, so the implied price deflators are not necessarily proportional to discounted interest rate differentials. Instead, real output is an index of the relevant bank services; for example, real services to borrowers is an index of, say, numbers of different categories of loans screened and reviewed, with each type of activity weighted by its nominal

[22] Sometimes the correct risk-adjusted reference rate turns out to be the risk-free rate. But this is a special case, not a general principle. In U.S. law deposits over $100,000 are not insured by the FDIC, implying that the reference rate for those deposits should include a risk premium. Furthermore, several countries (e.g., Switzerland) do not have deposit insurance. In those countries, the reference rate for depositors also needs to take risk into account.
[23] The agreement is only in principle though, since the actual reference rate use in the NIPAs is not truly risk free, as we will discuss in detail in the empirical section later.
[24] Note that the theory employed to justify this decomposition (usually Barnett, 1980) gives no guidance about the price deflator that should be used to compare real "output" (asset and deposit balances) over time. Presumably real bank output should not be proportional to current-dollar asset and liability holdings, otherwise imputed real output will change mechanically with inflation. But what price index should be used to deflate the nominal assets and

value. In turn, the implied price deflators are thus analogous to common deflators such as the CPI and the GDP deflator. As noted above, Basu and Wang (2006) show that actual bank services will be proportional to asset or liability balances only under stringent and unlikely conditions.

The same argument distinguishes the pure-services output measure from that used in virtually all studies of individual banks and bank holding companies. The existing measures of bank output used in micro banking studies basically uses the (deflated) book value of financial instruments (assets and sometimes deposits) as the quantity, and interest rates or rate differentials as the price.[25]

III. Implementation, Data and Results

In this section we first present an overview of the issues that arise when measuring bank output based on the theory reviewed in Section II. We then present the data, and discuss our estimates of the risk premia, which are critical for our measurements. We conclude by presenting our new measures of nominal and real bank output.

III.A Implementation—Overview

As explained above, to impute the value of implicitly priced services to borrowers (i.e., $r_t^S A_t$) we must infer r_t^S. We base our empirical estimate on equation (7). The proxy for r_t^M is the yield on market securities with the most similar risk.[26] We can proxy required rates of return using yields because these matched market securities all have minimal default probability

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liabilities of banks—the CPI, the GDP deflator, or something else? The theory gives no answer, which is surely a cause for concern.

[25] More specifically, there are three variants of the micro measure, each set apart by the treatment of deposits—as an output or an input. The asset approach views deposits as an input for making loans, which together with market securities constitute bank output, whose quantity is measured using the deflated book value. The value-added approach views every financial product whose creation requires labor and capital as output, and it thus records deposits as an output. It measures output using the book value of financial assets and deposits. The user-cost approach, which is regarded as the foundation for the output measure used in the NIPAs, classifies input and output endogenously: it specifies a reference rate, and treats financial assets (liabilities) whose realized rates of return are greater (less) than the reference rate as output, and the others as input. So transaction deposits are typically found to be output in data. For a recent survey, see Berger and Humphrey (1997).

[26] We match each category of loans with market securities in the same class: residential mortgage loans with MBS, consumer loans with ABS, and C&I loans with commercial papers. Unfortunately, all of the market securities have average realized default rates that are much lower than those of the corresponding loan portfolios. To the extent that the systematic component of default risk (as well as other types of risk) is the same for loans and the matched securities, expected return equation (7) still holds. If the systematic component differs between loans and securities, however, then our estimates of risk premia will be too conservative.

(that is, $d_t^e \approx 0$ in which, using equations (3) and (4), implies that $R_t^M \approx r_t^M$). At least in our data set, we do not observe r_t^A either; instead we observe the realized rate of return on loans, $R_t^A - d_{t+1}$, where d_{t+1} is the actual rate of default in period t+1. Hence, r_t^S is estimated as the received interest rate net of the comparable market yield:[27]

$$r_t^S = (R_t^A - d_{t+1}) - R_t^M \,. \tag{10}$$

The interest rates received by banks on individual categories of loans and securities can be computed using bank accounting data (see the next sub-section for details). R_t^M for each category of loans can only be estimated with error. The maturity and risk composition of loans on banks' books is not available, and there may not be exactly matching market securities. However, as we will detail below, the available market data almost surely result in a rather conservative estimate, likely near the lower bound, of the true required rate of return and thus risk premium on each category of loans.

Fortunately, it is much easier to infer implicit depositor services, since no risk adjustment is necessary. However, the need for a truly risk-free rate raises an important conceptual and data issue, which we discuss below. For now, we simply note that we impute depositor services based on equation (8).

III.B Data Sources

Our empirical estimates cover the years 1987 to 2003, as the BLS output series for commercial banks only covers those years. Moreover, some of the accounting information for commercial banks that we rely on are not available further back in time. Accounting data for individual commercial banks come from the Consolidated Reports of Condition and Income (the so-called Call Reports).[28] These are quarterly financial statements filed by banks to their

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[27] $R_t^A - d_{t+1}$ is an unbiased estimate of r_t^A, and on average equals r_t^A, since $r_t^A = \mathrm{E}_t(R_t^A - d_{t+1})$, if $d_t^e = \mathrm{E}_t(d_{t+1})$, where $\mathrm{E}_t(.)$ is the expectation based on period-t information. However, in a specific period, $R_t^A - d_{t+1}$ is a noisy estimate of r_t^A, since d_{t+1} almost surely does not equal d_t^e exactly. A more accurate estimate can be derived using the revised version of equation (7) (based on market securities, as described in the previous footnote): $R_t^A = R_t^M + d_t^e + r_t^S$. Then r_t^S can be estimated as $r_t^S = (R_t^A - d_{t+1}) + d_{t+1} - R_t^M - \hat{d}_t^e$, with d_{t+1} estimated using the charge-off data for the different categories of loans, and $\hat{d}_t^e$ (a sample estimate of d_t^e) equal to the time-series-average of the charge-off rates. (Actual charge-off rates do not precisely equal d_{t+1}, since the maturities of loans do not correspond exactly to the period used in the study, which is a calendar year.) We plan to implement this more elaborate version in future revisions.

[28] These correspond to the forms FFIEC 031-041, see www.ffiec.gov for details.

regulators, and made available by the Federal Reserve Bank of Chicago. Some aggregate data items for all commercial banks (such as total interest paid on deposits and total deposit balance) are from the FDIC Historical Statistics of Banking.[29]

Our main use of the Call Reports data is to measure interest rates earned by commercial banks on various loans and securities. This includes the average rate earned by banks on U.S. Treasury and U.S. agency securities, used in the NIPAs as the opportunity cost or reference rate for all balance sheet items (see Fixler, *et al.* 2003). We report annual average interest rates, calculated as the interest received or paid in a year divided by the average of current and previous year-end (i.e., fourth-quarter) balances of the relevant securities. Table A.1 lists the specific data items used in calculating the interest rate on each category of securities, loans and deposits. Over the years, reporting requirements and variable definitions have evolved for the Call Reports. Table A.2 summarizes the major definitional changes between 1987 and 2003 and how they are handled to arrive at a harmonized time series.

In addition, we collect yields of U.S. Treasury securities of varying maturities from the Federal Reserve Board data on Selected Interest Rates.[30] Yields on various grades of commercial papers come from the same source. Yields on mortgage- and asset-backed securities are based on indices constructed by Citigroup Global Markets (formerly Salomon Smith Barney). Last, we collect data on interest rates charged on commercial and industrial (C&I) loans for clients with different risk profiles from the Federal Reserve Survey of Terms of Business Lending.[31] Finally, Chris Kask at the BLS provided us with the detailed activity indices used by the BLS to construct their commercial banks output index, as well as the weights used to combine these activity indices.[32] Those weights are employment requirement shares of several lending and deposit taking activities and are based on the Functional Cost Analysis (FCA) conducted by the Federal Reserve. The FCA was performed once every five years and has been discontinued following the 1997 survey. Between survey years, the shares are linearly interpolated and the shares are assumed constant after 1997.

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[29] See: http://www2.fdic.gov/hsob/.

[30] See: http://www.federalreserve.gov/releases/h15/. We use the constant-maturity series.

[31] Release E.2, http://federalreserve.gov/releases/e2/. For more information on banks' internal risk rating, see data reported in Form FR2028a/s, at http://www.federalreserve.gov/boarddocs/reportforms/ReportDetail.cfm?WhichFormId=FR_2028a/s. Those data are available from 1997 onwards; see Appendix A for further details.

III.C Estimates of Risk Premia

As discussed above, to estimate the current value of bank services bundled with any type of loan, two pieces of information are needed, namely the risk-free rate and the risk premium. Based on equation (3), the risk premium for a class of loans can be estimated as the yield spread between market debt with comparable risk characteristics and the risk-free debt (i.e., a U.S. Treasury security) with the same maturity, net of the default premium.[33] That is,

$$r_t^P = R_t^M - r_t^F - d_t^e . \tag{11}$$

Note that the yield spread itself (i.e., $R_t^M - r_t^F$) is an upwardly biased estimate of the risk premium as it omits the default premium. The bias thus roughly equals the expected default probability, which can be estimated using the average actual default rate. For certain categories of debt, such as commercial paper, this bias is likely to be minimal, since the realized default rate is extremely low. For example, according to Moody's, commercial paper with the highest rating (P-1) has a historical average default rate of basically zero.[34]

However, such yield-spread-based risk premia are not strictly comparable to the interest rates calculated based on the Call Reports as those are the interest rates actually received *ex post* (also called a holding-period return) instead of an *ex ante* yield. We thus compute risk premia based on realized returns whenever data is available in the Call Reports (see details below).

In their estimation of bank output, the BEA uses the interest rate on U.S. Treasury and Government agency securities as its estimate of the risk-free rate. However, this is not truly risk-free as it includes not just Treasurys, but also mortgage-backed securities (MBS) issued by government agencies like Fannie Mae and Freddy Mac. These securities are not subject to default risk but they are subject to prepayment risk—the risk that mortgage holders may pay back their loans in part or in full ahead of schedule. A large fraction of residential mortgage loans in the U.S. carry no prepayment penalties, including virtually all conforming mortgages. As a result, prepayment risk is a significant factor in determining the yields on MBS, but

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[32] For the overall commercial bank output index of the BLS, see http://www.bls.gov/lpc/.

[33] In fact, even for the same maturity, there are multiple Treasury yields, corresponding to different degrees of liquidity in the secondary market (e.g., on- vs. off-the-run). The constant-maturity Treasury yields we use are based on on-the-run Treasurys, so the resulting yield spread also contain a liquidity premium, which is, fortunately, much smaller than the average risk premium and shrinking (see Sack and Elsasser, 2004).

[34] "For a 180-day 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. This is the yield spread used in this paper to estimate the risk premium on C&I loans, as discussed below.

irrelevant for most other securities.[35] So when a deposit holder has to choose between keeping funds in his (insured) account or an alternative investment with the same degree of risk, he would not consider a portfolio that also includes MBS.

To arrive at a reference rate that is truly free of default as well as prepayment risk, we compute a "Treasurys-only" rate, net of the interest received on mortgage-backed agency securities. For 2001 to 2003, this rate is calculated using the Call Reports data items because interest income from government agency MBS is reported separately (see Table A.1). For earlier years (1987-2000), the rate is calculated based on an estimate of the return on U.S. Treasurys. We calculate the maturity-weighted average yield on banks' holding of Treasury securities, using the maturity composition of banks' holding of Treasurys. This information is available since 1997 and assumed constant at the 1997 level for the earlier years (1987-96) as the maturity composition is fairly stable over the 1997-2005 period (see Figure A.1). As discussed above, the yield of an asset is often not a good measure of the holding period return, so we use the current- and prior-year average yield as our estimate of commercial banks risk-free return.[36]

The risk premium on a category of loans is then most suitably calculated as the spread between the actual interest rate received by banks on market securities with the most comparable risk characteristics and the Treasurys-only rate.[37] This can be done in the case of mortgage loans, using data on the return on government agency MBS.[38] Using this MBS rate is likely to give a conservative estimate of the risk premium, as government agency MBS are not subject to default risk. However, taking account of prepayment risk accounts for at least part of the total risk premium, and is likely to be fairly similar for MBS and mortgages on banks' books.[39]

For other categories of loans, we compute the risk premia using yields according to (11), but without the default premium adjustment. To determine a market yield, R_t^M, with closely matched risk and maturity, we have to rely on aggregate data from other sources. In the case of C&I loans, the Federal Reserve's Survey of Terms of Business Lending provides information

[35] See e.g. Dunn and McConnell (1981) or Kau *et al.* (1992) for the importance and determinants of prepayment risk.
[36] Experiments for the 2001-2005 period suggest that this calculation method ensures the best correspondence to the actually observed bank returns on U.S. Treasurys over this period.
[37] See Table A.3 for time series of risk premia and a detailed description of the calculation method.
[38] As with the estimate of our Treasurys-only rate, Call report data are only available from 2001 onwards. See Appendix A for estimation details and discussion for the earlier period.

about the interest rate charged to customers with different risk profiles. For two of those risk categories, yields on market debt are readily available. The ‘minimum risk’ category covers clients with a credit rating of AA or better, while the ‘low risk’ category corresponds to a BBB rating. For the ‘minimum risk’ category, a risk premium estimate can be made using the yield on 90-day AA non-financial commercial paper compared to the yield on 90-day Treasurys. For the ‘low risk’ category, the BBB bond yield can be compared to long-term Treasurys (10 or 30 years).[40] According to the Federal Reserve’s Survey of Terms of Business Lending, most C&I loans are for a period of one to two years, suggesting the commercial paper spread is more appropriate. In addition, the risk premium based on the commercial paper spread is lower than based on corporate bond yields, which is more consistent with our aim of making conservative risk premium estimates.[41]

Finally, we make an estimate of the risk premium on consumer installment and credit card loans. The corresponding market rate we use is the yield on the asset-backed bond index of Citigroup. It is not clear what the average maturity of those assets is, but comparing the asset-backed bond yield to the one-year Treasurys’ yield gives consistently positive and plausible risk premium estimates.[42] Again, using this risk premium is conservative as the asset-backed bond index only includes investment-grade bonds, while most consumer loans held by banks are likely to be riskier.

III.D New “Pure-Services” Estimates of Loan and Depositor Service Output

We first consider the measurement of nominal output of implicit bank services, and the impact of different treatments of risk premium in the rate of return on loans. Table 1 illustrates, for the year 2003, how explicitly accounting for risk premia affects bank output at current prices compared to current practice in the NIPAs.[43] In total, it lists six types of services, to holders of two types of deposit accounts and borrowers of four types of loans. As we would expect, the

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[39] One of the main determinants of prepayment risk is the interest rate on a mortgage relative to the current mortgage rate, since when current mortgage rates decrease, refinancing becomes more attractive. Our method does implicitly assume that the interest rate composition of mortgages on banks’ books is the same as that of MBS.

[40] The BBB bond yield corresponds to Moody’s BAA bond yield in the Federal Reserve interest rate data.

[41] See Figure A.3 for risk premia estimates for both cases.

[42] See Figure A.4 for a sensitivity exercise.

[43] For comparability, we only include balance sheet items for which the BLS has developed activity indices. The BEA also includes the contribution of other balance sheet items, such as inter-bank loans. In net terms, the contribution of those items to overall output is small.

BEA's reference rate exceeds the Treasurys-only rate, by one percentage point. The latter, free of prepayment-risk, is the correct risk-adjusted reference rate for insured deposits. As a result, the value of depositor services imputed using the 'BEA' rate exceeds that using the 'risk-adjusted' rate by $41.3 billions, nearly 40% of the nominal output of depositor services using the BEA's method. On the other hand, the BEA's reference rate is lower than all the risk-adjusted reference rates for loans. As it turns out, the prepayment-risk premium on MBS is about the same as the risk premium for every other category of loans in 2003. The result is that nominal output of all lending services imputed using the BEA's reference rate exceeds that using the risk-adjusted rates by $15.9 billions, about 17% of the former imputed value.

In total, adjusting for the risk of bank assets and liabilities using available data lowers the nominal value of all six categories of imputed banks services in 2003 by $57.1 billions. This amounts to 28% of the nominal output imputed using the BEA's reference rate.[44] Furthermore, we suspect that this figure is on the low end, because our estimates of risk premia, and hence the risk-adjusted reference rates, tend to be conservative. First, the MBS rate used for mortgage loans contains no systematic default risk premium, while this is almost certainly part of bank interest rates. Second, C&I loans have maturities of on average one to two years, while we use a 90-day commercial paper yield for our risk premium estimate. Finally, asset-backed bonds generally carry credit enhancements and thus subject their holders to minimal credit risk, while consumer loans on banks' books are almost certainly riskier.

Figure 2 plots the time series of the risk-adjusted reference rates for deposits and loans from 1987 to 2003. For comparison, it also plots the respective time series of interest rates paid on deposits and received on loans. As described above, the Treasurys-only interest rate is the reference rate for all deposits, and this rate plus the balance-weighted risk premium for each category of loans forms the risk-adjusted reference rate for loans as a whole (the detailed values for all sample years are reported in Table A.3). The figure shows that the reference rate for loans consistently exceeds that for deposits, and the two rates co-move closely over time, as well as with the realized average loan and deposit interest rates.

Nonetheless, the risk premium (equal to the spread between the two reference rates) as well as gaps between the loan and deposit rates and their respective reference rates exhibit distinctive cyclical patterns. The risk premium generally narrows under tightening monetary policy, as the reference rate for loans (essentially a weighted average of rates on risky market securities) does not adjust as quickly as that for deposits (i.e., a weighted average Treasury rate). The spread of the average loan rate over the risk-adjusted reference rate narrows during economic downturns and widens following monetary tightening, as the actual loan rate seems to respond to monetary policy moves more than the matched market rates.[45] (Table A.4 reports the time series of this spread – interest rate margins – for each category of loans, as well as deposits).[46] On the other hand, the rate paid on deposits is more inertial than the average Treasury rate (a well documented fact in empirical banking studies, see, e.g., Berger and Hannan, 1989), and so the gap between the two narrows during downturns and widens in booms (coinciding with loose and tight monetary policy, respectively).

Figure 3 depicts the time series (1987-2003) of imputed bank output and the risk premium, corresponding to the three interest rate spreads in Figure 2. “Deposit services” equals the gap between the reference and the actual rate paid for deposits times the average deposit balance at all banks, and “Loan services” is calculated likewise. “Risk premium” equals the spread between the loan and deposit reference rates in Figure 1 times a weighted average of loan and deposit balances. It reflects the extra nominal value of implicit bank output imputed using the BEA’s instead of the risk-adjusted reference rate. Clearly, the difference between the two output imputations is not constant over time, and its fluctuation follows a pattern basically the same as that of the risk premium in Figure 2 described above. This means that including the risk premium in the nominal value of implicit bank output not only inflates the level, but also alters the growth rates of bank output.

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[44] Based on the BEA’s 2003 Use table (in industry accounts), around 42 percent of bank output is delivered to final demand and hence contributes to GDP. Our downward adjustment of imputed bank output would therefore, by a fairly rough estimate, reduce U.S. GDP in 2003 by about $24 billions or 0.2 percent.

[45] This can be construed as evidence for the existence of lending relationship: part of the implicit contract characterizing the long-term relationship between a borrower and his bank is for the bank to keep the credit affordable in bad economic times. Or it can be viewed as evidence of partial segmentation of credit markets in that bank funding cost (deposit reference rate) affects the pricing of its loans more than the market interest rates on risky debt.

[46] The interest rate margin (discounted by the gross risk-free interest rate) is also referred to as the “user cost price” (see e.g., Fixler, 2004). We avoid the latter term because the rate margin is not a price variable in the usual sense, and we have argued that nominal output divided by this margin does not yield real output.

III.E Real Output of Implicitly-Priced Bank Services

Although more accurate estimate of financial services output at current prices is already valuable, for productivity analysis real output is more important.[47] In this section, we compare several measures of real output of implicit bank services, paying special attention to the effect of different weights for aggregating output of individual types of bank services. As in the case of output at current prices, the fact that customers do not pay explicitly for financial services makes real output measurement difficult. Even in the case of complex business services, it is conceivable that a specific service can be identified and priced through time, but if the financial service is implicitly-priced, proxy measures have to be used. Basu and Wang (2006) argue that the BLS approach to count the number of loans and the number of deposit account transactions is likely to be most accurate available. According to that paper, other approaches, such as deflating loan and deposit balances by the CPI, are likely to be inaccurate if there is technological change in the provision of banking services.

To give a general overview, Table 2 shows the growth of real balances, the average annual growth rate of various categories of bank activities for 1987 to 2003 based on the BLS's quantity indicators and the implicit price change based on nominal balances and the BLS quantity indicators. According to the BLS activity counts, time and savings deposit services experience the largest decline (4.6% per year based on the number of deposits into and withdrawals from such accounts), followed by consumer installment loans. C&I loans appear to have stagnated. In contrast, services to credit card holders have seen substantial growth (10.4% per year based on the number of transactions processed), followed by services to mortgage borrowers. (See the BLS technical notes for details on the specific activities counted for each type of service.)

In addition to the implicit price change of the BLS activity indicators, Table 2 also lists the change in a few selected price indices for comparison. Not surprisingly, time and savings deposits have seen the greatest inflation (10.2% per year), followed by consumer loans (6.5% per year). At the other end, the price of credit-card services have fallen by 2.7% per year, exceeding even the price decline for investment in equipment and software. The implicit price of demand deposit services has also been declining (0.5% per year). The average inflation for the other bank

[47] The term "real output" is used to refer to output quantity, output volume and output at constant prices.

services is similar to those for overall consumption (i.e., the PCE and the CPI inflation), and less than the inflation of the financial service component in the CPI.

Figure 4 represents a significant effort on our part to derive a quantity indicator of bank output indirectly from the associated asset balance and the proper price index. The aim is to approximate the number of mortgage loans processed (including both existing loans serviced and new loans originated) with a suitably deflated balances series. In addition to our theory-based deflated balances series, which is based on the house price index published by the Office of Federal Housing Enterprise Oversight (OFHEO), Figure 4 also depicts a balances series deflated using the CPI for comparison. In growth rate, the relationship among the number of mortgages and house prices can be expressed as:

$$n_t + p_t = b_t - v_t \,, \tag{12}$$

where n_t is the number of mortgage loans processed, p_t the price of homes (the OFHEO house-price inflation index), b_t the balance of mortgage loans, and v_t the loan-to-value ratio.[48] Both sides of (12) equal total value of homes, and n_t – the growth rate of a real bank output – can be inferred from the more easily observed asset balance (b_t). Figure 4 plots growth rates of both the BLS counts of mortgage loans processed and the two deflated balanced series. The BLS count and the series deflated by the house price index are highly correlated, and show an average growth of similar magnitude.[49] On the other hand, the CPI-deflated series shows lower growth in the first half of the sample and much higher growth in the second half, that is, too smooth in general. Moreover, the correlation between the BLS and the CPI-deflated series is considerably lower.

This exercise shows that an asset balance can be used to derive a quantity index of bank output indirectly, but only if the suitable price deflator for the asset is available. As a result, similar estimates cannot be carried out for other bank lending activities, because none of the other loan categories so closely match a class of assets whose value and price index relate to bank activity counts in the way described by (12). This was also illustrated by comparing the implicit price indices in the top panel of Table 2 to the selected price indices in the bottom panel.

Table 3 and Figure 5 together illustrate the impact of using different weights to aggregate the quantity indices of the BLS detailed activity counts. Table 3 lists the three different sets of

[48] The loan-to-value ratio is fairly stable over time, so it is not included in our calculations.
[49] This is not to say that either quantity series is free of the usual problem with quality adjustment.

share weights for real output – employment requirement vs. nominal output shares, plus the corresponding deposit and loan balances for comparison. The weights based on employment requirements for each type of activities are currently used by the BLS. They were derived using the data from the Federal Reserve's Functional Cost Analysis (FCA), which was discontinued in 1997.

In theory, the weights used for aggregating individual output indices should be their respective share in output at current prices. Two sets of output shares are shown, one set based on the BEA's reference rate, while the other uses the risk-adjusted reference rates.[50] The two sets of shares are virtually the same for 1997, and slightly different in 2003, with the BEA-based shares weighting time and savings depositor services more and lending services less. Moreover, the weights vary over time, quite substantially for some categories of bank services. For example, the share of demand depositor services more than halved from 1997 to 2003, as the nominal risk-free interest rate fell by more than four percentage points between the two years. This shows the importance of having up-to-date weights as compared to the set of weights for 1997 currently used by the BLS.

Comparing the nominal output shares with the employment weights in 1997 (the last year the FCA data were collected) shows that nominal output shares generally assign less weight to demand depositor and much more to time and savings depositor services. Moreover, time series of the weights (not shown) reveal that the employment weights are more stable than the two nominal-output-share weights.

Figure 5 then summarizes the impact of using different aggregation weights, in terms of the average annual growth rate of real bank output based on the BLS quantity indices. Using the nominal output shares as weights substantially raises the growth rate of lending service output ("Loan index") – more or less doubling it. Between the two nominal output weights, the one based on risk-adjusted reference rates generates a higher average growth than the other, by 0.8% per year. On the other hand, nominal output weights trim the growth of depositor services ("Deposit index"), somewhat more so with those based on risk-adjusted reference rates. Overall, using weights of nominal output based on the BEA's reference rate results in the lowest average growth rate (0.5% per year) of real bank output, while using the other two weights series results in nearly the same average growth rate (0.9% based on employment shares and 0.8% based on

[50] So the shares for 2003 correspond to the final two columns in Table 1.

risk-adjusted reference rates). However, the three weights series generate rather different growth rates from year to year (not shown).

IV. Conclusions

We have applied the new theories developed in a series of papers by Wang *et al.* to impute the output of commercial bank services. We have shown that the measurement implications of the new theories can be implemented in a satisfactory way using existing banking and financial data. We have also noted places where more data would be most useful for improving the measures presented here. Thus, as well as proving feasibility, this pilot study provides a guide for future data collection.

This study generates these important substantive lessons. Correcting for risk, as required by the new theories, reduces nominal bank output on average by 21 percent over the entire sample period. We show that the correction can be significantly larger in individual years or for particular output components. In particular, depositor services have been overstated because the BEA has used a reference rate that is not truly free of risk. Using U.S. Treasurys as a true risk-free rate reduces imputed depositor services by 40 percent.

Real output can also change substantially if constructed in accordance with the new theories. Using the correct risk-adjusted nominal output weights to aggregate the same disaggregated real output from BLS shows that risk-adjustment can make a noticeable difference. Much more important is the difference between using real output data from BLS, which is based on counts of actual services (transactions), and using deflated balances to represent real output, as proposed in a series of recent papers. [These results are available, and will be incorporated into a future draft of the paper.] Basu and Wang (2006) argue that, as a matter of theory, deflated balances are proportional to services only under implausible conditions. The data appear to confirm their reservations—real output based on deflated balances has a much higher growth rate than the real output measure implied by the robust method of counting actual services, and the two series have a near-zero correlation in their annual growth rates.

More than any other lesson, either theoretical or empirical, we would like to emphasize a procedural conclusion that we have drawn from this line of research. That lesson is that results in this area are difficult to derive without employing fully-specified models based on optimization under uncertainty, where banks are seen as one part of an overall financial system in which well-functioning markets price assets according to their risk and return. Much of the previous literature on measuring bank output has been based on intuition and analogy. Almost none of it has incorporated risk formally into the analysis, or specified clearly what banks do for their customers that those customers cannot do for themselves by transacting in the financial markets. Intuition and analogy are often powerful shortcuts for reaching a conclusion, but in this field they have not succeeded in delivering results that command broad general agreement.

Fortunately, the powerful tools available to economists give us the alternative option of working out formal models that start from primitives on which we can all agree. This option is often slow and laborious, but it is sure. And in any particular subfield of economics, we can make faster progress by drawing on large bodies of knowledge organized systematically by economists in other areas. In our particular application, it has proven very useful to incorporate standard lessons from finance to analyze what are, after all, financial firms. To some extent, this paper is only a first step towards developing estimates of risk premia, but we hope it provides a guide for future research. In general, to facilitate productive communications and to make quicker progress, we believe it is very important that such future research be based on formal models that are risk-based, with precise assumptions and rigorous analysis.

Table 1. The Effect of Risk Adjustment: Imputed Output of U.S. Commercial Banks at Current Prices in 2003 ($billions)

	Average Balance	Interest Flow	Interest Rate	Reference rate (BEA)	Reference rate (Risk-Adjusted)	Imputed Output (BEA)	Imputed Output (Risk-Adjusted)
Deposits in domestic offices	4,160	52.3	1.3%	3.8%	2.8%	107.5	66.2
Demand deposits	528	0.0	0.0%	3.8%	2.8%	20.3	15.0
Time and savings deposits	3,632	52.3	1.4%	3.8%	2.8%	87.2	51.2
Loans in domestic offices	3,761	239.6	6.4%	3.8%	4.3%	95.2	79.3
Real estate loans	2,134	123.7	5.8%	3.8%	4.2%	41.7	34.2
Consumer installment loans	403	26.4	6.5%	3.8%	4.4%	10.9	8.5
Credit cards loans	334	35.3	10.6%	3.8%	4.4%	22.5	20.5
Commercial & industrial loans	890	54.3	6.1%	3.8%	4.3%	20.1	16.1
Total						202.7	145.5
Treasury and government agency securiti	1,092	42.0	3.8%				
Mortgage-backed securities	808	33.9	4.2%				
Others (i.e., Treasuries-only)	285	8.1	2.8%				

Notes: Average balance is the average of the balance reported on December 31, 2002 and December 31, 2003. Interest rate is the interest flow (either expense or income) divided by the average balance. The 'Reference rate (BEA)' uses the average interest rate on Treasury and government agency securities, following the methodology described in Fixler *et al.* (2003). The risk-adjusted reference rate on deposits is equal to the interest rate on only Treasurys (i.e., all government securities other than mortgage-backed securities). The reference rate on loans is equal to the reference rate on deposits plus a risk premium. See Appendix Table A.1 and A.2 for a description of Call report items and codes used in the caluclation. See Table A.3 for the time series of risk premia and notes about their construction. See Table A.4 for the time series of interest rate margins (also referred to as "user cost prices").

Table 2. Growth of BLS Activity Indices and the Implicit Price Indices (Average Annual Rate, 1987-2003, %)

BLS activity indices	Real balances	BLS Quantity Indicators	Implicit Price
Demand deposits	-3.1	1.1	-0.5
Time and savings deposits	5.4	-4.6	10.2
Residential mortgages	7.2	6.1	4.0
Commercial mortgages	5.3	5.1	3.1
Consumer installment loans	0.9	-3.4	6.5
Credit card loans (transactions)	4.0	10.4	-2.7
Commercial and industrial loans	2.1	-0.2	2.7
Selected price indices			
Housing prices (OFHEO)			4.6
Housing prices (Census)			3.6
Non-residential structures investment (BEA)			3.4
Personal consumption expenditures (BEA)			2.5
Private fixed investment in equipment & software (BEA)			-1.1
Consumer price index (BLS)			3.0
Financial services CPI (BLS)			5.4

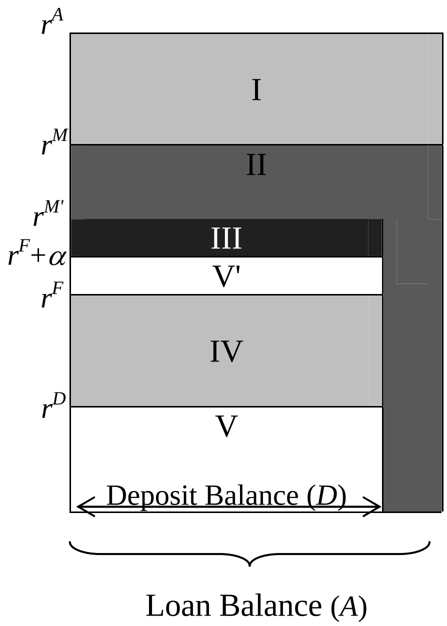
Notes: Real balances is the growth of outstanding balances, based on the FDIC Historical Statistics on Banking, minus the change in the CPI. Outstanding balances refer to the balance at the end of the year, so the value change is calculated using the year-average balance. BLS output growth is calculated based on detailed activity indices, kindly provided by Chris Kask of the BLS. Growth of the implicit price deflators is calculated using the outstanding balance of loans and deposits in each category. The source of each price index selected for comparison is noted in parentheses. The difference between OFEHO and Census housing prices is that the Census series considers only new houses, while the OFHEO index is based on repeat sales of both new and existing homes. Consumer price index refers to the All items index for All Urban consumers (U.S. city average) while the financial services CPI refers to item SEGD05 with the same coverage.

Table 3. Employment Requirements, Output Shares and Balance Shares of Commercial Bank Loans and Deposits

	Employment	Output (BEA)	Output (Risk Adj.)	Balance Share
1997				
Demand deposits	39%	24%	26%	11%
Time and savings deposits	11%	30%	29%	42%
ATM transactions	2%			
Real estate loans	18%	16%	17%	22%
Consumer installment loans	10%	7%	7%	6%
Credit card loans	4%	12%	12%	4%
Commercial and industrial loans	11%	12%	9%	15%
2003				
Demand deposits		10%	10%	6%
Time and savings deposits		43%	35%	46%
ATM transactions				
Real estate loans		21%	24%	27%
Consumer installment loans		5%	6%	5%
Credit card loans		11%	14%	4%
Commercial and industrial loans		10%	11%	11%

Notes: Employment shares are based on results from the last Functional Cost Analysis in 1997, as currently used by the BLS to weight its activity indexes (the FCA was discontinued in 1997; data have been kindly provided by Chris Kask of the BLS). Output (BEA) imputes financial services using the same reference rate for all loans and deposits, while Output (risk adj.) uses a risk-adjusted reference rate as in Table 1. The balance shares are percentages of the sum of all loan balances plus deposit balances. ATM transactions shares are not shown in the last three columns, because they do not correspond to any specific balance sheet item.

Figure 1. Decomposition of a Bank's Total Interest Receipt



Notes:
r^A: Total received interest rate on loans
r^M: Expected rate of return required on market securities with the same (or most comparable) risk characteristics as the loans
$r^{M'}$: Expected rate of return depositors would require without deposit insurance
r^F: Risk-free rate
r^D: Actual deposit interest rate
α: Insurance premium rate charged by FDIC

Area I: implicit fees for intermediation services (e.g., origination and monitoring)
Area II: loan risk premium for bank shareholders
Area III: implicit deposit insurance premium (taxpayer subsidy through FDIC)
Area IV: implicit fees for depositor services (e.g., transaction and payment services)
Area V: interest paid to depositors
Area V': the premium banks pay (to FDIC) for deposit insurance

Figure 2. Average Interest Rates on Loans and Deposit, and Their Corresponding Reference Rates, 1987-2003

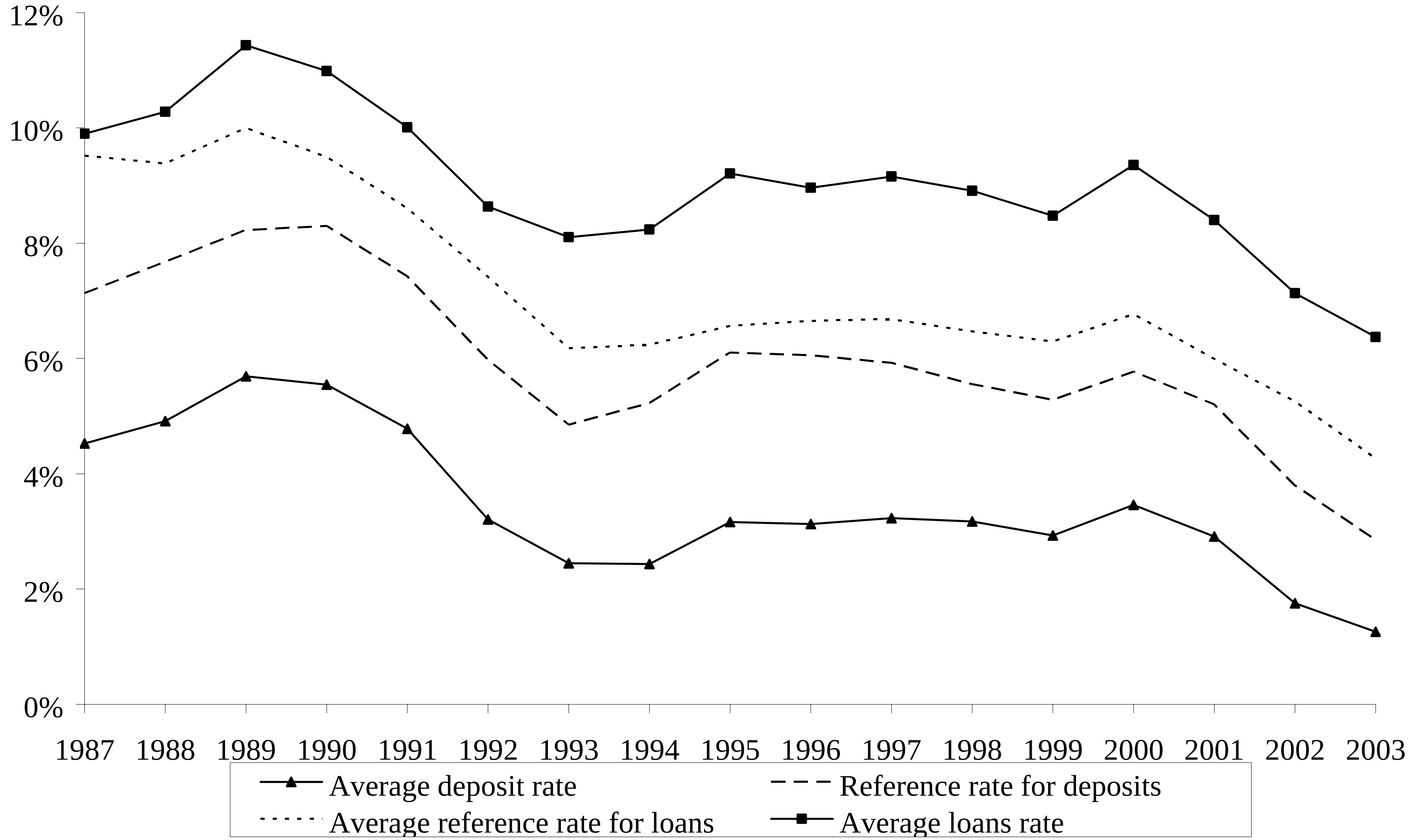


Figure 3. Imputed Output of U.S. Commercial Banks and Risk Premium at Current Prices, 1987-2003 (billions of dollars)

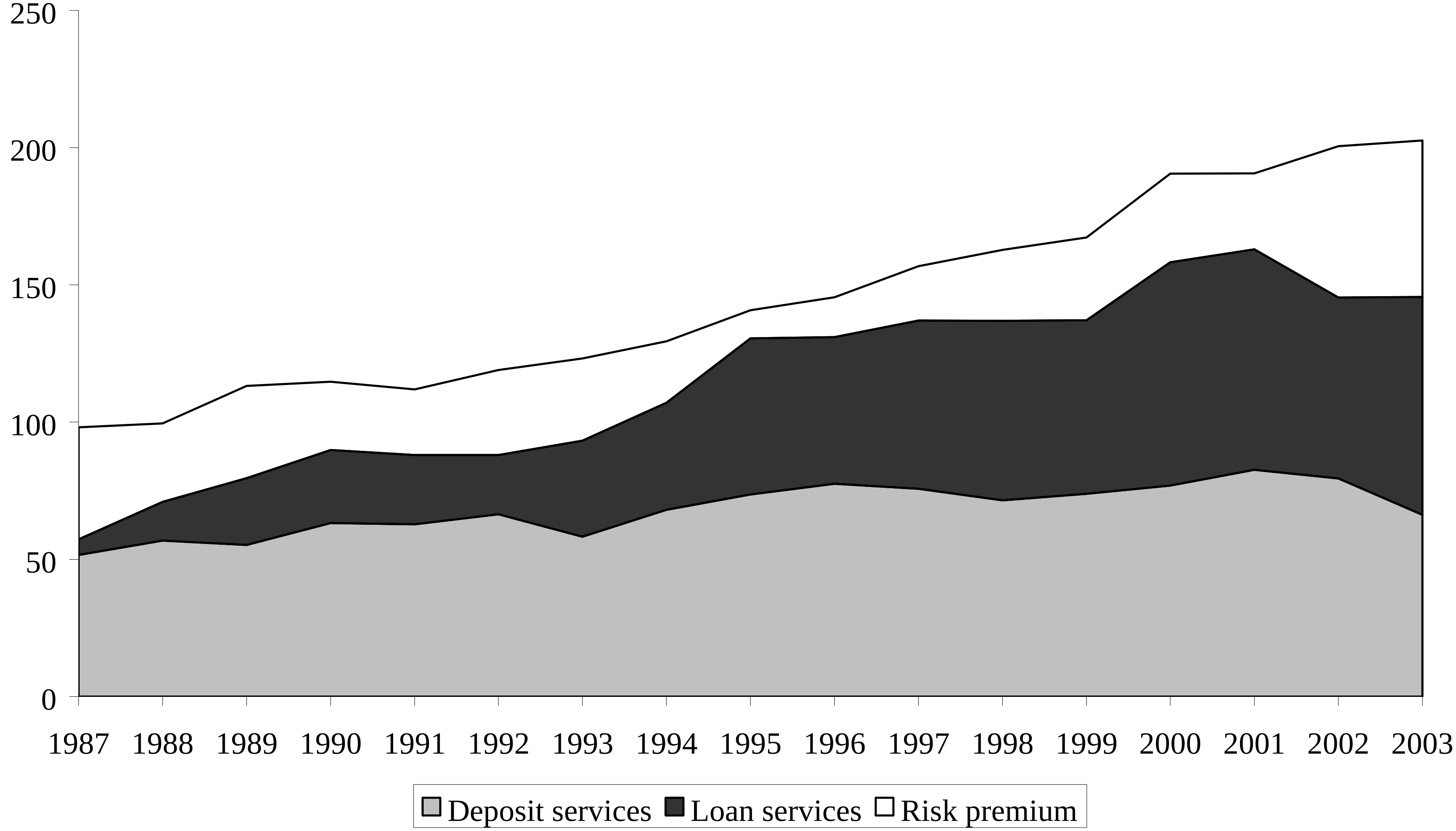


Figure 4. Growth of Residential Mortgage Origination, Number of Mortgages versus Deflated Balances, 1987-2003

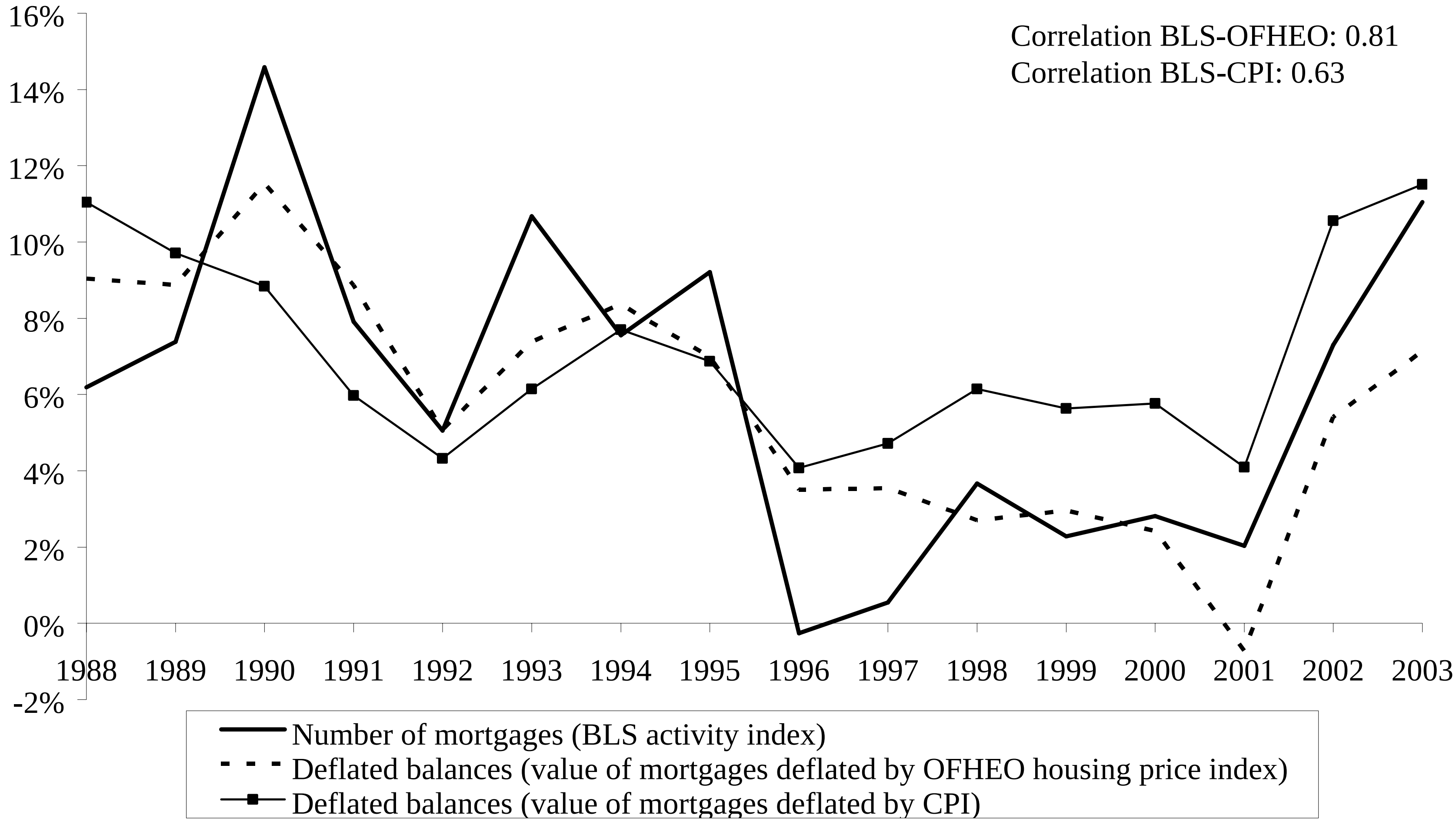
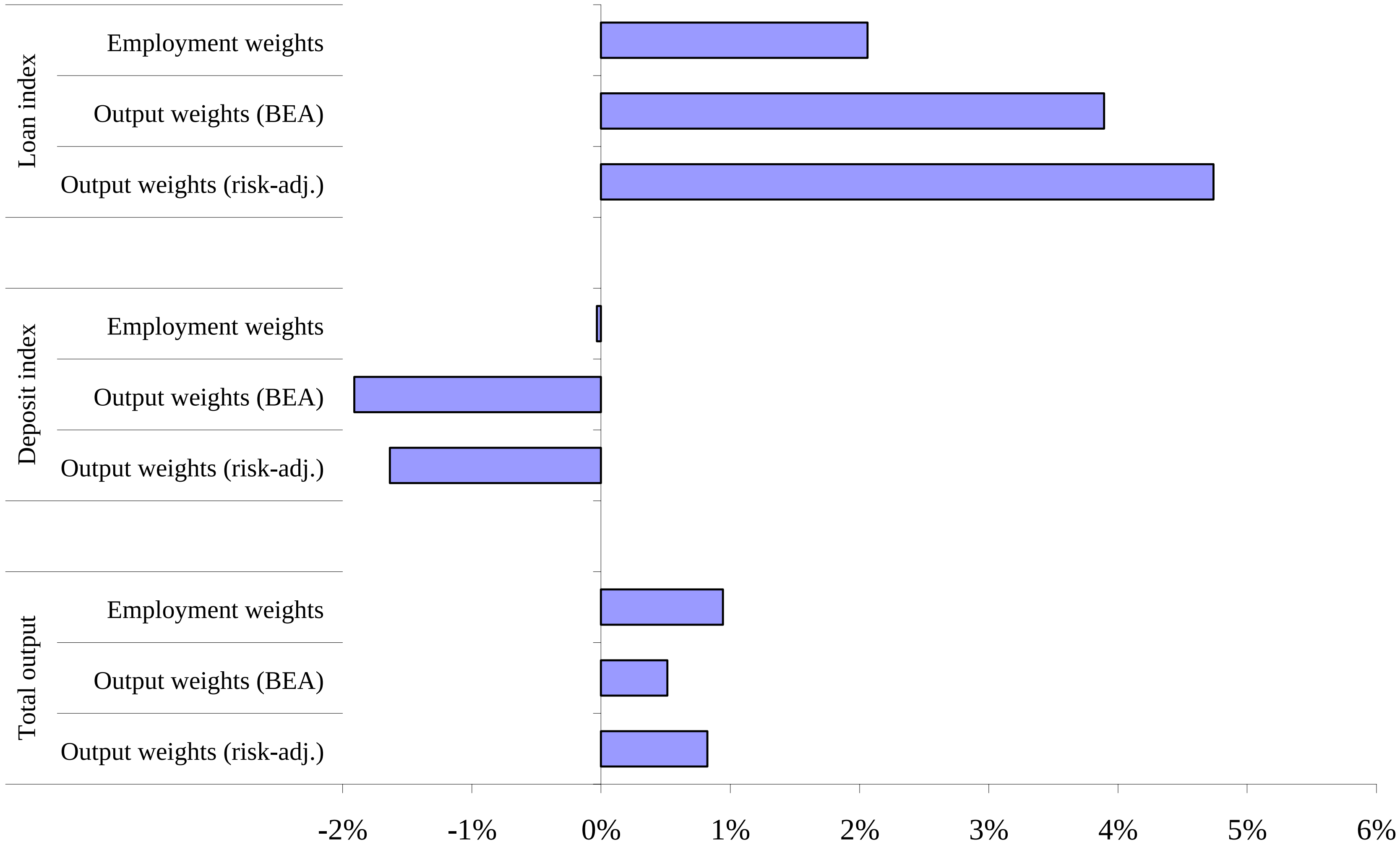


Figure 5. Growth of Imputed Real Output of U.S. Commercial Banks under Different Weights (Average Annual Rate, 1987-2003)



Appendix A. Detailed data and estimation procedures

Specifically, risk-premium on real estate loans equals the difference between the interest rate received by banks on MBS issued or guaranteed by government agencies (such as FNMA and FHLC) and the Treasurys-only reference rate for 2001-2003, when the interest rate received on MBS is calculated directly using the Call reports items. For 1987-2000, the premium is inferred indirectly as the difference between the realized rate on all government securities (which include both Treasurys and government MBS) and the constructed only-Treasury reference rate (as described above, and see Table A1). The share of MBS in the portfolio of all government securities before 1994 is extrapolated using the trend in the MBS share for the 1994-2003 period.

Figure A.2 compares the (two-year moving average) yield on a broad bond index of agency MBS (Citigroup) and the actual annual rate of return received on banks' holding of agency MBS over 1987-2003. The *ex ante* yield tracks the holding-period return quite closely, with the yield consistently exceeds the actual return by about 50 basis points.[51]

Risk premium on commercial & industrial (C&I) loans for 1997-2003 is inferred using survey data on C&I loan interest rates by risk categories (Federal Reserve Survey of Terms of Bank Lending). The risk premium for the "minimal risk" category is set equal to the spread of 3-month AA nonfinancial commercial paper over the 90-day Treasury bill yield.[52] The risk premia for the other risk categories are extrapolated based on the premium for the minimal-risk category. That is, the risk premium of the "low risk" category is equal to the risk premium of the minimal-risk category plus the difference between the interest rate of low risk and minimum risk customers. The overall risk premium for all C&I loans is a weighted average with the balance shares reported in the survey as weights. For 1987-1996, the overall C&I risk premium is extrapolated using the commercial paper-Treasury yield spread. We have also experimented with another estimate of the C&I risk premium using the yield spread of longer-term securities – the spread of BAA corporate bonds over 30-year Treasury bonds. Not surprisingly, the long-term spread is consistently higher than the short-term one throughout our sample period, and that sometimes results in negative imputed output. So most of our output estimates use the short-term-based risk premium.

Risk premium on consumer installment and credit-card loans equals the difference between asset-backed bond yields and the yield on 1-year Treasury for 1990-2003, as the former is based on bond yields published by the Citigroup Global Markets (formerly Salomon Smith Barney), which did not start until 1990. For 1987-1989, the premium is extrapolated using the trend in the risk premium for C&I loans.

[51] The most likely explanation is that the MBS held on banks' book have a shorter average maturity than the market portfolio of agency MBS. According to a Goldman Sachs trader, banks prefer to hold CMOs with short maturities, because this enables them to better match the short maturity of their liabilities.

[52] According to survey instructions, loans to "lenders with an AA or higher public debt rating" can be categorized as "minimal risk."

Table A.1. Call report items used in calculating commercial bank interest rates

	1987-1993	1994-2000	2001-2003
Interest income			
Real estate loans	RIAD4011+RIAD4246	RIAD4011+RIAD4246	RIAD4011
Consumer installment loans	RIAD4055+RIAD4247	RIAD4055+RIAD4247	RIADB486
Credit card loans	RIAD4054+RIAD4248	RIAD4054+RIAD4248	RIADB485
Commercial and industrial loans	RIAD4012	RIAD4012	RIAD4012
Treasury and government agency securities	RIAD4027+RIAD3660	RIAD4027+RIAD3660	RIADB488+RIADB489
Mortgage-backed securities			RIADB488
Other than mortgage-backed securities			RIADB489
Loan/security balance			
Real estate loans	RCON1410	RCON1410	RCON1410
Consumer installment loans	RCON2011	RCON2011	RCONB539+RCON2011
Credit card loans	RCON2008	RCON2008	RCONB538
Commercial and industrial loans	RCON1766	RCON1766	RCON1766
Treasury and government agency securities	RCFD0400+RCFD0600		
Mortgage-backed securities		RCFD1702+RCFD1705+RCFD1707+RCFD1710+RCFD1713+RCFD1715+RCFD1717+RCFD1719+RCFD1732+RCFD1734+RCFD1736	RCFD1702+RCFD1705+RCFD1707+RCFD1710+RCFD1713+RCFD1715+RCFD1717+RCFD1719+RCFD1732+RCFD1734+RCFD1736
Other than mortgage-backed securities		RCFD0213+RCFD1287+RCFD1290+RCFD1293+RCFD1295+RCFD1298+RCFD1699	RCFD0213+RCFD1287+RCFD1290+RCFD1293+RCFD1295+RCFD1298+RCFD1699

Notes: Entries refer to the codes used in the *Consolidated Reports of Condition and Income* of the Federal Financial Institutions Examination Council. Call report data were downloaded from the Federal Reserve Bank of Chicago (http://www.chicagofed.org/economic_research_and_data/commercial_bank_data.cfm). Data were used for the fourth quarter of each year, which contains data on loan balances on December 31st of that year, as well as the interest income accrued over the year to date. Using the Entity Type Code variable (RSSD9331), data covering only commercial banks were selected. Data for loan types for each bank are only included when data on both interest income and balances are available. This mostly affects banks with less than $25mln in assets, who before 2001 did not have to provide a breakdown of total interest income by loan category. In 2004, this category of banks represented around 0.1% of total commercial bank assets.

Table A.2. Notes about changing definitions in the Call reports between 1987 and 2003

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 & 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 $25mln in assets did not have to report any of these variables.
RIAD3660	Up to 2000, small banks used this variable to report their interest income for all debt securities. This leads to a small overstatement of interest income relative to the underlying securities. This variable is not available for 1987 and 1988 leading to a lower coverage for those years.
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.
Treasury and government agency securities	From 1994 onwards, both amortized cost and fair value of a larger number of U.S. government and government agencies securities is reported, as well as a distinction between securities held-to-maturity and available-for-sale. Fair value data are used for both held-to-maturity and available-for-sale securities.
RIADB485, RIADB486	From 2001 onwards, interest income on revolving loans other than credit cards was moved from credit cards to consumer installment loans.
RIADB488, RIADB489	From 2001 onwards, interest income on mortgage-backed securities issued by government agencies and other government securities are separately reported.
RCONB538, RCONB539	From 2001 onwards, credit card loans (RCONB538) do not include other revolving loans (RCONB539) anymore.

Table A.3. Risk-free reference rate and risk premia for loans, 1987-2003 (%)

	Reference rate	*Risk premium on:*			
		Real estate loans	Consumer installment loans	Credit card loans	Commercial and industrial loans
1987	7.1	2.2	2.8	2.8	2.3
1988	7.7	0.7	2.6	2.6	2.2
1989	8.2	1.4	2.2	2.2	1.9
1990	8.3	1.2	1.3	1.3	1.1
1991	7.4	0.9	2.0	2.0	1.0
1992	6.0	1.6	2.3	2.3	0.7
1993	4.9	1.7	1.6	1.6	0.4
1994	5.2	0.9	1.4	1.4	0.8
1995	6.1	0.1	0.7	0.7	0.9
1996	6.1	0.3	1.0	1.0	0.8
1997	5.9	0.5	0.9	0.9	1.1
1998	5.6	0.7	0.8	0.8	1.4
1999	5.3	0.6	1.3	1.3	1.5
2000	5.8	0.7	1.0	1.0	1.5
2001	5.2	0.7	1.4	1.4	0.6
2002	3.8	1.4	1.9	1.9	1.3
2003	2.8	1.3	1.6	1.6	1.4

Reference rate: equal to the return on Treasury and government agency securities other than mortgage-backed securities. For 2001-2003, this rate is calculated directly using the Call reports data items (see Table A.1). For 1987-2000, the rate is calculated indirectly as the average of current and one-year lag of the weighted average yield on bank holdings of Treasury securities. The maturity composition of bank holdings of Treasury securities is available for 1997-2003 and assumed constant before that period.

Risk-premium on Real estate loans: in general, equal to the difference between the interest rate on mortgage-backed securities (MBS) and the reference rate. For 2001-2003, the MBS rate is calculated directly using the Call report items; for 1987-2000, calculated indirectly based on the information about the portfolio of government securities (MBS plus 'other than MBS' from the Call reports) and the rate for 'other than MBS' securities (i.e., the reference rate, see above) (see Table A1). The portfolio composition of government securities is extrapolated based on the trend in the share of MBS for the 1994-2003 period.

Risk premium on Consumer installment and Credit card loans: for 1990-2003, equal to the difference between asset-backed bond yields (Citigroup Global Markets, Asset Backed Bond Yield) and the yield on 1-year Treasuries; for 1987-1989, extrapolated using the trend in the risk premium for Commercial & industrial loans.

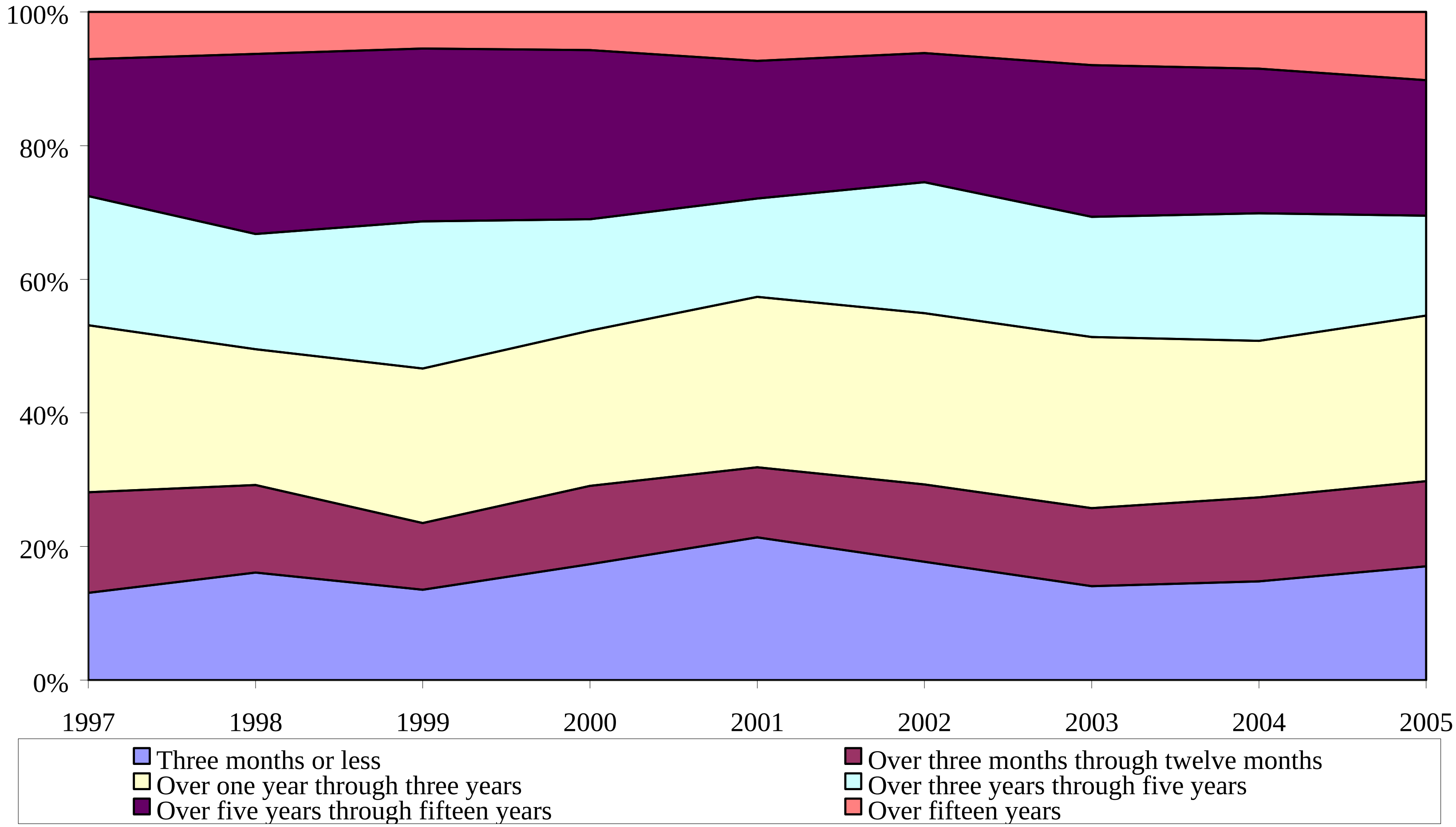
Risk premium on Commercial & industrial (C&I) loans: for 1997-2003, based on survey data on C&I loan interest rates by risk categories (Federal Reserve Survey of Terms of Bank Lending). The lowest-risk category should be applicable to lenders with a AA credit rating. The risk premium for this category of lenders is set equal to the difference between the 3-month AA Commercial paper yield and the 3-month Treasury yield. The risk premia for the other risk categories are extrapolated based on the premium for the lowest-risk category. The overall risk premium is a weighted average, using loan shares reported in the survey. For the 1987-1996 period, the overall C&I risk premium is extrapolated using the Commercial paper-Treasury risk premium.

Table A.4. Interest-rate margins for loans and deposits, 1987-2003 (%)

	Demand deposits	Time and savings deposits	Real estate loans	Consumer installment loans	Credit card loans	Commercial and industrial loans
1987	7.1	1.1	0.2	0.3	6.2	-0.4
1988	7.7	1.4	1.2	0.0	6.0	0.0
1989	8.2	1.0	0.9	0.6	6.4	1.5
1990	8.3	1.4	0.6	1.4	7.1	1.4
1991	7.4	1.5	1.1	1.2	6.8	0.7
1992	6.0	2.0	0.6	1.6	6.8	0.6
1993	4.9	1.7	0.9	2.6	7.6	1.8
1994	5.2	2.1	1.4	1.9	7.0	1.5
1995	6.1	2.0	2.1	2.4	7.4	2.1
1996	6.1	2.0	1.8	2.3	6.3	1.8
1997	5.9	1.8	2.0	2.7	7.3	1.7
1998	5.6	1.6	1.9	3.1	7.7	1.6
1999	5.3	1.7	1.9	2.9	6.5	1.3
2000	5.8	1.7	2.0	2.7	7.8	2.3
2001	5.2	1.8	1.8	2.1	7.1	2.3
2002	3.8	1.8	1.3	2.3	7.3	1.3
2003	2.8	1.4	1.6	2.1	6.1	1.8

Notes: The interest-rate margin (also referred to by some as the "use-cost price") for deposits equals the reference rate from Table A.3 minus the interest rate banks pay on these deposits (from the FDIC Historical Statistics on Banking). The interest-rate margin for loans is equal to the interest rate earned (see Table A.1 for sources) minus the reference rate and the corresponding risk premium from Table A.3.

Figure A.1. Maturity Composition of Banks' Holding of U.S. Treasurys and Other Government Agency Securities, 1997-2005



Note: maturity information is only available for a category of securities that also includes mortgage pass-through securities other than those backed by closed-end first lien 1-4 family residential mortgages.

Figure A.2. Market Yield vs. Banks' Holding Period Return on Mortgage-Backed Securities (MBS), 1987-2003

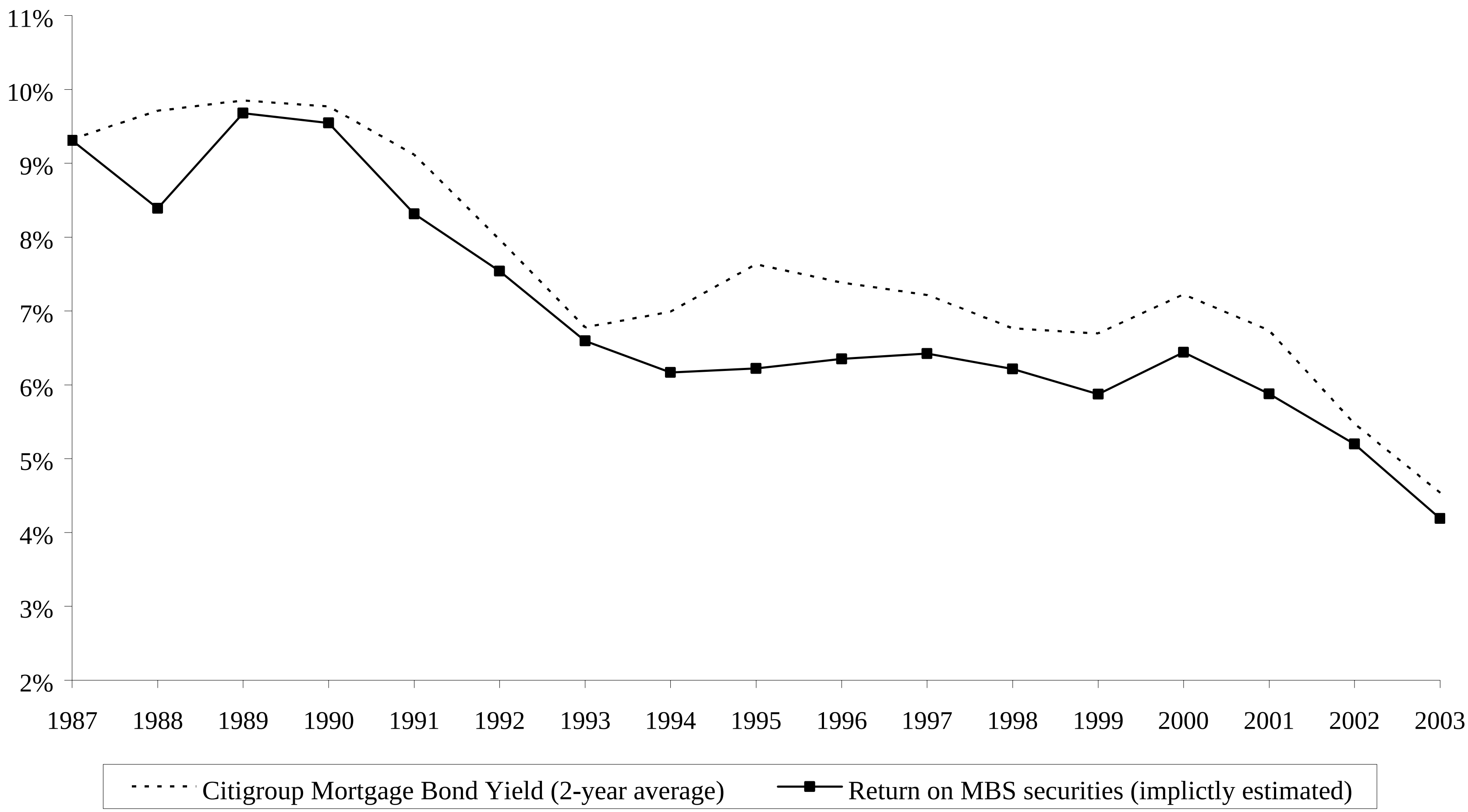
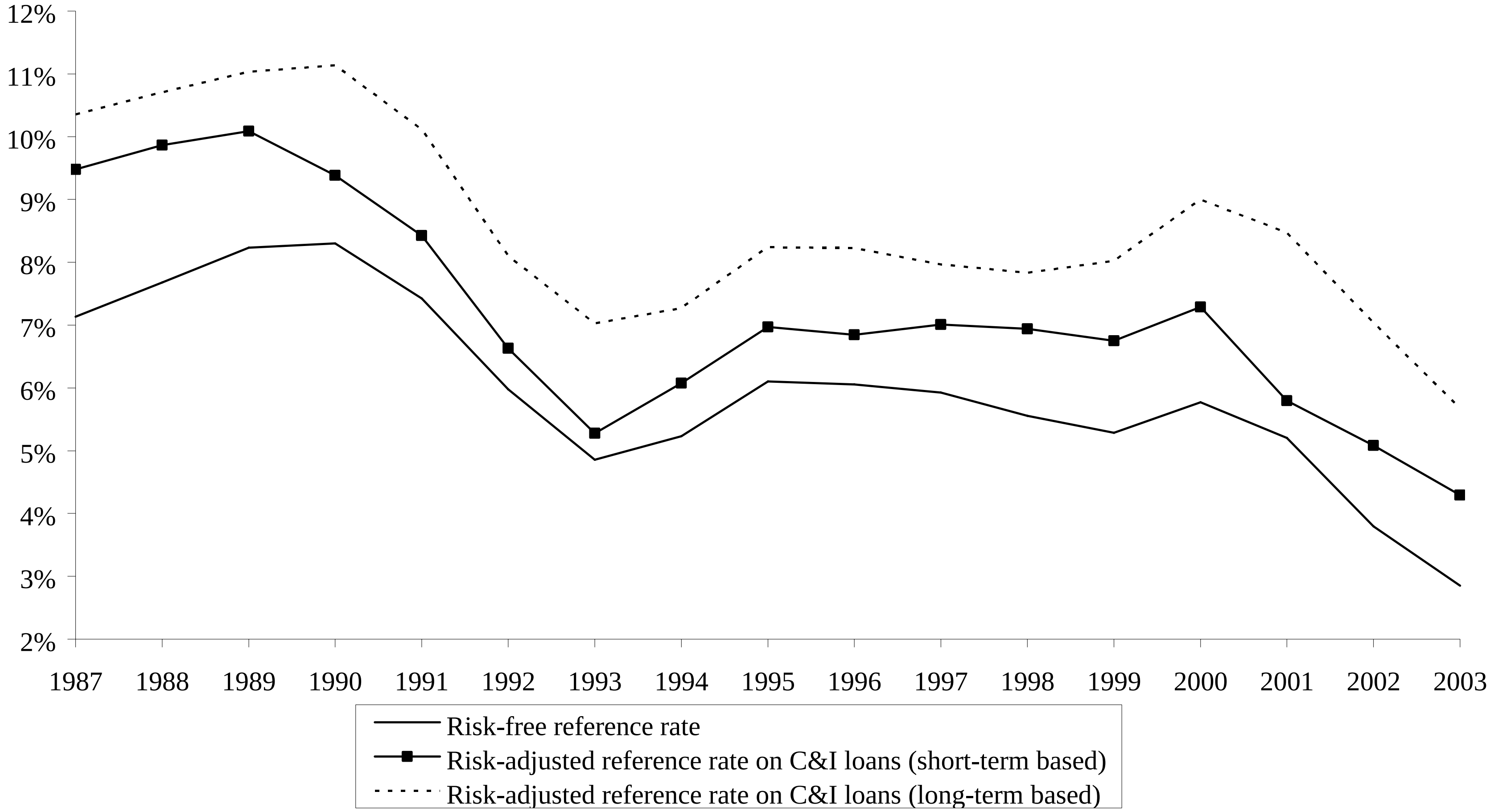
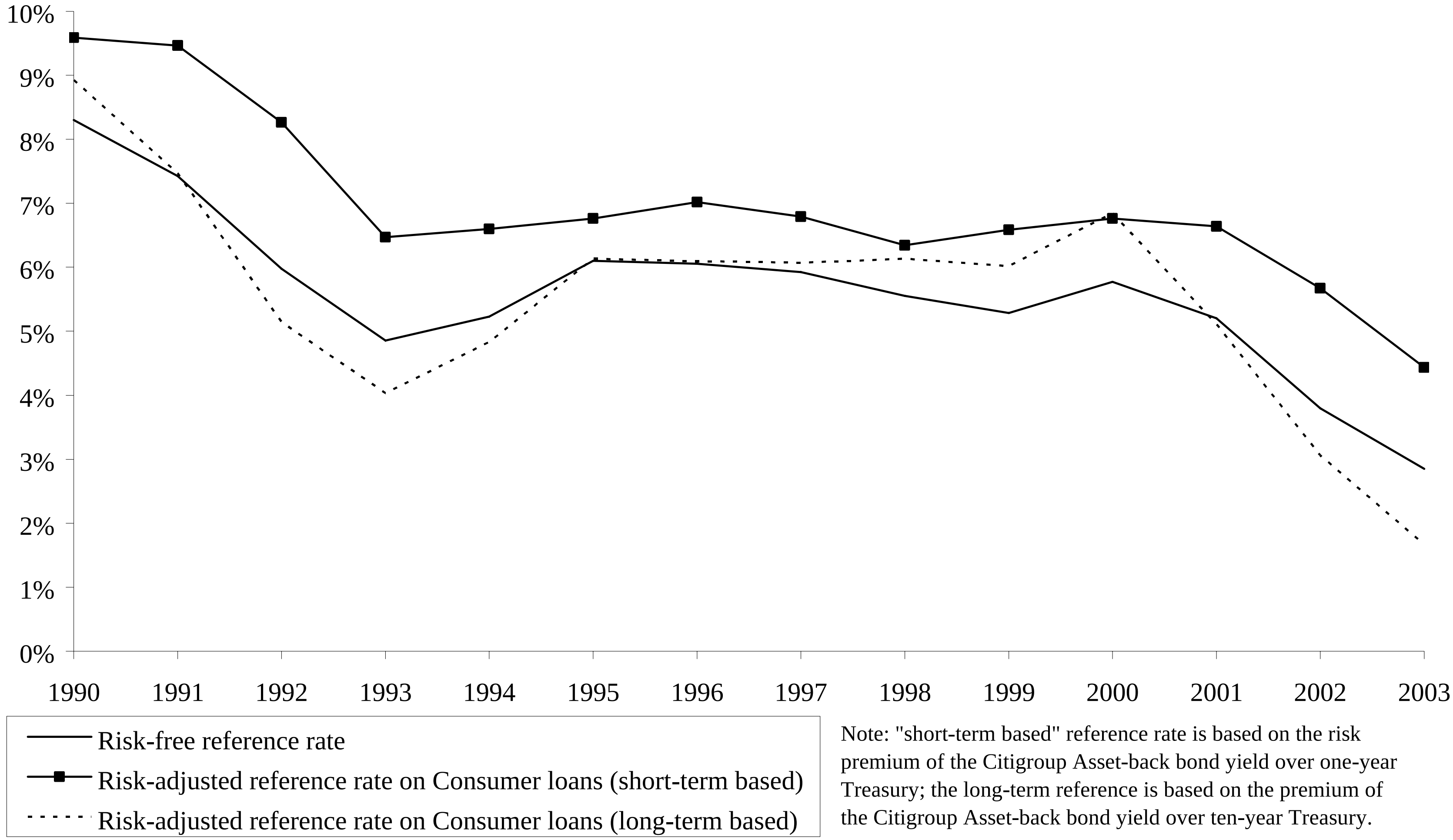


Figure A.3. Risk-Adjusted Reference Rates for Commercial & Industrial (C&I) Loans and the Risk-Free Rate, 1987-2003



Note: Short-term based reference rate is based on the premium of 3-month AA Commercial paper over 90-day Treasury bills; the long-term reference rate is based on the premium of 30-year BAA bond yield over Treasury bonds.

Figure A.4. Risk-Adjusted Reference Rates for Consumer Loans and the Risk-Free Rate, 1987-2003



Note: "short-term based" reference rate is based on the risk premium of the Citigroup Asset-back bond yield over one-year Treasury; the long-term reference is based on the premium of the Citigroup Asset-back bond yield over ten-year Treasury.

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