Preliminary
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Not Your Grandfather's Bank Any More?
Consistent Measurement of Non-Traditional Bank Output

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Abstract: The measurement of bank output, long a difficult and contentious issue, has been made more challenging by rapid expansions of the scope of banking activities in the past two decades. Many studies of bank efficiency rely on an assortment of ad-hoc output measures for traditional lending and deposit taking activities as well as non-traditional ones such as securitizing loans and underwriting derivatives. This paper shows that a theory that models banks as processors of (private) information and transactions implies a unified measure for output of both traditional and non-traditional bank services. The paper then implements this model-based new output measure at the industry level for U.S. commercial banks. Industry output growth according to this new measure differs noticeably from the official statistics and from growth rates according to methods used in virtually all existing bank efficiency studies. Last, this paper also suggests ways to implement our new output measure at the bank level for use in the analysis of individual bank performance.

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I. Introduction

The measurement of bank output has long been a difficult topic that is yet to see a consensus resolution. Micro studies of bank productivity and efficiency almost all measure output using the book value of assets (or asset-equivalents) deflated with a broad price index, such as the CPI. These "deflated-balances" approaches to output measurement generally lack rigorous theoretical foundation and, due to their disconnect from modern portfolio theory, especially have difficulty taking account of the differences in risk between assets.[1] On the other hand, statistical agencies have adopted a different set of measures to tally bank output at the industry and economy level.[2] One is immediately struck by the peculiarity of this situation – both the definition of output and the methods used to measure output are different at the micro vs. the macro level, as in other so-called "margin" industries (such as retail).

Apart from the usual difficulty with measuring properly quality-adjusted *real* output of services,[3] even *nominal* output of traditional banking activities (such as on-balance-sheet lending and deposit taking) is hard to measure because banks often do not charge explicitly for their services. Instead, banks get compensated in the form of interest margins – receiving higher interest rates on loans and paying lower rates on deposits than would be implied solely by their respective risk. Measuring bank output has been made even more challenging in the past two decades by the rapid growth of non-traditional bank activities, such as securitization, lending under commitment and derivatives underwriting. The efficiency literature, lacking a unified framework to account for the output of these activities along with that of traditional ones, therefore has to rely on an ad-hoc mix of output measures that are not well-founded in theory.

The right output measure of bank services is not just a matter of theoretical interest but in fact a matter of practical importance as well, as measurement choices have

[1] See Berger and Humphrey (1997) for a general survey of bank efficiency measurement and James (1988), Hunter, Timme and Yang (1990), Mester (1992), Jagtiani, Nathan and Sick (1995), Rogers (1998), Stiroh (2000) and Clark and Siems (2002) for academic research on this topic.
[2] See e.g. Brand and Duke (1982) for the approach taken by the U.S. Bureau of Labor Statistics (BLS) and Fixler and Reinsdorf (2006) for recent research by the U.S. Bureau of Economic Analysis (BEA).
[3] See e.g. Triplett and Bosworth (2004) for a recent overview.

been found to affect even the qualitative results of empirical analysis.[4] From a methodological standpoint, however, statistical properties of an output measure cannot *per se* determine whether it is right. One must instead rely on a coherent theory of bank operation to derive the right output measure – there is no measurement without theory.

The goal of this paper is to implement the output measure implied by just such a banking model, to obtain new estimates of real output growth in U.S. commercial banking, with a particular focus on non-traditional activities. Built on basic theories of production and asset pricing, this model has a framework general enough to accommodate the measurement of both traditional and non-traditional banking activities. Specifically, it implies an output measure based on quality-adjusted activity counts for the former and carefully deflated fees and commissions for the latter. In contrast, other existing bank output measures are more or less tied to the balance of specific bank assets and liabilities, and thus cannot handle the two types of bank output consistently.

This paper also compares the new output series with estimates from two existing measures of bank output, one following the current BLS procedure and the other akin to methods used in the existing bank efficiency literature. It shows that, not surprisingly, the three series yield rather different growth path of output and in turn productivity for the banking industry between 1987 and 2004. The paper then argues for the appeal of the new series. First of all, it is preferred on conceptual grounds, as expounded above. Second, our new series accounts for both traditional and novel banking services within the same framework, whereas the BLS index misses up to a quarter of industry output by counting only traditional activities. Likewise, our series is also preferred to the somewhat ad-hoc output measures used in the bank efficiency literature. Although our preferred output measure cannot yet be applied fully at the individual bank level due to data limitations, we suggest a method for incorporating a number of features from our approach into bank-level analyses, which should yield a more accurate assessment of individual bank performance over time than current methods.

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[4] In fact, there is often disagreement even regarding how different output measures affect the results of particular estimations. For example, Stiroh (2000, p. 1703) finds that "efficiency estimates are particularly sensitive to the output specification and failure to account for non-traditional activities like off-balance sheet (OBS) items leads profit efficiency, but not cost efficiency, to be understated for the largest [bank holding companies]," while Clark and Siems (2002, p. 987) find that "cost X-efficiency estimates increase with the inclusion of the OBS measure [while] profit X-efficiency estimates are largely unaffected."

The rest of the paper is organized as follows. In the next section we outline our methodology and compare with the other commonly used methods. Section three outlines the data sources, implements the three approaches to bank output measurement and compares the three output series. Section four discusses the implications for bank efficiency research and Section five concludes.

II. Methodology

This section first reviews the banking model underlying our preferred measure of bank output. The emphasis is on the theory's methodological implication for measuring bank output, at both current prices and, more importantly, constant prices – decomposing nominal output into its price and quantity components.[5] We discuss why our method yields consistent measure of output for both traditional and non-traditional banking activities, such as loan securitization.

2.1 The Theory and Its Implications for the Measurement of Traditional Services

The theory behind our measurement is developed in Wang (2003a) and Wang, Basu and Fernald (WBF, 2004). Wang (2003a) considers the partial-equilibrium case while WBF (2004) extend it to general equilibrium. In this model, the core function of banks is to screen and monitor borrowers to reduce information asymmetry in lending, and providing payment services to depositors and borrowers. Modeling banks' *raison d'être* as resolving asymmetric information problems follows the tradition of an extensive literature on financial intermediation.[6]

One key implication of this theory for output definition is that, even though the provision of traditional banking services is often integrated with the transfer of funds between depositors and borrowers, these funds *per se* are not bank's output. Rather, they can be thought of as a special kind of purchased intermediate input, serving a role analogous to that of the goods transported and marketed by wholesalers and retailers. This implication is particularly relevant for bank services that generate no explicit

[5] In what follows, real output is used interchangeably with output quantity and output at constant prices.
[6] See for example Campbell and Kracaw (1980), Leland and Pyle (1977), and Diamond (1984, 1991) for theoretical modeling along these lines. See Mester (1992) for an empirical analysis that takes some of these considerations into account.

revenue but extra interest margin, which characterizes most traditional banking activities. In fact, the WBF and Wang (2003a) models purposely consider the case where a bank charges for *all* services via interest margin.

Consequently, the models stipulate that, to measure bank output, one should try to directly estimate the *flow* of services (such as counting the number of each properly defined category of loans originated each quarter), just as one does services of consulting and accounting firms. And one should *not* use the accompanying *stock* of loan and deposit balances, since there is no theoretical basis for assuming fixed proportionality between service flow and asset balance. In fact, using an extension of the Baumol-Tobin model, Basu and Wang (2006) demonstrate that there is no constant relationship, let alone fixed proportionality, between the two if banks' technology for producing services changes over time. Besides technological progress, many other real-world factors, including inflation, can rule out a constant balance-service relationship.

Some may argue that the financial balances are merely used as proxies for the true bank output, which is agreed to be productive services such as loan screening. Then our models can be reinterpreted as establishing that financial balances are a poor proxy for financial service output. To see the logic, consider a simple example. Suppose loan A has a smaller balance but is more risky than loan B, then monitoring A may well require more bank services, manifesting in a bigger (implicit) income. An output measure based on loan balance will, however, give the opposite result. This example illustrates intuitively the basic problem with using financial balance to measure bank output: any single attribute of financial instruments is inevitably a poor proxy for the quantity of services. These instruments are fundamentally contracts of contingent claims and thus almost surely have multi-dimensional attributes, all of which can affect the amount of bank services produced in creating the contracts.

On the other hand, for the purpose of output measurement, any of the financial attributes matters only to the extent that it affects the value and quantity of services produced. To illustrate, consider the same example. Even if there were no monitoring, loan A would carry a higher interest rate because of its greater credit risk and so bring in more interest income so long as the borrower is solvent. But this extra interest represents purely a transfer of property income but not value creation from new (bank) services, *if*

there exist (combinations of) market securities with the same risk attributes. The intuition is that no productive activities are needed to invest in market securities and earn their risk-adjusted returns. So, only the interest above and beyond the risk-adjusted return should be counted as implicit revenue for bank services, and loan A may not bring more service revenue if the bank provides only the same basic clerical services for every loan.

The framework of Wang (2003a) and WBF (2004) also implies answers to some long-standing debates, in particular the role of deposits and depositor services. Notably, it can distinguish between deposits and depositor services and classify them separately. Deposits are regarded as an intermediate input in lending, whereas depositor services are an output of transaction services, albeit often furnished without explicit charges. In contrast, the three output measures used in bank efficiency studies cannot distinguish between depositor services and deposits, because the flow of services is measured using the stock of deposits, meaning that they have to be classified the same – both as input or both as output.[7]

In fact, classifying depositor services as an output is a natural conclusion since the models are motivated in part by the need for coherent measurement of implicitly priced bank services. Unsurprisingly, the models imply a definition and measure of output that is invariant to how a service is compensated for – via explicit revenue or a barter for cost saving on certain inputs.[8] The basic logic holds in general: when a firm expends inputs to create a commodity that is valued by certain parties, this commodity should be recognized as an output – it is conceptually irrelevant via what medium (e.g., fiat money or other commodities) the firm exchanges for the output's value. Applied to banks, this principle means that it makes no difference whether a bank charges depositors for its services and at the same time pays the market rate for the depositors' funds, or pays for the funds in part with the services directly.

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[7] Specifically, the intermediation approach treats deposits as an input for making loans, the value-added approach treats depositor services and hence deposits as an output, while the user-cost approach lets the role of deposits be set endogenously by the reference interest rate. More on their underlying theories later.

[8] The debate about depositor services goes at least as far back as Sealey and Lindley (1977) and Benston and Smith (1976). Sealey and Lindley (1977) argue that bank transaction services yield no direct revenue and are merely part of the cost of acquiring deposits while Benston and Smith (1976) argue that banks produce financial services ("commodities") for both depositors and borrowers and are compensated for the accompanying costs.

2.2 Implications for the Measurement of Non-Traditional Bank Output

As importantly, the theory's conceptual framework is equally applicable to measuring the output of non-traditional activities. For instance, in securitization, although the underlying loan balances and interest flows are repackaged and sold, banks' information services often remain the same, at least qualitatively.[9] So this theory stipulates the same flow measure for the service output regardless whether the loans are kept on bank balance sheets or securitized.

More generally, our model-implied output measure is *invariant* to either the balance-sheet status or the exact variety of financial instruments resulting from a bank service. Specifically, WBF (2004) reason that the (often implicit) services produced by banks in making a loan are qualitatively the same as services produced in underwriting a credit derivatives contract. A loan subject to default is shown to be equivalent to a default-free bond combined with a short position in a put option (Merton, 1974). Since all the credit risk in a loan subject to default risk lies in the embedded put option, issuing a loan involves similar processing tasks (e.g., screening and monitoring) as writing (i.e., creating a short position in) a put option to the borrower. In recent years, such implicit options have in fact been made explicit and traded in the rapidly growing credit derivatives market (e.g., credit default swaps).[10] Fundamentally the same argument can be made for novel banking activities that generate other OBS securities, such as forwards and swaps.

<u>The Classification of Capitalized-Returns-Turned Fee Incomes</u>

We must especially note our theory's implication for the accounting of fee incomes that are in fact present discounted values of future returns on the related financial claims: such fees should be counted as transfers of property income but not as bank output. This runs contrary to the common opinion that all explicit fees are service revenue and so should be automatically considered bank output. But it is the only logical conclusion so long as pure asset returns, risk-free or risky, are classified as transfers. That

[9] This was also noted by Mester (1992).

[10] Data published by the Bank of International Settlement in the Semiannual OTC derivatives statistics, http://www.bis.org/statistics/derstats.htm, gives a sense of the explosive growth of credit derivatives.

is, capitalized present value of future flows of asset returns should also be regarded as transfers, no matter what it is called – fee income or otherwise.

This argument is easily reasoned for basic securities such as bonds and stocks, whose values are well understood to equal the expected discounted value of all future (possibly risky) coupons plus principal repayment and dividends, respectively. If the interest income on loans (i.e., coupons on bonds) is counted as transfers of pure property income, so should the present value of such income, just to be conceptually consistent. This is the principle to follow in cases where it is not the flow of future returns but its upfront capitalized value that is part of the cash inflow. One such case is securitization: a bank originates a pool of loans and sells them to a third party.[11] If the bank receives an explicit servicing fee along with the market value of the loans, then it is clear that only the servicing fee should be considered the bank's output. Alternatively, if the bank receives a lump-sum payment for the sale, then the only consistent solution is to partition the total receipt and count as bank output only the part that represents the loan buyer's implicit payment for the bank's screening services. The rest of the receipt, corresponding to the value of the loans themselves, is but a transfer.

The same logic applies to more exotic securities underwritten by banks, which are largely OBS, such as swaps, forwards and options. Here we elaborate on the treatment of fee income from underwriting such securities, since these cases are often less obvious. In particular, we focus on the fee income associated with options, since, as Black and Scholes (1973) have first argued, virtually all contingent claims can be expressed as options, although some have non-standard features that deprive them of a closed-form pricing solution.

For example, loan commitments or lines of credit can be modeled as put options written by banks to their borrowers: a bank's obligation to lend under predetermined terms is equivalent to an option granted to the borrower to sell (i.e., put) a bond to the bank at the strike price.[12] Credit derivatives such as credit default swaps (CDS) can also be thought of as options. A CDS is essentially a contract to provide credit protection: it

[11] The case for loan sales is fundamentally the same.

[12] Typical features of loan commitments that differ from a standard option include the "material adverse clause" (MAC), which releases the bank from the obligation if the borrower's credit quality deteriorates beyond a threshold. For more details, see for example Greenbaum and Thakor (1995).

grants the buyer the option to put the bond to the seller at par upon the pre-specified credit event such as default or rating downgrade. This equivalence is conceptually the same as that elucidated in Merton's (1974) seminal analysis of corporate bond pricing. More directly, Duffie (1999) shows that, to prevent arbitrage, the premium of a CDS over Treasury yields must equal the spread of a comparable defaultable bond.

As shown in Merton (1973), who generalizes the option pricing formula in Black and Scholes (1973), an option can be "synthesized," i.e., its payoff precisely replicated, using a continuously rebalanced portfolio of the underlying asset and (borrowing in) a default-free bond with matching maturity. To rule out arbitrage, the option's price must equal the value of the portfolio. This no-arbitrage condition yields the following relationships in terms of excess return between the option and its underlying asset:[13]

$$\mu - r^F = \left[\frac{S(\partial H/\partial S)}{H}\right](\alpha - r^F) = \left[1 - \frac{F(\partial H/\partial F)}{H}\right](\alpha - r^F), \qquad (1)$$

where μ (H) and α (S) are the expected rates of return on (price of) the option and the underlying asset, respectively; r^F (F) is the return on (price of) the default-free bond. Given α, r^F and the stochastic processes (including the instantaneous variances, denoted σ^2 and δ^2) of S and F, respectively, the equalities in (1) pin down H as a function of S, F, the strike price (X) and the time to maturity (τ). Specifically, $H(S, F, \tau, X)$ satisfies following partial differential equation

$$\frac{1}{2}\left[\sigma^2 S^2 \frac{\partial^2 H}{\partial S^2} + 2\rho\sigma\delta \frac{\partial^2 H}{\partial S \partial F} + \delta^2 F^2 \frac{\partial^2 H}{\partial F^2}\right] = \frac{\partial H}{\partial \tau}. \qquad (2)$$

(1) and (2) combined imply that the value of any option is equivalent to an implicit flow rate of return. This is fundamentally similar to the connection between the value of any basic securities such as a bond or a stock and its underlying flow of returns. The only, superficial, difference is that a bond or a stock derives value from direct income such as a firm's revenue or profit, while an option derives value indirectly from payoff to the underlying asset (hence the term "derivatives").

By comparison, there is no need to partition the fee income from underwriting securities whose contract terms are typically chosen to yield a zero initial value, such as

[13] This condition is the same for call and put options, which have different pricing solutions only because their boundary conditions differ.

forwards and swaps. Since there are no intrinsic value of the securities to "contaminate" the fees, the entire fee income should be counted toward bank output. For example, suppose the forward price of a security at time *t*, denoted F_t, is set according to

$$F_t = X_t e^{r(T-t)},$$

where X_t is the spot price, T the expiration date, and r the continuously-compounded yield to maturity. Then the forward contract has a zero value at *t*, and the buyer would not need make any payment were not for the bank's transaction cost charges. Of course, the market value of the forward will fluctuate over (*t*, *T*), but those fluctuations will be counted as capital gains or losses and excluded from bank output.

In short, consistent treatment of all types of bank output, regardless of the superficial features (such as balance-sheet status) of the financial claims, is a conceptual advantage of our method, especially in an era of rapid financial innovations. The bottom line of our model-based output measure is that one should count the flow of bank services *only*, but not returns – be it a flow or a capitalized value – on financial claims *per se*, and one should try to count the flow of services *directly*, instead of using proxies such as balance-sheet stock values just because they are more readily observed.

2.3 Comparison with other methods commonly used in bank efficiency studies

Now compare our preferred method with those used in previous studies, with a focus on real output measurement, especially of non-traditional (largely OBS) activities. (See WBF (2004) and Basu, Inklaar and Wang (2006) for expositions of the differences with regard to nominal output measurement.)

First, the user-cost approach uses (deflated) balance-sheet value of the relevant bank assets or liabilities to measure real bank output, even though its underlying framework resembles ours except for the treatment of risk – it does not incorporate modern asset-pricing theory to consider risk explicitly.[14] Its real-output measure in essence assumes implicitly that the asset balance varies in fixed proportion to the amount of services provided.[15] This is clearly a restrictive assumption, as (explained above) it

[14] It is developed in Hancock (1985), essentially applying Diewert (1974) to bank assets and liabilities.
[15] For calculating output growth, it does not matter whether that proportion is the same for all types of loans, as long as all the proportions stay constant.

rules out changes in the balance-service relationship over time due to, among other things, technological progress. Moreover, in discrete time, it ignores all the activities that change asset balances within each period but leave the end-of-period balance unchanged, since only the latter is observed. More subtly, the user-cost approach includes the (unmodeled) risk-based return in nominal output, whereas our model indicates that such return should be excluded. The two methods thus lead to different aggregation weights for calculating the total-output index.

The user-cost method, because of its use of asset balances, also does not apply readily to the rapidly growing new (and mostly OBS) banking activities. It is obviously problematic to extend the assumption of a fixed ratio between services and asset balance to OBS activities and use the notional values of OBS instruments, not the least because the notional value generally bears no definite relationship to the true, but typically unobserved, obligation an OBS instrument represents for the bank.

A seemingly symmetric way to treat OBS activities is to convert OBS obligations into a balance-sheet equivalent figure. One example is the credit-equivalent approach adopted by the Basel-I Capital Accord to computing capital requirements for OBS obligations. It converts the notional value of specific OBS instruments into an amount of on-balance-sheet assets that would result in comparable risk exposure for the bank.[16] So, implicit in this approach is the assumption that the relationship between service production and risk-weighted balance is the same for on- and off-balance-sheet activities. This is clearly also a restrictive assumption for measuring service output, even if it is a reasonable approximation for calculating capital requirements. Besides, this method by design ignores any OBS activities that incur little risk exposure, such as loan servicing.

Partly to remedy such undercounting, Boyd and Gertler (1994) propose an alternative. The "noninterest income capitalization" method obtains an equivalent asset balance by capitalizing all non-interest income from OBS activities with the rate of return on balance-sheet assets, which is defined as net interest income (and further net of loan loss provision) over total assets. This in essence assumes that on- and off-balance-sheet instruments earn the same net rate of return. It is hard to interpret this as a reduced-form

[16] The 1988 Basel Accord specifies the "credit conversion factors" (http://www.bis.org/publ/bcbsc111.pdf, p. 19) for converting the notional value of specific OBS instruments.

representation of optimal bank behavior, since a bank should equalize the marginal net return on and off its balance sheet only if the securities have the same risk and generate the same (often implicit) service profit margin. It is not at all clear whether either condition is satisfied. This output measure thus also suffers from the shortcoming that there may well be no definite relationship between the amount of service and the rate of return on the associated assets, let alone the same for on- and off-balance-sheet activities.

Fundamentally the same problems afflict the other two existing output measures used in the bank efficiency literature – the value-added and the intermediation approaches, because they too measure bank output using balance-sheet value of the relevant bank assets and liabilities, despite their different definitions of bank output.[17] Hence, they cannot be naturally extended to accommodate OBS activities. And the same caveats apply to any approximation of OBS output using either of the asset-equivalent approach described above, because of all the implicit restrictions.

Since all these existing methods are unable to measure on- and off-balance-sheet activities consistently, some studies simply use an ad-hoc mix of output measures. For example, Rogers (1998) uses loan balances as the output of on-balance-sheet lending but uses net non-interest income for securitization and other OBS activities. Hunter *et al*. (1990) also uses non-interest income, but net of the income of service charges on deposit accounts, to measure OBS output.[18] Apart from the lack of coherence, by using a lump-sum net income, these studies also make no distinction across the variety of OBS services and thus cannot account for the likely different price and quantity movements.[19]

To sum up, the theoretical implications of the WBF model, output of banks should measure the *flow* of services provided, regardless of the method by which these services are paid for. In particular, there is no theoretical justification for converting the flow into a stock value conditional on restrictive assumptions of their relationship. Distinguishing

[17] The value-added approach classifies as output any asset or liability associated with an activity that expends labor and capital. The intermediation approach, according to Sealey and Lindley (1977), views banks as producing loans and other interest-earning assets. Sealey and Lindley (1977) thus do not accommodate bank activities leading to instruments that earn no interest, which encompass many OBS securities.

[18] Clark and Siems (2002) summarize the three approaches to measuring OBS output that have been followed in the literature.

[19] Net non-interest income excludes service charges for deposit accounts and this measure was suggested by Hunter, Timme and Yang (1990) and later used by, for example, Rogers (1998), Stiroh (2002) and Clark and Siems (2002).

between price and quantity movements should then follow the same principles as for other industries, i.e. a careful distinction between different types of services and separate pricing for each of those services.

III. Data and Estimates of Bank Output

This section first describes the methodological choices we have to make in order to implement our theory-implied output measure using available data. It then outlines the data sources (with greater detail available in the data appendix) and discusses the construction and properties of output series for a range of bank services. Special attention is paid to constructing a price and a quantity index for non-traditional bank activities. Indices of different bank activities are then aggregated into an overall industry output series.

3.1 Methodological Choices for Implementing Our Output Measure

3.1.1 Bank Services at Current Prices

As in other industries, a logical starting point for measuring nominal output is total revenue. The special feature of financial intermediaries such as banks is that part of their revenue stems from pure returns on loanable funds, while at the same time some services – mostly in association with traditional lending and deposit taking – are provided without explicit fees. So the (difficult) task is to isolate the implicit service revenue from total interest income, because our theory concludes that only this part should be counted toward banks' output. This conclusion is in fact consistent in spirit, if not in letter, with the principle adopted by the System of National Accounts (SNA93) that the supply of financing *per se* is not a productive activity, and so the "time value of money" is regarded as a transfer of property income (from users to owners of funds).

Our theory simply refines this principle by recognizing that the return on loanable funds also depends on the risk of the security concerned, and adjusts upward the amount of property income that should be excluded from the nominal value of bank output. This return is then consistently accredited to the users of funds as part of their output (cost of capital, to be precise). Following the same reasoning, we also exclude interest income

from inter-bank loans or market securities, since there are little or no financial services generate in association with those assets.[20] (For more details about the empirical implementation of our nominal output measure to implicitly-priced bank services, see Basu, Inklaar and Wang, 2006).

Most of the data used in this study comes from Consolidated Reports of Condition and Income (the so-called Call reports). These are quarterly statements of income and balance-sheet and OBS obligations filed by FDIC-insured, U.S.-chartered commercial banks.[21] The Call reports provide interest income and expenses data on a wide variety of loans, deposits and securities. By comparison, data on the rapidly growing non-traditional activities is more limited, although the availability has improved in recent years. Since 2001, the Call reports have started to report non-interest income from 12 types of non-traditional activities. For estimating bank output, however, we must distinguish between income from productive services – most of the fees and commissions – and income from asset holding gains or losses. As explained above, only the former should be considered a payment for financial services, while the latter represents a transfer of property income.[22]

Unfortunately, this distinction is often hard to implement in practice. The nature of some categories of income is reasonably clear-cut. For example, service charges on deposit accounts all belong to fees and commissions, and trading revenue to holding gains or losses. Others, however, are less clear. For example, venture capital revenue includes fees and commissions as well as holding gains or losses.[23] One clue lies in the fact that total venture capital revenue of the commercial banking industry turned negative in 2001 and 2002, indicating that holding gains or losses sometimes dominate.

We identify seven of the twelve categories of non-interest income as containing mostly fees and commissions, based on the series of Call reports instructions over time.

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[20] Indeed, in Europe the inter-bank rate is used by statistical agencies to approximate a risk-free, services-free interest rate. Some may argue that there is value created by activities to "beat the market," but a theory to account for the output of such activities or, for that matter, of (stock) markets in general, is beyond the scope of this paper.

[21] There are four versions of the reports, corresponding to form numbers FFIEC031-034. Instructions and actual forms can be found on the website of the Federal Financial Institutions Examination Council (FFIEC) http://www.ffiec.gov/ffiec_report_forms.htm.

[22] Fixler and Moulton (2001) also make this distinction. As a rule-of-thumb intuition, any type of income that can be either positive or negative would not represent payment for services since negative output has no economic interpretation.

[23] See the instructions for filling out the Call reports at www.ffiec.gov.

The other five categories map mostly into holding gains or losses. Together, the seven categories of fees account for around 90 percent of non-interest income. As described in detail in the data appendix, data on most of these categories are collected only since 2001, so certain assumptions, together with data from other sources, are needed to extrapolate them back to 1987. As will be made clear below, for some categories, the quinquenial Census provides the relevant detailed data used for extrapolation, while for the others, only balance sheet data are available for approximating output flows (at current prices).

3.1.2 Lending and Depositor Services at Constant Prices

As mentioned above, traditional bank activities often generate interest margins but no explicit fees for services. So, the difficulty with measuring their output at current prices carries over to measuring real output. The usual method – deflating revenue using price indices to estimate indices of real output – is seldom applicable. The alternative we adopt is what we will call the "activity-counts" method: estimate real output indices directly using the quantity indicators published by the BLS, which include the number of four types of loans (i.e., real estate, credit card, other consumer and commercial & industrial loans) and transactions on two types of deposit accounts (i.e., demand, and time and savings deposits).[24] We then infer the price indices using these quantity indices together with imputed service revenue.

Conceptually, these activity counts by the BLS accord best, among the available data, with our model-based output measure, because they correspond more directly to the natural units of bank services. They are of course not perfect, since using them in effect assumes that a given loan or a given depositor transaction represents the same quantity of services over time. Nevertheless, we argue that this assumption is (much) more sensible compared to assuming that a given amount of purchasing power lent or deposited represents a constant quantity of services over time, which is implicit in the deflated-balances-based output measures used in most bank efficiency studies.

To see the intuition of the distinction between the activity-counts and the deflated-balances methods, consider the analogy to estimating the service output of a car dealership. Is it more sensible to count the number of each make of cars *sold* in a period

[24] We thank Chris Kask at the BLS for kindly providing these data along with the documentation.

(and aggregate using sales commissions by make as weights), or count the deflated dollar value of the *inventory* of cars on the lot at period-end? Counting the number of car sales is surely imperfect, since it ignores possible changes in the quality of sales services over time.[25] But this is fundamentally no different from the general problem of inadequate quality adjustment that troubles the output measurement for all services.

In contrast, deflating the dollar value of cars sitting on the lot at a point in time by some general price deflator (such as the CPI) is obviously nonsensical.[26] One should at least deflate the dollar value of cars *sold* during the period with a price index for autos and based on the mix of cars sold. However, for the series to proxy the number of cars sold, one still needs the assumption of a constant relationship between the price of cars and the price of sales services.[27] (The problem, to be addressed in greater detail below, lies in the aggregation weights implicit in this series.) Furthermore, it too suffers from the same quality adjustment problem that afflicts the output measure based on direct number counts. So, in short, it seems that one can do no better than to use counts directly.

Counting the number of loans and depositor transactions is exactly analogous to counting the number of cars sold, while using deflated loan and deposit balances is analogous to using the deflated dollar amount of the auto dealer's car inventory. Hence, it follows that the former is more sensible. The number counts are in fact likely to be quite accurate output indicators for certain categories of bank services, such as the origination of residential mortgage loans within some broad categories (e.g., conforming loans), each of which calls for basically the same amount of credit screening and administrative tasks.

Nevertheless, given that asset balance is often more readily observable, we next examine situations where properly deflated loan balances can approximate the quantity of services. We hypothesize that this is true for categories of loans for which the loan-to-value ratio is available, as well as a price index for the underlying asset pool. The prime

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[25] Differences in service quality across sales of different kinds of cars (for example, selling Mercedes entails more up-scale services) in principle cause no problem (for aggregation), so long as nominal output of each type of sales services, i.e., revenue accrued to the services only, is correctly measured. This will be made clear below in the section on aggregation.

[26] The resulting series has little reason in theory to bear any stable relationship to even the number of cars sold, let alone the amount of sales services. And this is true even under the stringent assumption that all dealers sell the same mix of cars at all times.

[27] Under perfect competition in both markets, this amounts to assuming the same rate of technological progress in the production and sales of cars.

example is mortgage loans. In growth rate, the relationship between house prices and the number of mortgages can be expressed as:

$$n_t + p_t = b_t - v_t \,, \tag{3}$$

where n_t is the number of mortgage loans processed, p_t the price of homes financed with loans, b_t the balance of mortgage loans, and v_t the average loan-to-value ratio. Both sides of (3) equal total value of homes financed with loans. Thus, the growth rate of a real bank output (n_t) can be inferred from the more easily observed asset balance (b_t) so long as p_t and v_t are also available. Note, however, that the correct asset balance to use should be a *flow* instead of a stock variable: it should be the cumulative balance of loans processed within a period, but not the outstanding balance at the end of a period. The latter may serve as a proxy at best.

Assuming the loan-to-value ratio is stable, then the relationship simplifies to

$$n_t = b_t - p_t \,. \tag{4}$$

That is, an output quantity indicator (n_t) can be derived from a deflated balance. The key element in (4) is the proper deflator – it should be the price index for the assets funded but not just any general price indices. Obviously, the validity of (4) hinges on a stable loan-to-value ratio, and its accuracy hinges on the quality of the deflator.

Ultimately, to improve the accuracy of the output estimates, more effort should be devoted to directly counting the number of precisely defined transactions, since any output measures based on asset balance are at best approximations whose accuracy depends on the validity of the underlying assumptions. For lending services, effort should be made to collect data of loan numbers for a larger set of more finely classified loans, since the content of bank services is likely to be more stable for finer categories of loans. In particular, the data should distinguish between new loans made each period (which maps into origination services) and outstanding loans (which maps into monitoring services). Moreover, multi-dimensional data on the features of each type of lending service are also needed to facilitate adjusting for quality changes over time. Similar data collection efforts should be expended also for depositor services.

3.1.3 Non-Traditional Bank Output at Constant Prices

It should be easier, at least in principle, to measure the output of bank activities that generate explicit fees. However, as discussed above, fees that embody the value of the associated contingent claims such as options should not be counted toward bank output. Accordingly, we recognize five categories of fee-generating OBS activities as bank services: fiduciary activities, investment banking, securitization activities, insurance, and a residual category of activities that generate explicit fees.[28]

For fiduciary activities, there are two ways to derive a quantity measure. First, the BLS constructs an index of the number of trust accounts, which is the only item in their output index that covers fee-generating activities. Second, there is a personal consumption expenditure (PCE) deflator for trust fees. In practice though, this deflator is also constructed based on a count of trust accounts, which in fact include only personal and not corporate accounts.[29] So we choose to use the BLS quantity index, which covers both types of trust accounts, but the trends are fairly similar.

The only available deflators for investment banking and insurance revenue are the industry gross output deflators from the BEA's GDP by Industry accounts. We recognize though that they are imperfect, in that the investment banking and insurance activities conducted by commercial banks likely differ from those conducted by investment banks and insurance companies, respectively. For instance, commercial banks underwrite mostly bond issues but not stocks, and they sell (largely life) insurance contracts but do not handle claims.

Securitization fees and commissions are earned on loans that are no longer on the bank's balance sheet but which the bank either originated or still services. Since there are no explicit price deflators for such fees, we use the deflators that are imputed for implicitly priced lending services (i.e., the implicit income from on-balance-sheet loans divided by the BLS loan counts). Given the limitation on deflators, we decide to lump

[28] Income from underwriting derivatives contracts is not explicitly included in this residual category, although it may be implicitly contained in "Net gains (losses) on nonhedging derivative instruments held for purposes other than trading." However such income is accounted for in bank financial statements, it is unlikely to have any material impact on our results, because data from the 2002 Census show that such fees are tiny – a mere 0.1% of all fee revenue.

[29] Starting December 2003, the BLS also collects data on the price of trusts services directly as part of its PPI program. But this series is too short yet to be useful.

together the two categories of securitization income – net servicing fees and net securitization income. The resulting output estimate of overall securitization activities is of course but an approximation, but it is in theory no worse than using industry price index to deflate individual firm revenue. On the other hand, it is a concern that the estimate can be biased if the amount of screening and servicing needed or the degree of bank market power differs systematically between loans kept on banks' books and loans securitized, such as discussed in Mester (1992). The direction of the potential bias, however, is unclear, and we will explore some possibilities below when presenting the numerical results.

The final category of fee-generating activities is a catch-all category labeled "other noninterest income" in the Call reports. According to instructions for the reporting forms, it covers 25 classified types of fees and commissions plus any other fees and commission not elsewhere classified. The subcategories mentioned include credit card fees, fees for issuing commercial letters of credit and certain types of loan commitment fees. Since loan commitments are basically options, this raises the possibility that some of the fees contain the value of the embedded options, which, as discussed above, should be excluded. There is, unfortunately, insufficient detail for such adjustment. In addition, even if more detailed fees were reported, real output estimate would still be hampered by the lack of suitable price indices.[30] In fact, for this reason, we have to make do with the PCE deflator for service charges on deposit accounts, which is also the choice of the BEA.

The output estimate for all these other fee-generating activities is clearly the "weakest link" in our estimate of OBS output as a whole. The impact is non-negligible, since this category includes a number of OBS items and accounts for a substantial share of OBS and even total bank output (two-thirds of all OBS output in 1990 and still nearly half in 2004, see Table 1). Nonetheless, this should not detract from the conceptual advantage of our proposed (flow) measure of bank service output. Furthermore, the

[30] According to the Call reports instructions, further details are only provided if the category in question represents more than 1 percent of total revenue, which is rarely the case. The Economic Census typically collects revenue data on more fee categories. However, the product categories for fee-generating activities in the 2002 Census do not overlap the categories in the Call reports and, more problematically, 'other services' – the residual category – accounts for almost half of fee and commission revenue.

empirical exercise here to implement this output measure also supplies a list of additional data statistical offices should collect to facilitate output accounting.

3.1.4 Aggregate Industry Output

Real output series of the variety of bank services need to be aggregated to arrive at total industry output. Here we adopt the Törnqvist index to combine our output series. The BLS also frequently uses Törnqvist indices for aggregation, since they are an exact index for the translog production function.[31] The specific aggregation formula is as follows:

$$\Delta \ln q^{t,t-1} = \sum_i \frac{1}{2}\left(w_i^t + w_i^{t-1}\right)\Delta \ln q_i^{t,t-1} = \sum_i \overline{w}_i \Delta \ln q_i^{t,t-1} . \qquad (5)$$

Equation (5) states that the percentage growth of total output q from period t-1 to t equals the weighted average growth of the individual output components, q_i. The weight ($\overline{w}_i$) used is the two-period average share of component i in total nominal output (i.e., service revenue). Note that total service revenue includes both explicit fees and the imputed value of implicitly priced services. The latter mostly stems from traditional services to borrowers as well as depositors.

By comparison, instead of revenue shares, the BLS uses employment-requirement shares based on the Functional Cost Analysis (FCA) to aggregate quantity indicators of the various commercial bank services. Apart from the lack of conceptual justification for using labor input shares as weights, the FCA data is outdated – the underlying quinquennial survey was discontinued in 1997. So the weights may well have changed systematically since then. Furthermore, the FCA was a voluntary survey in which mostly small banks participated, so the shares are in general not representative of the industry as a whole.[32] In the next section, we will examine the impact of using employment shares rather than revenue shares to aggregate output series for lending and depositor services.[33]

[31] See e.g. Diewert (1976) on the Törnqvist index. Many bank efficiency studies estimate translog cost and profit functions, but unfortunately translog cost functions are not dual to translog production functions.
[32] See Ors (2004).
[33] The BLS uses the same shares for five years before switching to new shares, thereby creating a Laspeyres index. Here we interpolate the shares linearly between the FCA years and apply the Törnqvist index from (5). Moreover, we only estimate output growth for U.S.-chartered commercial banks and not for branches

3.2 Estimates of Traditional and Non-Traditional Bank Service Output

In this section, we describe and compare empirical estimates of the real output of a variety of bank services according to the different measures. We pay special attention to the non-traditional bank activities, especially the impact of different deflators on the estimates. These activities have not been studied as extensively as the traditional ones, despite their rapidly increasing share in bank non-interest income. Table 1 illustrates the considerable change in the mix of activities at commercial banks in the past two decades. It compares the composition of bank output at current prices in 1990 and 2004.[34] About half of the growth in current output over this period can be attributed to fees and commissions from non-traditional activities, whose share has thus increased from 27% to 41%. The share of services to depositors, on the other hand, has decreased by 18 percentage points.

3.2.1 Real Output of Traditional Bank Services

Table 2 compares the empirical result of different output measures of borrower and depositor services for two subperiods 1987-1995 and 1995-2004.[35] We choose 1995 as the dividing line because it is commonly regarded as the incipient period of the U.S. productivity growth acceleration and, for this sample, roughly the midpoint of the time series. The first row in each panel shows the estimates according to the deflated-balances measure – total loan balance deflated using the price index of gross domestic purchases.[36] The second and third rows in each panel are both aggregates based on the detailed loan and transaction counts from the BLS. The second row simulates the actual BLS series by

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of foreign banks, since some data is unavailable for those branches. Together these two factors drive a wedge between our simulated BLS-like output series and the published output index.

[34] Our data series start in 1987, but output of lending services is uncommonly low in 1987-1989 due to relatively high risk premia, so 1990 is shown to give an indication of the broader trends over this period.

[35] We choose to report period-average growth instead of applying specific smoothing procedures to the estimated time series of output. We think this is more sensible for the purpose of comparing across different output measures, since there may be potentially large measurement errors in our estimates owing to the various assumptions that we have to make in order to extrapolate data.

[36] The figures in the table are based on simple sums of loan and deposit balances, although using our preferred revenue weights to aggregate balances of individual loan and deposit categories yields a similar time series of growth. Also, the result is virtually the same as using the GDP deflator. In Panel A, only loans are included for comparability to the other measures, but a similar average growth rate obtains for the deflated balance of all interest-earning assets.

using employment weights to aggregate the individual indicators, while the third row uses our model-based nominal output estimates as weights.

Average growth rates estimated using the three output measures are obviously different, especially in the case of deposits. In 1995-2004, while deposit balances rose rapidly, the number of transactions actually declined. According to the BLS activity counts, time and savings deposit services experience the largest decline (over 4% per year based on the number of deposits into and withdrawals from such accounts). At the same time, these deposits' share in total deposit balance has increased steadily (from 66% in 1994 to 88% in 2006), while the real balance of transaction deposits has basically been flat (see also the *pro memoria* part of Table 2).[37] The BLS loan counts also show a change in the mix of lending activities: the number has declined for consumer installment loans, stagnated for C&I loans, but grown substantially for credit card loans (10% per year based on the number of transactions processed) and for residential mortgage loans (See the BLS technical notes for details on the specific activities counted for each type of service.)

Figure 1 illustrates our effort to derive a quantity indicator of bank service output indirectly from the associated asset balance and the proper price index. Specifically, we approximate the number of mortgage loans processed (including both existing loans serviced and new loans originated) with a suitably deflated balance.[38] According to equation (4), the theoretically correct deflator is a house price index, and we use the one published by the Office of Federal Housing Enterprise Oversight (OFHEO).[39] For comparison, Figure 1 also depicts the series based on the same balance but deflated using the CPI, and (of course) the direct quantity indicator (i.e., the BLS mortgage loan counts). The BLS quantity series and the OFHEO-index deflated balance are highly correlated, and have a similar average growth rate.[40] On the other hand, the CPI-deflated balance

[37] To be specific, among the three approaches to output measurement used in bank efficiency studies. The intermediation approach counts all deposits as an input, user-cost approach generally counts only transaction accounts as output (depending on exact values of the actual and reference interest rates), while value-added approach counts only transaction deposits (consisted mostly of demand deposits) as output.
[38] The loan-to-value ratio is fairly stable over time, so we omit it in our calculations.
[39] Strictly speaking, the price index should be correspond specifically to the houses whose purchases are financed with loans. So the implicit assumption here is that there is no systematic price difference between the pool of houses underlying the OFHEO index and the houses financed with loans.
[40] This is not to say that either quantity series is free of the usual problem with quality adjustment.

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 loan counts and the CPI-deflated series is considerably lower.

This mapping between deflated balance and loan counts for residential mortgages is also verified by the high correlation (in growth) between housing price and the average mortgage size.[41] They should have identical growth rates if (4) holds exactly. Such a relationship, however, does not exist for the other loan categories: the correlation between the average loan or deposit balance (approximated by the balance-to-count ratio) and the price inflation for the most relevant capital assets varies between -0.6 and +0.3 across loan and deposit categories.[42] This is not surprising, since neither a valid price index for the underlying assets nor a stable loan-to-value ratio is likely to exist for the other loan categories.

The choice of weights for aggregation also matters. Nominal-output-weighted aggregate output show higher growth for lending services (based on loan counts) and lower growth for depositor services (based on transaction counts) than their employment-weighted counterparts. The growth differences are more pronounced for the earlier years (1987-95) than the recent period (1995-2004). This pattern implies that the relatively fast-growing payment services account for a bigger employment share than revenue share, while the reverse is true for lending services. There can be many reasons for these differences. Apart from differences in technology (such as capital-labor ratio) and market structure (such as the degree of competition) that can lead to genuine cross-product heterogeneity in the employment-revenue ratio, data limitations can also be a culprit. First, since the FCA does not adjust for labor quality, those services counted as requiring more employees may simply use more unskilled labor and thus account for less in total revenue. Second, as discussed above, employment weights based on the FCA may not be representative. Third, revenue from implicitly priced services is estimated imprecisely, although the consistent pattern of the growth differentials would indicate biases rather

[41] Residential real estate loans are a component of overall real estate loans and average mortgage size is published by the Federal Housing Finance Board.

[42] For deposits, the balance-to-count ratio equals the average dollar of deposits per transaction. Appendix Table A.5 reports the indices of these ratios for each activity covered by the BLS quantity counts.

than mere classic measurement errors in the estimates.[43] To summarize, there is neither theoretical nor practical reason to favor the use of employment weights for aggregation.

3.2.2 Real Output of Non-Traditional Bank Services

Table 3 compares the different measures of real growth of non-traditional activities. First, the three measures used in the bank efficiency literature, namely the credit equivalent and the asset equivalent of OBS items, and net non-interest income, are derived using the gross-domestic-purchases deflator. The pattern of average growth differs considerably across the measures, consistent with Stiroh's (2000) finding that bank efficiency estimates are sensitive to the output measure used. The credit-equivalent measure shows high but declining growth, the asset-equivalent measure shows increasing growth, while the net income measure shows more moderate and stable growth. Recall that the asset-equivalent measure simply equals non-interest income capitalized by the financial return on balance-sheet assets,[44] so the difference between the two measures reflects a rising return on assets before 1995 and a declining return after 1995.

The "BLS measure" of fee-generating activities contains only the number of trust accounts. This category saw very low growth in 1987 to 2004, during which period fiduciary activities' revenue share in all "Fees and commissions" shrank from about a quarter to 17 percent (see Table 1).

The bottom block of Table 3 presents the estimates according to our more comprehensive measure, which covers all the fee-generating OBS activities.[45] The top line ('total fee-generating activities') shows that such activities as a whole has grown at a moderate yet increasing pace. Securitization revenue, which is the sum of net servicing fees and net securitization income, has seen its share grow from just over one percent to more than 11 percent of output. This category of revenue has been the single largest

[43] That is, for some not yet understood reason, estimates of revenue from implicitly priced lending services were systematically higher for loan categories with faster growing number counts, while the opposite were true for implicit depositor services.

[44] Also recall that this is measured as net interest income (after subtracting loan loss provisions) over total assets.

[45] Specifically, this covers all non-interest income other than service charges on deposits accounts and income related to holding gains and losses, such as trading revenue.

contributor to the growth in fees and commissions.[46] Since banks perform qualitatively the same tasks – credit screening, payment transfers, etc. – whether the loans are securitized or kept on banks' balance sheet,[47] it suggests that some of those labeled "non-traditional" may in fact be traditional activities in disguise. Like securitization, they basically substitute for activities that used to generate accompanying asset balances on the book so that banks can continue to utilize their comparative advantage.

Despite their growing importance, bank securitization activities are both ignored in the BLS quantity counts and, as discussed above, mostly omitted by bank efficiency researchers when using the credit equivalent of OBS items. On the other hand, the more often mentioned investment banking and insurance activities by commercial banks in fact only make up less than 5 percent of fees and commissions even in 2004.

As discussed above, real growth of the OBS activities as a whole is influenced by the deflator used; the available deflators are hardly satisfactory. In particular, if we were to compute real value of the residual category "Other activities" using the gross domestic purchase deflator instead of the PCE deflator for service charges on deposit accounts, the growth of "Other activities" would be faster, by 3.1 percentage points before 1995 and 1.7 afterward. In turn, the aggregate growth rate of all OBS activities would be faster as well: average growth of total fee-generating activities would be 5.4 percent before 1995 and 7.5 percent afterward.[48] Nevertheless, the qualitative pattern of accelerating moderate real output growth would remain. Moreover, notice that the incremental growth contribution from "Other activities" is much less after 1995, mainly because securitization have grown to account for the bulk (nearly two-thirds) of real growth of all fee-generating activities.

Last, we aggregate traditional and non-traditional activities, whose growth rates are reported in Tables 2 and 3 respectively, to compute the growth of overall bank output.

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[46] Compared in terms of balance, securitized loans have increased from about 10 percent of total loans (i.e. balance sheet and securitized loans) to more than 40 percent.

[47] This is not to say that the *quantity* of credit screening and especially monitoring remains the same for securitized loans compared to their balance-sheet counterparts. Some studies (e.g., Morrison, 2005) have pointed out that banks' incentive to monitor may well be impaired when loan pools are sold to third parties without recourse.

[48] Note that for comparability, we exclude trading gains or losses from the nominal value of both 'total fee-generating activities' and 'net non-interest income,' so that the two nominal values are comparable and their difference in real growth rate stems entirely from the different deflators.

The aggregation weights for the BLS indices are the FCA employment shares, while the weights for our preferred measure, which covers many more categories of activities, are the corresponding nominal-output shares. There are, however, no standard aggregation weights in the bank efficiency literature, since banks are viewed as multi-product firms and the different outputs enter the cost function estimation individually.[49] So, here we aggregate the balance-based output items using the same nominal-output weights.[50]

Since deposits are treated as either an input or an output by the three different output measures in the efficiency literature, we calculate different output series accordingly. The first three series in Table 4 follow the user-cost and the value-added approaches and view depositor services as an output, along with lending services. The remaining three follow the intermediation approach and view only lending services as an output.

The main finding from Table 4 is that the assumptions made about bank output matter for evaluating development in the U.S. commercial banking industry. Growth over 1987 to 1995 varies between 1.2% and 12.8% on average per year, while growth over 1995 to 2004 varies between 0.9% and 8.7%. Furthermore, the profile of growth differs: some measures show faster growth after 1995, while others show either stable or slower growth. In particular, our preferred output measure shows modest growth of 1.9% on average per year before 1995, accelerating to 2.5% after 1995.

Given the considerable growth differences across different output measures, one cannot afford to take an agnostic view of the right measure of financial service output of commercial banks. We argue that there is no data without theory and, in principle, the most theoretically sound output measure should be adopted. The theory should then guide the data collection effort to enable more accurate empirical implementation of the theory-based output measure.

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[49] Some studies do analyze overall productivity growth in the industry; see e.g. Stiroh (2000) for an overview of approaches and results.

[50] Absent a consensus on the weights for aggregation, one can of course calculate aggregate output growth using any of the alternative weighting schemes.

IV. A measurement guide for bank efficiency research

Our output measurement for the commercial banking industry cannot be exactly applied at the bank level, since quantity indicators such as the BLS activity counts are not available for individual banks. However, the price indices derived using industry aggregate quantity and revenue can be used to deflate each bank's nominal output (see Appendix Table A.5).[51] This is no different from the common practice of using industry price indices to deflate sales of firms or establishments in micro productivity analysis of other industries. And it should be, in theory, an improvement over current practice of using a general price index to deflate nominal balances of assets and liabilities.

The increasing amount of data since 2001 on non-traditional activities also facilitates improving the measurement of this increasingly important set of bank output. First, information about trust accounts (Call reports, schedule RC-T) allows for a bank-specific count of the number of accounts; for earlier years, the industry price index (as imputed above) can be used to deflate each bank's revenue from trust activities. Second, securitization revenue can be imputed using balances of securitized loans, which are reported by type in schedule RC-S of the Call reports since 2001. The data appendix below details how these balances can be extrapolated to years before 2001 using industry-wide trends. By comparison, there is scanty bank-specific information to infer trends in investment banking and insurance revenue, so the respective industry trends in revenue will have to be used to extrapolate back to years before 2001. Fortunately, this should have only limited adverse impact on the accuracy of total output for most banks, for whom these two revenues together account for a negligible share, especially before 2001.

V. Conclusions

Operations of commercial banks have undergone significant transformations over the past two decades or so. In particular, banks have substantially expanded the scope of their business, evidenced in the rapidly growing share of income from OBS activities. How to measure the output from these non-traditional bank activities has added new

[51] For even further refinement in the area of residential mortgages, one could even use local housing price indices, in combination with data on the location of deposit holders, to deflate these loans, to the extent that banks tend to keep on their balance sheet loans to local home buyers.

challenges to the already difficult task of measuring even just the traditional bank output. Thus, existing studies have used mostly ad-hoc mixes of methods to measure the two types of bank output.

Recent theoretical effort (Wang 2003a, WBF 2004) to model the operation of financial institutions such as banks yields a coherent framework for measuring the output from traditional as well as non-traditional bank activities. These models recognize that, in both types of activities, banks perform qualitatively the same services – processing information (especially to resolve asymmetric information problems) and transactions – and so their output should and can be measured in the same way. This generally entails constructing quantity indices based on quality-adjusted count for each type of finely and exactly defined transaction. To aggregate across these types of bank services, the true revenue from each type serves as the weight, In cases where implicit charges for services are bundled with asset returns, the true service revenue needs to be imputed from total bank income by removing the risk-dependent returns on the associated assets.

This study applies the above model-implied output measure to derive consistent time series of non-traditional along with traditional bank service output. It first extends the theory to clarify a conceptual issue – why not all fees should be counted toward bank output at current prices. In particular, for fees that include the capitalized value of the associated contingent claims (mostly OBS), such as fees from underwriting options, only the portion net of the asset value should be counted toward service output. This treatment is necessary to achieve consistent accounting of explicitly and implicitly priced bank services, since it stems from the same principle that asset returns should be considered transfers of property income but not new value created by true productive activities.

This paper then constructs output series for as many types of non-traditional bank activities as permitted by available data, along with traditional lending and deposit-taking activities. Following the theory, we rely on the BLS activity counts (such as the number of loans and deposit transactions) whenever available to estimate a real quantity index for each category of bank service. These output indices are estimated at the industry level, since such quantity counts are only available for the aggregate. Also, to best utilize existing data, the empirical estimates cover the period 1987 to 2004.

The new output series is then compared to alternative output estimates according to extant measures used by the BLS or in the bank efficiency literature. The advantage of our new measure over the BLS series is more empirical than theoretical – the latter uses employment weights and only cover a subset of activities conducted in modern banks, in particular neglecting the rapidly growing and increasingly important OBS activities. On the other hand, the advantage of our preferred measure over those used in bank efficiency studies, which can be summarized as specific asset balances deflated using a general price index, is mostly theoretical. Deflated balance has been shown (Basu and Wang, 2006) to be a valid indicator of service quantity only under restrictive conditions, such as static technology for producing the services.

Empirically, the output series based on our preferred measure has rather different growth rates than those based on the extant output measures, both over the entire period and in the two subperiods before and after 1995. The different patterns of pre- and post-1995 output growth will translate into different patterns of productivity growth, and in turn imply different answers to the question whether banks too experienced a productivity acceleration after 1995. In fact, our new estimates suggest that labor productivity growth in commercial banking was at least as fast after 1995 as before, in contrast to the declining trend shown by the BLS figures.

Statistical properties of an output estimate cannot *per se* establish its validity or superiority. Instead, it should be justified on theoretical grounds – being consistent with basic economic theories that can rationalize, under realistic assumptions, the operation of the firms concerned. This is exactly the logic underlying our preference for the new output measure – it is consistent with widely received theories of banking, asset pricing and production, and thus able to provide a coherent measurement framework for both traditional and non-traditional bank output.

This conceptually sound measure, however, can only be imprecisely implemented at present because of data limitations. So, we argue that a sensible approach to improving the empirical estimates is to collect additional data that are called for by the theory. Arguably the most important among such data needs is the quantity counts of a broader array of more finely defined transactions. Meanwhile, when one has to use approximations for practical purpose, one must be clear about the conditions under which

the proxies are appropriate. Our example, a deflated-balance-based proxy for the output of mortgage lending, showed that, in practice, such proxies are often hard to justify.

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Table 1, Output of U.S. commercial banks at current prices, 1990 and 2004

	Billions of dollars		Share in total	
	1990	2004	1990	2004
Total	123.1	322.0	100.0	100.0
Deposits	65.5	115.5	53.2	35.9
Loans	24.4	74.6	19.8	23.2
Fees & commissions	33.3	131.9	27.0	41.0
of which:				
Fiduciary activities	7.9	22.6	6.4	7.0
Investment banking	0.8	9.7	0.7	3.0
Securitization activities	1.5	36.5	1.2	11.4
Insurance	0.1	4.2	0.1	1.3
Other activities	22.9	58.8	18.6	18.3

Notes: Output associated with deposits and loans is based on the interest margins of Basu *et al.* (2006). See the data appendix for details on other items.

Table 2, Average annual real growth of borrower and depositor services of U.S. commercial banks, 1987-2004

	1987-1995	1995-2004
A: Real growth of borrower services		
Deflated loans	1.8	5.3
Loan counts (employment weights, BLS)	1.7	3.7
Loan counts (output weights, preferred)	5.9	4.3
B: Real growth of depositor services		
Deflated deposits	0.1	4.7
Transaction counts (employment weights, BLS)	1.6	-1.2
Transaction counts (output weights, preferred)	-0.3	-2.3
C: Real growth of depositor and borrower services		
Deflated loans and deposits	0.8	5.0
Activity counts (employment weights, BLS)	1.6	1.0
Activity counts (output weights, preferred)	1.2	0.4
Pro memoria: demand vs. time and savings deposits		
Deflated demand deposits	-1.0	-2.4
Deflated time and savings deposits	0.4	6.1
Demand deposit transaction count	3.3	-0.8
Time and savings deposit transaction count	-4.8	-3.6

Notes: Deflated loans and deposits is the growth of year-average balances from the Call reports, deflated using the price indes of gross domestic purchases from the U.S. NIPA. Loan counts, transaction counts and employment are provided by Chris Kask of the BLS and output weights are based on the same data as Table 1.

Table 3, Average annual real growth of non-traditional (fee-generating) activities of U.S. commercial banks, 1987-2004

	1987-1995	1995-2004
Bank efficiency measures		
Credit equivalent	20.0	11.0
Asset equivalent	0.9	9.5
Net non-interest income	7.0	7.3
BLS measure		
Fiduciary activities	0.4	0.1
Preferred measure		
Total fee-generating activities	3.3	6.6
Contributions from:		
Fiduciary activities	0.1	0.0
Investment banking	0.6	1.1
Securitization activities	0.6	4.1
Insurance	0.1	0.3
Other activities	2.0	1.0

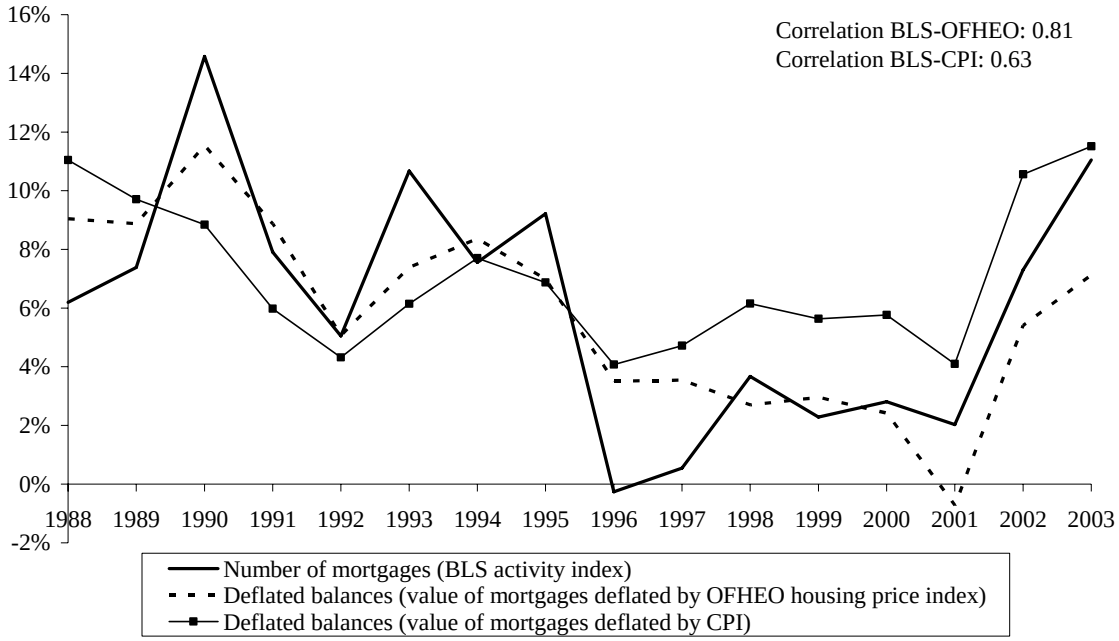
Notes: Credit equivalent measure is the risk-weighted sum of OBS items, based on the definitions in the data appendix of Berger and Mester (2003). Fiduciary activities is based on data provided by Chris Kask of the BLS. Methods used in deriving other fee-generating activities are detailed in the main text and appendix. Contributions to total fee-generating activities are calculated by multiplying annual growth rates by the two-period average output share (see equation (1)).

Table 4, Average annual growth of U.S. commercial bank output, 1987-2004

	1987-1995	1995-2004
Bank efficiency measures		
Loans, deposits & OBS items as output		
Credit equivalent	6.2	7.2
Asset equivalent	1.4	4.2
Net non-interest income	2.9	3.0
Only loans & OBS items as output		
Credit equivalent	12.8	8.7
Asset equivalent	1.2	7.2
Net non-interest income	6.6	6.1
BLS measure	1.5	0.9
Preferred measure	1.9	2.5

Notes: Bank efficiency measures combine different series from Tables 2 and 3. The items under 'loans, deposits & OBS items as output' use the growth of deflated loans and deposits (Table 2, panel C) and each of the three OBS items from Table 3 and combines them using output shares based on the same data as Table 1 for loans and deposits on the one hand and fee-generating activities on the other hand. The items under 'Only loans & OBS items as output' use the growth of deflated loans from Table 2, panel A. BLS measure is calculated using employment weights and the relevant items from Table 2 and 3. Preferred measure is calculated using output weights and items from Table 2 and 3.

Figure 1 Growth of Residential Mortgage Origination, Number of Mortgages versus Deflated Balances, 1987-2003



Data Appendix

This appendix covers in detail the variety of data sources used as well as the approximations and assumptions made in situations where data is not available. Basu, Inklaar and Wang (2006) have detailed the imputation of the nominal value of deposit and loan services, so here we focus on constructing time series of the price and quantity of various services that generate fees or other non-interest income. Tables of detailed underlying calculations and the Call report data items used are also provided.

The value of fee-generating services at current prices

As described in the main text, existing data allows us to consider seven different fee-generating services. Excluded from overall non-interest income are trading account revenue, venture capital revenue and gains and losses on the sale of loans, other real estate and other assets. Appendix Table A.1 gives an overview of the Call report items used, while Table A.2 shows the time series for each of these activities. From 2001 onwards, the Call reports provide information on all of these categories. For the period before 2001, however, the Call reports provide information on only two of them, namely fiduciary activities and service charges on deposit accounts. As argued in the main text, we consider service charges on deposit accounts to be payments for transaction services, so we add the service charges to the imputed output associated with deposits.[52]

For income from investment banking and insurance, the only data source was the Economic Census, which provides a detailed breakdown of commercial bank revenue for 1992, 1997 and 2002. Clearly one could only use interpolation to estimate a time series and there is also the drawback of no data about insurance revenue in 2002. On the other hand, for investment banking revenue, the 2002 Census provides a useful verification for the Call reports: $9.2 billions in the Call reports vs. $8.5 billions in the Census. These figures seem fairly close given that the definitions of revenue sources do not exactly match between the two sources. Specifically, the $8.5 billions from the Census represents only fees and commissions related to investment banking activities, so the discrepancy

[52] Since we have two types of deposits, namely demand deposits and time & savings deposits, we distribute the service charges in proportion to the outstanding balance of both types of deposit accounts.

between the two sources can perhaps be attributed mostly to holding gains and losses, which are explicitly omitted from the Census data.[53]

Since the Census is the only data source for insurance and investment banking revenue before 2001 that we are aware of, we use the Census figures for 1992 and 1997 and interpolate the years in between assuming a constant growth of revenue. To form a plausible estimate for 1987, we assume, between 1987 and 2001, constant relative growth of investment banking and insurance revenue in all fee-generating activities, excluding fiduciary activities and service charges on deposit accounts. That is, we assume the share of these two revenues rose the same percentage points between 1987 and 1992 as between 1992 and 1997. According to the Census, shares of investment banking and insurance in all fee-generating service output were, respectively, 6 and 1.3 percent in 1997, up from 4.4 and 0.8 percent in 1992.[54] Obviously, without additional information, one could just as easily make other assumptions, but since it seems that any reasonable estimate for 1987 would imply only a small role for these two activities, the impact on the overall results from alternative (plausible) assumptions should be limited.

Two of the remaining categories – net servicing fees and net securitization income – stem from closely related activities: originating and servicing loans that no longer reside on the bank's balance sheet. For example, these cover cases where a bank sold a pool of residential mortgages to Fanny Mae (FNMA) but retains the task of collecting interest and principal repayment. It must be noted that both categories report the revenue from the relevant financial services *net* of direct expenses. So, by definition, the reported figures understate the true nominal value of the services.

As before, estimates need to be made of revenue before 2001; in this case, we make use of not just the Census data, but also information in the Call reports on securitized loans and servicing assets. In the case of servicing fees, the Call reports instructions make clear the link with the balance of servicing assets, which is defined to be the fair (or amortized) value of all future net income from servicing activities. Indeed, the annual growth of net servicing fees between 2001 and 2005 is highly correlated with

[53] As a further confirmation of the close mapping between the Census and the Call reports data, the revenue figures for fiduciary activities and service charges on deposit accounts from the two sources are also generally within 10 percent of each other.

[54] In 2001, the share was 9.7 percent investment banking and 3.1 percent for insurance.

the annual growth of servicing assets (0.90). In addition to this figure based on a short time series of industry aggregates, we also calculate the cross-section counterpart of the correlation for the years since 2001, the first year in which servicing fees were included in the Call reports. In 2001, the cross-section correlation between servicing fees and servicing assets was 0.5, and higher (0.7) for banks reporting positive net servicing fees. By 2004, this correlation had risen to 0.8 (in both cases), suggesting that reporting consistency improved over the years. By comparison, the cross-sectional correlation between servicing fees and the principal amount of securitized loans is much weaker, at only 0.5 in 2004 and 0 in 2001.

Net securitization income is harder to parse. According to the Call report instructions, it should include fees on securitizations, structured finance vehicles and administrative support, but also holding gains and losses related to securitization transactions. The time-series correlation with servicing assets based on aggregate data since 2001 is in fact negative. The cross-sectional correlations are also relatively weak, varying between 0.3 in 2001 to 0.6 in 2004. The correlation with the principal amount of securitized loans is weaker still, between 0 and 0.3.

The above figures suggest that servicing assets should be most informative for imputing both servicing fees and securitization income in earlier years. The Call reports provide information about mortgage servicing assets back to 1987.[55] The amount of securitized loans is estimated back to 1987 for the four categories that match those on the balance sheet (i.e., real estate, credit card, other consumer and C&I loans). From 2001 onwards, all these categories are available in the Call reports; before 2001, only real estate loans are available directly. So we use the growth of total outstanding private asset-backed securities (ABS) of consumer loans. reported in the Flow of Funds, to approximate the growth of credit card and other consumer loans,. For real estate loans before 1992, we approximate using the trend in total outstanding mortgage-backed securities (MBS), also from the Flow of Funds. For other loans (including C&I loans), we use the average growth of securitized real estate and consumer loans. Since the other

[55] Although the subcategory "other servicing assets" is not reported separately before 1992 but as part of "other intangible assets," it is most likely that, based on the post-1992 data, the former make up a substantial share of the latter, so the trend in "other intangible assets" can be directly applied to estimate total servicing assets.

loans make up only 4 percent of total securitized loans, even in 2004, the exact extrapolation method will have only a small impact on the overall results.

Apart from servicing assets and securitized loans, we can also use the data of overall securitization revenue, provided in the Economic Census of 1992 and 1997, to gauge the evolving importance of securitization revenue. Unfortunately, the definition of such revenue is not fully comparable either across Census years or between the Census and Call reports. As discussed above, the Call reports distinguish net servicing fees and net securitization income, which includes both fees and some holding gains and losses. The closest Census category is "loan (and line of credit) servicing fees collected after placement" in 1992 and "loan servicing and administration fees" in 1997. So the 1992 Census figure includes more revenue relative to the Call report definition via line-of-credit servicing, but also less revenue by excluding holding gains and losses. At the same time, it is not clear whether the Census includes any of the fees in "net securitization income" in the Call reports. The 1997 Census definition does not cover holding gains and losses, which are in the Call-report definition.

To deal with the ambiguity in the data definition by some of the sources, we extrapolate in a few different ways the securitization revenue prior to 2001. Table A.3 and Figure A.1 report the extrapolations. The first version shown in Table A.3 uses the Census benchmarks for 1992 and 1997, while the other versions use trends of servicing assets and/or securitized loans. These extrapolations suggest that, in 1997, the Census definition yields a lower estimate than the Call report definition. Although the former is conceptually superior because it excludes holdings gains and losses, it cannot be made consistent over time because we have no information to remove holding gains and losses in the post-2001 data. For 1992, the estimate of securitization revenue based on the trend in servicing assets exceeds that according to the Census definition, which in turn exceeds the estimates based on trends in the other two variables.

Figure A.1 then shows that, while the balance of securitized loans implies a basically monotonic rise in securitization revenue, servicing assets imply a more variable growth, particularly a decline in 2001. Note that we do not linearly interpolate the growth of securitization revenue between Census benchmarks, but follow the variation in the growth of servicing assets. Therefore, the general trend in securitization assets closely

resembles that in servicing assets. Based on the data available to us, there is no clear-cut choice of the best series to use for extrapolating securitization revenue. We have chosen to extraplote based on the trend in servicing assets for a few reasons.[56] First of all, the cross-section correlations suggest that servicing assets are a good predictor of servicing fees and a reasonable predictor of securitization income. The balance of securitized loans is a notably weaker indicator. Second, the differences in definition between Call reports and the Census make it hard to use Census information directly with any degree of confidence. Finally, the pattern of growth between 2001 and 2005 suggests that securitization income does not rise as monotonically as securitized loans, and that servicing assets provide a better approximation.

Even though there are uncertainties about which imputed series best approximates the actual securitization revenue, we would like to stress that taking this revenue stream into account is important. Its share in total revenue from fee-generating services grew substantially between 1987 and 2004, no matter which asset series we use to extrapolate securitization income. For instance, its share rose from only 3 percent in 1987 to 22 percent in 2004, according to the estimate based on the growth in servicing assets. This makes it a more important revenue category than fiduciary activities and service charges on deposit accounts, as well as one of the most important sources of revenue growth for commercial banks since the late 1980s.

Besides revenues from investment banking, insurance and securitization, the residual category is ”other non-interest income.” This category is reported separately for years 2001 to 2004, but calculated as a residual for earlier years. As discussed in the main text, this category includes a large number of plausibly pertinent service revenue. Unfortunately, neither the Call reports nor the Census provides much guidance about the bulk of revenue types in this category. Estimates of this revenue category are thus the least reliable. Real growth for this category is estimated with even less accuracy because of the use of a deflator that does not directly cover any of the included activities.

[56] Industry estimates based on respective trends in the alternative variables are available upon request.

Price and quantity data

The underlying series used to deflate nominal fee income are listed in Tables A.4 and A.5. Table A.4 shows the price deflators that can be used to calculate quantities of fee-generating services, whose nominal values are reported in Table A.2. The service charges on deposit accounts are included in both tables, even though we count these charges in the imputed output for deposit accounts. In case one is interested in estimating the quantity of only the implicit depositor services, the nominal value and price provided in Tables A.2 and A.4, respectively, can be used to 'back out' the explicit charges.

As discussed in the main text, the price deflator for service charges is based on a PCE deflator; this same index is used to deflate other non-interest income. The price index for fiduciary activities is that implied by the quantity count from the BLS and the value of those services (see Table A.2). For investment banking and insurance revenue, we use the relevant gross output deflator from the BEA GDP-by-Industry accounts – the deflator for Securities, commodity contracts, investments (NAICS 523) and the deflator for Insurance carriers and related activities (NAICS 524), respectively.

For net servicing fees and net securitization income, we use the same implicit price deflator as implied by the BLS quantity counts for balance-sheet loans. This amounts to assuming that a loan that is kept on a bank's balance sheet requires the same financial services as a securitized loan of the same category. Obviously, even though this is a reasonable assumption in principle, it is unlikely to be exactly true in reality, but it is the best we can do without further information.

Under this assumption, the balance-to-count ratio for each category of on-balance-sheet loans, combined with the interest margin estimated for that category of loans (Basu, Inklaar and Wang, 2006), can be used to derive real output index for securitization activities. That is, real securitization output (in growth rate, q^Z) can be imputed as

$$q^Z = y^Z - (x + \Delta r),$$

where y^Z is (the growth in) securitization income, x the (percentage) change in balance-to-count ratio, and Δr the change in interest-rate margin. Table A.5 shows an index of the balance-to-count ratios for the different categories. The percentage change in a ratio equals the growth in the year-average balance of the relevant loans or deposits minus the

growth in the relevant quantity count. In the case of loans, any rise in this figure implies a rise in the average loan size.

The real output index of securitization activities for each loan type is then aggregated using nominal-output shares to obtain the overall securitization output. This output series is volatile, the result of a volatile implicit price deflator series, which saw a particularly steep rise from 1987 to 1988. This rise can mostly be traced to a rise in the interest rate margin from 0.2 to 1.2 percent; likewise, changes in interest margin are the main driver of volatility in other years. One can of course apply smoothing procedures as in Fixler and Reinsdorf (2006), but here we have chosen not to do so but instead focus on the average growth over a period of time. We think this is more sensible for the purpose of comparing across different output measures, since there may be potentially large measurement errors in our estimates owing to the various assumptions that we have to make in order to extrapolate data.

Appendix Table A.1, Call report items used in estimating fee-based output at current and constant prices

Description	*Period*	*Item*	*Notes*
Fees & commissions			
Fiduciary activities	1987-2004	RIAD4070	
Service charges on deposit accounts	1987-2004	RIAD4080	
Investment banking, advisory, brokerage, and underwriting fees and commissions	2001-2004	RIADB490	Before 2001 based on Census
Net servicing fees	2001-2004	RIADB492	Before 2001 based on servicing assets
Net securitization income	2001-2004	RIADB493	Before 2001 based on servicing assets
Insurance commission fees and income	2001-2004	RIADC386+RIADC387	Before 2001 based on Census
Other noninterest income	2001-2004	RIADB497	Before 2001 calculated as residual
Servicing assets for extrapolation of securitization income			
Mortgage servicing assets	1987-2004	RCFD3164	
Purchased credit card relationships and nonmortgage servicing assets	1992-2004	RCFDB026	Before 1992 calculated using the trend in "Other identifiable intangible assets"
Other identifiable intangible assets	1987-1991	RCFD3165	
Holding gains/losses			
Trading revenue	1996-2004	RIADA220	
Noninterest income on other gains (losses) and fees from foreign exchange transactions	1987-1995	RIAD4075	Part of RIADA220
Noninterest income on other foreign transaction gains (losses)	1987-1995	RIAD4076	Part of RIADA220
Noninterest income on other gains (losses) and fees from trading assets and liabilities	1987-1995	RIAD4077	Part of RIADA220
Net gains (losses) on sales of:			
Loans and leases	1991-2004	RIAD5416	1)
Other real estate owned	1991-2004	RIAD5415	1)
Other assets (excluding securities)	2001-2004	RIADB496	
Premises and fixed assets	1991-2000	RIAD5417	Almost consistent with RIADB496 1)
Securitized loans			
Outstanding principal balance of 1-4 family residential mortgage loans serviced for others:			
Serviced with recourse or other servicer-provided credit enhancements	2001-2004	RCFDB804	
Serviced with no recourse or other servicer-provided credit enhancements	2001-2004	RCFDB805	
Serviced under a GNMA contract	1992-2000	RCFD5500	Part of RCFDB804+RCFDB805 2)
Serviced under a FHLMC contract with recourse to servicer	1992-2000	RCFD5501	Part of RCFDB804+RCFDB805 2)
Serviced under a FHLMC contract without recourse to services	1992-2000	RCFD5502	Part of RCFDB804+RCFDB805 2)
Serviced under a FNMA regular option contract	1992-2000	RCFD5503	Part of RCFDB804+RCFDB805 2)
Serviced under a FNMA special option contract	1992-2000	RCFD5504	Part of RCFDB804+RCFDB805 2)
Serviced under other servicing contract	1992-2000	RCFD5505	Part of RCFDB804+RCFDB805 2)
Outstanding principal balance of assets sold and securitized by reporting bank:			
Home equity lines	2001-2004	RCFDB706	3)
Credit card receivables	2001-2004	RCFDB707	3)
Auto loans	2001-2004	RCFDB708	3)
Other consumer loans	2001-2004	RCFDB709	3)
Commercial and industrial loans	2001-2004	RCFDB710	4)
All other loans and leases	2001-2004	RCFDB711	4)

Notes:

1) Unclear whether there is a corresponding Call report code before 1991, so extrapolated using trend in total assets

2) Before 1992 extrapolated using trend in overall mortgage-backed securities from Flow of Funds

3) Before 2001 extrapolated using trend in overall asset-backed securities of consumer loans from Flow of Funds

4) Assumed a constant share of overall securitized loans before 2001

Appendix Table A.2, Time series of fee-generating services output at current prices of U.S.-chartered commercial banks, billions of dollars, 1987-2004

	Fiduciary activities	Service charges on deposit accounts	Investment banking	Net servicing fees	Net securitization income	Insurance activities	Other noninterest income
1987	6.8	8.7	0.5	0.5	0.7	0.1	17.7
1988	7.1	9.4	0.7	0.6	0.8	0.1	19.4
1989	7.9	10.3	0.8	0.6	0.9	0.1	22.9
1990	8.5	11.4	1.0	1.1	1.6	0.2	22.9
1991	9.1	12.8	1.2	1.4	1.9	0.2	23.8
1992	10.0	14.0	1.5	1.5	2.1	0.3	28.2
1993	10.9	14.9	1.8	1.5	2.0	0.3	31.9
1994	11.8	15.3	2.1	2.0	2.8	0.4	33.0
1995	12.3	16.0	2.5	2.7	3.7	0.5	36.1
1996	13.7	16.9	3.0	4.0	5.4	0.6	40.1
1997	16.1	18.5	3.5	5.5	7.5	0.7	41.3
1998	18.5	19.8	4.5	8.8	12.1	1.0	47.1
1999	19.7	21.5	5.6	13.3	18.3	1.5	52.6
2000	21.4	23.8	7.2	13.5	18.5	2.0	54.1
2001	20.8	26.5	9.1	11.8	16.2	2.9	53.1
2002	20.4	29.7	9.2	11.4	19.5	3.4	58.9
2003	20.8	31.7	10.3	14.2	21.8	3.5	58.8
2004	22.6	31.9	9.7	14.5	22.0	4.2	58.8

Notes: see data appendix for detailed source and method description.

Appendix Table A.3, Extrapolation options for total securitization revenue of U.S. commercial banks (billions of dollars)

	1992	1997	2001
Census benchmarks	4.5	9.1	28.0
Trend in servicing assets	3.6	12.9	28.0
Trend in securitized loans	5.2	13.7	28.0
Trend in servicing assets for servicing fees & trend in securitized loans for securitization income	4.7	13.7	28.0

Notes: total securitization revenue includes net servicing fees and net securitization income. The 2001 column shows the actual Call report data, while the 1992 and 1997 columns show different extrapolation scenarios.

Appendix Table A.4, Output price indices of fee-generating services of U.S.-chartered commercial banks, 1987-2004 (1987=100)

	Fiduciary activities	Investment banking	Securitization activities	Insurance activities	Other activities
1987	100.0	100.0	100.0	100.0	100.0
1988	96.3	99.1	267.0	106.2	106.0
1989	112.0	101.4	242.2	116.1	111.8
1990	119.8	102.6	211.7	124.4	119.2
1991	120.3	103.9	253.4	130.4	128.6
1992	131.1	110.7	189.1	138.7	135.8
1993	153.0	110.6	220.9	147.0	143.1
1994	164.8	103.8	251.6	154.2	152.2
1995	175.2	104.6	337.9	164.0	161.0
1996	203.1	104.3	301.2	173.7	170.1
1997	233.5	101.1	326.2	183.2	178.5
1998	259.4	88.9	327.6	186.9	183.5
1999	259.8	78.0	302.6	190.5	189.2
2000	285.7	68.0	337.2	195.6	197.9
2001	295.3	62.6	332.8	200.2	206.2
2002	303.5	60.1	279.9	206.8	211.9
2003	302.4	62.1	315.4	214.7	216.1
2004	320.6	63.0	292.0	224.5	222.0

Notes: see data appendix for detailed source and method description.

Appendix Table A.5, Implicit loan balance and deposit transaction deflators, 1987-2004 (1987=100)

	Demand deposits	Time & savings deposits	Real Estate	Other Consumer	Credit Card	Commercial & Industrial
1987	100.0	100.0	100.0	100.0	100.0	100.0
1988	92.2	116.3	110.6	104.1	103.5	102.3
1989	87.9	135.2	115.8	110.4	106.7	97.2
1990	84.4	144.1	110.1	121.7	101.9	98.9
1991	81.3	157.9	113.0	134.3	98.4	110.1
1992	83.8	160.1	110.2	146.0	90.9	146.7
1993	88.3	158.6	102.0	166.4	81.7	98.7
1994	88.5	170.3	101.8	186.3	78.2	107.5
1995	89.2	190.6	106.8	208.0	75.5	109.8
1996	91.7	224.1	114.1	230.4	74.9	116.7
1997	90.5	265.4	111.4	255.8	73.8	116.8
1998	92.0	291.0	120.3	249.1	68.0	125.4
1999	90.2	329.9	127.4	248.7	58.3	140.0
2000	88.6	374.3	136.9	245.3	55.5	153.8
2001	95.3	429.9	151.9	245.6	57.0	168.8
2002	96.1	475.7	145.8	232.9	60.4	161.7
2003	91.8	508.8	158.1	225.7	65.1	154.6
2004	91.5	539.6	165.2	225.0	71.1	139.7

Notes: Index calculated based on changes in the balance-to-count ratio. The change in the balance-to-count ratio is calculated as the growth rate of the year-average outstanding balance of deposits or loans minus the change in the BLS activity index, which counts the number of deposit transactions or the number of loans.

Appendix Figure A.1, extrapolation of securitization income of U.S. commercial banks (1987-2005), billions of dollars