Real Output of Bank Services:
What Counts Is What Banks Do, Not What They Own

Robert Inklaar and J. Christina Wang

Abstract:

The measurement of bank output, a difficult and contentious issue, has become even more important in the aftermath of the devastating financial crisis of recent years. In this paper, we argue that models of banks as processors of information and transactions imply a quantity measure of bank service output based on transaction *counts* instead of *balances* of loans and deposits. Compiling new and comparable output measures for the United States and a range of European countries, we show that our counts-based output series exhibit significantly different growth patterns from those of our balances-based output series over the years 1997 to 2009. Since the U.S. official statistics rely on counts while European statistics rely on balances, this implies a potentially considerable bias in the estimate of bank output growth in Europe vis-à-vis that in the United States.

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I. Introduction

The measurement of bank output has long been a difficult and sometimes contentious topic that has yet to see a consensus resolution.[1] Achieving the right output measure for bank services has become more important in the aftermath of the recent devastating financial crisis, as the role of financial firms has come under intense scrutiny. One of the questions attracting greater attention concerns how much banks have truly contributed to the real economy in terms of the services they provide.

This paper focuses on the methodological question of how to measure the real value of these services. We construct model-based output measures for banking services and compare these with alternative measures commonly used by statistical agencies. The underlying banking model is built on theories of financial intermediation and asset pricing. Its central message is that bank output should be measured in terms of indices of quality-adjusted[2] counts of different categories of banking transactions.[3] This approach amounts to assuming that each transaction within a suitably defined category, such as a conforming mortgage loan origination or a deposit withdrawal, corresponds to a constant flow of services over time.

We contrast our model-based output measures derived from activity counts with measures based on outstanding balances of loans and deposits deflated by a general price index; such measures are used by statistical agencies in many countries. This latter approach in effect assumes that every (real) currency unit such as the euro or dollar corresponds to a constant flow of services over time. However, assuming such fixed proportionality between outstanding balances and service flows requires restrictive

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[1] See, for example, Triplett and Bosworth (2004) and Diewert (2010) for overviews, and Basu, Inklaar, and Wang (2011) and Fixler and Zieschang (2010) for contributions to the debate in recent years.

[2] Throughout the paper, "quality-adjusted" refers to adjusting for variations in the composition as well as the quality, if feasible, of individual services constituting an aggregate output index.

[3] This is generally equivalent to deflating revenue when fees for services are explicit, as with novel bank activities that typically generate no financial claims on the balance sheet. We focus on the case where banks charge implicitly via an interest margin on loans and deposits, so that it becomes necessary to measure output by directly constructing quantity indices based on quality-adjusted activity counts.

assumptions.[4] In contrast, counting activities always yields the right output measure in theory.

In practice, adequate quality adjustment is difficult because of the lack of relevant detailed data. Nevertheless, we argue that our activity-count-based measures with imperfect quality adjustment using available data still constitute an improvement over deflated balances because of the conceptual advantage. Moreover, we find large empirical differences between the two types of measures. In the case of U.S. commercial and industrial (C&I) loans, the average loan size (in both nominal and real dollars) has decreased steadily over time, so the deflated-balances approach underestimates the true output growth of C&I lending services. Likewise, the number of deposit transactions has grown faster than deposit balances, and this means that deflated balances understate true output growth of depositor services. On the other hand, house prices in the united States and most European countries have increased faster than the overall price level, leading to an increase in the average size of residential mortgages. As a result, the CPI-deflated balances overestimate true output growth of mortgage lending activity.

These findings also have important implications for cross-country growth comparisons. In the United States, official statistics have so far been based on the activity-count approach,[5] while the European statistics rely almost entirely on the deflated-balance approach.[6] Following our reasoning, the official estimate of European bank output growth is most likely biased relative to that of the United States, although the direction and size of the overall bias is unclear given our finding of biases in both directions. More accurate estimates have to await additional data needed to conduct a similar comparison for the other types of loan and deposit services.

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[4] These arguments are formalized more extensively in Wang, Basu, and Fernald (2009) and Basu and Wang (2006). They delineate the restrictive assumptions needed to justify fixed proportionality between balances and services.

[5] See, for example, 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).

[6] In the Netherlands, the number of deposit transactions is used for depositor services, but a deflated-balances approach is used for lending services.

Our proposal for an activity-count measure of bank output can also have implications for productivity estimates over the past decade or so. In particular, if bank output has been overestimated because of inflated asset valuations (and hence balances), it would call for revisiting estimates of the U.S. productivity revival since the mid 1990s, because the financial services industry accounts for a non-trivial fraction of the productivity speed-up. Furthermore, growing interest has been expressed in discussions of financial regulatory reform to separate banks' utilities-like function from their risk-taking function.[7] Our estimates in this study can be viewed as a first attempt to gauge the contribution of the utilities-like functions of banking to growth that is minimally contaminated by the risky returns earned by banks or by asset inflation.

The rest of the paper is organized as follows. In Section II we outline the theory underlying our empirical estimates and compare it with the other commonly used methods. Section III describes the methodological choices made in mapping the theory to the available data. Section IV presents the results, and Section V concludes.

II. Intermediation theory and its implication for bank output measurement

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 constant prices—decomposing nominal output into its price and quantity components.[8] We discuss why our method yields a consistent measure of bank services regardless of whether the services are associated with financial claims on the balance sheet, and whether they generate explicit fees.

The theory behind our measurement is developed in Wang (2003) and Wang, Basu, and Fernald (WBF, 2009).[9] In these models, the core function of banks is to screen and monitor borrowers in order to reduce information asymmetry in lending, and to

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[7] See, for example, various speeches by the Bank of England governor Mervyn King, one of which can be found at http://www.bankofengland.co.uk/publications/speeches/2009/speech406.pdf.

[8] In what follows, real output is used interchangeably with output quantity and output at constant prices.

[9] Wang (2003) considers the partial-equilibrium case, while WBF (2009) extend it to general equilibrium.

provide 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.[10]

One key implication of this theory for output definition is that, even though the provision of banking services is often integrated with the transfer of funds between depositors and borrowers, these funds *per se* are not banks' output. Rather, the role of these funds can be thought of as analogous to that of the goods transported and marketed by wholesalers and retailers.[11] This implication is particularly relevant for bank services that are remunerated implicitly through extra interest margins, because they result in financial claims on the balance sheet, as is characteristic of most traditional banking activities. In fact, the models in both WBF (2009) and Wang (2003) purposely consider the polar case where a bank charges for *all* services via an interest margin.

Consequently, the models stipulate that to measure bank output one should try to estimate the *flow* of services directly, just as one estimates 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 the technology for producing bank services changes over time relative to the rest of the economy. Besides technological progress, many other real-world factors, including inflation, can cause the balance-service relationship to vary over time.

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

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[10] 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.

[11] Although helpful for intuition, this analogy should not be taken literally, because funds do not satisfy the technical definition in the current national income accounting system of purchased intermediate inputs, which must have themselves been counted as the output of some other productive units.

(and aggregate using sales commissions by make as weights), or to count the CPI-deflated dollar value of the *accounts receivable* on the dealer's book at period-end? Counting the number of specific types of cars sold is no doubt imperfect, since it ignores possible changes over time in the quality-adjusted sales services devoted to each vehicle sold.[12] But this is no more than the usual empirical difficulty with quality adjustment.

In contrast, the (deflated) value of accounts receivable at a point in time would not bear a fixed relationship to the amount of sales services except under restrictive and often unrealistic conditions.[13] One should at least deflate the dollar value of cars *sold* during the period with a composite price index for autos, based on the mix of cars sold. However, for this series to be a valid proxy for the amount of sales services, one would still need to assume a constant relationship between the price of cars and the price of sales services.[14] Furthermore, this method too suffers from the same quality-adjustment problem that afflicts the output measure based on direct number counts. So 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 accounts receivable. We argue that the former is more sensible. For indices of transaction counts to accurately measure bank output, however, each category of bank services must be defined properly. Since, in principle, products should be identified from the perspective of demand, bank services should be classified according to customers' perception of the

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[12] Differences in service quality across sales of different kinds of cars (for example, selling Mercedes entails more upscale services) in principle cause no problem (for aggregation), so long as the revenue accrued to each type of sales services is measured correctly, providing the right aggregation weights.

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

[14] The problem lies in the aggregation weights implicit in this proxy: it is based on a vehicle's entire value instead of just the sales commission part, which is the appropriate weight for aggregating across types of sales services. Under perfect competition in both car manufacturing and sales markets, the use of this proxy amounts to assuming the same rate of technological progress in the production and sale of cars.

distinct objectives of the tasks performed.[15] For instance, if all residential mortgage loans are perceived to be the same product, then the origination of such loans should be defined as a type of bank service. Likewise, the origination of business loans with principal less than $100,000 to fund working capital may be another type of service. With the output of each type of service measured, aggregate output growth can be derived in the standard way, using (implicit as well as explicit) revenue shares.

In practice, data limitations largely dictate how many distinct categories of bank services can be identified. This is the case for our empirical estimates and comparisons. As will be described in the next two sections, we distinguish as many (potentially) distinct types of services as possible. For instance, within C&I loans made by U.S. banks, we further distinguish across loans of different risk ratings and with different repricing periods. Even though our activity-based estimates of bank output are imperfect because we are unable to make distinctions across different types of banks services as finely as called for by theory, they can still help gauge the extent to which balance-based measures of output may have biased the official statistics of bank output over the past decade or so. Being approximately right is preferable to being precisely wrong. Besides, there is no evidence that deflated balances are better able to distinguish among different types of bank services. The correct strategy for further improvements should be to collect count data on additional types of bank activities.

III. Data and empirical methodology

This section details how we map concepts under the theory described above to the best available data, encompassing three categories of bank services. We discuss in turn lending services associated with C&I loans and residential real estate loans and transaction services associated with deposit accounts. Table A.1 in the appendix lists the data sources by type of banking service and, where available, by country.

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[15] Particularly in the case of bank services that do not directly generate utility for customers, such as monitoring borrowers, bank customers likely classify those according to the associated financial instruments, which are what they truly seek. For instance, residential mortgage loans are likely regarded as a different kind of product than consumer car loans or credit card loans for this reason.

3.1 Commercial & industrial loans

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 have termed the "activity-count" method: estimate real output indices using direct quantity indicators. The Bureau of Labor Statistics (BLS) is one source of such activity data. The BLS series track the number of four types of loans—residential real estate, credit card, other consumer, and commercial & industrial (C&I) loans—and transactions on two types of deposit accounts—demand deposits and time and savings deposits.[16]

We also derive activity counts of business lending services using data gathered by the Federal Reserve's Survey of Terms of Business Lending (STBL). The STBL collects data quarterly on terms of C&I loans originated during the survey week at a sample of banks operating in the United States; for this study, we use only data on domestic banks in order to scale up to the industry level by mapping to the C&I loan balances in the Call Reports. The publicly available information covers total volume, average size and maturity of loans originated by credit risk rating, and repricing (that is, interest rate reset) frequency.[17] This enables us to infer the number of C&I loans originated by risk rating, which is probably the attribute most relevant for the quantity of screening services performed. Accordingly, aggregate growth of overall bank C&I lending services can be calculated as the weighted average growth in different rating classes. That is,

$$\Delta \ln L_t = \sum_i \overline{w}_{it} \Delta \ln L_{it} \text{ , where } \overline{w}_{it} = .5\left(w_{it} + w_{i,t-1}\right) \text{ and } w_{i.} = V_{i.}\Big/\sum_i V_{i.} \text{ .} \tag{1}$$

$\Delta \ln L_t$ is the growth rate of the overall C&I loan count index L_t, while $\Delta \ln L_{it}$ is the growth of loans in rating class i. $\overline{w}_{it}$ is the average share of rating-i loans in total implicit revenue from C&I services. Implicit revenue from rating-i loans, V_{it}, can be imputed as follows:

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[16] We thank Chris Kask at the BLS for kindly providing these data along with the documentation.
[17] For documentation and more details, see data release E.2 at http://federalreserve.gov/releases/e2/.

$$V_{it} = \left[\left(r_{it} - r_{it}^M \right) Z_{it} \right] L_{it} , \tag{2}$$

where r_{it} is the interest rate on rating-i loans, r_{it}^M the yield on reference market securities, and Z_{it} is the average size of rating-i loans. $\left(r_{it} - r_{it}^M \right) Z_{it}$ is the extra interest margin on each loan of type i to pay implicitly for the bank's lending services; its role is analogous to the price, albeit implicit, of services.

As detailed in Basu, Inklaar, and Wang (2011), r_{it}^M for loans in "minimal" and "low" risk classes can be identified according to the STBL instructions, whereas r_{it}^M for risk classes "moderate" and "other" are unclear. We hence experiment with two polar assumptions about their r_{it}^M : 1) use the same r_{it}^M for moderate- and other- as for low-risk loans so that all the extra interest margin is regarded as greater implicit revenue for services; 2) raise r_{it}^M for moderate- and other-risk loans until their service margins (that is, $r_{it} - r_{it}^M$) equal that for low-risk loans. For reference, Figure A.1 in the appendix shows the respective estimates of $r_{it} - r_{it}^M$.[18] These two alternatives yield the upper- and lower-bound estimate, respectively, of $\left(r_{it} - r_{it}^M \right) Z_{it}$, the true implicit service revenue associated with moderate- and other- risk C&I loans.

An index of the weighted number of loans originated is our theory-consistent measure of banks' output of screening services. Extra interest margins earned by banks as implicit revenue for screening loans serve as the weights. By the same token, an index of the weighted number of outstanding loans is our output measure for monitoring services, assuming that banks monitor every loan in the portfolio. Implicit revenues earned on monitoring serve as the weights. So, one needs respective revenue data for screening and monitoring to account for their output separately. With only the estimate of all C&I-based implicit revenue, we choose to account for bank C&I services using the number of loans outstanding in each period. This sum includes new loans originated in the current quarter plus loans that were originated in previous quarters but remain on

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[18] While these margins do vary over time, as discussed in more detail in Basu et al. (2011), the average over time illustrates well their general relationship.

bank balance sheets. So we in effect assume that screening and monitoring each C&I loan with a given set of attributes (that is, rating and repricing frequency in this case) involves an equal amount of services, and that newly originated loans need no monitoring in the period of their origination.[19]

To estimate the number and dollar volume of outstanding loans implied by the STBL data on originations, we apply the perpetual inventory method (PIM) to the origination count as well as to volume. That is:

$$L_{it} = \sum_{\tau=t}^{t-K} (1-\delta_{i\tau})^{t-\tau} L_{i\tau}^{N}, \text{ and } A_{it} = \sum_{\tau=t}^{t-K} (1-\delta_{i\tau})^{t-\tau} A_{i\tau}^{N}. \tag{3}$$

L again denotes the number of type-i C&I loans, while A denotes the corresponding dollar volume. L and A are the total number and total amount of loans outstanding, respectively, while superscript "N" stands for new origination. δ_{τ} is the constant rate of amortization for loans originated in quarter τ, determined by their maturity. Specifically, we estimate a geometric amortization rate δ_{τ} as follows:

$$\delta_{i\tau} = \alpha/T_{i\tau}. \tag{4}$$

α is analogous to the so-called declining balance rate for capital accounting, and we adopt the value of 2, which is typically used for fixed capital. $T_{i\tau}$ is the average life of type-i loans originated in period τ, which we assume equal to the average maturity.[20]

The STBL data are based on a survey of commercial banks, so these data may not represent the trend for the overall banking industry. To arrive at an estimate of C&I output for all U.S. domestically chartered banks, we therefore scale up the STBL-based figures using C&I balances in the Call Reports. That is, we estimate the number of type-i loans outstanding in all domestic banks (L_{it}^{Call}) using the ratio between STBL-based total loan balances $\sum_i A_{it}$ and Call-Reports-based loan balances (A_t^{Call}):

$$L_{it}^{Call} = L_{it} \times \left(A_t^{Call} / \sum_i A_{it} \right). \tag{5}$$

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[19] We could instead use the sum of loans outstanding plus half of originations, which amounts to assuming that loans are on average originated in the middle of a period and then immediately monitored in the same period. Since the number of loans outstanding exceeds the number originated by many times, this alternative estimate exhibits similar time-series properties.

[20] Lacking sufficient information on prepayment, we ignore its potential impact on amortization.

The implicit assumption here is that the composition of C&I loans in the STBL sample is the same as that of the aggregate C&I portfolio in the Call Reports.

3.2 Real estate loans

Among the existing data, activity counts, such as the number of C&I loan originations in the STBL, accord best conceptually with our model-based output measure, because they map directly to the natural units of bank services (and most non-bank financial 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 a specific type of service over time. But this is fundamentally an empirical limitation and no different from the general difficulty with quality adjustment that troubles the measurement of all services. Moreover, it is clearly more sensible than assuming that a given amount of purchasing power on a bank's book represents a constant flow of services over time, which is the implicit assumption underlying commonly used output measures that are based on loan or deposit balances deflated by the CPI or the like.

Nevertheless, since asset balances are often more readily observed, it is useful to examine the conditions under which bank activity counts can be adequately approximated using properly deflated loan balances. We hypothesize that such balance-based proxies are most promising for categories of loans that are used to finance purchases of assets for which accurate price indices exist.

A prime example is residential mortgage loans, and we use it to illustrate the mapping between activity counts and loan balances. In growth rates, the relationship between the number and the balance of mortgages can be expressed as:

$$n_t + p_t = b_t - v_t. \tag{6}$$

n_t is the growth of the number of mortgage loans processed. Importantly, the number of loans should equal the number of houses purchased, a condition mostly satisfied in the United States, where almost all borrow to buy houses and most take out just one mortgage against each house. p_t is the growth in the price index of those houses whose purchases are financed with loans and b_t is the growth in the loan balance. v_t is the

percentage change in the average ratio of mortgage loans to house prices, frequently referred to as the loan-to-value ratio. Both sides of (6) therefore equal total value (in terms of growth rate) of homes financed with loans. This way, the growth rate of a bank's real output (n_t) can be inferred from the more readily available loan balance (b_t) so long as p_t and v_t are also available.

Note that, for (6) to hold, n_t and p_t can be chosen as either unweighted or house-value-weighted indices. The two alternatives correspond to different assumptions about the relationship between loan counts and bank service output, so the choice should be guided by our assessment of which assumption is more plausible. Using value-weighted loan counts amounts to assuming that the implicit-revenue share of each (type of) mortgage equals its house-value share, while using unweighted loan counts assumes that each loan generates about the same implicit revenue. We choose the unweighted indices because we deem the latter assumption more plausible. Note that the correct asset balance to use should still be a *flow* instead of a stock variable—the cumulative balance of loans processed within a period, not the outstanding balance at period end. In particular, cumulative balances account for refinancing services, whereas period-end balances cannot. The latter may serve as a proxy if such balances are the only available data.

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

$$n_t = b_t - p_t . \tag{7}$$

That is, an output quantity indicator (n_t) can be derived from a deflated balance. Key to the derivation is using the proper deflator—it should be the price index for the assets funded, and not just any general price index. In the empirical section below, we estimate the output of residential mortgage origination based on (7).

3.3 Deposit transactions

Compared with the limited data on the number of loans, more are available on the number of deposit transactions. In particular, the *Red Book*, published by the Bank of International Settlements (BIS), includes annual figures of a variety of payment

transactions for a number of countries. We use the transaction data for the United States along with all the European countries—Belgium, France, Germany, Italy, Netherlands, Sweden and United Kingdom—covered in the *Red Book*. From annual publications of the *Red Book*, we compile time series for every type of transaction covered: credit transfers, direct debits, credit and debit card payments, e-money, checks, and other transactions. For the comparison of activity counts with deflated balances, we have data on balances of transaction accounts in the United States and overnight deposit accounts in Europe. Table A.1 in the appendix includes further details of the data sources.

These data present a particular methodological challenge: we do not know the bank revenue (implicit or explicit) associated with each of these types of transactions, which would be needed to aggregate them. So we construct the aggregate index under two different assumptions for the revenue weights and discuss the sensitivity of the estimates. First, we weight every type of transaction equally, which amounts to assuming that customers are willing to pay the same fee for each. This is the weighting scheme chosen by the BLS for its index of aggregate bank output. At the other extreme, we assume that customers' willingness to pay for each transaction is proportional to the amount transacted. Under this assumption, we would weight the growth of each type of transaction by its share in total transaction value. Note that the value of a transaction is a flow, not a stock, such as (deflated) deposit balances, which are a snapshot of the maximal amount of funds available for transactions at a point in time.

IV. Results

In this section, we describe and compare empirical estimates of the real output of a variety of bank services according to the different measures. Following the same order as in the previous section, we discuss commercial & industrial loans, real estate loans, and deposit transactions in turn.

4.1 Commercial & industrial loans

Figure 1 plots the time series of different estimates of the output index for C&I lending services. All the series are scaled to the industry level. First, the line labeled "deflated balance" is based on the CPI-deflated balance of C&I loans. In contrast, the other three output series are based on the Call Reports number of outstanding C&I loans in each rating and repricing frequency class (that is, L_{it}^{Call}), as described in equation (5) in Section 3.1 above. The indices are all derived according to formula (1) in Section 3.1, only with different aggregation weights w_{it}'s. The "summed number" index is calculated using the simple sum of all C&I loan counts, equivalent to setting $w_{it} = 1/N$ in (1), for every t and class i =1,…,N. Both of the other series use i's implicit-revenue share as the weight, but they differ in the assumption regarding the market reference rate r_{it}^{M}, leading to different w_{it}'s. The "weighted number - common risk" line assumes the same r_{it}^{M}, while the "weighted number - common margin" line assumes the same service margin (that is, $r_{it} - r_{it}^{M}$), for C&I loans in all but the minimal-risk class.

One clear pattern emerging from the chart is that the CPI-deflated balance series exhibits by far the lowest growth rate throughout the sample period, averaging a mere 0.5 percent per year. The faster growth of count- vs. balance-based indices is to be expected, given that the average size of C&I loans has fallen steadily by over 40 percent during the sample years (see Figure A.2 in the appendix). Among the loan-count-based indices, the "summed number" and "weighted number - common margin" lines have similar time series, with average annual growth rates of 2.0 percent and 2.2 percent, respectively. This is not surprising, given that the latter series assumes the same aggregation weight (that is, service margin) for over three-quarters of the loans. The fastest growing is the "weighted number - common risk" index, averaging 3.1 percent per year. This is the combined result of 1) much higher service margins for the two riskier (that is, "moderate" and "other") classes of loans (see Figure A.1), and 2) faster growth in the number of these riskier classes of loans (see Figure A.3). The true output index should lie between the "common risk" and the "common margin" series, given the

underlying polar assumptions about the service margin, but in either event, growth is faster than when based on the deflated-balances approach.

4.2 Real estate loans

Figure 2 illustrates our effort to derive a proxy for bank service output from the associated asset balance and the most suitable 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. According to the discussion above (Section 3.2.1), we apply the equal-weighted purchase-only house price index published by the Federal Housing Finance Agency (FHFA) to equation (6).[21] The loan-to-price data also come from the FHFA; loan-to-price ratios for all mortgages prior to October 2002 are spliced with values specific to mortgage loans made by commercial banks afterward. For comparison, Figure 2 also depicts the index based on the same loan balance deflated using the CPI. Last, it plots the index based on simple counts of mortgage loans, derived from the loan balance and average loan size. The count series and the FHFA-index deflated balance are highly correlated, and have a similar average growth rate of roughly 5 percent per year.[22] This is to be expected since the average loan-to-price ratio has been stable over the sample period. By comparison, the CPI-deflated balance shows faster growth throughout the sample, especially since around the turn of the millennium. This pattern is no surprise, given that house price appreciation far outstripped general inflation from the late 1990s through 2007. The growth correlation between the loan-count and the CPI-deflated series is also lower.

We extend this modified deflated-balance approach to estimating the output of mortgage lending services to an international sample. Figure 3 shows estimates for a panel of European countries for which we have found fairly consistent data on house

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[21] Formerly known as the Office of Federal Housing Enterprise Oversight (OFHEO). Strictly speaking, the price index should be specific to the houses whose purchases are financed with bank loans. So the implicit assumption here is that there are no systematic price differences between houses financed by mortgages on banks' balance sheets and conforming-mortgage-financed houses underlying the FHFA index. The two alternative house price indices, LoanPerformance and Case-Shiller S&P, are both value-weighted.
[22] This is not to say that either quantity series is free of the usual problem with quality adjustment.

prices and aggregate mortgage balances; Appendix Table A1 details these data. We again compare the house-price-deflated balance with the CPI-deflated balance. The former is not adjusted for variations in the loan-to-price ratio over time because of the lack of data. But this should have minimal impact on the overall time-series properties of the output estimates provided that the loan-to-price ratio has been as stable in these European countries as in the United States. The most prominent finding emerging from these comparisons is that, with the exception of Germany, using house price indices to deflate loan balances lowers the estimates of growth in residential mortgage lending services in all the other seven countries.

This is the same pattern seen in the U.S. data, and for the same reason—house price appreciation outpaced general inflation over the sample period in almost all these European countries as well. In fact, six of these countries saw the relative price of houses rise by five to seven percentage points on average per year over the 15 years of our sample, much more rapid growth than that experienced in the United States. As we have elaborated above, this means that one would be overstating the growth of bank services in making mortgage loans by a considerable margin for some countries if one used CPI-deflated loan balances. These overstatements would in turn bias productivity estimates for the banking industry in these European countries vis-à-vis in the United States.

4.3 Depositor services

Figure 4 depicts the composite output index of bank depositor services estimated according to the three different approaches discussed in the previous section. As the legend indicates, one of them is based on "Deflated transaction account balances," while the other two are indices of the number of transactions associated with deposit accounts.

As detailed in the previous section, because of the lack of revenue data, we consider the aggregate index of deposit services under two different assumptions for the aggregation weight, namely ,equal weighting versus weighting by the currency value of each type of transaction. "Number of transactions: unweighted sum" is an index derived according to the simple sum of the total number of transactions across all types,

equivalent to setting the weights equal to shares in total transaction numbers. It averages 3 percent growth per year. "Number of transactions: transaction-value weighted" weights the growth of each type of transaction by its share in total value of all transactions. It averages 2 percent growth per year, somewhat slower than the index that is based on the simple sum of transaction counts. On the other hand, both of these indices show faster growth vis-à-vis the third index, which is based on deflated balances of transaction accounts. In fact, the CPI-deflated account balances fall by an average of 2 percent per year over the sample period.

Figure 5 summarizes an international comparison of the same three indices of depositor services. Specifically, it shows the average growth rates of the three similarly constructed output indices in the seven European countries for which the BIS has collected comparable data since 2000. We use overnight accounts as the European counterpart to transaction accounts in the United States. (again, see Table A.1 for details of the data). A similar pattern emerges from this panel of European countries: as in the United States, the output index based on the simple sum of the number of transactions experiences consistently higher growth rates than the index based on deflated balances of overnight accounts. On the other hand, the relationship between the two transaction-number-based indices (due to different weights) varies from country to country. For instance, between the two series, growth in the value-weighted transaction index is faster in Italy and the United Kingdom but much slower in Germany and Sweden. Nevertheless, the transaction-count series grew faster than the deflated balances series for a clear majority of cases.

V. Conclusions

The activities of banks have attracted greater scrutiny in the aftermath of the recent damaging financial crisis. The difficult question of how to measure bank output has thus taken on greater importance as well. Recent theoretical efforts (Wang 2003a, WBF 2009) to model the operation of financial institutions, such as banks, yield a coherent framework for measuring the output of bank services whether or not they generate

explicit fees. This theory implies that quantity indices, based on quality-adjusted counts for each type of transaction, are always the right measure of bank output in principle. They offer a special advantage in the case of bank services furnished without explicit charges. In contrast, asset balances deflated by a general deflator are a valid proxy for the flow of services only under restrictive conditions, such as static technology for producing bank services. They often result in biased estimates of bank output growth.

To highlight how activity-count-based quantity indices of bank output differ from deflated-balance-based indices empirically, this study applies the above model-implied output measure to several categories of traditional bank services for which data on both transaction counts and affiliated financial balances are available over the years 1997 to 2009. These include lending to businesses, lending to households for home purchases, and deposit account transactions.

These output indices based on activity counts exhibit notably different trends from output indices based on deflated balances. Moreover, the bias of the deflated-balance series varies across types of bank services, countries, and over time. These findings imply that deflated balances are unlikely to be a valid proxy for true bank output because the conditions needed are too restrictive to be satisfied in practice.

The conceptually sound, activity-count measure, however, can be implemented only imprecisely at present because of data limitations. Even though we believe that even these activity-count output series are an improvement over deflated balances, we would also advocate collecting activity data on additional categories of bank services. Arguably, the most important among such data needs is quantity counts of a broader array of more finely defined transactions. In addition, data on the ex post performance of loans by detailed category should be gathered to enable better quality adjustment of the output of lending services. Meanwhile, if approximations are used, it must be made clear under which conditions they are appropriate. Our example of a proxy for the output of mortgage lending based on house-price-deflated loan balances illustrates that deflated balances are reasonable proxies for only a few types of bank activities and only when the appropriate asset price deflators are available.

Finally, our results also suggest that considerable caution is needed when comparing bank output growth across countries. The index of bank output in the U.S. National Accounts is mostly based on activity counts, while its counterpart in official European statistics is mostly based on deflated balances. While the direction as well as the magnitude of the overall bias of the European bank output index is unclear, our results indicate that this bias can be sizable and is likely to vary over time and across countries. We therefore recommend concerted efforts to harmonize the measurement of bank output across countries.

References

Basu, Susanto, Robert Inklaar and J. Christina Wang (2011). "The Value of Risk: Measuring the Services of U.S. Commercial Banks." *Economic Inquiry* 49(1): 226–245.

Basu, Susanto and J. Christina Wang (2006)."Technological Progress, 'Money' in the Utility Function, and the 'User Cost of Money.' " paper presented at the NBER/CRIW Summer Institute 2006, downloadable at http://www.nber.org/~confer/2006/si2006/prcr/wang.pdf.

Baumol, W. J. (1952). "The Transactions Demand for Cash: An Inventory Theoretic Approach." *Quarterly Journal of Economics* 66: 545–556.

Benston, George J. and Clifford W. Smith (1976). "A Transactions Cost Approach to the Theory of Financial Intermediation." *Journal of Finance* 31(2): 215–31.

Berger, Allen N. and David B. Humphrey (1997). "Efficiency of Financial Institutions: International Survey and Directions for Future Research." *European Journal of Operational Research* 98: 175–212.

Berger, Allen N. and Loretta J. Mester (2003). "Explaining the Dramatic Changes in Performance of U.S. Banks: Technological Change, Deregulation, and Dynamic Changes in Competition." *Journal of Financial Intermediation* 12: 57–95.

Black, Fischer and Myron S. Scholes (1973). "The Pricing of Options and Corporate Liabilities." *Journal of Political Economy* 81(3): 637–54.

Boyd, John H. and Mark Gertler (1994). "Are Bank Dead? Or Are The Reports Greatly Exaggerated?" *Federal Reserve Bank of Minneapolis Quarterly Review* 18(3): 2–23.

Brand, Horst and John Duke (1982). "Productivity in Commercial Banking: Computers Spur the Advance." *Monthly Labor Review* December: 19–27.

Campbell, Tim S. and William A. Kracaw (1980). "Information Production, Market Signaling, and the Theory of Financial Intermediation." *Journal of Finance* 35(4): 863–82.

Clark, Jeffrey A. and Thomas F. Siems (2002). "X-Efficiency in Banking: Looking beyond the Balance Sheet." *Journal of Money, Credit, and Banking* 34(4): 987–1013.

Diamond, Douglas W. (1984). "Financial Intermediation and Delegated Monitoring." *Review of Economic Studies* 51(3): 393–414.

Diamond, Douglas W. (1991). "Monitoring and Reputation: The Choice between Bank Loans and Privately Placed Debt." *Journal of Political Economy* 99(4): 688–721.

Diewert, W. E. (1974). "Intertemporal Consumer Theory and the Demand for Durables." *Econometrica* 42(3): 497–516.

Diewert, W. Erwin (1976). "Exact and Superlative Index Numbers." *Journal of*

Econometrics 4(2): 115-45.

Diewert, W. Erwin (2010). "The Measurement of Banking Services in the System of National Accounts." *mimeo.*

Duffie J.D. (1999). "Credit Swap Valuation." *Financial Analysts Journal* 1: 73–85.

Fixler, D. J. and B. R. Moulton (2001). "Comments on the Treatment of Holding Gains and Losses in the National Accounts." paper for the OECD Meeting of National Accounts Experts, downloadable at http://www.oecd.org/dataoecd/57/56/1909872.pdf.

Fixler, D. J. and M. Reinsdorf (2006). "Computing Real Bank Services." paper presented at the NBER/CRIW Summer Institute 2006, downloadable at http://www.nber.org/~confer/2006/si2006/prcr/reinsdorf.pdf.

Fixler, D. J. and K. Zieschang (2010). "Deconstructing FISIM: Should Financial Risk Affect GDP?" paper presented at IARIW 2010, downloadable at http://www.iariw.org/papers/2010/4aFixler.pdf.

Greenbaum, S. I. and A. Thakor (1995). *Contemporary Banking Theories*. Dryden Press, Fort Worth.

Hunter, William C., Stephen G. Timme, and Won Keun Yang (1990). "An Examination of Cost Subadditivity and Multiproduct Production in Large U.S. Banks." *Journal of Money, Credit, and Banking* 22 (4): 504–525.

Jagtiani, Julapa, Alli Nathan, and Gordon Sick (1995). "Scale Economies and Cost Complementarities in Commercial Banks: On-and Off-balance-sheet Activities." *Journal of Banking & Finance* (19): 1175–89.

James, Christopher (1988). "The Use of Loan Sales and Standby Letters of Credit by Commercial Banks." *Journal of Monetary Economics* (22): 395–422.

Leland, H. E. and D. H. Pyle (1977). "Informational Asymmetries, Financial Structure, and Financial Intermediation." *Journal of Finance* 32(2): 371–87.

Merton, Robert C. (1974). "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates." *Journal of Finance* 29: 449–470.

Mester, Loretta J. (1992). "Traditional and Nontraditional Banking: An Information-Theoretic Approach." *Journal of Banking & Finance* 16: 545–66.

Morrison, Alan, (2005). "Credit Derivatives, Disintermediation and Investment Decisions." *Journal of Business* 78: 621–647.

Ors, Evren (2004). "Postmortem on the Federal Reserve's Functional Cost Analysis Program: How Useful Was the FCA?" *Review of Financial Economics* 13: 121–48.

Rogers, Kevin E. (1998). "Nontraditional Activities and the Efficiency of U.S. Commercial Banks." *Journal of Banking & Finance* 22: 467–82.

Sealey, Calvin W. and James T. Lindley (1977). "Inputs, Outputs, and a Theory of

Production and Cost at Depository Financial Institutions." *Journal of Finance* 32 (2): 1251–66.

Stiroh, Kevin J. (2000). "How Did Bank Holding Companies Prosper in the 1990s?" *Journal of Banking & Finance* 24: 1703–45.

Tobin, James (1956). "The Interest Elasticity of Transactions Demand for Cash. *Review of Economics and Statistics* 38: 241–247.

Triplett, Jack E. and Barry P. Bosworth (2004). *Productivity in the U.S. Services Sector; New Sources of Economic Growth*, Brookings Institution: Washington, DC.

Wang, J. Christina (2003). "Loanable Funds, Risk, and Bank Service Output." Federal Reserve Bank of Boston, Working Paper Series, no. 03-4.
Website: http://www.bos.frb.org/economic/wp/wp2003/wp034.htm

Wang, J. Christina and Susanto Basu (2006). "Risk Bearing, Implicit Financial Services, and Specialization in the Financial Industry." Federal Reserve Bank of Boston Public Policy Discussion Papers, no. 06-3, website:
http://www.bos.frb.org/economic/ppdp/2006/ppdp063.htm

Wang, J. Christina, Susanto Basu and John Fernald (2009). "A General-Equilibrium Asset-Pricing Approach to the Measurement of Nominal and Real Bank Output." in *Price Index Concepts and Measurement*, NBER Studies in Income and Wealth 70: 273–328, ed. W. E. Diewert, J. S. Greenlees, and C. R. Hulten, Chicago University Press.

Table 1. Average annual growth of U.S. commercial bank output of commercial & industrial lending services (%), 1997:Q2–2009:Q3

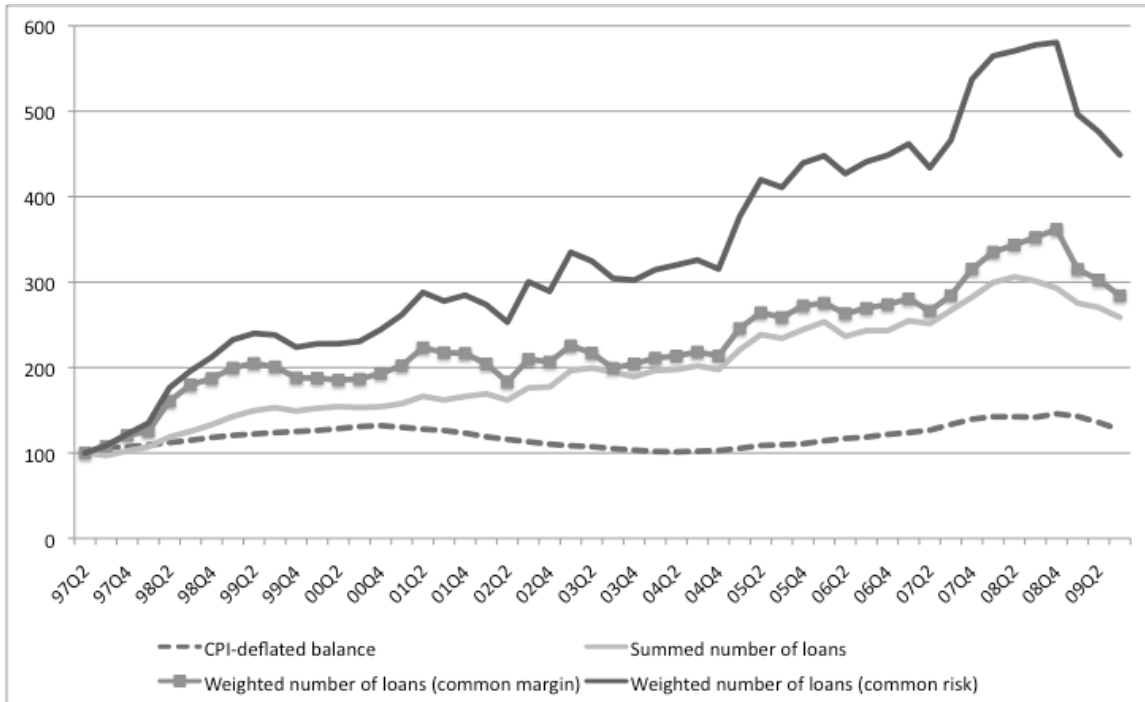|	
CPI-deflated balance	2.0
Summed number of loans	7.8
Weighted number of loans (common margin)	8.6
Weighted number of loans (common risk)	12.4

Notes: "Summed number of loans" means a simple unweighted sum of all C&I loans. "common margin" and "common risk" both refer to the assumption used to impute the implicit service revenue that serves as the aggregation weights: "common margin" assumes that loans of different risk ratings involve the same service margin in their interest rates, while "common risk" assumes that the three risky categories have the same risk-based interest rate spread. See Section 3.2.1 for details.

Table 2. Average annual growth of U.S. commercial bank output of residential mortgage lending services, 1991–2009

	1991–2009	1991–1996	1997–2009
CPI-deflated balance	6.5	6.7	5.1
Loan count	5.2	7.0	3.0
House price-deflated balance (FHFA index)	5.4	6.9	3.3

Notes: the house price index used is the equal-weighted index published by the FHFA.

Figure 1. Output indices for U.S. commercial & industrial lending services: deflated balances vs. loan counts, 1997:Q2–2009:Q3 (1997:Q2=100)

Notes: "Summed number of loans" means a simple unweighted sum of all C&I loans. "common margin" and "common risk" both refer to the assumption used to impute the implicit service revenue that serves as the aggregation weights: "common margin" assumes that loans of different risk ratings involve the same service margin in their interest rates, while "common risk" assumes that the three risky categories have the same risk-based interest rate spread. See Section 3.2.1 for details.

Figure 2. Output indices for U.S. residential mortgage services: loan counts, CPI-deflated balances, and house price-deflated balances, 1991:Q1–2009:Q4 (1991:Q1=100)
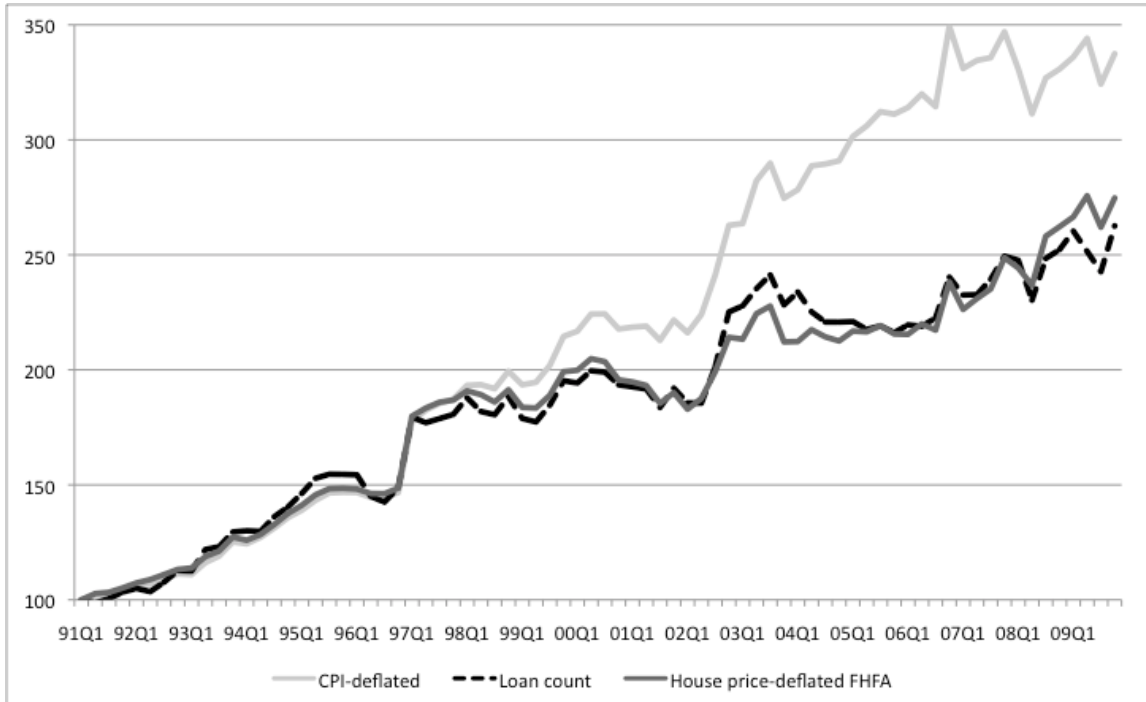

Notes: The house price index used is the equal-weighted index published by the FHFA.

Figure 3. Average annual output growth of residential mortgage services in Europe and the United States: CPI-deflated vs. house price-deflated balances, 1995–2009
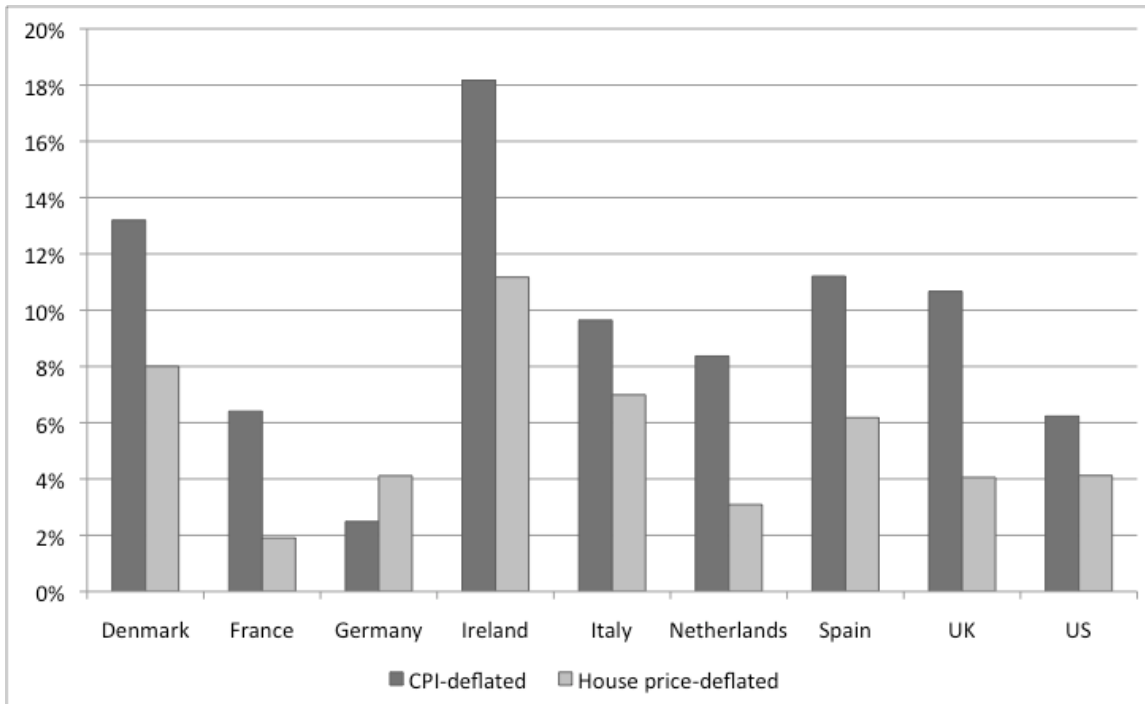

Figure 4. Output indices for U.S. deposit services: deflated balances vs. alternative transaction counts, 1997–2008 (1997=100)
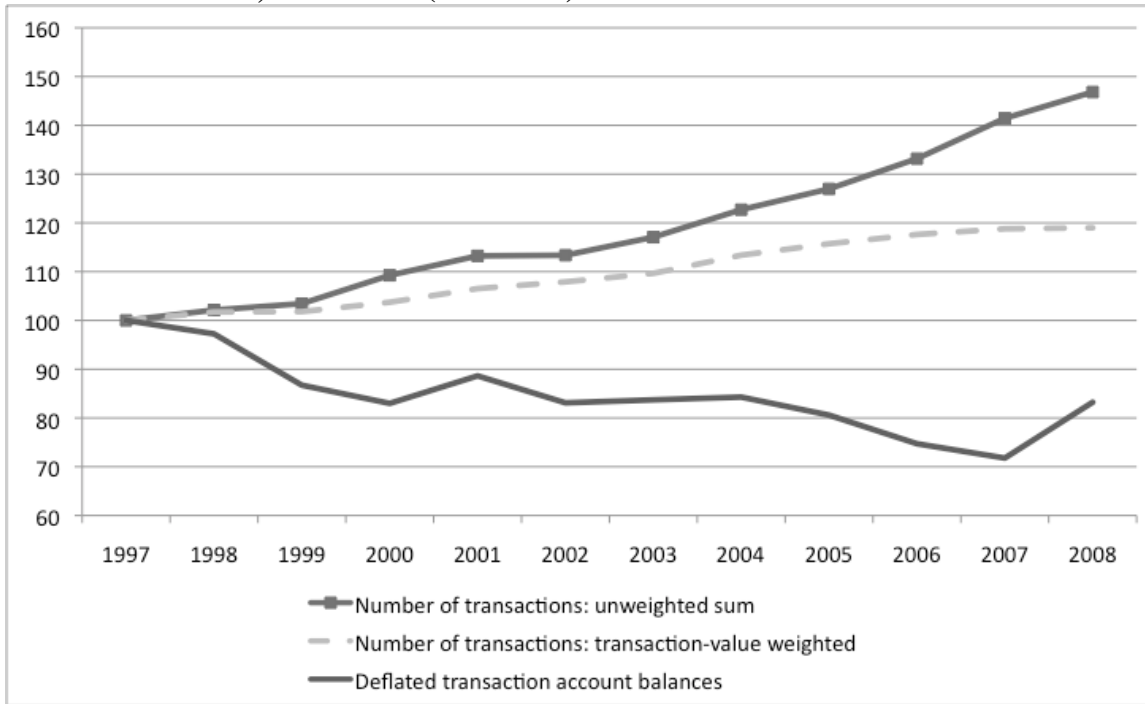
Figure 5. Average annual output growth of transaction services in Europe and the United States: CPI-deflated vs. transaction counts, 2000–2008
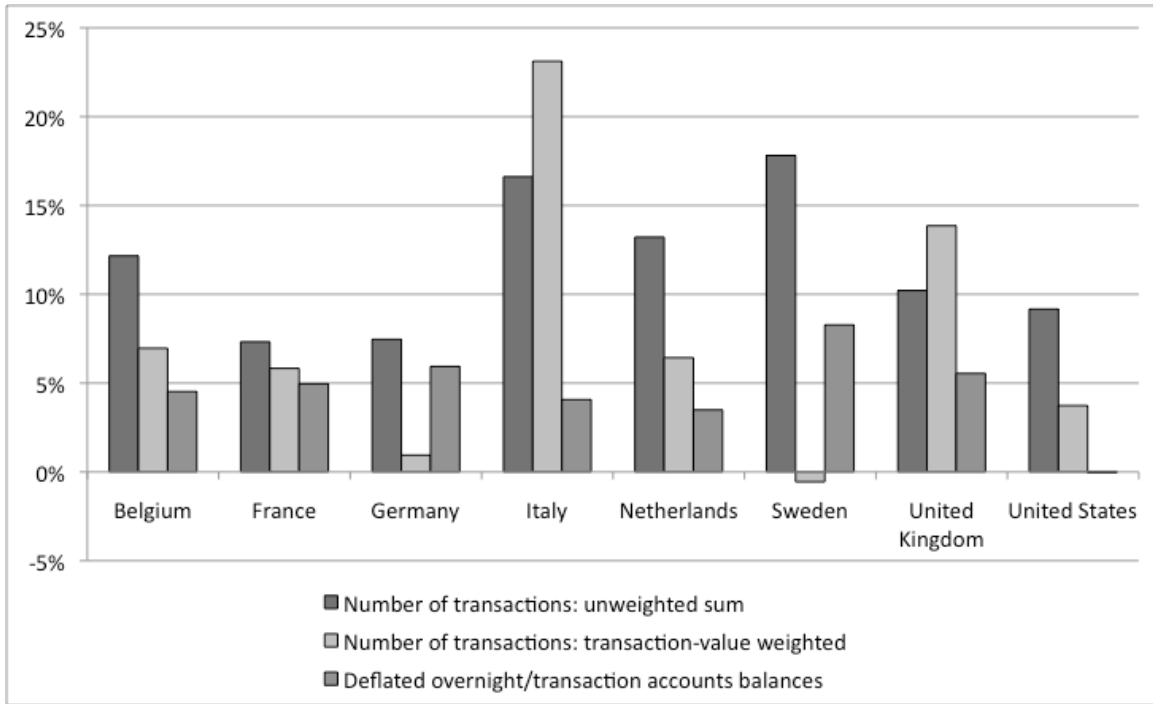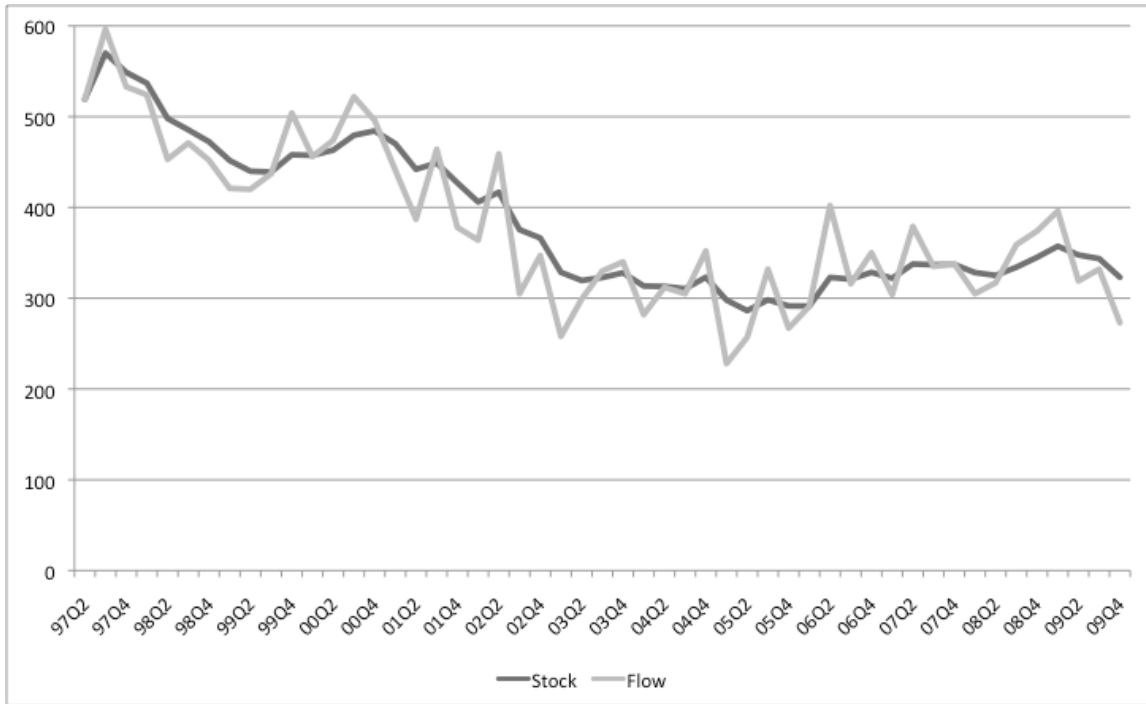
Appendix Figure A1. Average interest margin on U.S. commercial and industrial loans across risk categories (%), 1997:Q2–2009:Q3
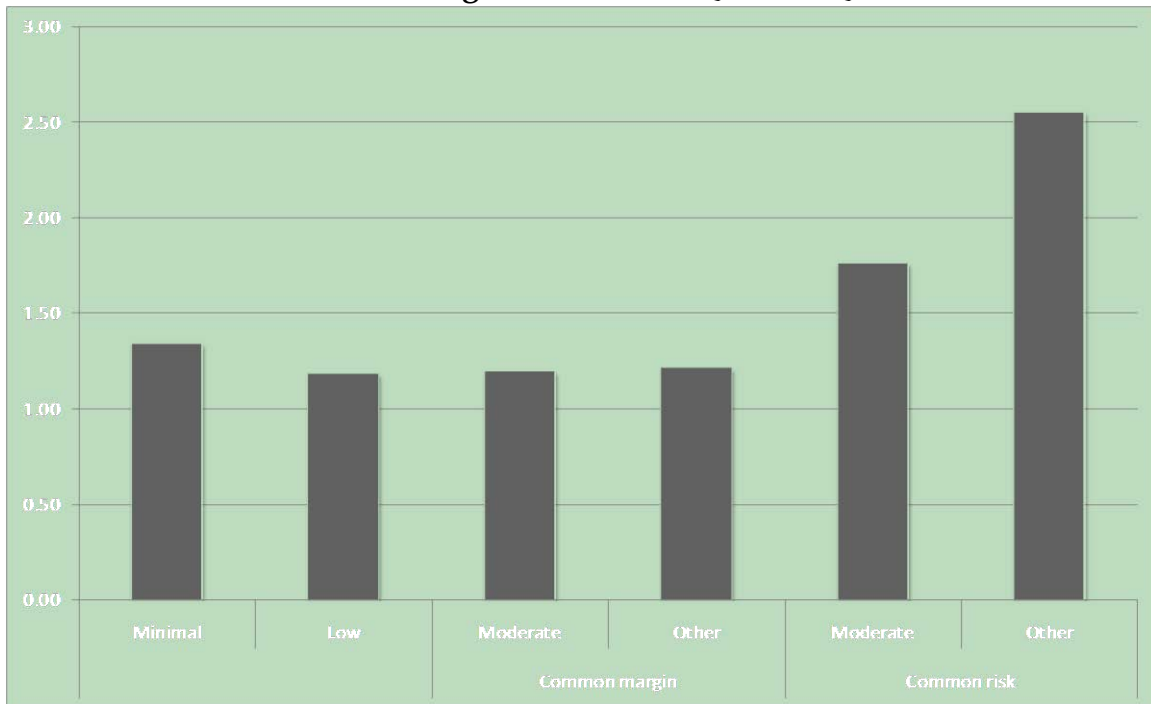
Notes: "inimal," "low," "moderate," and "other" refer to the risk categories. "Common margin" and "common risk" both refer to the assumption used to impute the implicit service revenue that serves as the aggregation weights: "Common margin" assumes that loans of different risk ratings involve the same service margin in their interest rates, while "Common risk" assumes that the three risky categories have the same risk-based interest rate spread. See Section 3.2.1 for details.

Appendix Figure A2. Average size of all U.S. commercial and industrial loans, flow vs. stock

Appendix Figure A3. Average annual growth rate of the number of U.S. commercial and industrial loans by type, 1997:Q2–2009:Q3

Notes: "Minimal," "low," "moderate" and "other" refer to the risk categories. "Zero interval," "Daily," etc. refer to the repricing frequency of the C&I loans.

Appendix Table A1. Data sources by bank activity and country

Source	Data	Period
Commercial & Industrial loans - U.S. only, Figure 1, Table 1		
Federal Reserve - Survey of Terms of Business Lending	Average loan size, interest rate, average time to maturity; by maturity and risk category	1997:Q2–2009:Q3
Federal Reserve - Commercial Paper	Commercial paper yields	1997:Q2–2009:Q3
FDIC - Report of Condition and Income (Call reports)	Commercial & Industrial loans in domestic offices	1997:Q2–2009:Q3
Residential mortgages, Figures 2 and 3, Table 2		
<u>United States</u>		
FDIC - Report of Condition and Income (Call reports)	Closed-end loans secured by first liens on 1–4 family residential properties in domestic offices	1991:Q1–2009:Q4
FHFA - Monthly Survey of Rates and Terms on Conventional Single-Family Non-farm Mortgage Loans	Historical summary tables on average mortgage size, all homes, all mortgages	1991:Q1–2009:Q4
FHFA - House Price Index	FHFA USA Indexes, seasonally-adjusted purchase-only index (1991:Q1=100)	1991:Q1–2009:Q4
<u>Denmark</u>		
Danmarks Nationalbank - Balance Sheets and Flows of the MFI Sector	Bank lending to domestic households by purpose and maturity, Households - Housing, extrapolated before July 2000 using total Household loans	1995–2009
Statistics Denmark	Price index for sales of property (2006=100) by time and category of real property; transaction-weighted index of one-family houses, weekend cottages and owner-occupied flats	1995–2009
<u>France</u>		
Banque de France - Monthly Monetary Statistics	Lending by credit institutions to households (stocks) - Housing (MH.M.EC.CREDIT.3.R.1D.HF.T.M.E.B.X)	1995–2009
Insée	Price index of existing houses	1996–2009

BIS	BIS Real House Price data, downloaded at http://www.finfacts.ie/biz10/BISHOUSE_PRICE_DATA.xls; re-inflated using the CPI	1995–2006

Germany

European Central Bank - Balance Sheet Items (BSI) database	Lending for house purchase (BSI.M.DE.N.A.A22.A.1.U2.2250.Z01.E)	2003–2009
Bundesbank - Statistical Supplement Banking Statistics	Mortgage loans to domestic enterprises and resident individuals / Total / All categories of banks (PQ3013) (used for extrapolation of 'Lending for house purchase' series, assuming constant individual mortgage share)	1995–2009
OECD - Banking Statistics	Loans (used to bridge time series break in 1998 due to the removal of Trauhandkredite)	1995–2007
Hypoport	House price index, hedonic, composite of apartments, new homes and existing homes	1995–2009
DeStatis	House price index of new homes and of existing homes (unweighted average of price change)	2000–2008
BIS	BIS Real House Price data, downloaded at http://www.finfacts.ie/biz10/BISHOUSE_PRICE_DATA.xls; re-inflated using the CPI	1995–2006

Italy

Banca d'Italia - Supplements to the Statistical Bulletin	Bank loans for house purchases, sum of <1Y, 1< <5, >5Y maturity	1998–2009
OECD - Banking Statistics	Loans (used for extrapolation of 'Bank loans for house purchases' series, assuming constant mortgage share in total loans)	1995–2007
Muzzicato, Sabbatini and Zollino	"Prices of residential property in Italy: Constructing a new indicator" Banca d'Italia Occasional papers, no. 17; August 2008	1995–2007
Global Property Guide	Price index from Banca d'Italia and Statistics Italy, data at http://www.globalpropertyguide.com/Europe/Italy/Price-History	2008–2009

Ireland

European Central Bank - Balance Sheet Items (BSI) database	Lending for house purchase (BSI.M.IE.N.A.A22.A.1.U2.2250.Z01.E)	2003–2009
OECD - Banking Statistics	Loans (used for extrapolation of 'Lending for house purchase' series, assuming constant mortgage share in total loans)	1995–2007
ESRI - Permanent tsb/ESRI House Price Index	National index	1996–2009
BIS	BIS Real House Price data, downloaded at http://www.finfacts.ie/biz10/BISHOUSE_PRICE_DATA.xls; re-inflated using the CPI	1995–2006

Netherlands

De Nederlandsche Bank - Domestic MFI Statistics (Monetary)	MFI Lending for house purchases, sum of <1Y, 1< <5, >5Y maturity	1995–2009
CBS/Kadasters (Statistics Netherlands/Property Register)	Sales price index, existing homes	1995–2009

Spain

European Central Bank - Balance Sheet Items (BSI) database	Lending for house purchase (BSI.M.ES.N.A.A22.A.1.U2.2250.Z01.E)	2003–2009
OECD - Banking Statistics	Loans (used for extrapolation of 'Lending for house purchase' series, assuming constant mortgage share in total loans)	1995–2007
Ministerio de Vivienda	House price per m2	1995–2009

United Kingdom

Bank of England	Quarterly amounts outstanding of UK resident banks' (inc. Central Bank) sterling net secured lending to individuals and housing associations (in sterling millions) seasonally adjusted (LPQVTXI)	1995–2009
Nationwide	House price, all houses	1995–2009

Deposit transactions, Figures 4 and 5
All countries

BIS Red Book, editions 2004 through 2008	Credit transfers, Direct debits, Card payments, E-money, Cheques and Other transactions, number and value of transactions	2000–2008 (1997–2008 for U.S.)
United States FDIC - Report of Condition and Income (Call reports)	Transaction accounts	1997–2008
European countries European Central Bank - Balance Sheet Items (BSI) database	Overnight deposits (BSI.M.??.N.A.L21.A.1.U2.2300.Z01.E, where '??' refers to the 2-letter country code)	2000–2008
Statistics Sweden	Total deposits (used to extrapolate for 2000 and 2001 data for Sweden missing from ECB - BSI)	