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

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We argue that models of banks as processors of information and transactions imply a quantity measure of bank output based on transaction counts instead of balances of loans and deposits. Compiling new and comparable real output measures for the USA and a range of European countries, we show that counts-based output series exhibit substantially different growth patterns than balances-based output series. Since the US official statistics rely on counts while European statistics rely on balances, this implies that comparisons of bank output growth between Europe and the USA are biased.

## INTRODUCTION

The measurement of bank output has long been a difficult and sometimes contentious topic that has yet to see a consensus resolution.<sup>1</sup> Achieving the right output measure for bank services has become even more important in the aftermath of the recent 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 that they provide.

This paper focuses on the methodological question of how to measure the quantity (or real value) of these services. Starting from the premise that banks primarily provide information services to borrowers (such as screening and monitoring) and transaction services to depositors, we construct model-based output measures for banking services and compare these to alternative measures commonly used by statistical agencies. The underlying banking model is built on theories of financial intermediation and asset pricing, and its central message is that bank output should be measured in terms of indices of quality-adjusted<sup>2</sup> counts of different categories of banking transactions.<sup>3</sup> 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 output measures derived from activity counts with measures based on outstanding balances of loans and deposits deflated by a general price index. This latter approach in effect assumes that every (real) euro or dollar corresponds to a constant flow of financial intermediation services over time. However, assuming such fixed proportionality between outstanding balances and service flows requires restrictive assumptions.<sup>4</sup> In contrast, counting activities should in theory yield an appropriate output measure.<sup>5</sup> In practice, adequate quality adjustment is difficult because of the lack of relevant data. Nevertheless, we argue that our activity-count-based measures with imperfect quality adjustment using available data still constitute a conceptual improvement over deflated balances.

The main finding of this paper is that bank output series based on activity counts differ noticeably from output series based on deflated balances.<sup>6</sup> In the case of US

commercial and industrial (C&I) loans, the average loan size (in both nominal and real dollars) has trended down over time, so the deflated-balances approach underestimates the true output growth of C&I lending services. In contrast, house prices in the USA and most European countries had risen faster than the overall consumer price index (CPI) until a few years ago, leading to an increase in the average size of residential mortgages. As a result, the CPI-deflated balances overestimate true growth of mortgage lending services.

We then show that in the case of collateralized lending such as mortgages, activity counts may be well approximated by deflating loan balances with the price of the underlying asset. The output index using *house-price*-deflated mortgage balances indeed matches closely the index using the number of mortgage loans. As for the output of depositor services, the series based on the number of deposit transactions has grown at substantially different rates than that based on deposit balances.

Our findings have important implications for cross-country growth comparisons. In the USA, official statistics have so far been based on the activity-count approach, while European statistics rely almost entirely on the deflated-balance approach.<sup>7</sup> Regardless of one's stance on the conceptual appeal of these approaches, the finding that they imply considerably different growth patterns is worrisome. We argue that the US approach is preferable conceptually, and this implies a bias in the official estimates of European bank output growth. The direction and size of the overall bias, however, is unclear since biases in both directions are found in the activities covered in this paper. To estimate the overall bias will require the collection of transaction count data on a broader array of bank activities.

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), this would call for revisiting estimates of the US 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.<sup>8</sup> 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 I we summarize the theory underlying our empirical estimates and compare it with other commonly used methods. Section II describes the methodological choices made in mapping the theory to the available data. Section III presents the results, and Section IV concludes.

## I. 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.<sup>9</sup>

The theory behind our measurement is developed in Wang (2003) and Wang *et al.* (2009).<sup>10</sup> In these models, the core function of banks is to screen and monitor borrowers in order to reduce information asymmetry in lending, and to provide payment services to depositors and borrowers. Modelling banks' *raison d'être* as mitigating information

asymmetry and transaction costs follows the tradition of an extensive literature on the fundamental role of financial intermediation.<sup>11</sup> In principle, our method yields a consistent measure of bank services both when supplied in the traditional way—services charged for implicitly via margins between loan and deposit interest rates—and when the services are charged through explicit fees, as in the securitization process. This is because the economic functions served by banks, such as resolving information asymmetry, remain invariant even though the agents performing those functions will be organized differently over time as technology evolves. By focusing on the flow of services that fulfil these fundamental banking functions, our method in principle offers a consistent measure of bank output over time even as the process of intermediation evolves, such as from balance-sheet lending to originate-and-securitize.<sup>12</sup>

One key implication of our preferred 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.<sup>13</sup> 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 Wang *et al.* (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 as proxies for the flow of services, since there is little 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.

Our measure of output is the same in practice as the transactions approach used so far in the US National Accounts.<sup>14</sup> We strengthen the theoretical foundation of this approach by formalizing its link to theories of financial intermediation, according to which the varieties of bank output should be identified and defined. For example, all else being equal (that is, the same loan principal, maturity, etc.), originating C&I loans to borrowers of different risk ratings likely constitutes different types of lending services since riskier borrowers require more intensive analysis. By comparison, other conceptions of bank output tend to be tied closely with the traditional mode of banking and measure output using the (real) balances of assets (or liabilities as well) held on bank balance sheets. For example, Sealey and Lindley (1977) model banks as producing loans and other earning assets using deposits and other inputs, and thus output is measured as the balance of earning assets. Likewise, the user-cost approach, pioneered by Donovan (1978) and Barnett (1978) and developed further by Hancock (1985) in the context of banks, also uses the real balances of assets or deposits, or both, as the measure of bank output.<sup>15</sup> An asset (liability) is defined to be an output if its rate of return is higher (lower) than the reference interest rate. So a given category of asset or liability can switch between output and input over time as the reference rate fluctuates.<sup>16</sup>

To see the intuition of the distinction between the activity-counts and deflated-balances methods, consider the analogy to estimating the service output of a car dealer-

ship. Is it more sensible to count the number of each type (e.g. make) of cars *sold* in a period (and aggregate using sales commissions by type 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.<sup>17</sup> But this is no more than the usual empirical difficulties 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.<sup>18</sup> One should at least deflate the dollar value of cars *sold* during the period with a composite price index for cars based on the mix of models 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.<sup>19</sup> Furthermore, this method 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 broadly analogous to counting the number of cars sold,<sup>20</sup> while using deflated loan and deposit balances is analogous to using the deflated dollar amount of the car 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 distinct objectives of the tasks performed.<sup>21</sup> 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 distinct types of services as possible. For instance, within C&I loans made by US banks, we further distinguish across loans of different risk ratings and with different repricing periods. Even though we are unable to make distinctions across different types of banks services as finely as would be suggested by theories of financial intermediation, this problem is no less relevant for measures based on deflated balances.

## II. DATA AND 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 A1 in the Appendix lists the data sources by type of banking service and, where available, by country.

### *Commercial and industrial loans*

We derive activity counts of C&I 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 USA; 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 newly originated by credit risk rating, and repricing (that is, interest rate reset) frequency.<sup>22</sup> This enables us to infer the number of C&I loans originated by risk rating and repricing period, probably the most relevant attributes for the quantity of screening services performed. Growth of overall bank C&I lending services can be calculated as the weighted average growth in different rating-repricing classes. That is,

$$(1) \quad \Delta \ln L_t = \sum_i \bar{w}_{it} \Delta \ln L_{it}, \quad \text{where } \bar{w}_{it} = 0.5(w_{it} + w_{i,t-1}) \text{ and } w_i = V_i / \sum_i V_i.$$

Here  $\Delta \ln L_t$  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-repricing class  $i$ .  $\bar{w}_{it}$  is the average share of type- $i$  loans in total implicit revenue from C&I services. Implicit revenue from type- $i$  loans,  $V_{it}$ , can be imputed as follows:

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

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

The loan interest rate  $r_{it}$  is reported in the STBL while the reference rate  $r_{it}^M$  is chosen to be the yield on non-financial commercial paper (CP) or corporate bonds of comparable risk rating and repricing frequency.<sup>23</sup> In terms of repricing frequency, the majority of C&I loans are repriced in less than a year, so we match them to the non-financial CP with the nearest maturity.<sup>24</sup> For the best match in terms of credit risk, we follow the STBL instructions, which classify loans as 'minimal' risk for borrowers with an AA or higher rating on their public debt, and as 'low' risk for borrowers with a BBB or higher rating. We therefore use the yields on AA-rated and A2/P2-rated non-financial CP as the reference rates for minimal-risk and low-risk loans, respectively. For the C&I loans with maturities above one year, we use the yields on corporate bond indexes with the closest rating classes as compiled by Merrill-Lynch.<sup>25</sup>

For the risk classes 'moderate' and 'other', there are no market securities as clearly comparable, so we experiment with two polar assumptions about their  $r_{it}^M$  that in turn correspond to polar estimates of the implicit revenue on these two types of lending services. First, we use the same  $r_{it}^M$  for moderate- and other-risk loans as for low-risk loans; this amounts to assuming that all the extra interest margins earned on moderate- and other-risk loans are extra implicit revenue for services. In the second case, we make the opposite assumption that service margins (that is,  $r_{it} - r_{it}^M$ ) are the same on these three categories of loans, so the respective  $r_{it}^M$  for moderate- and other-risk loans are raised correspondingly, to represent their greater risk. The true implicit service revenue associated with moderate- and other-risk C&I loans is almost surely somewhere in between these two polar alternatives, which thus provide plausible bounds.<sup>26</sup> For reference, Figure A1 in the Appendix reports the respective estimates of  $r_{it} - r_{it}^M$  for each loan category under the relevant assumption.<sup>27</sup>

An index of the weighted number of loans originated would be the preferred measure of banks' output of screening services, with the implicit revenue imputed above for new loans as the weights. By the same token, an index of the weighted number of loans outstanding would be the output measure for monitoring services, assuming that banks monitor every loan in the portfolio. Implicit revenue earned on monitoring serves as the weights. To estimate the output of screening and monitoring services separately would thus require dividing the implicit revenue between new and outstanding loans. Since data allow us to estimate only the overall C&I-based implicit revenue, we choose to account for C&I lending services using the number of loans outstanding in each period. This sum includes new loans originated in that quarter plus loans originated in previous quarters but remaining on bank balance sheets. So our choice can be viewed as in effect assuming that newly originated loans are screened while outstanding loans are monitored, and that screening and monitoring a given type of C&I loan involves an equal amount of services.<sup>28</sup>

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:

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

$L$  again denotes the number of type- $i$  C&I loans, while  $A$  denotes the corresponding dollar volume; superscript  $N$  denotes new origination.  $\delta_{i\tau}$  is the constant rate of amortization for loans originated in quarter  $\tau$ , determined by their maturity. Specifically, we estimate a geometric amortization rate  $\delta_{i\tau}$  as follows:

$$(4) \quad \delta_{i\tau} = \alpha / T_{i\tau}.$$

$\alpha$  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  $\tau$ , which we assume equal to the average maturity.<sup>29</sup>

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 US 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 ( $L_{it}^{\text{Call}}$ ) using the ratio between STBL-based total loan balances  $\sum_i A_{it}$  and Call-Reports-based loan balances ( $A_t^{\text{Call}}$ ):

$$(5) \quad L_{it}^{\text{Call}} = L_{it} \times (A_t^{\text{Call}} / \sum_i A_{it}).$$

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.

### *Real estate loans*

Activity counts, such as the number of C&I loan originations in the STBL, accord best 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 imperfect indicators, to

the extent that a given type of loan or depositor transaction does not represent 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 and many goods. Moreover, this is likely less restrictive than assuming that a given amount of consumer purchasing power on a bank's book represents a constant flow of bank services over time, which underpins output measures that use CPI-deflated loan or deposit balances.

But asset balances are often more readily observed, so it is useful to examine under what conditions 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

$$(6) \quad n_t + p_t = b_t - v_t.$$

$n_t$  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 USA, 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.

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 an 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 asset balance to use should be 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 can serve as a proxy if such balances are the only available data.

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

$$(7) \quad n_t = b_t - p_t.$$

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 a general price index. In the empirical section below, we estimate the output of residential mortgage origination based on (7). Table A1 in the Appendix provides

detailed information on the sources that we used to get data on mortgage balances and house prices.

### *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 USA along with all the European countries—Belgium, France, Germany, Italy, the Netherlands, Sweden and the UK—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, cheques, and other transactions. For the comparison of activity counts with deflated balances, we have data on balances of transaction accounts in the USA and overnight deposit accounts in Europe. Table A1 in the Appendix includes further details of the data sources.

The preferred approach to aggregating over these different types of transactions would be similar to obtaining the output of all C&I lending services, namely to weight the growth rate in the number of each type of transaction with its share in implicit plus explicit revenue. The implicit revenue would be imputed in a way similar to that above, based on interest margins between matched reference rates and deposit rates. However, it is not feasible to allocate the implicit revenue to individual types of transactions since account holders typically have access to and utilize several or all of these transaction services.

So we adopt the empirical strategy of constructing the aggregate index of depositor transactions under two different assumptions for the revenue weights. We show the difference between these estimates in the next section. First, we weight every type of transaction equally, which amounts to assuming that customers are willing to pay the same (implicit) fee for each. This is the weighting scheme used by the US Bureau of Labor Statistics for its index of aggregate bank output. Write  $D_{it}$  for the number of type- $i$  transactions in year  $t$ . Then the growth rate ( $\Delta \ln$ ) of the aggregate index is calculated as follows:

$$(8) \quad \Delta \ln D_t^1 = \Delta \ln \sum_i D_{it}.$$

As an alternative, we assume that customers' willingness to pay for the services embedded in each transaction is proportional to the amount transacted. Under this assumption, we would weight the growth rate of the number of each type of transaction by its share in total transaction value.<sup>30</sup> Write  $T_{it}$  for the value of type- $i$  transactions in year  $t$ . Then the growth rate of this alternative aggregate transaction index is calculated as follows:

$$(9) \quad \Delta \ln D_t^2 = \sum_i \bar{v}_{it} \Delta \ln D_{it}, \quad \text{where } \bar{v}_{it} = 0.5(v_{it} + v_{i,t-1}) \text{ and } v_{it} = T_{it} / \sum_i T_{it}.$$

In the next section, we compare  $\Delta \ln D_t^1$  and  $\Delta \ln D_t^2$  to the growth of CPI-deflated deposit account balances.

## III. 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 and industrial loans, real estate loans, and deposit transactions in turn.

*Commercial and industrial loans*

Figure 1 plots different estimates of the output index for C&I lending services. The line labelled ‘CPI-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 category (that is,  $L_{it}^{\text{Call}}$ ), as described in equation (5). The indices are all derived according to formula (1), but with different aggregation weights  $w_{it}$ . The ‘Summed number of loans’ 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 category  $i = 1, \dots, N$ . 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  $r_{it}^M$  for loans in the moderate- and other-risk categories, leading to different  $w_{it}$ . The ‘Weighted number of loans (common risk)’ line assumes that they have the same risk and hence  $r_{it}^M$ , while the ‘Weighted number of loans (common margin)’ line assumes that they have the same service margin (that is,  $r_{it} - r_{it}^M$ ) as low-risk C&I loans.

One clear pattern emerging from Figure 1 is that the CPI-deflated balance series exhibits by far the lowest growth rate throughout the sample period, averaging 2.0% per

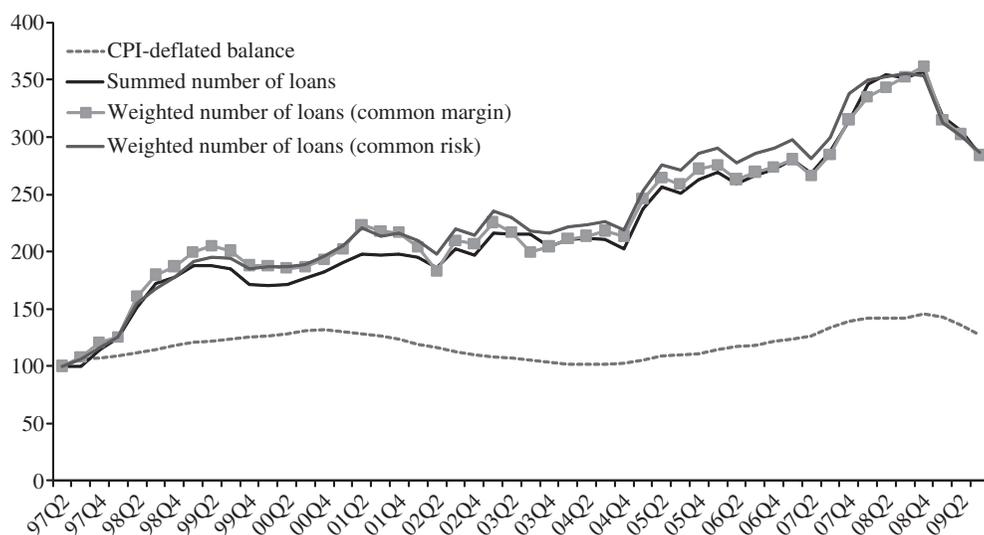


FIGURE 1. Output indices for US commercial and industrial lending services: deflated balances vs loan counts, 1997Q2–2009Q3 (1997Q2 = 100). *Notes:* ‘Summed number of loans’ means an unweighted sum of all C&I loans. The terms ‘common margin’ and ‘common risk’ both refer to the assumption used to impute 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 subsection ‘Commercial and industrial loans’ in Section II for details.

year; see also Table 1. The faster growth of count- versus balance-based indices is caused by the steady decline in the average size of C&I loans by over 40% between 1997 and 2009 (see Figure A2 in the Appendix). The two ‘weighted number’ series are similar to the simple summed number of loans, with all three series showing average annual growth of 8.6–8.7%. Even though the different risk and repricing categories of C&I loan numbers exhibit different output growth trends, the variation in their growth rates and implicit revenue weights (based on the interest margins) is not sufficiently pronounced to influence the aggregate growth pattern. Other sources of heterogeneity that cannot be accounted for with the existing data notwithstanding, the results in Figure 1 suggest that accounting for changes in the composition of C&I loans is of second-order importance compared with the distinction between output indexes based on deflated balances and those based on the number of loans.

TABLE 1  
AVERAGE ANNUAL GROWTH OF US COMMERCIAL BANK OUTPUT OF COMMERCIAL AND INDUSTRIAL LENDING SERVICES (%), 1997Q2–2009Q3

CPI-deflated balance	2.0
Summed number of loans	8.6
Weighted number of loans (common margin)	8.6
Weighted number of loans (common risk)	8.7

*Notes*

‘Summed number of loans’ is an unweighted sum of all C&I loans. The terms ‘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 subsection ‘Commercial and industrial loans’ in Section II for details.

*Real estate loans*

Figure 2 plots three output series for US residential mortgages. We compare the series based on the number of mortgage loans processed (including both existing loans serviced and new loans originated) with two series based on deflated balances, one using the CPI and one using a house price index as the deflator. Based on the discussion in subsection ‘Real estate loans’ in Section II, we use the equal-weighted purchase-only house price index published by the Federal Housing Finance Agency (FHFA).<sup>31</sup> The number of loans is derived as total loan balance divided by the average loan size from the FHFA. The loan-count series and the house-price-index-deflated balance are highly correlated, and have a similar average growth rate of roughly 5% per year (see also Table 2).<sup>32</sup> 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 until mid-2007, especially since about 2000. This reflects the fact that house price appreciation far outstripped general inflation from the late 1990s to 2007. The growth correlation between the loan-count and the CPI-deflated series is also lower.

Given that the index of house-price-deflated balances tracks the loan-count index closely for the USA, we estimate the output of mortgage lending services for an international sample based on house-price-deflated balances. Figure 3 shows average annual growth rates from 1995 to 2009 for a panel of European countries for which we have obtained fairly consistent data on house prices and aggregate mortgage balances; Appendix Table

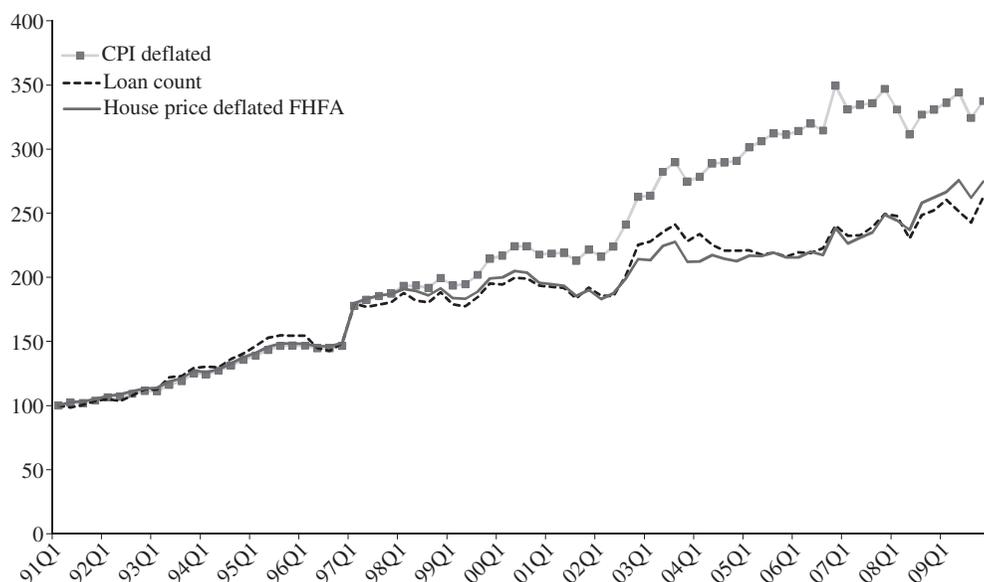


FIGURE 2. Output indices for US residential mortgage services: loan counts, CPI-deflated balances and house price-deflated balances, 1991Q1–2009Q4 (1991Q1 = 100).

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

TABLE 2  
AVERAGE ANNUAL GROWTH OF US 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.

A1 details these data. We again compare the house-price-deflated balance with the CPI-deflated balance. The most prominent finding emerging from these comparisons is that using house price indices to deflate loan balances lowers the estimates of growth in residential mortgage lending services in all countries except Germany.

This is the same as the pattern seen in the US 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 5–7 percentage points on average per year over the 15 years of our sample, much more rapid growth than that experienced in the USA. This means that using CPI-deflated loan balances would understate the growth of mortgage lending services by a considerable margin. The reverse can be seen in more recent years, as declining house prices in many countries since around 2007 cause CPI-deflated-balance series to overstate the growth of mortgage services.

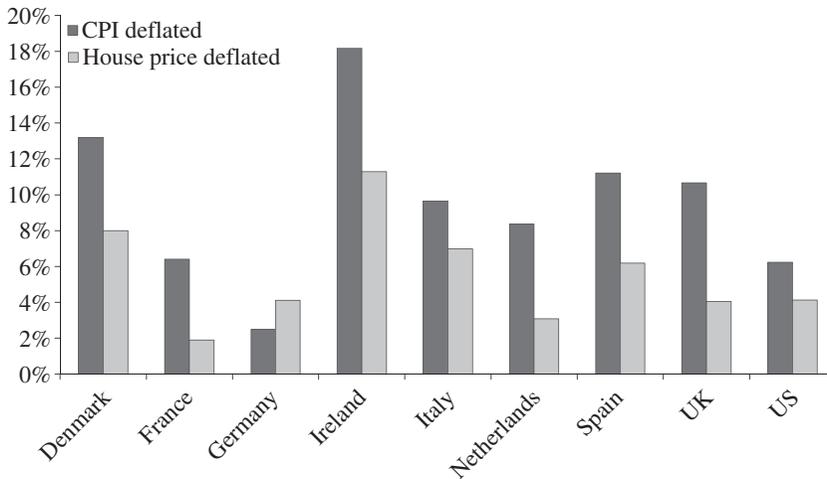


FIGURE 3. Average annual output growth of residential mortgage services in Europe and the USA: CPI-deflated vs house price-deflated balances, 1995–2009.

### *Deposit transactions*

Figure 4 depicts the composite output index of bank depositor services for the USA, estimated according to the three different approaches discussed in the previous subsection. 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 subsection, 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% 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% 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% 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 between 2000 and 2008. We use overnight accounts as the European counterpart to transaction accounts in the USA. (See Table A1 in the Appendix for details of the data.) The relationship among the three output indices is more varied across these countries. Two regularities are nonetheless worth noting. First, in five of the seven countries (i.e. all but Italy and the UK), the value-weighted sum of transaction counts grows on average more slowly than both the unweighted sum of transactions and the deflated account balance. Second, in four countries, the unweighted sum of transactions grows faster than the deflated balances. More importantly, note that the differences

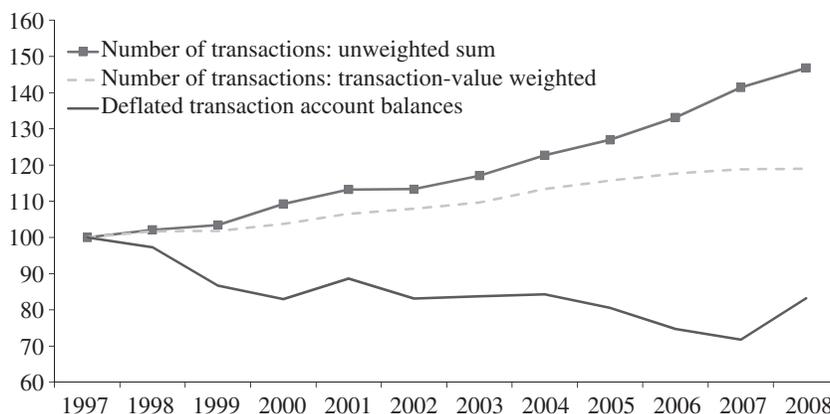


FIGURE 4. Output indices for US deposit services: deflated balances vs alternative transaction counts, 1997–2008 (1997 = 100).

between the counts-based and the deflated-balances series are substantial for all these countries.

#### IV. CONCLUSIONS

The activities of banks have attracted greater scrutiny in the aftermath of the recent financial crisis. The difficult question of how to measure bank output has thus taken on greater importance as well. Recent theoretical efforts (Wang 2003; Wang *et al.* 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, can in principle provide a consistent measure of bank output. In contrast, loan and deposit balances deflated by a general deflator, such as the CPI, are a valid proxy for the flow of services only under restrictive conditions, such as static technology for producing bank services.

To highlight how activity-count-based quantity indices of bank output differ from deflated-balance-based indices empirically, this study compares counts-based and deflated-balances-based output series for a variety of financial services and countries for recent years. These services include lending to businesses, lending to households for home purchases, and deposit account transactions. The 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, across 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 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

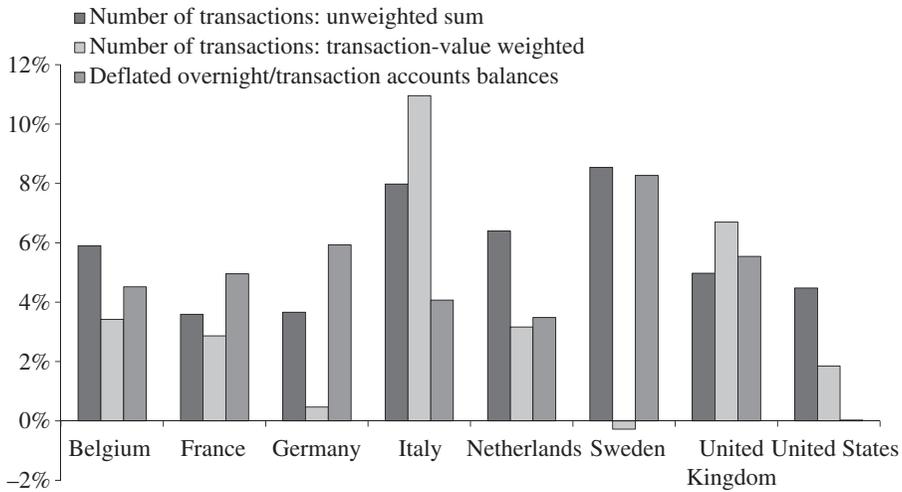


FIGURE 5. Average annual output growth of depositor transaction services in Europe and the USA: CPI-deflated vs transaction counts, 2000–8.

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 good proxies for some bank activities, but 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 US 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 sizeable and is likely to vary over time and across countries. We therefore recommend concerted efforts to harmonize the measurement of bank output across countries.

## APPENDIX

TABLE A1  
DATA SOURCES BY BANK ACTIVITY AND COUNTRY

Source	Data	Period
C&I loans—US 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	1997Q2–2009Q3
Federal Reserve—Commercial Paper	Commercial paper yields	1997Q2–2009Q3
FDIC—Report of Condition and Income (Call Reports)	C&I loans in domestic offices	1997Q2–2009Q3
Residential mortgages( Figures 2 and 3, Table 2)		
USA		
FDIC—Report of Condition and Income (Call Reports)	Closed-end loans secured by first liens on 1–4 family residential properties in domestic offices	1991Q1–2009Q4
FHFA—Monthly Survey of Rates and Terms	Historical summary tables on average mortgage size, all homes, all mortgages on Conventional Single-family Non-farm Mortgage Loans	1991Q1–2009Q4
FHFA—House Price Index	FHFA USA Indexes, seasonally-adjusted purchase-only index (1991Q1 = 100)	1991Q1–2009Q4
Denmark		
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
France		
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, <a href="http://www.finfacts.ie/biz10/BISHOUSE_PRICE_DATA.xls">www.finfacts.ie/biz10/BISHOUSE_PRICE_DATA.xls</a> ; 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)	2003–9

TABLE A1  
CONTINUED

Source	Data	Period
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)	2000–8
BIS	BIS Real House Price data, <a href="http://www.finfacts.ie/biz10/BISHOUSE_PRICE_DATA.xls">www.finfacts.ie/biz10/BISHOUSE_PRICE_DATA.xls</a> ; re-inflated using the CPI	1995–2006
Italy		
Banca d’Italia—Supplements to the Statistical Bulletin	Bank loans for house purchases, sum of under 1 year, 1–5 years, greater than 5 years 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 <i>et al.</i> (2008)	Prices of residential property in Italy: constructing a new indicator	1995–2007
Global Property Guide	Price index from Banca d’Italia and Statistics Italy, data at <a href="http://www.globalpropertyguide.com/Europe/Italy/Price-History">www.globalpropertyguide.com/Europe/Italy/Price-History</a>	2008–9
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)	2003–9
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, <a href="http://www.finfacts.ie/biz10/BISHOUSE_PRICE_DATA.xls">www.finfacts.ie/biz10/BISHOUSE_PRICE_DATA.xls</a> ; re-inflated using the CPI	1995–2006
Netherlands		

TABLE A1  
CONTINUED

Source	Data	Period
De Nederlandsche Bank— Domestic MFI Statistics (Monetary)	MFI Lending for house purchases, sum of under 1 year, 1–5 years, greater than 5 years 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)	2003–9
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 square metre	1995–2009
UK		
Bank of England	Quarterly amounts outstanding of UK resident banks’ (including 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 <i>Red Book</i> , editions 2004–8	Credit transfers, Direct debits, Card payments, E-money, Cheques and Other transactions, number and value of transactions	2000–8(1997– 2008 for USA)
USA		
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 two- letter ISO country code)	2000–8
Statistics Sweden	Total deposits (used to extrapolate for 2000 and 2001 data for Sweden missing from ECB—BSI)	

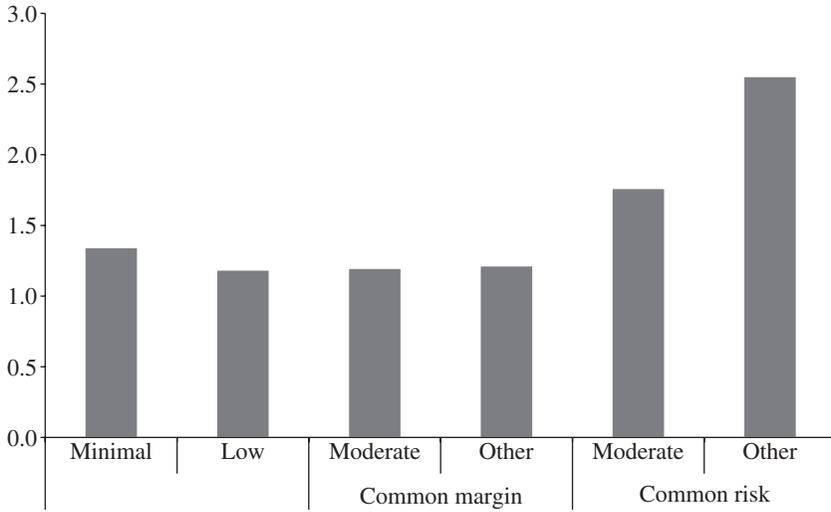


FIGURE A1. Average service interest margin on US commercial and industrial loans across risk categories (%), 1997Q2–2009Q3.

Notes: ‘Minimal’, ‘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 subsection ‘Commercial and industrial loans’ in Section II for details.

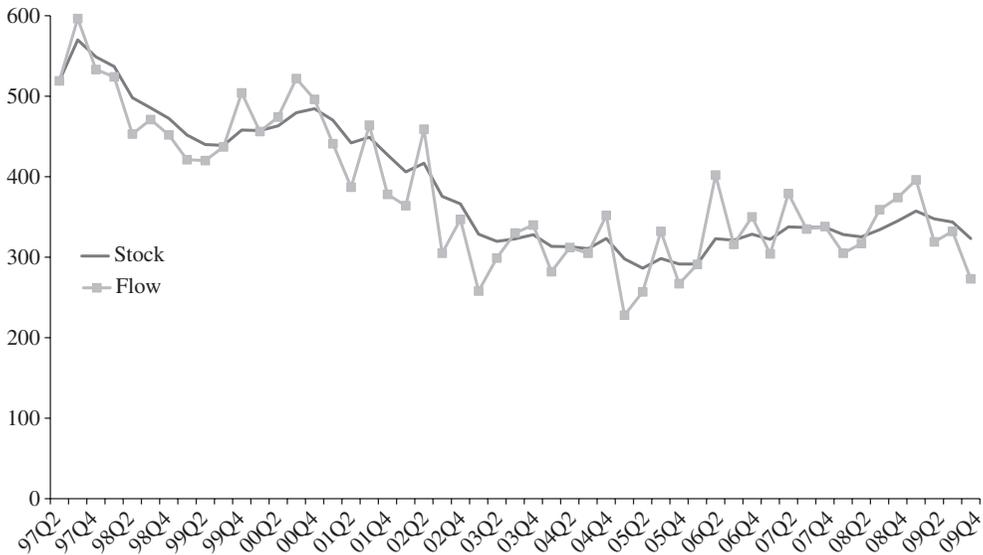


FIGURE A2. Average size of all US commercial and industrial loans, flow vs stock.

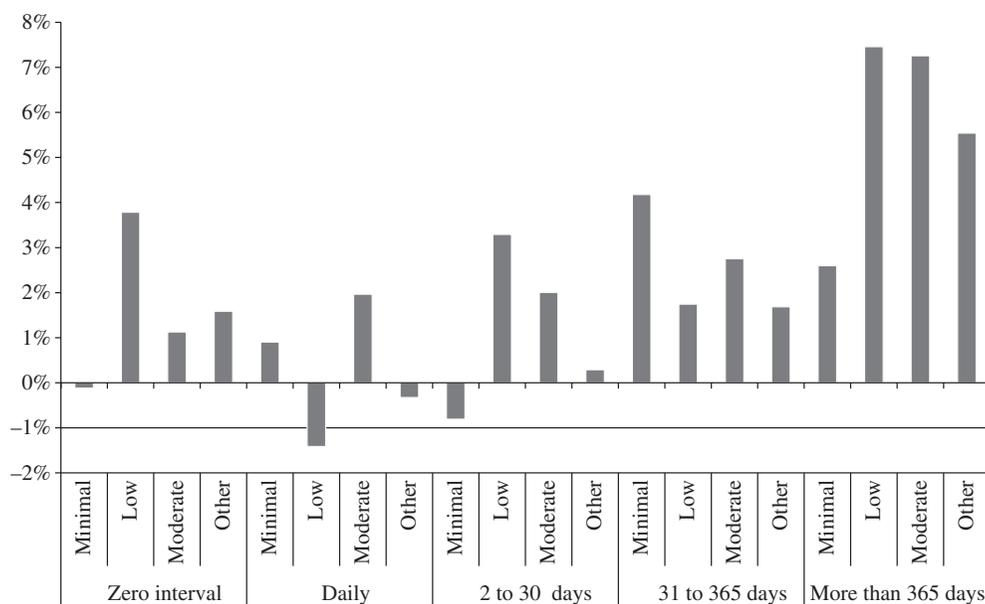


FIGURE A3. Average annual growth rate of the number of US commercial and industrial loans by type, 1997Q2–2009Q3.

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.

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We would like to thank Chris Kask of the Bureau of Labor Statistics (BLS) for providing us with the data and description of the BLS output statistics for commercial banks, and Susanto Basu, Erwin Diewert, John Fernald, Alice Nakamura, Marshall Reinsdorf, Paul Schreyer, Kevin Stiroh, Marcel Timmer, Jack Triplett, and participants at the NBER/CRIW Summer Institute 2006, the 2010 IARIW meeting, the World KLEMS meeting 2010, and seminars at the Federal Reserve Bank of San Francisco and the University of Groningen, for useful comments and suggestions on previous versions. Robert Inklaar thanks the European Commission, Research Directorate General, for support as part of the 7th Framework Programme, Theme 8, ‘Socio-Economic Sciences and Humanities’, and part of the project ‘Indicators for evaluating international performance in service sectors’ (INDICSER).

The views expressed in this paper are those of the authors and not necessarily those of the Federal Reserve System or the Federal Reserve Bank of Boston.

#### NOTES

1. See, for example, Triplett and Bosworth (2004) and Diewert *et al.* (2011) for overviews, and Basu *et al.* (2011), Colangelo and Inklaar (2012) 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.
4. These arguments are formalized in Wang *et al.* (2009) and Basu and Wang (2006). They discuss the restrictive assumptions needed to justify fixed proportionality between balances and services.
5. Again, we start from the premise that bank customers receive information services when taking out a loan and receive transaction services on deposits. An alternative would be the intermediation approach of Sealey

- and Lindley (1977), which considers deposits as an input for producing loans and other interest-earning assets; see also Berger and Humphrey (1997). This approach is not easily fit into the framework of the National Accounts, making it harder to establish how banks contribute to overall economic growth.
6. This mirrors the findings of Fixler and Reinsdorf (2006), who also compare the growth rates of bank output based on transaction counts versus deflated balances. However, their comparison is at a less detailed level and covers only the USA for a shorter time span.
  7. In the Netherlands, the number of deposit transactions is used for depositor services, but a deflated-balances approach is used for lending services.
  8. See, for example, various speeches by the Bank of England governor Mervyn King (one of which can be found at [www.bankofengland.co.uk/publications/speeches/2009/speech406.pdf](http://www.bankofengland.co.uk/publications/speeches/2009/speech406.pdf), accessed 16 April 2012) or the *Interim Report* of the UK's Independent Commission on Banking (2011).
  9. In what follows, real output is used interchangeably with output quantity and output at constant prices.
  10. Wang (2003) considers the partial-equilibrium case, while Wang *et al.* (2009) extend it to general equilibrium.
  11. See, for example, Benston and Smith (1976), Campbell and Kracaw (1980), Leland and Pyle (1977), and Diamond (1984, 1991) for theoretical modelling along these lines. See Mester (1992) for an empirical analysis that takes some of these considerations into account.
  12. Merton (1995) also advocates this 'functional perspective of financial intermediation'.
  13. Although helpful for intuition, this analogy should not be taken too far, as moving funds is quite different to moving goods. See also Diewert *et al.* (2011) for more discussion on banks in the National Accounts.
  14. See, for example, Brand and Duke (1982) for the approach taken by the US Bureau of Labor Statistics, and Fixler and Reinsdorf (2006) and Fixler (2009) for recent research by the US Bureau of Economic Analysis.
  15. See also Hancock (1991) and Fixler and Zieschang (1992) for further elaborations and applications.
  16. We note here that our measure of *nominal* bank output is related to the user-cost approach in that we also use a reference rate to infer the implicit revenue generated by a specific type of lending or depositor service. Our theory differs in that it explicitly accounts for risk in defining the reference rate for each bank output, and it defines bank output versus input independent of the realization of reference rates. See Basu *et al.* (2011) for more detailed comparisons; here we focus on the measurement of *real* bank output.
  17. Differences in service quality across sales of different kinds of cars (e.g. 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.
  18. There is little reason in theory for the resulting series to bear a stable relationship even to the number of cars sold (e.g. if more or less purchases are financed with credit), 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.
  19. The problem lies in the aggregation weight 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.
  20. Since a car of the same make and trim line corresponds to the same real quantity in different periods (if we ignore the quality improvements), the analogy becomes more exact if we deflate each loan balance with the price index for the activity financed by the loan. Note also that we talk of a car dealership that sells different types of cars, just as a bank originates and monitors different types of loans.
  21. 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 to consumer car loans or credit card loans for this reason.
  22. For documentation and more details, see data release E.2 at <http://federalreserve.gov/releases/e2> (accessed 17 April 2012).
  23. See Basu *et al.* (2011) for more detailed expositions of the empirical choices of reference rates.
  24. All commercial paper matures in less than a year, and they are invariably repriced on maturity.
  25. Specifically, we use the average of AAA- and AA-rated bonds for the minimal-risk category of loans, and the average of A- and BBB-rated bonds for the low-risk category, in line with the STBL instructions. The maturities of these bonds are between three and five years. The data are provided through Datastream.
  26. Above all, underwriting more risky (i.e. higher  $r_{it}^M$ ) loans likely entails more services (i.e. higher  $r_{it} - r_{it}^M$ ).
  27. 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.
  28. We could instead use the sum of loans outstanding plus a half of origination, 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.
  29. Lacking sufficient information on prepayment, we ignore its potential impact on amortization.
  30. Note that the value of a transaction is a flow, not a stock, such as (deflated) deposit balances, which give a snapshot of the amount of funds available for transactions at a point in time.

31. The FHFA was 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.
32. This is not to say that either quantity series is free of the usual problem with quality adjustment.

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