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By *Robert DeYoung, John Goddard, Donal G. McKillop, John O.S. Wilson*

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Keywords: Commercial banks, credit unions, profit inefficiency, tax exempt status

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1. Introduction

In this paper, we investigate how credit unions allocate subsidies derived via income tax exemptions and non-profit status across various stakeholders. Credit unions are non-profit, tax-exempt cooperatives that provide financial services to their members. The exemption from federal (and many state) corporate income taxes in the U.S. dates to the 1930s and is justified by credit unions "specified mission of meeting the credit and savings needs of consumers, especially persons of modest means" (Credit Union Member Access Act, 1998).[1]

Commercial banks have long complained that the tax exemption provides credit unions with an unfair competitive advantage, which credit unions can exploit to provide additional costly services, pay above-market interest rates to retail depositors, and offer below-market interest rates on consumer loans.[2] Moreover, regulatory rulings have in recent years blurred the traditional competitive distinctions between credit unions and banks, chief among them a series of rulings by the National Credit Union Administration (NCUA) that relaxed the restrictions on credit union membership and financial activities.[3] One reflection of this strategic repositioning and mission creep is the recent increase in US credit union purchases of commercial banks, with 42 such deals in 2018-2021 alone (Albicocco and Hayes 2022). To many, these changes are contradictory to the traditional status of credit unions as small

[1] In exchange for this tax exemption, both the size and the scope of credit unions has been restricted by various federal and state regulations. For example, credit unions must specialize in providing retail financial services (consumer credit, mortgage finance, small savings vehicles, retail payment services, etc.) to members who must share a common bond (such as employment in the same organization or industry, residence in a specific geographic area, or membership of a social organization or religious institution).

[2] Researchers have examined whether credit unions channel benefits toward their borrowing members, their saving members, or both. In early theoretical studies credit unions are modeled in static settings and favor neither group over the other (Taylor, 1971; Smith et. al., 1981; Smith, 1984; Smith, 1986). More recently, theoretical studies place credit unions in intertemporal settings, allowing them to vary the timing and magnitude of benefits across their saving and borrowing members (Rubin et al., 2013). The results from the majority of empirical studies suggest that the majority of credit unions favor neither saver or borrowing members (see McKillop and Wilson, 2011 for a detailed review).

[3] These include looser restrictions on the amount of business loans that credit unions can make to their members (February 2016), less restrictive field-of-membership rules for determining what constitutes a common bond (October 2016), allowing credit unions to raise financial capital from non-member external sources (January 2017), and allowing credit unions to securitize their loans (June 2017). A suit filed by the Independent Community Bankers of America (ICBA) against the business lending rule was dismissed in 2017. A suit filed by the American Bankers Association (ABA) against the field-of-membership rule is pending.

cooperative organizations and have resulted in intense policy debates regarding the efficacy and fairness of the credit union tax exemption (DiSalvo and Johnston 2017, Marshall and Pellerin 2017).[4]

Evaluating whether credit union tax subsidies remain justified requires a more comprehensive financial performance framework than implemented previously in the literature. Our main empirical analysis comprises four steps. First, we estimate a structural profit model (Berger, Hancock and Humphrey 1993, DeYoung and Nolle 1996) for a balanced panel of 2,580 small US commercial banks between 2005 and 2017. We specify the profit model to include activities that are closely associated with credit unions' legal mandate (such as attracting deposits and making loans) as well as activities that are not closely associated with credit unions' legal mandate (such as hiring labour and investing in securities). Second, we use the estimated model parameters to calculate the *profit inefficiency* of each bank, which we define as the foregone profits that each bank would have earned had it operated using best commercial banking practices. Third, we reuse the estimated model parameters to calculate profit inefficiencies for a separate panel of 1,279 US credit unions that were operating during the same period. Fourth, we calculate the *profit inefficiency gap* for 1,024 matched pairs of banks and credit unions, which we define as the credit union's profit inefficiency minus the bank's profit inefficiency.

Lacking shareholders who expect a market return from placing their wealth at risk, credit unions may be compelled to spend rather than retain the cost advantage derived from not having to pay taxes on their profits. They might accomplish this by consuming too many inputs, paying above-market prices for inputs, producing at non-optimal output levels, and/or charging below-market prices for those outputs—in other words, by operating in a profit-inefficient fashion relative to otherwise similar commercial banks, which we capture in our estimated profit inefficiency gaps. If one proceeds under the assumption that credit unions and small commercial banks compete against each other in local financial services markets, then these profit inefficiency gaps should be close proxies for the (otherwise unobservable) subsidies that credit unions enjoy.

[4] In a January 2018 letter to the National Credit Union Association (NCUA), Senator Hatch (Chair, US Senate Finance Committee), stated "the credit union industry is evolving in ways that take many credit unions further from their tax-exempt purpose." In February 2018, legislation was introduced in Iowa that would equalize the state income tax treatment of commercial banks and credit unions (American Banker, February 28, 2018).

We find statistically and economically large profit inefficiency gaps. When we value inputs and outputs by their prices in local banking markets, credit union profit inefficiency averaged 75 basis points per dollar of assets more than at their matched pair commercial banks. When we disaggregate this inefficiency gap across the inputs and outputs in our model, the overuse of deposit inputs by credit unions is by far the largest component. The financial services associated with these excess deposit inputs (safe-keeping, member liquidity, payments services, risk-free savings vehicles) are mandated services under the federal legislation cited above, a *quid pro quo* that credit unions provide in exchange for their tax exemption. We find only a small amount of outright operational inefficiency at credit unions (e.g., hiring too many workers, paying above-market wages and benefits, earning below-market returns on portfolio of securities investments); for every dollar of non-mandated inefficiency at credit unions, we find an estimated thirteen dollars of mandated inefficiencies. Using a separate analytic framework, we determine that slightly more than half of the annual average 75 basis point profit inefficiency gap is made possible by credit unions' exemption from income taxes, and slightly less than half were made possible by credit unions' non-profit status.

The narrative shifts, however, when we value inputs and outputs by the prices that credit unions actually pay or charge for them. Credit unions can and often do provide their members with prices more favourable than those that can otherwise be found in local banking markets. When the profit inefficiency gap is measured in terms of these prices, we find that 90% of the gap is comprised of pricing inefficiencies. On average, these pricing inefficiencies are accounted for almost entirely by above-market interest rates to member-depositors. Contrary to the conventional credit union profile, we find only limited evidence that member-borrowers benefit from preferential loan rates. Hence, we conclude that most of the tax and non-profit subsidies enjoyed by credit union are simply redistributions, passed through from taxpayers to credit union depositors in the form of higher interest payments. This finding is orthogonal to the legislation that establishes both the mission and the tax-exempt status of credit unions, which emphasizes "the credit and savings needs of consumers" but makes no mention of income redistribution. This misalignment, between the purpose of credit unions and their actual performance, seems even larger when considered alongside evidence which suggests that credit union clientele tend to earn above-average incomes (e.g., US Government Accountability Office 2005, 2006, Credit Union National Association 2015, DiSalvo and Johnston 2017, Maskara and Neymotin 2021).

Our study contributes to several related areas of the literature, including: the efficient performance of joint stock versus mutually owned financial institutions (O'Hara 1981, Deshmukh, Greenbaum and Thakor, 1982, Mester 1989, 1993); the corporate governance of regulated financial institutions (Caprio, Laeven and Levine 2007); the objective function and potential conflicts of interest between depositors and borrowers at credit unions (Flannery 1974, Smith, Cargill and Meyer 1981, Leggett and Stewart 1999, McKillop and Wilson 2011; Rubin et al., 2013); how the financial performance of credit unions varies with their scale of operation (Wheelock and Wilson 2011); and the incidence of taxes on financial institutions (Albertazzi and Gambacorta 2010, Capelle-Blancard and Havrylchyk 2017, Schandlbauer 2017). Our study is most comparable to Frame, Karels and McClatchey (2003), who use cost function analysis to compare the financial performance of US credit unions and US mutual thrift institutions. Consistent with the spirit of our results, they find that credit unions with residential common bonds incurred higher costs than mutual thrifts, and that a portion of the tax benefit was redirected away from credit union members.

The rest of this paper is structured as follows. In section 2 we provide additional institutional details about credit unions, the regulation of credit unions, and the credit union tax exemption. In section 3 we present two testable hypotheses: The *mandated inefficiencies* hypothesis that the legally mandated mission of credit unions requires them to operate less efficiently than commercial banks, and the *absolute inefficiencies* hypothesis that the poor corporate governance environment at credit unions will result in higher levels of non-mandated inefficiency relative to commercial banks. In section 4 we provide an overview of the profit inefficiency model and introduce the key credit union profit inefficiency gap measure. In section 5 we describe the data and the variables used to estimate the model. In section 6 we present our empirical results, which include testing the main hypothesis tests, allocating the inefficiency gap across different credit union activities, estimating the relative influence of the tax and non-profit subsidies on credit union inefficiencies, and testing whether and how credit union pricing decisions determine who consumes the credit union subsidies. Section 9 concludes.

2. Background

Credit unions originated as self-help cooperatives for persons and households of modest economic means that are not served well by commercial banks.[5] Credit unions tend to be small but collectively have become a major supplier of consumer credit in the US. In the first quarter of 2018, there were 5,530 federally insured (federal and state chartered) credit unions in the US, serving 112.7 million members with $972 billion in outstanding loans (Credit Union National Association 2018). Approximately 71% of these credit unions are small institutions with assets less than $100 million. Membership in a credit union has traditionally been limited to depositors and borrowers that share a close common bond, such as employment in the same company, industry, or profession. Credit unions have traditionally offered their members a limited set of financial services, such as checking accounts, savings vehicles, personal loans, consumer credit, and home mortgages.

Credit unions offer an alternative to commercial banks and may (in some cases) allow retail customers to circumvent credit constraints, which arise following exogenous shocks to the financial services industry. 'Recent evidence suggests that declines in bank credit supply have real economic implications. Borrowers with a higher exposure to the bank balance sheet shocks via their existing banking relationships reduce investment activity and employment (Degryse et al., 2020; Dwenger, Fosser and Simmler, 2020; Berger, Molyneux and Wilson, 2020). Credit unions offer an alternative to commercial banks, and may (in some cases) allow retail customers to circumvent credit constraints, which arise following exogenous shocks to the financial services industry. Smith and Woodbury (2010) and Smith (2012) suggest that credit unions are less exposed than commercial banks to business cycle fluctuations, and thus are better equipped to sustain lending during economic downturns. This appears to suggest that while banks contract commercial lending during periods of economic stress the opposite is true for credit unions. Ramcharan et al. (2016) do, however, note that US credit unions most exposed

[5] While the financial intermediation functions performed by credit unions and commercial banks are fundamentally the same, a parallel lexicon has developed to describe credit union activities. For purposes of clarity, we will discard much of this idiosyncratic verbiage. For example, we use the commercial bank words "depositors, transactions accounts, profits, and dividends" rather than the credit union equivalents of "savers, share draft accounts, surplus, and patronage dividends." We retain the use of the word credit union "member" because the rights, powers and expectations of these credit union owners differ in fundamentally important ways from the rights, powers and expectations of bank shareholders.

to the failure of large corporate credit unions (because of declining investment values) reduced real estate and consumer lending during the global financial crisis. Chatterji et al. (2015) find that US credit unions on average gained market share from banks following the financial crisis, while Cororaton (2020) shows that lending growth rates for credit unions were significantly higher than banking counterparts following the onset of the financial crisis, thus reducing the real effects arising from any reduction in overall bank credit supply. However, Maskara and Neymotin (2019) find that during the financial crisis, credit unions were no more likely than other depositary institutions to extend a home equity line of credit to households facing financing constraints, thus providing a counterpoint to those who have lauded credit unions for providing liquidity during times of crisis.

Regulators require credit unions to retain minimum amounts of equity capital as a buffer against future losses.[6] Credit unions begin their existence with little or no equity capital and meet this regulatory requirement gradually over time by retaining profits as they occur; as cooperative organizations, credit unions lack access to external capital markets. This equity capital belongs collectively to the credit union members, but members that wish to sever their ties with their credit union are not entitled to any share of this accumulated communal wealth. If a credit union generates excessively large profits, it can distribute these sums to its members by increasing deposit rates and/or by reducing loan rates, obviating an explicit financial dividend. Although credit union members sometimes receive taxable dividend earnings pay-outs, such payments are relatively rare.[7]

Credit unions are exempt from paying taxes on earnings. The rationale for this exemption is stated explicitly in the Credit Union Member Access Act (1998): "Credit unions…are exempt from Federal…taxes because they are member-owned, democratically operated, not-for-profit organizations generally managed by volunteer boards of directors *and because they have the specified mission of meeting the credit and savings needs of consumers, especially persons of modest means* (emphasis

[6] In the US credit unions are subject to the prompt corrective action framework included in Section 301 of Credit Union Membership Access Act 1998 and implemented in August 2000 (Goddard, McKillop and Wilson, 2016).
[7] Credit unions refer to these pay-outs as "patronage dividends," and make these payments conditional on meeting predetermined levels of net worth, ROA and/or ROE. A survey of 466 credit unions by Callahan Associates (2015) found that only about four in ten credit unions consider making these payments in a given year, and only about one in ten actually make these pay-outs.

added).”[8] Clearly, this legislation assigns to credit unions a mandate to provide greater access to financial services. Although the legislation does not state specifically that the tax exemption should be used to subsidize better-than-market prices for their members, credit unions typically pay higher interest rates on deposits, and often (but not always) charge lower interest rates on loans, than commercial banks.[9]

Although the legislation explicitly links the tax subsidy to serving persons “of modest means,” members of US credit unions tend to have above average household incomes and above average amounts of formal education. A survey conducted by the Credit Union National Association (2015) finds that credit union members tend to be older (48.5 years old for credit union members versus 45.5 for non-members), employed full time (54% versus 39%), better educated (40% with college degrees versus 24% without), and own homes (76% versus 52%). A study conducted by the US Government Accountability Office (2006) finds that 69% of credit union members have middle-to-upper incomes versus 59% for commercial bank customers, and only 31% of credit union members have low-to-moderate incomes versus 41% of commercial bank customers. DiSalvo and Johnston (2017) find that credit unions reject mortgage applications twice as frequently as small commercial banks in low-to-moderate income census tracts, while Maskara and Neymotin (2021) find that low-income individuals are less likely to use the services of a credit union.

In contrast, US commercial banks are for-profit, shareholder-owned corporations and are not tax exempt. For banks organized as corporations under Subchapter C of the US tax code, bank income is subject to double taxation: Earnings are taxed fully at the corporate level, and any post-tax earnings distributed to shareholders as dividends are taxed again at the personal level. For banks organized as corporations under Subchapter S of the US tax code, earnings are fully taxed at the personal level regardless of whether they are retained or distributed.[10] The Credit Union Membership Access Act of

[8] 12 U.S.C. 1757a; Public Law 105–219, 112 Stat. 913 (1998). The tax-exempt status of credit unions dates to the Revenue Act of 1916 for state-chartered credit unions and to the Federal Credit Union Act of 1934 for federally chartered credit unions.

[9] See Figures 2 and 3, which we discuss in detail in a subsequent section, for some pricing examples.

[10] Subchapter S of the Internal Revenue Code (IRC), introduced in 1958, allows small organizations to reduce their tax burdens by paying tax at the individual level rather than the corporate level. Banks were not permitted to elect Subchapter S status until 1996. The Small Business Job Protection Act of 1996 permitted US commercial

1998 encouraged federally chartered credit unions to grow larger by permitting them to adopt multiple common bonds, enrol members from outside their original membership groups, and transact with any resident of a geographical area defined as a community. As a result, a growing number of credit unions are no longer locally focused organizations. In the first quarter of 2018, there were 294 federally insured credit unions with assets exceeding $1 billion. These credit unions comprised just 5% of the industry population but held 64% of total industry assets. There were 50 federally insured credit unions with more than a quarter of a million members each.[11] Total business lending grew approximately fourfold at credit unions between 2001 and 2014, at which point more than one thousand credit unions were at or near the statutory business loan limit of 12.5% of total assets.[12] In response, new federal legislation passed in December 2017 lifted the statutory cap on member business loans from 12.5% to 27.5% of assets.

The total dollar amount of the credit union tax subsidy is non-trivial. In a 2010 report on tax reform, The President's Economic Recovery Advisory Board estimated that eliminating the credit union tax exemption would raise $19 billion in government revenue over 10 years.[13] Banks argue that the tax exemption distorts competition in deposit and loan markets by conferring an unfair competitive advantage to credit unions. Current period cash flows that banks must transfer to the government are available free-of-charge to credit union managers to provide additional customer services and better-

banks with 75 or fewer shareholders to convert from Subchapter C to Subchapter S status, later expanded to 100 shareholders by the American Job Creation Act of 2004. Related family members are treated as a single shareholder. The number of Subchapter S banks increased from 606 in 1997 to 1,841 (35% of all commercial banks) in 2018. Several states, including California, Connecticut, Louisiana, Michigan, New Hampshire, New Jersey, North Carolina, Tennessee, Utah and Vermont, do not recognize Subchapter S status and subject the earnings of these organizations to double taxation for ***state*** corporate taxes and ***state*** income taxes.

[11] Data from the National Credit Union Association Annual Report (2018) and www.usacreditunions.com.

[12] Based on statements made by officials at, respectively, the federal credit union regulatory agency (NCUA) and the credit union industry association (CUNA), quoted in "Credit Unions Poised to Be Bigger Business Lending Foe," American Banker, June 22, 2015. Ely and Robinson (2009) and DiSalvo and Johnston (2017) provide further analyses of credit unions' small business lending activities.

[13] Other studies find tax revenue effects of similar magnitudes. In a study for the US Tax Foundation, Tatom (2005) estimates that the credit union tax exemption resulted in a $2 billion annual loss of tax revenue, and an aggregate future loss of $30 billion over ten years. The Joint Committee on Taxation (2017) estimates a $2.9 billion annual loss of tax revenue, projected to rise to $3.2 billion annually by 2020, for a five-year reduction of $14.4 billion. In contrast, a study prepared on behalf of the National Association of Federally Insured Credit Unions (Feinberg and Meade 2017) concludes that requiring credit unions to pay income tax would result in a $38 billion decline in tax revenues over ten years, due to reduction in credit, lost jobs, and other indirect effects from a shrinking credit union sector.

than-market prices. Banks also argue that the tax-subsidized stakeholder group now extends well beyond the original credit union mandate to include business borrowers, credit union employees, and member-depositors who do not truly share a strong common bond.[14]

Credit unions also enjoy a second subsidy relative to commercial banks by nature of their different organizational form. Repeating the above passage from the Credit Union Member Access Act (1998), this time with a different emphasis added: "Credit unions…are exempt from Federal…taxes *because they are member-owned, democratically operated, not-for-profit organizations* generally managed by volunteer boards of directors and because they have the specified mission of meeting the credit and savings needs of consumers, especially persons of modest means." While the owners of banks hold equity shares, the member-owners of credit unions hold liquid, interest-bearing, insured deposit contracts; hence, unlike bank owners who put capital at risk, credit union members do not require a return on risk-taking. Retained earnings that would otherwise be distributed to equity holders are available free-of-charge to credit union managers to provide additional customer services and better-than-market prices. In our analysis below, we shall refer to this financial advantage as the non-profit subsidy.

3. Testable hypotheses

By legislative mandate, a credit union is required to use its tax and non-profit subsidies to the benefit of its members. If the credit union satisfies this mandate by paying above-market interest rates to its member-depositors, then it will appear to be cost inefficient relative to otherwise similar for-profit banks: Its total interest expenses will be higher not only because it is paying inefficiently high input prices, but also because these high prices will attract an inefficiently large volume of deposits.[15]

[14] For a more detailed treatment of the historical origins and current justifications for a tax-free credit union industry, see Marshall and Pellerin (2017).

[15] Throughout our analysis, we presume that banks and credit unions of similar size and location have access to the same production functions, face the same market prices for inputs and outputs, and compete for overlapping customer populations. If these structural presumptions are reasonable ones—and we believe that they are—then the concept of "otherwise similar for-profit banks" should be non-controversial. Aside from interest expenses on deposits and interest revenues on loans, all the other components of pre-tax profits (e.g., employee expenses, overhead expenses, investment revenues) should be the same for banks and credit unions in the absence of managerial inefficiencies.

Similarly, if the credit union satisfies its mandate by charging below-market interest rates to its member-borrowers, then it will appear to be revenue inefficient relative to otherwise similar for-profit banks: Its total interest revenues will be lower not only because it is charging inefficiently low input prices, but also because these low prices will attract an inefficiently large volume of borrowers. For the remainder of this paper, we shall refer to these inefficiencies as *mandated inefficiencies*. It is in this context that we state the first of our two hypotheses:

> Mandated Inefficiencies Hypothesis (H1): Given their legislative mandate to use their tax and non-profit subsidies to expand households' access to financial services, profits at credit unions will naturally be lower than pre-tax profits at otherwise similar commercial banks.

Like other mutually owned enterprises, credit unions are significantly different from shareholder-owned financial institutions in terms of their ownership, ethos and governance (Smith, Cargill and Mayer 1981; Flannery 1981; Deshmukh, Greenbaum and Thakor 1982; Van Rijn, Zeng and Hueth 2022). At shareholder-owned corporations, management is guided by the profit motive and is monitored by a board of directors elected by shareholders whose voting power is based on the number of shares they own. In contrast, at credit unions there is no profit motive to guide managers' resource allocation decisions, and credit union directors are elected by members with only one vote each regardless of their share of member deposits (Rubin et al., 2013). Management must balance the interests of multiple corporate stakeholder groups—including depositors, borrowers, and employees—none of which has a strong incentive to monitor managers. Member-depositors with large accounts at stake have little incentive to monitor, because they have no more governing power than members with small accounts.[16] Moreover, in the absence of externally held capital, and with no tradeable ownership rights to facilitate a hostile takeover bid, the market for corporate control is unlikely to constrain the actions of management. Relatively few members attend the annual general meeting, scrutinize the board's prudential measures, or otherwise actively monitor the board (Goth, McKillop and Wilson

[16] Ferretti, Pattitoni and Castelli (2019) study co-operative banks and joint stock banks in Italy and find that banks with "one head-one vote" governance policies have greater agency costs than banks with "one share-one vote" governance policies.

2012). Credit union directors are elected from the general credit union membership, and as such they have no greater financial stake in the credit union than the members that elect them. Few if any of the members, who are essentially small savers, possess the experience or business acumen necessary to effectively monitor financial conditions and operations.

Given that internal stakeholders have little incentive, and external parties have no incentive, to monitor or discipline credit union management, credit union managers have greater opportunities to pursue their own self-interest via efficiency-reducing activities.[17] These activities might include shirking, empire building, overinvestment, excessive or deficient risk-taking, or the pursuit of a quiet life.[18] Such behaviour diverts a portion of the tax and non-profit subsidies away from credit union members. For the remainder of this paper, we shall refer to these inefficiencies as *absolute inefficiencies*. It is in this context that we state the second of our two hypotheses:

> Absolute Inefficiencies Hypothesis (H2): Given the weaker corporate governance environment at credit unions relative to banks, a portion of credit unions' tax and non-profit subsidies will be absorbed by non-maximizing behaviour, thus reducing the generation of mandated member benefits.

We illustrate the outcomes associated with hypotheses 1 and 2 in Figure 1, which shows how a given amount of pre-tax commercial bank profits might be consumed at a tax-exempt, not-for-profit, but otherwise identical credit union. The bank has three uses for its pre-tax profits: Pay some to the government in tax expenses; distribute some to stockholders as dividends; and retain the remainder as equity capital. Like the bank, the credit union will retain some of its profits to increase, maintain or rebuild its equity capital cushion, but it neither pays income taxes to the government (the tax subsidy A) nor distributes dividends to risk-taking shareholders (the non-profit subsidy B). Both A and B are

[17] The seminal studies on the value-reducing incentives and behaviours of firm management include Berle and Means (1932), Fama and Jensen (1983), Jensen and Meckling (1976), Demsetz and Lehn (1985), Shleifer and Vishny (1986), Morck, Shleifer, Vishny (1988), and Laeven and Levine (2008). More recent contributions include: Roe (2021) and Bebchuk and Tallarita (2022).

[18] Compensation is typically lower at credit unions relative to banks (Branch and Baker 2000). Moreover, opportunities for career advancement are limited. Consequently, credit union managers have at best weak incentives to run their organizations in a productively or financially efficient fashion.

available to credit union management for other purposes and will be consumed in the form of higher costs (above-market interest rates for members, costly services for members, costly benefits to non-member agents, or pure excess costs) and/or lower revenues (e.g., below-market interest rates on loans to members, or lower financial services fees charged to members). We refer to the sum of these cost overruns and revenue shortfalls (relative to banks) as profit inefficiencies C. If banks and credit unions are vying for the same customers, and if they purchase inputs and sell outputs in competitive markets, then credit unions will not be able to operate inefficiently relative to banks over the long run without receiving subsidies. That is, the sum of the subsidies A + B enjoyed by credit unions must equal the total profit inefficiencies C generated by credit unions. Returning to our two testable hypotheses, the primary objective of this study is to determine the incidence of these credit union subsidies: To what extent can we attribute credit union profit inefficiencies to mandated inefficiencies D and absolute inefficiencies E?

4. Modelling relative financial performance

We modify the Berger, Hancock and Humphrey (1993) profit inefficiency model to test hypotheses H1 and H2. The model is derived from standard neoclassical assumptions that banks are price takers in both input and output markets and attempt to maximise profits through their choices of input and output quantities. While these assumptions arguably hold for the small commercial banks in our data, they clearly do not hold for credit unions. Given their cooperative status, credit unions lack a profit motive and routinely offer better-than-market prices to their member-depositors and member-borrowers. As explained below, we use the model to estimate best-practices input and output choices based solely on commercial bank data, and then evaluate the performance of every commercial bank and credit union in our data against those best- practices levels.

In our version of the model, banks maximise their short-run variable profits by choosing the levels of four variable netputs: Loans and investments are positive netputs, while labour and deposits are negative netputs. Banks take fixed factors as given (physical assets, risk-weighted assets, equity capital, and non-interest income), which we assume are pre-determined by long-run strategic business decisions that were made in the past.

More formally, let bank i compete in market s=(1,…,S) at time t=(1,…,T). The bank maximises variable profits $\pi^*_{i,t} = \pi(\mathbf{p_{s,t}}, \mathbf{z_{i,t}})$ by choosing its optimal vector of n netputs $\mathbf{x^*_{i,t}} = \{x_{j,i,t}$ for $j=1,\ldots,n\}$, taking as given both the vector of n local market netput prices $\mathbf{p_{s,t}} = \{p_{j,s,t}$ for $j=1,\ldots,n\}$ and its own vector of m fixed factors $\mathbf{z_{i,t}} = \{z_{r,i,t}$ for $r=1,\ldots,m\}$. We specify the variable profit function using a Fuss normalized quadratic functional form, and then we apply Hotelling's lemma to derive a system of n netput demand equations plus the parent variable profit equation. The parameters of this system are then estimated using a balanced data panel of T quarterly observations for each bank. (A more detailed presentation of the model is provided in Appendix 1.)

In a standard neoclassical profit model, one not only assumes that firms are price takers that seek to maximise profits, but also assumes a perfect information environment where principal-agent problems cannot fester. We relax this additional assumption and allow our model to reveal any profit inefficiencies in the data. For every bank in the data, we can recover n×T residuals from the estimated model. Averaging the residuals over time results in an n-vector of average residuals for each bank, with each bank having a separate average residual for each of its n netputs. We assume that random error attenuates to zero in the process of averaging, so that the average residuals contain only information about bank i inefficiency. Finally, we transform the average residuals into a set of netput inefficiency terms $\hat{\xi}_{j,i}$ for each bank, where $\hat{\xi}_{j,i} = 0$ for the least inefficient bank. That is, the bank with the most positive (least negative) average residual for outputs (inputs), becoming increasingly positive (negative) for banks that are more inefficient. Note that the best-practices bank for netput j need not be the best-practices bank for the other netputs. To summarize, the $\hat{\xi}_{j,i}$ terms measure the under-production of outputs j (loans, securities investments) and the excess use of inputs j (deposits, labour) by bank i on average over the T years in the data, relative to the best practices bank in each of the n netput categories.

As discussed above, our model presumes that banks are price-takers and profit maximisers, assumptions that clearly do not hold for credit unions. Moreover, we know that banks incur tax expenses while credit unions do not. We deal with these inconsistencies as follows. First, we estimate the parameters of the profit inefficiency model using data from commercial banks only. Thus, the estimated parameters of the model will capture the relationships between market prices, fixed netputs, variable netput choices, and ultimately profitability at firms for which the price taking and profit maximising assumptions arguably hold. Second, we define the dependent variable in the parent profit equation as bank net income before taxes, which is the functional equivalent of the non-taxable credit union 'surplus.' Third, we generate the netput inefficiency terms $\hat{\xi}_{j,i}$ for credit unions and commercial banks using the exact same procedures: We calculate fitted netput values for both banks (which we used to estimate the model parameters) and credit unions (which we did not use to estimate the model parameters), generate residuals by subtracting those fitted netput values from actual netput values, and then transform the averaged residuals into the netput inefficiency terms $\hat{\xi}_{j,i}$ using the procedures described above. For any credit union i in our sample, the $\hat{\xi}_{j,i}$ terms can be interpreted as the netput inefficiencies generated at a price-taking, profit-maximising commercial bank that made the same netput decisions as credit union i. In other words, we allow credit unions to behave based on their non-profit maximising, non-price taking incentives, but then evaluate that behaviour against a profit maximising, price taking standard. Note that nothing in this procedure prevents credit unions from being less netput inefficient than commercial banks, nor does this procedure preclude a credit union from establishing the best-practices standard for any of the variable netputs.

With the netput inefficiencies terms $\hat{\xi}_{j,i}$ in-hand for both banks and credit unions, we construct a variety of profit inefficiency measures. Our goal is to evaluate the relative profit performance of banks and credit unions, but the $\hat{\xi}_{j,i}$ are unit inefficiency measures (the volumes of loans, investments, deposits, and labour) not revenue and expense inefficiencies. We easily rectify this problem by multiplying netput inefficiency j by its associated price (loan interest rate, rate of return on securities, deposit interest rate, wage) in netput market j. Then profit inefficiency can be written as $Ineff_i$ = $\sum_{j=1}^{n} \hat{p}_{j,s}\hat{\xi}_{j,i}$, where $\hat{p}_{j,s}$ is the average prevailing price for netput j in market s during the sample period. The netput-specific profit inefficiencies $\hat{p}_{j,s}\xi_{j,i}$ can be obtained by undoing the summation $\sum_{j=1}^{n} \hat{p}_{j,s}\hat{\xi}_{j,i}$ into its n parts. Profit inefficiency per dollar of assets is given by $Ineff_i/\widehat{assets_i}$, where $\widehat{assets_i}$ is the average assets of bank or credit union i during the sample period. Profit inefficiency per dollar of potential profits is given by $Ineff_i/(Ineff_i + \hat{\pi}_i)$, where $\hat{\pi}_i$ is the average profits of bank or credit union i during the sample period.

To test our hypothesis H1, we must compare the profit inefficiencies of banks and credit unions. We make these comparisons using the profit inefficiency gap:

$$\textit{profit inefficiency gap}_{pair} = (\textit{Ineff/assets})_{credit\ union} - (\textit{Ineff/assets})_{bank} \qquad (1)$$

where the subscript *pair* indicates that we use matched pairs of banks and credit unions to calculate this measure. Equation (1) is the quantified expression of the inefficiency gap graphically represented in Figure 1. To test our hypothesis H2, we decompose the profit inefficiency gap (1) into its n netput-specific inefficiencies, which we can then use to calculate netput-specific inefficiency gaps.

All of the above inefficiency measures are expressed in terms of market prices, as is appropriate for valuing the social costs of inefficiency. However, this approach can misstate the costs of inefficiency to bank shareholders and/or credit union stakeholders. On the one hand, if a bank somehow pays less than the prevailing market price for its inputs, or charges more than the prevailing market price for its outputs, then our market value-based measures will overstate inefficiency by not capturing these internal pricing efficiencies. On the other hand, if a credit union pays more than the prevailing market price for its deposit inputs, or charges less than the prevailing market price for its loan outputs, then our market-value measures will understate inefficiency by not capturing these internal pricing inefficiencies. We can investigate this issue through the following decomposition:

$$\hat{p}_{j,i}\xi_{j,i} = \hat{p}_{j,s}\xi_{j,i} + (\hat{p}_{j,i} - \hat{p}_{j,s})\xi_{j,i} \qquad (2)$$

where $\hat{p}_{j,s}$ is the average market price for netput j in state s, and $\hat{p}_{j,i}$ is the average price actually paid or charged by bank i for netput j. The left-hand term is *internal inefficiency*, i.e., netput profit inefficiency valued at internal bank prices. This term captures both the inefficiencies attributable to setting netput prices at non-market levels, as well as the inefficiencies from the suboptimal netput quantities that are attracted by these non-market prices. Internal inefficiencies are likely to be large for credit unions, which have a legal mandate to offer favourable prices to their member-depositors and member-borrowers. The first right-hand term is *market inefficiency*, which can be interpreted as the portion of internal inefficiency attributable to suboptimal netput quantity choices. This term values inefficiencies using local market prices. Given that market prices represent the value of a marginal unit of the netput allocated to its next best use, this term captures the social costs that occur when banks and credit unions purchase too many inputs and/or produce too few outputs. The second right-hand term is *pricing inefficiency*, which can be interpreted as the portion of internal inefficiency attributable to deviations from local market prices. For inputs, a positive pricing inefficiency term indicates internal pricing inefficiency; the institution is paying above-market prices.[19] For outputs, a negative pricing inefficiency term indicates internal pricing inefficiency; the institution is charging below-market prices.[20]

It is important to note that our primary measure of profit inefficiency *Ineff* does not distinguish between technical inefficiency and allocative inefficiency. This is a departure from the original Berger, Hancock and Humphrey (1993) model, which measured technical inefficiencies at the bank level and allocative inefficiencies at the industry level. The original model specifies a j-1 vector of parameters τ_j that absorbs allocative inefficiencies for the average bank in the data. Essentially, the presence of these terms in the model forces banks to the expansion path and isolates technical inefficiencies in the regression residuals. While this approach was an innovation in the estimation of parametric bank profit functions, it is not useful for the purposes of the present study. First, in order to calculate our inefficiency gaps, we require institution-specific estimates of inefficiencies for both banks and credit unions, not industry-average estimates.[21] Second, the very concept of allocative inefficiency has firms taking

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[19] Alternatively, a positive value could indicate that the institution is purchasing higher quality inputs than other institutions in its local market. Our matched-pairs analysis should minimize this possibility by comparing similar banks in similar markets.

[20] Alternatively, a negative value could indicate that the institution is selling higher quality outputs than other institutions in its local market. Our matched-pairs analysis should minimize this possibility by comparing similar institutions in similar markets.

[21] An alternative approach would estimate separate Berger, Hancock and Humphrey (1993) profit functions for banks and credit unions, which would yield separate estimates of average allocative inefficiencies for both sets of institutions, which we could then use to construct an average inefficiency gap. But as we have discussed,

market prices as given, and then choosing non-optimal combinations of inputs and outputs that are inconsistent with those prices. However, this concept fails for credit unions, which have a legal mandate to choose non-market prices, and in practice choose netput prices that diverge substantially from market prices (as shown in Figures 2 and 3). Instead, we restrict the parameters $\tau_j = 1$ (that is, we estimate the remaining profit function parameters assuming allocative efficiency), which forces allocative inefficiencies into the residuals where they are co-mingled with technical inefficiencies.[22] We then calculate overall profit inefficiency *Ineff* from the residuals and use our *pricing inefficiency* measure to extract the portion of *Ineff* that is related to divergences from market prices.

5. Data

All data used in this study are publicly available. The data for commercial banks come from the Reports on Condition and Income (Call Reports) published by the Federal Financial Institution Examination Council (FFIEC). The data for credit unions come from the Call Reports published by the National Credit Union Association (NCUA). Both sets of data are available via the S&P Global Market Intelligence (formerly SNL Financial) database. We construct two data sets: a balanced panel of quarterly data for 2,580 commercial banks that we use to estimate the parameters of the profit function, and a balanced panel of 1,024 matched pairs of commercial banks and credit unions that we use to test our main hypotheses. Both data sets begin in the first quarter of 2005 and end in the fourth quarter of 2017. Balanced panels are crucial for our methodology, as they allow us to calculate the averaged residuals for each bank or credit union using the same number of observations.

Table 1 summarizes the data selection process. We begin with the 4,582 banks and 5,621 credit unions that were in operation during all 52 quarters of our 2005-2017 data period. We then exclude extremely small institutions with average 2005-2017 assets less than $50 million, as well as relatively

estimating a profit function for credit unions is not appropriate because it violates the price-taking and profit maximizing assumptions of the neoclassical profit function.

[22] It is possible that the best-practice institutions that we use to benchmark the $\hat{\xi}_{j,i}$ terms only appear to be the most efficient institutions because of large allocative inefficiencies—that is, they inefficiently under-use input j or inefficiently over-produce output j. In this scenario, we would be systematically over-estimating netput inefficiencies. We guard against this possibility by winsorizing the averaged netput residuals at the 5th and 95th percentiles of their distributions before benchmarking the $\hat{\xi}_{j,i}$ terms. This is documented in Appendix 1.

large institutions with average 2005-2017 assets greater than $8.152 billion (the 99th percentile of the combined distribution of average assets for banks and credit unions). From this set of similarly sized banks and credit unions, we retain only those institutions for which we can observe/construct a full set of model variables (profits, netputs, netput prices, fixed netputs) in every quarter of the sample period. Finally, to prevent outlying values from influencing our estimates of profit inefficiencies, we exclude institutions with average 2005-2017 return on assets (ROA) in the 1st or 100th percentiles of the sample distribution.

This filtering process results in a balanced panel of 2,580 commercial banks and 1,279 credit unions. We estimate the parameters of the profit function using only the data from the 2,580 commercial banks, because banks arguably conform with the assumptions of our neo-classical profit model but credit unions do not; as discussed above, credit unions are neither price-taking nor profit-maximising institutions. We then use those estimated parameters to generate profit inefficiency estimates for all 2,580 commercial banks and all 1,279 credit unions. Finally, we conduct formal statistical tests of hypotheses H1 and H2 using only the estimated profit inefficiencies for the commercial banks and credit unions that are in the smaller data set of 1,024 matched pairs.

We retain Subchapter S banks in all of our samples. The earnings of S corporations are exempt from corporate income tax, but shareholders must pay personal income taxes on 100% of annual corporate earnings. In exchange for this tax treatment, S corporations must remain closely held with no more than 100 shareholders. We include these banks in our data, together with the double-taxed banks organized as Subchapter C corporations, for two reasons. First, nearly 40% of all US commercial banks were organized as S corporations at the end of our sample period, so excluding these banks would seriously limit the size and diversity of our matched-pairs data set. Second, because Subchapter S banks are relatively small institutions, they are natural matches for credit unions which also tend to be small.

5.1. Matched-pairs sample

We draw the matched-pairs sample from the parent sample of 2,580 commercial banks and 1,279 credit unions. Given that credit unions are stand-alone entities, we eliminate all commercial banks that are affiliates of multi-bank holding companies prior to drawing the sample. For each credit union, we select a commercial bank that is (a) located geographically close to the credit union and (b) similar in size to the credit union.

It is important to match on geography because competitive conditions, economic conditions, business practices, government regulations, demographics, and cultural norms—all of which can influence the profitability and efficiency of financial institutions—can vary substantially across a country as large and as heterogeneous as the U.S. We measure geographic similarity as the distance in miles between the headquarters location of a credit union and the headquarters locations of banks with which it can potentially be paired. It is important to match on size because credit unions tend to be smaller than commercial banks, and as such are more likely at sub-optimal scale. There is near complete agreement among researchers that substantial scale efficiencies exist across the size range of the institutions in our sample (Berger and Mester, 1997; Wheelock and Wilson, 2011, 2012; Hughes and Mester, 2013).[23] We measure size similarity as the difference between a credit union's average asset size during our 52-quarter sample period and the average asset sizes of the banks with which it can potentially be paired.

We used a nearest-neighbour matching procedure to select the best matching bank for each credit union. The nearest-neighbour bank is the one that minimizes the value of a quadratic distance function, which is specified in terms of our geographic similarity and asset size similarity variables. We match with replacement, so that any given bank could be paired with multiple credit unions. We eliminate credit unions for which we cannot find a good match, rejecting all matched pairs in the top two deciles of the calculated distribution of quadratic losses. The resulting matched-pair sample contains 1,024 pairs, consisting of 1,024 unique credit unions and 569 unique banks.[24]

Our matching approach errs on the conservative side. Matching without replacement, imposing a tighter quadratic loss threshold for rejecting matched pairs, or requiring matched banks and credit

[23] There is less agreement regarding the relationship between institution size and technical efficiency, with some studies finding positive relationships and others finding negative relationships (see Berger, Demsetz and Strahan, 1999 for a review).

[24] On average, the banks and credit unions in these matched pairs differ in asset size by about 8% and are located 54 miles distance from each other. When we instead sample without replacement, the average size difference is little changed at 7%, but the average distance increases to 152 miles. Hence, sampling without replacement to increase the heterogeneity of the matched banks would be achieved only at the cost of greatly reducing the localness of the credit union-bank pairs.

unions to be located in pre-defined geographic areas (states, metropolitan areas, rural areas) reduces the size of the sample and results in larger estimated *profit inefficiency gaps* (see Appendix 2).

5.2. Variables

The line items in the credit union Call Reports do not match up perfectly with the line items in the commercial bank Call Reports. These inconsistencies prevent us from populating the netput and netput price vectors **x** and **p** as granularly as we would have liked. We take care to populate these two vectors as completely as possible, while including only those netputs and netput prices that are similarly measured in the two Call Reports. We display the two sets of Call Report definitions in Table 2 and report summary statistics in Table 3 for all the variables used to estimate and evaluate the profit model. The underlying bank and credit union Call Report data codes are displayed in Appendix 3.

We define *Profit* π as pre-tax net income at commercial banks and as total surplus at credit unions. Conducting our analysis in terms of pre-tax profitability is essential for comparing profit performance among double-taxed Subchapter C commercial banks, single-taxed Subchapter S commercial banks, and non-taxed credit unions.[25] We specify four variable netputs in **x**. *Loans* includes total on-balance sheet loans. *Investments* includes total securities currently held on balance sheet, plus deposits held in, loans made to, or stock held in other banks or credit unions. *Labour* is equal to the number of full-time equivalent (FTE) workers. Commercial banks directly report the number of FTEs, but credit unions separately report the numbers of full-time and part-time workers. We estimate FTEs for credit unions as full-time workers plus 0.50 times part-time workers.[26] *Deposits* is equal to total deposits and other borrowings, on which banks and credit unions may or may not pay interest.

We define local netput markets using the geographic borders of the 50 US states, and we assign banks and credit unions to these local markets based on the location of their headquarters offices. We

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[25] Berger, Hancock and Humphrey (1993) define π as pure variable profits $\sum_j^n p_j x_j$, which is constructed using only the revenues and expenses associated with the four variable netputs specified in the empirical model. In contrast, our net income before taxes definition of π captures 100% of bank and credit union revenues and expenses. When we re-estimate our model using the variable profit measure, the means value for *profit inefficiency gap* is .00919, substantially larger than the .00753 mean in our baseline model. Hence, our definition of π is a conservative choice that avoids overstating the size of the subsidies that credit unions enjoy.

[26] This follows industry precedent. The Credit Union National Association uses this weighting scheme to calculate FTEs in its *Credit Union Report, Mid-Year 2014* (see table on page 9, "Credit Union Employees by Asset Size"). Nevertheless, we test our results for robustness using alternative definitions of credit union FTEs using weights both larger and smaller than 0.50 (see Appendix 4).

calculate the netput prices $\mathbf{p}_{s,t}$ in these markets using the post-filtered data from 2,580 banks and 1,279 credit unions (Line D in Table 1) and the following formula: The market price for netput *j* in state *s* is equal to the aggregate revenue or expense flows for netput *j* at the banks and credit unions in state *s*, divided by the aggregate quantity of netput *j* produced or used by the banks and credit unions in state *s*, during quarter *t*. *Price(Loans)* is the aggregate interest revenues from loans divided by aggregate *Loans*. *Price(Investments)* is the aggregate interest and dividend revenues from investments divided by aggregate *Investments*. *Price(Labour)* is the aggregate wages and benefits paid to employees divided by aggregate *Labour*. *Price(Deposits)* is the aggregate interest paid on deposits and other borrowing money divided by aggregate *Funds*. Table 3 displays statistics for both market prices $\hat{p}_{j,s}$ (the unweighted average price for neput j in local market s) and internal prices $p_{j,i}$ (the prices actually paid or charged by bank i for netput j).

We specify four fixed factors in **z**. *Premises* includes the book value of land, buildings and other fixed assets; we include this to control for the effects of branches, ATMs, and other physical investments on profits. *Equity* is accounting net worth; we include this to control for the effect of financial leverage on profits. *Noninterest income* includes fees earned from providing transactions services to depositors, selling non-loan financial services, and capital gains income; we include this to control for the impact of profit-generating activities for which the data sources do not allow us to observe prices. *Risk-weighted assets* is the regulator-defined risk-weighted assets measure; we include this to control for the impact of asset risk on profits.

As indicated in Table 3, the matching process reduced *Assets* at both the average bank and average credit union by statistically and economically significant amounts. Accordingly, the mean values of all size-related variables in our data (*Profit*, netputs, fixed factors) also declined by statistically significant amounts. Changes to means netput prices (market and internal) were mixed and tended to be economically small. The sole exception is the economically large increase in the price of *Labor* for commercial banks (though not for credit unions), a natural outcome of retaining only those banks situated close to credit unions, which are less likely than banks to operate in rural places. The average matched-pairs bank earned materially lower *Return on assets* than the average bank in the parent sample, again suggesting that our *profit inefficiency gaps* will be conservative estimates.[27]

5.3. Survivorship

Our structural profit approach necessarily restricts the data to banks and credit unions that survived the entire 2005 to 2017 data period. As shown in Table 4, the numbers of both commercial banks and credit unions in the US (with assets between $50 million and $8.152 billion) were in decline during our sample period, with the attrition rate at banks (41%) more than double the attrition rate at credit unions (16%). This difference is consistent with an active market for corporate control that exerts strong discipline on banks but not on credit unions. It also gives us pause to wonder whether and how this survivor bias might bias our estimates of credit union subsidies.

We can ascertain the direction of any such survivor bias in our estimates by comparing the profitability in 2004 for banks and credit unions that did or did not survive until the end of our 2005-2017 sample period. On average, 2004 ROA for surviving banks was 47.7 basis points higher than for non-surviving banks (.01163 minus .00686), while 2004 ROA for surviving credit unions was 95.4 basis points higher than for non-surviving credit unions (.00505 minus -0.00449). In other words, the profit-improving impact of survivorship was twice as large for the credit unions in our data than for the commercial banks in our data. This suggests strongly that any survivorship bias imposed by our methodology will understate the size of the credit union profit inefficiency gaps.[28]

6. Results

We use seemingly unrelated regression (SUR) techniques to estimate the parameters of the profit efficiency model, using data from the 2,580 commercial banks in the parent sample. We do not include the 1,279 credit unions in the parent sample in this estimation, because credit unions are neither

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[27] We do not conduct difference-in-means tests for banks versus credit unions within our matched sample. In our theoretical model, banks choose their netput quantities and take market netput prices as given, and in our empirical application credit unions choose both netputs and netput prices. Because netputs and netput prices are the fundamental determinants of profit inefficiency, requiring the banks and credit unions in our matched pairs sample to have the same mean netput quantities and netput prices would be equivalent to rejecting our testable hypotheses by construction.

[28] Appendix 5 provides further information regarding the number of survivors, annual rates of attrition, and average return on assets (ROA) among banks and credit unions

profit-maximisers nor price-takers as assumed by the theory. We then use the estimated parameters to generate a vector of n×T residuals for each of the 2,580 commercial banks included in the estimation; we use the same parameters to estimate a vector of residuals for each of the 1,279 credit unions. The residuals are then used to calculate a complete set of netput inefficiency terms $\hat{\xi}_{j,i}$ and profit inefficiency measures $Ineff_i$ for each bank and each credit union. (More complete details are provided in Appendix 1.) Thus calculated, we can interpret $Ineff_i$ as the inefficiency that would have been generated by a price-taking, profit-maximising commercial bank that made the same variable netput decisions as did credit union *i*.

6.1. Profit inefficiency and profit inefficiency gaps

Table 5 displays our estimates of profit inefficiency for the 1,024 matched pairs of commercial banks and credit unions (Panel A) and also for the parent sample of 2,580 commercial banks and 1,279 credit unions (Panel B). Our main focus here is on the matched-pairs results. All of the inefficiency measures displayed in this table are expressed in quarterly terms and are valued using average local market netput prices $\hat{p}_{j,s}$.[29]

The estimated profit inefficiencies are large. For example, we estimate that the average matched-pair commercial bank incurred more than $6 million of profit inefficiency each quarter, which amounts to $0.0198 per dollar of assets each quarter (*Ineff/Assets*, which is our preferred measure of profit inefficiency) or $0.0792 per dollar of assets in annualized terms. To put this last figure into perspective, eliminating this much profit inefficiency would increase a bank's pre-tax ROA by 732% (0.0792/0.01082). While this result at first may seem to be too large, it conforms with the variation in pre-tax bank ROA in the raw data: Pre-tax ROA more than doubles as a bank moves from the 50th percentile to the 99th percentile; nearly quintuples as a bank moves from the 10th to the 99th percentile; and increases seven-fold as a bank moves from the 5th percentile to the 99th percentile (see Table 6).

[29] Appendix 6 provides estimates of profit efficiency of matched pair of banks and credit unions under various scenarios including: imposing the restriction that all matched pairs must have the same metro/micro/rural classification; imposing the restriction that all matched pairs must be more than 10 miles distant from each other; using sampling without replacement where each sample bank is eligible to be paired with no more than one sample credit union; and restricting the pool of banks available for matching to those located in states in the lowest two quartiles of the distribution of states by average corporate tax rate. Appendix 7 examines the sensitivity of measured inefficiency to survivorship/non-survivorship.

Profit inefficiency accounts for an estimated 84.84% of potential profits at the average matched-pair credit union, and 100.81% of potential profits in the parent sample. Again, these results may at first seems overly large, but upon reflection they are economically sensible: Not-for-profit institutions are expected to earn only enough profit to maintain/replenish their capital and liquidity buffers, and to direct any additional potential profit to their intended beneficiaries—in the case of credit unions, by providing extra financial services, better service quality, or favourable prices to their members (mandated inefficiencies).

Table 7 displays our estimates of *profit inefficiency gaps* and *netput inefficiency gaps* for the matched-pair data sample. As before, we value the estimated inefficiencies using local market prices: If loans, deposits, labour and investment securities are purchased and sold in competitive markets, then market prices represent the value of a marginal unit of these netputs allocated to their next best uses, and the estimated market-value inefficiency gaps displayed in this table represent the gross social costs of credit union inefficiency relative to banks.[30] All of the numbers in Table 7, and in all the remaining tables, are expressed in annual magnitudes.

We find economically meaningful *profit inefficiency gaps*. The mean estimated profit inefficiency gap is .00753 per year, indicating that the average credit union was 75.3 basis points of assets less profit efficient than the average commercial bank. This gap is the equivalent of 69.6% of the annual pre-tax profits earned by the typical commercial bank in our match-sample data (0.00753/0.01082).

6.2. Mandated versus absolute inefficiencies

We find strong support for the mandated inefficiency hypothesis H1. Valued using local market prices, the average credit union in our matched pairs data generated 72.1 basis points more mandated inefficiencies per dollar of assets than the average commercial bank. This mandated profit inefficiency gap is dominated by deposit-related financial services (safe-keeping, member liquidity, payments services, risk-free investment vehicles) with only a trivial portion consisting of credit-related financial

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[30] We refer to these are gross costs because they do not include the potentially offsetting intangible social benefits derived from redistributing income *via* the tax and/or non-profit subsidies. Measuring such benefits is a normative exercise and lies far beyond the scope of this study.

services. Relative to the average bank, the average credit union overused deposit inputs by 70.9 basis points of assets and over-produced loan outputs by 1.2 basis points of assets; the former result adds to the *profit inefficiency gap* because it generates excess costs, while the latter result reduces the *profit inefficiency gap* (slightly) because it generates extra revenues.[31]

We find relatively weak support for the absolute inefficiency hypothesis H2. Valued at local market prices, the average credit union generated just 5.6 basis points more absolute inefficiencies per dollar of assets than the average commercial bank. This economically small absolute inefficiency gap is comprised almost entirely by the under-production of investment outputs at credit unions. We find little evidence to suggest that credit unions overuse labour inputs, on average, relative to similar commercial banks. Although the raw data suggest substantial over-hiring by credit unions (as shown in Table 3), credit unions employ 14% more full-time equivalent workers than matched-pair banks. Our model accounts for the additional labour inputs necessary to provide more depositor services than banks, and merely hints at positive labour inefficiency gaps in two of the asset-based subsamples.[32]

Overall, when we use local market prices to value the netput inefficiencies estimated in our model, the credit union *profit inefficiency gap* is economically large and is explainable almost entirely by credit unions' legislative *raison d'être*. On average, for every extra dollar of absolute inefficiency that they generate relative to commercial banks, credit unions generate thirteen dollars of mandated inefficiencies. Moreover, although the absolute inefficiency gap is statistically greater than zero, it is economically small.[33] The overall *profit inefficiency gap* shrinks with asset size. This is caused by a

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[31] Our analysis assumes no difference in the quality of the loans on credit union and commercial bank balance sheets. But credit unions make loans only to their depositor members, and those relationships could result in informational advantages that improve the quality of credit union loans—if so, then the loan inefficiency gap would arguably overstate credit union inefficiency relative to banks. Nevertheless, the data offer no support for this argument. Measured relative to total loans, average annual provisions for loan losses (.0067 versus .0039), loans delinquent more than 30 days (.0232 versus .0130) and loans charged off (.0084 versus .0050) were higher for credit unions than for commercial banks over our 13-year sample period (see Appendix 8).

[32] Our analysis assumes that a positive labour inefficiency gap represents absolute inefficiencies at credit unions relative to banks. But if those extra workers were employed to provide financial services consistent with credit unions' underlying mission—say, credit counselling for credit union members—then some or all of the labour inefficiency gap would be more properly classified as mandated inefficiency. Regardless, this turns out to be a moot argument in our analysis, given the very small labour inefficiency gaps in Table 7.

[33] Thus, we interpret our findings are thus inconsistent with Boyer and Kempf (2020) who show that (in the absence of bank mobility) regulatory contracts can be designed in such a way as to ensure that banks are regulated based upon their relative efficiency. The authors conclude that this optimal regulatory contract is supported by two instruments, comprising taxes on bank profits and liquidity requirements. In the present setting, where credit

reduction in the mandated inefficiency gap across the four asset-size subsamples, albeit these declines are relatively small and non-monotonic.

6.3. Tax subsidies versus non-profit subsidies

Decomposing the estimated profit inefficiency gap into its fundamental institutional drivers—namely, the credit union tax subsidy and the credit union non-profit subsidy—is of central importance to this study. Unfortunately, neither of these subsidies is observable directly. In this section, we attempt to back-out a reasonable decomposition, based on the logic of our analytic framework and the characteristics of the credit unions and banks in our matched-pair data. We begin by expressing the profit inefficiency gap as the simple difference in profits between a well-matched bank-credit union pair:

$$\pi_B - \pi_{CU} = [t \cdot \pi_B + div_B + retain_B] - [0 + 0 + retain_{CU}] \tag{3}$$

where π_B is pre-tax bank profits and π_{CU} is pre-tax credit union profits.[34] The first bracketed term indicates that the bank's pre-tax accounting profits equal the sum of three items: income taxes paid $t \cdot \pi_B$; earnings distributed to shareholders div_B; and earnings retained $retain_B$. In the second bracketed term, the credit union neither distributes earnings nor pays income taxes but does retain some earnings $retain_{CU}$.[35] Rearranging (3) provides a formula useful for calculating the relative size of the two credit union subsidies:

$$t \cdot \pi_B = (\pi_B - \pi_{CU}) - div_B + (retain_{CU} - retain_B) \tag{4}$$

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unions are at an overall level more inefficient than banks, this at first glance may appear that there are gains from regulating credit unions less permissively. However, such an approach would not be justified, given that we find almost all of the observed differences between banks and credit unions are attributable to mandated (rather than absolute) inefficiency.

[34] The pre-tax difference in profits $\pi_B - \pi_{CU}$ provides an appropriate representation of the inefficiency gap because, for a well-matched pair, the inefficiencies of both institutions are estimated by comparing their profits to the same place on the efficient bank profit surface.

[35] The interest payments that credit union members receive are not returns to ownership. Credit union members lack some of the most basic ownership characteristics: (a) they only very infrequently receive distributions (Callahan Associates 2015), which are called "patronage dividends" which itself suggests something very different from ownership, (b) they do not receive payments in exchange for ownership rights when their credit union is acquired, and (c) their interest income is not an entrepreneurial return to risk taking because they are not placing any capital at risk (and in most cases, their deposits are fully insured).

The *tax* subsidy is given by $t \cdot \pi_B$, taxes that the bank must pay, but from which the well-matched credit union is exempt. The *steady-state non-profit subsidy* is given by div_B, the return to risk capital in a hypothetical steady state (in which earnings neither grow nor shrink, so that the dividend payment fully accounts for the shareholder's required rate of return) which in the absence of shareholders the matched credit union need not pay. In this hypothetical steady state, the well-matched bank and credit union each retain only the earnings necessary to maintain their required equity cushions, and as such the "retention difference" $retain_{CU} - retain_B = 0$. Hence, the tax subsidy $t \cdot \pi_B$ becomes calculable because we have estimates of the profit inefficiency gap $\pi_B - \pi_{CU}$ and we can observe the bank dividend payments div_B. This simple arithmetic is depicted in Figure 1 as A + B = C.

The special case in which $retain_{CU} - retain_B = 0$ is hypothetical and hence unobservable, but the actual values for the retention difference are easily observable in the matched-pairs data, and can be used along with equation (4) to roughly decompose the profit inefficiency gap into its two subsidy roots. As demonstrated in this accounting identity-based equation, the tax subsidy increases with the retention difference: Holding bank dividends constant, a larger retention gap indicates higher bank profits relative to credit union profits, causing the bank's tax bill (which the credit union escapes via legislation) to increase. These rough calculations are displayed in Table 8. At least on average, the tax and non-profit subsidies are about equally responsible for the poor relative performance of the credit unions in our data: the tax subsidy accounts for 55% of the profit inefficiency gap at the average bank-credit union pair.

The average retention difference is small, only about two basis points per asset dollar, and accordingly has only a small influence on this result. Indeed, if we had allocated the retention difference to the non-profit subsidy instead of to the tax subsidy (an action for which we have no justification), the calculated tax subsidy would decline only from .00414 to .00392 and would still account for 52.1% of the profit inefficiency gap. It is perhaps surprising that the average retention difference is positive. In 56 percent of the bank-credit union pairs, the credit union retains more earnings per dollar of assets than the bank. There are reasonable explanations for why incentives to retain earnings (at the margin) could be stronger at credit unions than at commercial banks. First, a dollar of earnings retained and reinvested at an un-taxed credit union will generate a larger expected *after-tax* return than at a bank. Second, a dollar of earnings retained and reinvested imposes a liquidity cost on bank shareholders because it requires the bank to distribute smaller dividends but imposes no such cost at credit unions.

6.4. Valuing inefficiencies using internal netput prices

We have thus far valued our estimated profit and netput inefficiencies at local market prices. Using this approach, the profit inefficiency gap is the social cost of the resources a credit union uses *in excess of* those used by an otherwise similar commercial bank. However, if credit unions transact with their members at better-than-market prices, a market-value approach will understate the pecuniary benefits that credit unions provide those members. We address this issue by decomposing our estimated profit and netput inefficiencies into *internal inefficiencies*, *market inefficiencies*, and *pricing inefficiencies* per dollar of assets, using the relationship in equation (2). The results of this decomposition are displayed in Table 9.

On average, internal inefficiencies (.02037) and market inefficiencies (.01948) are very similar for banks. Equivalently stated, pricing inefficiencies per dollar of assets are very small for banks. This result is consistent with our maintained assumption that commercial banks are price takers, and it infers that profit inefficiency at banks is associated almost entirely with the overuse of inputs and/or the underproduction of outputs. We find starkly different results for credit unions, where internal inefficiencies (.09393) dominate market inefficiencies (.02737). Equivalently stated, in addition to over-using inputs and/or underproducing outputs to a larger extent than do banks, credit unions transfer a portion of their subsidies to their members (and/or other agents) in the form of favourable netput prices. When value the profit inefficiency gap using the actual prices that credit unions charged and paid for netputs, 89.8% of this performance gap can be attributed to non-market pricing by credit unions (.06603/.07356).

The prices paid on credit union member deposits are the dominant component of these transfers. For loans (.00010), investments (.00085), and labour (-.00060) netputs, pricing inefficiencies per dollar of assets were small and not terribly different from those at the commercial banks. On average, credit unions are paying near-market prices for these three netputs, and the pricing inefficiency gaps associated with these netputs are either statistically non-significant (for investments) or economically small (credit unions charged lower rates on loans and paid lower wages/benefits to labour).[36] The large credit union pricing inefficiencies are nearly entirely associated with above market prices for deposits. These results suggest that credit unions deploy their tax and non-profit subsidies as pass-through benefits for their members; it is the dominant channel through which these subsidies flow.

Our pricing inefficiency results are qualitatively consistent with interest rate data collected annually by the NCUA.[37] Figure 2 graphs the difference in average annual interest rates (credit unions minus commercial banks) for selected deposit products in 2003 through 2016. According to these data, credit unions have on average paid premiums over commercial banks as high as 69 basis points on certificates of deposit (CDs), 19 basis points on regular savings accounts, and 16 basis points on interest-bearing checking accounts. Figure 3 graphs the difference in average annual interest rates for selected loan products and shows that loan prices are not always lower at credit unions than at commercial banks. Credit unions consistently under-price commercial banks by 100 to 200 basis points on automobile loans and unsecured consumer loans, products that most commercial banks have either abandoned or deemphasized. However, interest rates on residential mortgages (which account for approximately half of the assets in credit union loan portfolios, and which are priced in highly competitive national financial markets that leave little room for strategic pricing) are relatively similar for credit unions and banks.[38]

7. Conclusions

In the US, credit unions are exempt from paying federal income taxes. Yet they compete directly in credit and deposit markets with small commercial banks that pay both federal and state

[36] It is possible that our results for loan netputs reflect unspecified differences in the business models of banks and credit unions. To investigate, we re-estimated our model after expanding the vector of fixed netputs $\boldsymbol{z}$ with two additional control variables: the level of *business loans* (important to most commercial banks, but unimportant to most credit unions) and the level of *real estate loans* (which vary idiosyncratically in importance at both banks and credit unions). Our results—shown in Appendix 4are robust to making this change.

[37] A caution to the reader: The deposit interest rate differences in Figure 2 and the estimated deposit pricing inefficiency gap in Table 9 are not directly comparable. The former are raw interest rate differences, while the latter are interest rate differences multiplied by an estimated inefficiency term. While we would expect these two measures to be qualitatively similar, one would not expect them to map into each other quantitatively.

[38] For additional research comparing the deposit rates and loan rates charged by credit unions and commercial banks, see Tatom (2005), Feinberg and Rahman (2006), Jackson (2006), US Government Accountability Office (2006), Swidler (2010), and PolEcon Research (2017).

income taxes. The tax exemption dates as far back as 1937, when the Federal Credit Union Act of 1934 was amended to exempt credit unions from income taxation at the federal level. The tax exemption was to encourage credit unions to organize and supply credit to low- and moderate-income households, at a time when neither commercial banks nor savings banks made many consumer loans. Today in the United States, credit unions remain the sole organisational form amongst mainstream financial institutions to enjoy a federal tax exemption. Mutual banks and savings and loan institutions lost their tax exemption in the Revenue Act of 1951, on the grounds that these institutions had strayed from their mutual purpose and thus should no longer enjoy competitive advantages over commercial banks (White, 2012). In this paper, we argue and provide new empirical evidence that US credit unions have also strayed from their original missions and, as such, there is no longer a compelling reason for their federal tax exemption.

Considerable changes have occurred in the banking industry, financial markets, and information technology over the past 80 years. New forms of financial intermediaries have emerged, which along with banks and credit unions offer an array of products and services tailored to meet the needs of households, proprietors, and small corporates. Consequently, previously excluded or poorly served low- and moderate-income households now have plentiful (some might argue too plentiful) access to credit. Moreover, regulatory rulings have loosened longstanding geographic and product market restrictions; many credit unions can now extend membership to depositors anywhere in the US, and most credit unions no longer face any meaningful limitations on their portfolio shares of business loans. Such changes have led to a blurring of historical demarcations between credit unions and commercial banks in terms of the scale and scope of activities.

In recent times, credit unions have enjoyed unprecedented levels of both asset and membership growth. Between 2018 and 2021, total assets at US credit unions increased by 40 percent from $1.45 trillion to $2.04 trillion, while the number of credit union members increased by 12 percent from 116 million to 130 million members. Over the same period, credit unions have embarked on a spree of acquisitions that includes the purchase of more than 60 for-profit community banks. Perhaps most significant, recent evidence suggests that low-income individuals have become less (rather than more) likely to use the services of a credit union: the average credit union member has similar or even higher income than the average bank customer (US Government Accountability Office, 2005, 2006; White, 2012; Maskara and Neymotin, 2021).

Ironically, while banks are mandated under the provisions of the Community Reinvestment Act to provide for the credit needs of low- and middle-income communities, credit unions are not so required, nor are they required provide information on the proportion of their members designated as low-income. Not surprisingly, credit union industry stakeholders (including the Credit Union National Association) traditionally resist efforts to require credit unions to disclose detailed information regarding the income composition of members, and the extent to which they serve those of low- and moderate income (Jacob, Bush and Immergluck, 2002). Based on the accumulated evidence that credit unions have strayed from their "specified mission of meeting the credit and savings needs of consumers, especially persons of modest means" and instead have refocused their attention on a customer base that is similar (or even more affluent) than that served by commercial banks, it begs the question: Should credit unions still be exempt from paying income taxes?

In this study, we scrutinize how US credit unions utilize their income tax exemptions as well as their non-profit status, and how the subsidies derived from their institutional differences with commercial banks are allocated to credit unions' various constituents. We begin by estimating a structural profit inefficiency model for a quarterly data panel of small US commercial banks between 2005 through 2017; in this way, we establish a theoretically complete performance surface with which to compare the efficiency with which credit unions intermediate between savers and borrowers. We use the estimated model parameters to evaluate the relative performance of 1,024 matched pairs of US credit unions and commercial banks. When we use average local market prices to value inputs and outputs (an appropriate benchmark for the opportunity benefits and costs of government policy), the estimated profit inefficiency gap between credit unions and commercial banks is an economically substantial 75 annual basis points of assets. Although neither of the subsidies embedded in credit unions' institutional structures is directly observable, some rough calculations suggests that slightly more than one-half of these market-value inefficiencies is made possible by the tax subsidy, with the balance made possible by the non-profit subsidy.

In the end, who consumes these subsidies? When we value input and outputs using average local market prices, our results show that over 90 percent of the inefficiency gap is generated by credit unions' production of depository services (safe-keeping, member liquidity, payments services, risk-free savings vehicles) over-and-above those produced by otherwise similar commercial banks. However, when we value inputs and outputs using the actual prices that banks and credit unions pay and charge—that is, when we allow for the fact that credit unions often provide better-than-market prices to their members—the results suggest that the bulk of the credit union subsidies are simply passed through to credit union member-depositors in the form of higher interest payments. Contrary to conventional wisdom, we find little significant evidence that member-borrowers benefit from preferential loan rates, on average. Moreover, and inconsistent with our priors that weaker governance arrangements and less effective monitoring incentives at credit unions allow managers to operate more inefficiently than comparable commercial banks, we find little significant evidence that operational inefficiencies are any greater at the average credit union than at otherwise similar commercial banks.

Our findings have implications for three sets of stakeholders. First, these findings strongly buttress arguments made by commercial banks that the tax exemption provides credit unions with an unfair competitive advantage, predominantly in the capture of retail deposits. Second, when combined with evidence from household income surveys conducted by the others (including the leading credit union industry association), our findings indicate that the majority of the credit union tax subsidy is being diverted away from the intended beneficiaries. That is, away from individuals of "modest means" and especially away from those for whom accessing credit is difficult. Third, if the benefits that credit union members receive are indeed merely pecuniary—as our results indicate, merely a passthrough from taxpayers to credit union depositors—then arguments for the continuation of the credit union tax exemption, estimated to currently cost over $2 billion per annum, would appear to rest on increasingly shaky ground (Joint Committee on Taxation, 2020).

There is a need—long called for by various stakeholders in the financial services industry—to better understand whether and how credit unions are serving the financial services needs of low- and moderate-income households. Going forward, public policy could require credit unions to disclose information on the income composition of their membership bases. Expanding the Community

Reinvestment Act (which requires commercial banks and savings banks to meet the credit needs of the communities in which they chartered, including low- and moderate-income neighbourhoods) to include credit unions might also be a useful step in this direction.

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Table 1: Sample Selection

This table summarizes the procedures used to filter out banks or credit unions with incomplete data, outlying values, or characteristics inconsistent with the requirements of our model and tests. Asset values are in 2010 dollars.

	Commercial Banks	Credit unions
A. Institutions reporting positive assets in every quarter, 2005.1 through 2017.4	4,582	5,621
Less: Mean quarterly assets less than $50 million	(564)	(3,451)
Less: Mean quarterly assets greater than $8.152 billion	(104)	(9)
B. Institutions with assets between $50 million and $8.152 billion	3,914	2,161
Less: Data needed to calculate variables is missing	(1,335)	(856)
C. Institutions with complete data	2,633	1,305
Less: Mean ROA in 1st or 100th percentile of bank or credit union distribution	(53)	(26)
D. Filtered data	2,580	1,279
E. ***Estimation data set:*** Commercial banks used to estimate the profit function	2,580	--
F. ***Parent sample:*** Institutions from which the matched sample is drawn	2,580	1,279
G. ***Matched-pairs data set:*** Institutions used to test hypotheses H1 and H2	1,024	1,024

Table 2: Variable Definitions

This table reports definitions of the variables used in the profit function estimations and the matched-sampling procedure. Netput prices are calculated using aggregate industry data in the headquarters state of each bank or credit union. All other variables are observed at the individual bank or credit union. See the Appendix for variable definitions expressed in terms of the data codes in the FFIEC call reports and the NCUA call reports.

	Commercial banks	Credit unions
Profit		
Profits $\pi_{i,t}$	Pre-tax net income	Net income ("surplus")
Netputs		
Loans $x_{1,i,t}$	Total loans (excluding leases)	Total loans (excluding leases)
Investments $x_{2,i,t}$	Total securities investments	Total investments
Labour $x_{3,i,t}$	Full-time equivalent workers (FTEs)	Full-time workers + 0.5*Part-time workers
Deposits $x_{4,i,t}$	Deposits and all other borrowed funds	Member shares, non-member deposits, and other borrowings
Netput prices		
Price(Loans) $p_{1,s,t}$	Interest income on loans/*Loans*	Interest income on loans/*Loans*
Price(Securities) $p_{2,s,t}$	(Interest income on securities + Dividends on securities)/*Securities*	(Interest income on securities + Dividends on securities)/*Securities*
Price(Labour) $p_{3,s,t}$	(Salaries + Benefits)/*Labour*	(Salaries + Benefits)/*Labour*
Price(Deposits) $p_{4,s,t}$	(Interest expenses on deposits and other borrowings)/*Deposits*	(Interest expenses on deposits and other borrowings)/*Deposits*
Fixed factors		
Premises $z_{1,i,t}$	Premises and fixed assets	Land, buildings and other fixed assets
Equity $z_{2,i,t}$	Equity capital	Net worth
Noninterest Income $z_{3,i,t}$	Non-interest income	Non-interest income
Risk-weighted Assets $z_{4,i,t}$	Risk-weighted assets (using Federal Reserve formula)	Risk-weighted assets (using NCUA formula)
Other		
Assets	Total assets	Total assets

Table 3: Descriptive Statistics for Matched-pairs and Parent Samples

This table reports descriptive statistics for the variables used in the profit function estimations and construction of the profit inefficiency measures. Firm-quarter observations for 2005-2017. Number of firms are reported in parentheses. All monetary amounts in 2010 prices. Netputs, Fixed factors, and Other variables are end-of-quarter values. The netput market price and netput internal price variables are constructed using quarterly flows. Profitability variables are annualized. ***, ** and * indicate that the means for banks (credit unions) in the matched-pairs sample are statistically different from the means for banks (credit unions) in the parent sample, respectively, at the 1%, 5% and 10% levels.

	Panel A: Matched-pairs data set				**Panel B: Parent sample**			
	Commercial banks (n=1,024)		Credit unions (n=1,024)		Commercial banks (n=2,580)		Credit unions (n=1,279)	
	mean	std dev	mean	std dev	mean	std dev	mean	std dev
Assets ($ million)	309.0***	429.3	314.3***	449.3	410.3	747.8	399.0	715.3
Profitability								
Profit ($ million, pre-tax, annualized)	3.7***	6.2	1.9***	3.9	5.5	11.8	2.6	6.0
Return on assets (pre-tax, annualized)	.01082***	.00501	.00521	.00332	.01251	.00467	.00529	.00332
Netputs ($ million)								
Loans	193.9***	267.6	200.6***	295.8	263.9	499.5	254.5	470.0
Investments	82.3***	150.2	73.4***	139.5	104.6	199.9	95.2	224.4
Labour	73.7***	83.1	86.0***	91.2	103.6	190.6	101.5	138.4
Deposits	238.7***	343.5	278.1***	399.4	320.6	593.9	353.2	635.2
Netput market prices								
Price(Loans)	.01336***	.00214	.01353**	.00219	.01390	.00148	.01374	.00228
Price(Securities)	.00748***	.00051	.00754	.00061	.00753	.00042	.00756	.00067
Price(Labour) ($ thousand)	20.17***	4.30	19.85	4.13	18.03	3.10	19.84	4.07
Price(Deposits)	.00354***	.00041	.00354**	.00043	.00365	.00041	.00350	.00047
Netput internal prices								
Price(Loans)	.01556	.00237	.01470	.00179	.01552	.00183	.01474	.00235
Price(Securities)	.00884**	.00907	.00923	.00619	.00810	.00546	.00918	.00588
Price(Labour) ($ thousand)	16.28***	4.86	14.42	3.25	14.97	3.57	14.41	3.23
Price(Deposits)	.00364***	.00101	.01390	.00273	.00376	.00085	.01383	.00271
Fixed factors ($ million)								
Premises	4.6***	6.1	7.2***	9.3	7.1	12.8	8.5	13.0
Equity	31.7***	45.5	33.5***	47.4	43.2	83.0	42.2	74.7
Noninterest Income	0.8***	1.4	1.1***	1.6	1.1	3.6	1.4	2.4
Risk-weighted Assets	213.6***	304.2	201.1***	287.8	288.1	548.0	253.2	455.0

Table 4: Impact of Survivorship

This panel compares the asset size and return-on-assets for banks and credit unions that survived (and hence were retained in the data sample) and did not survive (and hence were removed from the data sample) from 2005 through 2017. Banks and credit unions present at the start of 2005 had assets between $50 million and $8.125 billion in 2010 prices. (Note: The numbers of observations in this table do not match the numbers of observations in Table 1, due to the different methodological objectives of the tables.)

	Present at start of 2005	Survived to end of 2017	Did not survive to end of 2017	Difference	Attrition Rate
Number of commercial banks	6,028	3,578	2,450	--	40.6%
Number of credit unions	2,181	1,837	344	--	15.8%
Mean assets at commercial banks	--	$536.5m	$515.0m	$21.5m	--
Mean assets at credit unions	--	$421.4m	$253.8m	$167.6m	--
Mean ROA at commercial banks	--	.01163	.00686	47.7 bps	--
Mean ROA at credit unions	--	.00505	-.00449	95.4 bps	--

Table 5: Estimated Raw Profit Inefficiencies

This table reports estimates of profit inefficiency for commercial banks and credit unions over the 2005-2017 data period. Mean values for the matched sample of 1,024 banks and credit unions are displayed in columns [1] and [2]. Mean values for the larger parent samples of 2,580 banks and 1,279 credit unions are displayed in columns [3] and [4]. The raw estimated inefficiency measures were winsorized at the 5^{th} and 95^{th} percentiles of the sample distributions before calculating the statistics in this table. All of the *Ineff* data reported in this table are calculated in terms of local market netput prices and are expressed as ***quarterly magnitudes***.

	Panel A: Matched-pairs data set		**Panel B: Parent sample**	
	[1] Commercial banks (n=1,024)	[2] Credit unions (n=1,024)	[3] Commercial banks (n=2,580)	[4] Credit unions (n=1,279)
Ineff ($ millions)	6.167	8.415	7.865	10.024
Ineff/assets	0.0198	0.0274	0.0206	0.0274
Ineff/(Ineff+π)	0.6903	0.8484	0.7227	1.0081
mean *Ineff/assets* by asset size:				
$50 - $100 million	0.0244	0.0321	0.0251	0.0310
$100 - $200 million	0.0173	0.0244	0.0190	0.0246
$200 - $500 million	0.0159	0.0243	0.0167	0.0243
$500 million or more	0.0220	0.0289	0.0206	0.0286

Table 6: Distribution of Average Annualized Return on Assets

This table displays the distribution of average ***annualized*** return on assets (ROA) for the 1,024 commercial banks in the matched-pairs sample, calculated using 52 quarters of data (2005-2017) for each bank.

Percentile	**Annualized ROA** 1,024 banks in the matched-pairs sample
99th	.02475
95th	.01957
90th	.01733
75th	.01382
50th	.01045
25th	.00773
10th	.00506
5th	.00251
1st	-.00073

Table 7: Profit Inefficiency Gaps

This table reports mean values for the estimated ***profit inefficiency gaps*** for 1,024 matched pairs of commercial banks and credit unions over the 2005-2017 sample period.

$$\textit{profit inefficiency gap}_{pair} = (\textit{Ineff/assets})_{credit\ union} - (\textit{Ineff/assets})_{bank}$$

All of the *inefficiency gaps* reported in this table are calculated in terms of average netput prices in local markets and are expressed as ***annualized magnitudes***. ***, ** and * indicate statistically different from zero at the 1%, 5% and 10% levels.

	[1] *Profit inefficiency gap*	[2] *Loans*	[3] *Deposits*	[4] *Mandated (-2+3)*	[5] *Investments*	[6] *Labour*	[7] *Absolute (5+6)*
All matched pairs (n=1,024)	.00753***	-.00012***	.00709***	.00721***	.00054***	.00002	.00056***
By asset size:							
$50-$100 million (n=301)	.00764***	-.00001	.00707***	.00708***	.00063***	-.00006	.00057***
$100-$200 million (n=292)	.00704***	-.00032***	.00676***	.00708***	.00049***	.00012*	.00061***
$200-$500 million (n=258)	.00839***	-.00007***	.00815***	.00822***	.00033***	-.00001	.00031***
$500-$5,260 million (n=173)	.00687***	-.00004***	.00609***	.00614***	.00078***	.00005*	.00083***

Table 8: Extracting the Average Tax Subsidy

This table evaluates equation (4): $t \cdot \pi_B = (\pi_B - \pi_{CU}) - div_B + (retain_{CU} - retain_B)$, where the left-hand side is the credit union tax subsidy and the three right-hand side terms are, respectively, the profit inefficiency gap, bank dividends, and the retention gap. All data are mean values for the matched-pairs sample of 1,024 banks and credit unions and are expressed in annual terms per dollar of assets.

(1) profit inefficiency gap	(2) bank dividends	(3) bank retained earnings	(4) credit union retained earnings	(5) retention difference	(6) tax subsidy	(7) = (6) ÷ (1) tax subsidy % of inefficiency gap
.00753	.00361	.00499	.00521	.00022	0.00414	55.0%

Table 9: Internal, Market, and Pricing Inefficiencies

This table decomposes ***profit inefficiencies*** and ***profit inefficiency gaps*** into internal inefficiency, market inefficiency, and the pricing inefficiency according to equation (2):

$$\hat{p}_{j,i}\xi_{j,i} = \hat{p}_{j,s}\xi_{j,i} + (\hat{p}_{j,i} - \hat{p}_{j,s})\xi_{j,i}$$

Data are mean values for 1,024 matched pairs of commercial banks and credit unions over the 2005-2017 sample period. In Panel B, the ***, ** and * indicate statistically significant differences at the 1%, 5% and 10% levels, respectively. All numbers are expressed as ***annualized magnitudes*** per dollar of assets. All variables are defined in the text.

	Total	*Loans*	*Deposits*	*Investments*	*Labour*
Profit inefficiencies					
Banks					
Internal inefficiency/assets	.02037	.00085	.01605	.00211	.00136
Market inefficiency/assets	.01984	.00068	.01582	.00145	.00190
Pricing inefficiency/assets	.00053	.00017	.00024	.00066	-.00054
Credit Unions					
Internal inefficiency/assets	.09393	.00066	.08912	.00283	.00132
Market inefficiency/assets	.02737	.00056	.02290	.00199	.00192
Pricing inefficiency/assets	.06657	.00010	.06622	.00085	-.00060
Profit inefficiency gaps					
Internal inefficiency gap	.07356***	-.00019***	.07307***	.00073***	-.00004
Market inefficiency gap	.00753***	-.00012***	.00709***	.00054***	.00002
Pricing inefficiency gap	.06603***	-.00007***	.06598***	.00019	-.00006**

Figure 1: How the Pre-Tax Profits of a Commercial Bank might be consumed at a Tax-exempt, Not-for-profit (but otherwise identical) Credit Union

This figure shows how the pre-tax profits of a commercial bank might be consumed at a tax-exempt, not-for-profit, but otherwise identical credit union. The darkened bars represent pre-tax profits at either the bank (first column) or the credit union (the remainder of the columns). Like the bank, the credit union will retain some of its profits to maintain its equity cushion, but neither pays income taxes (the tax subsidy A) nor distributes dividends (the non-profit subsidy B). Both subsidies are available to credit union management and will be consumed either in the form of higher expenses or deficient revenues (profit inefficiencies C). Some of these profit inefficiencies are prescribed by the legislation under which credit unions operate (mandated inefficiencies D) while the remainder are not (absolute inefficiencies E).

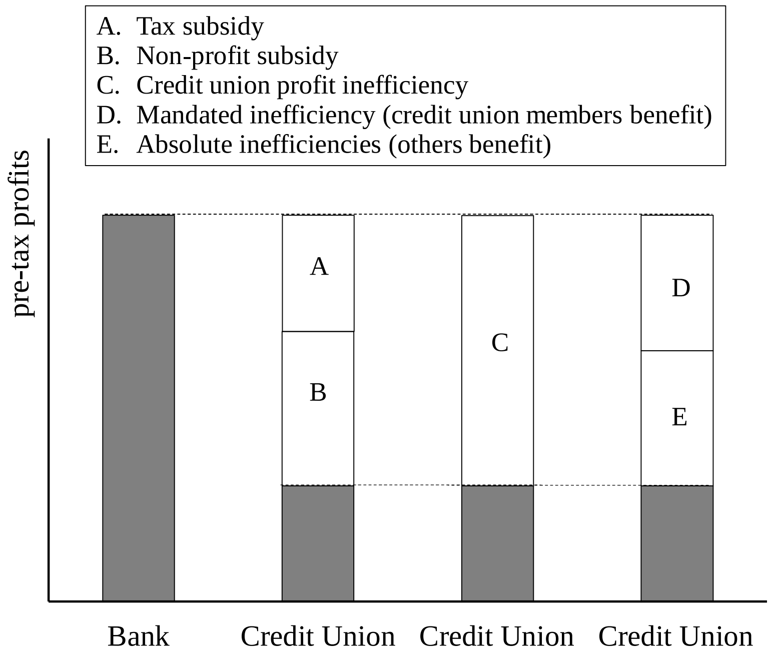


Figure 2: Comparing Deposit Rates for Credit Unions and Banks

Average credit union interest rate minus average commercial bank rate for standard deposit products from 2003 through 2016. Data provided by the National Credit Union Administration (NCUA). Data from 2005 and 2006 are unavailable.

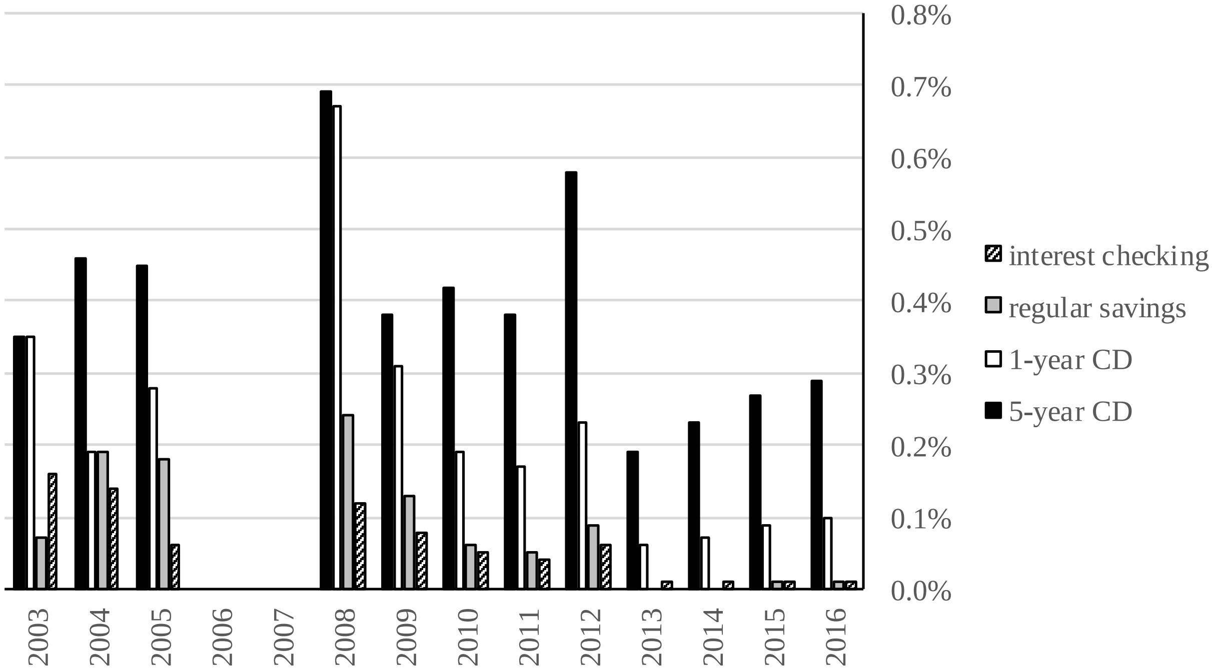
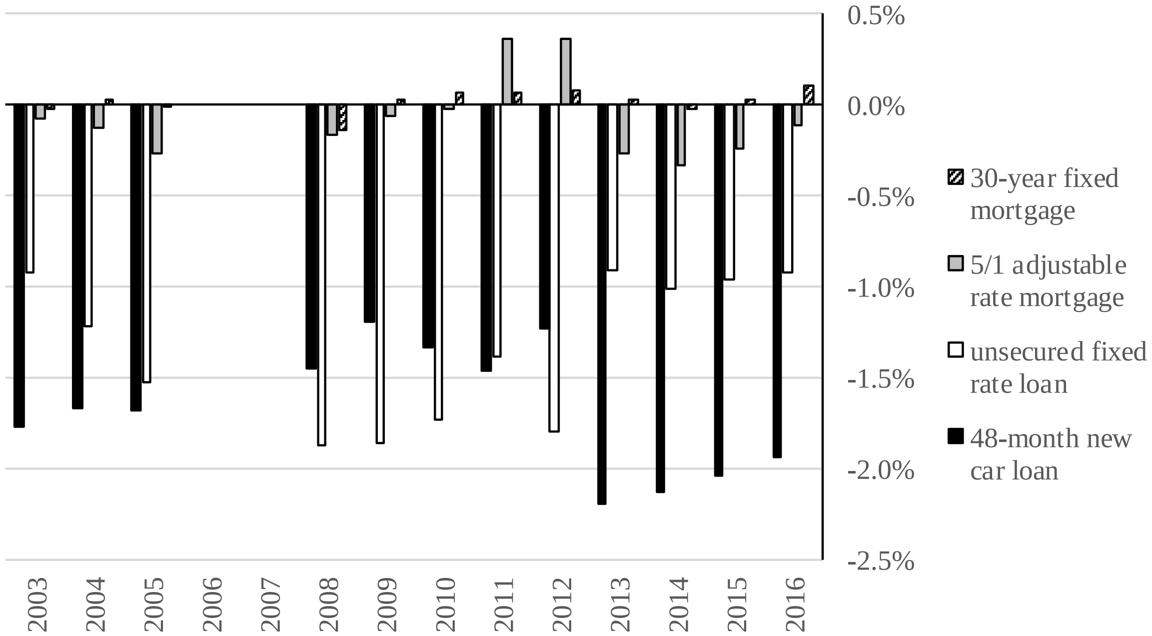


Figure 3: Comparing Lending Rates for Credit Unions and Banks

Average credit union interest rate minus average commercial bank rate for standard loan products from 2003 through 2016. Data provided by the National Credit Union Administration (NCUA). Data from 2006 and 2007 are unavailable.



Supplementary Material to

Who Consumes the Credit Union Subsidies?

May 10, 2022

Contents

Appendix 1

Methdology

This Appendix follows closely to the original presentation in Berger, Hancock and Humphrey (1993). Let bank i compete in market s=1,…, S at time t=1,…,T. The bank maximises variable profits $\pi^*_{i,t} = \pi(\mathbf{p}_{s,t}, \mathbf{z}_{i,t})$ by choosing its optimal vector of n netputs $\mathbf{x}^*_{i,t} = \{x_{j,i,t} \text{ for } j=1,\dots,n\}$, taking as given both the vector of n local netput prices $\mathbf{p}_{s,t} = \{p_{j,s,t} \text{ for } j=1,\dots,n\}$ and its own vector of m fixed factors $\mathbf{z}_{i,t} = \{z_{r,i,t} \text{ for } r=1,\dots,m\}$.[39] We adopt a Fuss normalized quadratic functional form for the variable profit function:

$$\left(\frac{\pi^*_{i,t}}{p_{n,s,t}}\right) = \sum_{j=1}^{n} \alpha_j \left(\frac{p_{j,s,t}}{p_{n,s,t}}\right) + \frac{1}{2}\sum_{j=1}^{n-1}\sum_{k=1}^{n-1} \varphi_{j,k}\left(\frac{p_{j,s,t}p_{k,s,t}}{p^2_{n,s,t}}\right)$$

$$+\sum_{r=1}^{m}\beta_r z_{r,i,t} + \frac{1}{2}\sum_{r=1}^{m}\sum_{q=1}^{m}\theta_{r,q} z_{r,i,t} z_{q,i,t} + \sum_{r=1}^{m}\sum_{j=1}^{n-1}\gamma_{r,j}\left(\frac{p_{j,s,t}}{p_{n,s,t}}\right) z_{r,i,t} \qquad \text{(A1)}$$

where linear price homogeneity is imposed by using the n^{th} netput price as the numeraire. Hotelling's Lemma can be used to generate the n optimal netput demand equations:

$$x^*_{j,i,t} = \alpha_j + \sum_{k=1}^{n-1}\varphi_{j,k}\left(\frac{p_{j,s,t}}{p_{n,s,t}}\right) + \sum_{r=1}^{m}\gamma_{r,j} z_{r,i,t} \qquad \text{for } j=1,\dots,n\text{-}1 \qquad \text{(A2a)}$$

$$x^*_{j,i,t} = \alpha_j - \frac{1}{2}\sum_{j=1}^{n-1}\sum_{k=1}^{n-1}\varphi_{j,k}\left(\frac{p_{j,s,t}p_{k,s,t}}{p^2_{n,s,t}}\right) + \sum_{r=1}^{m}\beta_r z_{r,i,t} + \frac{1}{2}\sum_{r=1}^{m}\sum_{q=1}^{m}\theta_{r,q} z_{r,i,t} z_{q,i,t} \quad \text{for } j=n \qquad \text{(A2b)}$$

where the netputs x_j take positive values when j is an output and negative values when j is an input.

[39] Note that a bank's fixed factors can vary with t, as long as the strategic decisions that alter these fixed factors are made prior to time t.

Equations (A1) and (A2) assume that all banks make efficient choices. We now relax that assumption. Let bank i's actual netput choices $x_{j,i,t}$ be related to its optimal netput values $x^*_{j,i,t}$ by the identity $x^*_{j,i,t} = x_{j,i,t} + \xi_{j,i,t}$. The inefficiency terms $\xi_{j,i,t}$ are non-negative, and indicate the degree to which a bank under-produces outputs and/or over-uses inputs. Substituting this expression into (A2) yields the actual netput demand equations:

$$x_{j,i,t} = (\alpha_j - \xi_{j,i,t}) + \sum_{k=1}^{n-1} \varphi_{j,k}\left(\frac{p_{j,s,t}}{p_{n,s,t}}\right) + \sum_{r=1}^{m} \gamma_{r,j} z_{r,i,t} \qquad \text{for j=1,…,n-1} \qquad \text{(A3a)}$$

$$x_{j,i,t} = (\alpha_j - \xi_{j,i,t}) - \frac{1}{2}\sum_{j=1}^{n-1}\sum_{k=1}^{n-1} \varphi_{j,k}\left(\frac{p_{j,s,t}p_{k,s,t}}{p^2_{n,s,t}}\right) + \sum_{r=1}^{m} \beta_r z_{r,i,t} + \frac{1}{2}\sum_{r=1}^{m}\sum_{q=1}^{m} \theta_{r,q} z_{r,i,t} z_{q,i,t} \qquad \text{for j=n} \qquad \text{(A3b)}$$

The actual profit function can then be derived by taking the inner product of the actual netput vector $\mathbf{x_{j,t}}$ and the netput price vector $\mathbf{p_{s,t}}$, which after some manipulation yields:

$$\left(\frac{\pi_{i,t}}{p_{n,s,t}}\right) = \sum_{j=1}^{n} (\alpha_j - \xi_{j,i,t})\left(\frac{p_{j,s,t}}{p_{n,s,t}}\right) + \frac{1}{2}\sum_{j=1}^{n-1}\sum_{k=1}^{n-1} \varphi_{j,k}\left(\frac{p_{j,s,t}p_{k,s,t}}{p^2_{n,s,t}}\right)$$

$$+ \sum_{r=1}^{m} \beta_r z_{r,i,t} + \frac{1}{2}\sum_{r=1}^{m}\sum_{q=1}^{m} \theta_{r,q} z_{r,i,t} z_{q,i,t} + \sum_{r=1}^{m}\sum_{j=1}^{n-1} \gamma_{r,j}\left(\frac{p_{j,s,t}}{p_{n,s,t}}\right) z_{r,i,t} \qquad \text{(A4)}$$

By definition, variable profit inefficiency is the difference between actual variable profits $\pi_{i,t}(\mathbf{p_{s,t}}, \mathbf{z_{i,t}}, \boldsymbol{\xi_{i,t}})$, which are observable, and optimal variable profits $\pi^*_{i,t}(\mathbf{p_{s,t}}, \mathbf{z_{i,t}}, \mathbf{0})$, which are unobservable and must be estimated. Equivalently, variable profit inefficiency is the sum of the market values of the n individual netput inefficiencies, which can be written as $\sum_{j=1}^{n} p_{j,s,t}\xi_{j,i,t}$, where the netput prices $p_{j,s,t}$ are observable, but the netput inefficiencies $\xi_{j,i,t}$ are unobservable and must be estimated. We follow Berger, Hancock and Humphrey (1993) in assuming that these short-run profit inefficiency terms are uncorrelated with the market-determined netput prices $p_{j,s,t}$ and the pre-determined fixed factors $z_{r,i,t}$.

Before estimating the actual profit system (A3, A4), we need to specify a random error term for each of the equations. The expression ($\alpha_j - \xi_{j,i,t}$) that appears in each of these equations contains two terms: A parameter α_j that is constant across banks and time and hence serves as the regression intercept, and a set of unobservable inefficiency terms $\xi_{j,i,t}$ that vary across both banks and time and hence are captured in the regression residuals.[40] Our challenge is to extract these netput inefficiency terms from the regression residuals.

Following Berger, Hancock and Humphrey (1993), we replace each of the expressions $(\alpha_j - \xi_{j,i,t})$ with $(\alpha_j - \xi_{j,mean})$, where $\xi_{j,mean}$ is the theoretical population mean of $\xi_{j,i,t}$. These expressions are now pure constants. The remainders from these substitutions get absorbed into the regression residuals, $\nu_{j,i,t} + (\xi_{j,mean} - \xi_{j,i,t})$, where $\nu_{j,i,t}$ is a standard random disturbance term and $(\xi_{j,mean} - \xi_{j,i,t})$ is a relative netput inefficiency term. We separate the inefficiency from the random error by taking bank-specific averages $\hat{\nu}_{j,i}$ of the regression residuals; these $\hat{\nu}_{j,i}$ converge in probability to $(\xi_{j,mean} - \xi_{j,i,t})$ because the random error $\nu_{j,i,t}$ attenuates to zero in the averaging.[41] Finally, we generate the netput j inefficiency for each bank i using the expression $\hat{\xi}_{j,i} = \overline{\nu}_j - \hat{\nu}_{j,i}$, where $\overline{\nu}_j$ is the maximum value (the least inefficient bank relative to the population mean) of $\hat{\nu}_{j,i}$ over all banks.[42] $\hat{\xi}_{j,i} = 0$ for the least inefficient bank (that is, for $\hat{\nu}_{j,i} = \overline{\nu}_j$) and becomes increasingly positive (more inefficient) with increasing $\hat{\nu}_{j,i}$.

We take two additional steps to limit the impact of outlying values on our estimates of profit inefficiency. First, we truncate the raw residuals $\nu_{j,i,t}$ as follows: If $\nu_{j,i,t} > x_{j,i,t}$ for positive netputs (or if $\nu_{j,i,t} < x_{j,i,t}$ for negative netputs), we replace the residual with the value of $x_{j,i,t}$. This plausible adjustment prevents any of the T raw residuals $\nu_{j,i,t}$ used in the calculation of the netput inefficiencies from being

[40] In equation (A4) the expression $p_{j,s,t}/p_{n,s,t} = 1$, so $\xi_{j,i,t}$ falls cleanly out of the specification and into the regression residual for the j=n[th] netput.

[41] We assume that the regression residual terms are distributed symmetrically with zero mean, so that the intra-bank averaging is essentially an application of the 'distribution-free' approach introduced by Berger (1993).

[42] Note that the averaging process precludes us from recovering the theoretical netput inefficiencies $\xi_{j,i,t}$ in every time period.

larger than the netput quantities themselves. Second, following DeYoung and Nolle (1996), we divide the data into ten asset deciles, and then (before using the average residuals to calculate *Ineff*$_i$) we winsorize the average residuals $\hat{v}_{j,i}$ at the 5th and 95th percentiles of their distributions within those size deciles. We perform this winsorization to limit the effects of outlying $\hat{v}_{j,i}$ on the calculation of *Ineff*$_i$; we let the winsorization thresholds vary with bank size to purge *Ineff*$_i$ of scale effects.

We estimate the parameters of the system (A3, A4) for the balanced panel of 2,580 commercial banks using seemingly unrelated regression (SUR) techniques. We impose the usual symmetry restrictions on $\varphi_{j,k} = \varphi_{k,j}$ and $\theta_{r,q} = \theta_{q,r}$. We use *Price(Labour)* as the numeraire $p_{n,s,t}$. We do not include bank fixed effects, as these would absorb the bank-specific inefficiencies $\xi_{j,i,t}$ that we wish to be included in the regression residuals. We exclude credit unions from this estimation, because credit unions are neither profit-maximisers nor price-takers as assumed by the model. With the estimated model parameters in-hand, we calculate profit inefficiency measures for all of the commercial banks and credit unions in our data. Strictly speaking, the calculated profit inefficiency for credit union *i* can be interpreted as the inefficiency that would have been generated by a price-taking, profit-maximising commercial bank that made the same variable netput decisions as did credit union *i*.

Appendix 2

Additional details regarding the matching procedure

To construct our matched-pairs sample, we use the nearest-neighbour matching procedure described by Abadie et al. (2004) to locate for each credit union, the bank whose values of ln(Assets) and the latitude and longitude coordinates of its headquarters minimize a quadratic loss function, specified using the differences between these values for the bank and the corresponding values for the credit union, with an inverse variance weighting matrix used to normalize the arguments of the loss function. Each bank is eligible to be paired with more than one credit union.

On completion of the matching procedure, the 1,279 matched pairs of credit unions and banks are ranked in ascending order of the following measure of the closeness of the match: $\eta = \varphi^2/V_\varphi + \psi^2/V_\psi$, where φ = absolute difference between the mean log(asset) values for each paired bank and credit union (means calculated using 52 quarterly observations over the period 2005-2017); ψ = geographical distance in miles between each paired bank and credit union; and V_φ and V_ψ are the sample variances of φ and ψ. Geographical distances are calculated 'as the crow flies' by applying the haversine formula to the latitude and longitude coordinates corresponding to the zipcodes of the institutions' headquarters.

We apply an arbitrary cut-off threshold at the 8th decile of the distribution of η to eliminate poorly matched pairs. This procedure reduces the number of matched pairs to 1,024 in the truncated sample, for which results are reported in the body of the paper. The following table reports the distribution of the paired banks by the number of credit unions with which each of these banks is paired, for both the full sample and the truncated sample. In the former, 617 different banks are paired with 1,279 credit unions. In the latter, 569 different banks are paired with 1,024 credit unions.

No. of pairings	Full sample	Truncated sample	No. of pairings	Full sample	Truncated sample	No. of pairings	Full sample	Truncated sample
1	352	343	9	3	1	17	1	0
2	122	118	10	2	0	18	0	0
3	61	58	11	4	2	19	0	0
4	29	19	12	0	0	20	0	0
5	20	16	13	1	1	21	1	0
6	17	8	14	0	0	22	0	0
7	0	1	15	0	0			
8	3	1	16	1	0	Total	617	569

The following table illustrates the performance of the matching procedure, by reporting the average values of φ, ψ and η for the full sample (prior to application of the cut-off threshold) subdivided into deciles defined by η; and for the truncated sample in its entirety.

Deciles of η	Average φ	Average ψ	Average η
1st	.0271	16.1	.0660
2nd	.0456	27.6	.1734
3rd	.0607	34.5	.2852
4th	.0687	46.9	.4526

5th	.0779	57.4	.6701
6th	.0913	67.9	.9545
7th	.1191	78.2	1.3959
8th	.1462	104.7	2.3383
9th	.1633	158.6	4.3532
10th	.3851	258.0	21.8830
Truncated sample (1st - 8th deciles)	.0796	54.2	.7920

Using this construction allows us to employ standard difference of means techniques to test our hypotheses H1 and H2, using one-sample z-tests of the null hypothesis of a zero average difference between the values of any selected profit-inefficiency metric, across all matched pairs of firms.

Our results are robust to using different values for the cut-off threshold used to define the matched-pairs samples created by the nearest-neighbour matching procedure. The cut-off threshold controls the closeness of the match required for any pair of institutions to be included in the matched-pairs sample: smaller values of the cut-off threshold imply a closer match is required for inclusion; larger values or no cut-off threshold imply less closely matched pairs are included in the matched-pairs sample. The principal results investigated are the inefficiency/assets metric, and the components of the inefficiency/assets metric attributed to each of the four netputs. The following table reports the mean difference between the values of each metric across the matched pairs of institutions, and (in italics) the z-statistic for the test of the null hypothesis that the true mean difference between the values of each metric is zero. The rows for a cut-off threshold at the 8th decile of the distribution of η in the full sample replicate results reported in the body of the paper.

Cut-off for η	No. of matched pairs	*Ineff/assets* $\sum_j \hat{p}_{j,s}\xi_{j,i}/\hat{a}_i$	*Loans* $\hat{p}_{1,s}\xi_{1,i}/\hat{a}_i$	*Investments* $\hat{p}_{2,s}\xi_{2,i}/\hat{a}_i$	*Labour* $\hat{p}_{3,s}\xi_{3,i}/\hat{a}_i$	*Deposits* $\hat{p}_{4,s}\xi_{4,i}/\hat{a}_i$
6th decile	768	.00774*** *21.10*	-.00009** *-2.03*	.00041*** *4.92*	.00010* *1.89*	.00733*** *20.87*
7th decile	895	.00766*** *21.88*	-.00011*** *-2.73*	.00049*** *6.32*	.00002*** *0.40*	.00725*** *21.81*
8th decile	1,024	.00753*** *22.00*	-.00012*** *-3.02*	.00054*** *7.35*	.00002 *0.40*	.00709*** *21.55*
9th decile	1,151	.00708*** *20.93*	-.00013*** *-3.34*	.00059*** *8.34*	.00004 *0.73*	.00658*** *20.13*
None	1,279	.00668*** *20.59*	-.00010*** *2.75*	.00060*** *9.01*	.00010** *2.03*	.00609*** *19.27*

Robustness in the profit inefficiencies estimates translates into robustness in our calculations of the proft inefficiency gaps. This panel shows how the mean profit inefficiency gap varies for four different methods for matching commercial banks and credit unions. The numbers in the following table mean averages and are all statistically different from zero at the 1% level.

	baseline result (1,024 pairs)	sampling banks without replacement (1,024 pairs)	truncating at the 6th quadratic loss function decile (768 pairs)	restricting matched banks to same type of Census area (metropolitan, micropolitan, or rural) (1,024 pairs)
Profit inefficiency gap	.00753***	.00806***	.00774***	.00762***

Appendix 3
Definitions for Variables used in the Profit Function Estimations.
(Detailed mappings using data codes from the FFIEC call reports and the NCUA call reports)

Banks				
Variable Name	**Generic Definition**	**Definition in data source**	**Call Report Item Codes**	**SNL Data Item Code**
Profits	Profit	Pre-tax net income	RIAD4340+RIAD4302	206265+206260
Loans	Total Loans	Tot Loans & Leases - Total Leases	RCON2122-RCON2165	206616-206614
Investments	Total investments	Securities (held to maturity and available for sale) + trading assets + deposits in other banks + loans to other banks (fed funds sold and repurchase agreements)	RCON1754+RCON1773+RCFD3545+RCON0082+RCON0070+RCONB987+RCFDB989	206099
Labour	Employees	Full time employees	RIAD4150	206272
Deposits	Deposits and borrowed funds	Deposits and all other borrowed funds	RCON2215+RCON2385-RCON2210+RCON993+RCONB995+RCON3190+RCON3200	206926+206128+206129+206136+206139
Price (Loans)	Price of Loans	Interest income on loans / loans	RIAD4010/RCON2122-RCON2165	206185/ 206616-206614)
Price (Investments)	Price of Investments	(interest and dividend income from Investments)/ Investments	RIADB488+RIADB489+RIAD4060+RIAD4069+RIAD4115+RIAD4107 / RCON1754+RCON1773	206202/ 206099
Price (Labour)	Price of Labour	(Salaries + benefits)/ full time employees	RIAD4135/RIAD4150	206251/206272
Price (Deposits)	Price of Deposits	(Interest expenses on deposits and other borrowings)/deposits	RIAD4508+RIAD0093+RIADA518+RIADA517+RIAD4180+RIAD4185+RIAD4200/ RCON2215+RCON2385-RCON2210+RCON993+RCONB995+RCON3190+RCON3200	(206207+206210+206212+206211+206215+206216+206218)/(206926+206128+206129+206136+206139)
Premises	Fixed Assets	Premises and fixed assets	RCON2145	206110
Equity	Equity	Equity capital	RCON3210	207626
Non-interest income	Non-interest income	Non-interest income	RAID4079	206247
Risk-weighted assets	Risk-weighted assets	Risk-weighted assets (using Federal Reserve formula)	RCONA223	207790
Assets	Total Assets	Total Assets	RCON2170	207674
Age	Year of establishment	Age in years	RSSD9052	2009-(225998)
Dividend Pay-out	Dividends / Income	Dividends / (net income + taxes)	RIAD4470+RIAD4460/(RIAD4340+RIAD4302)	208117/206265
Sub-chapter S Election			RIADA530	206287

Credit Unions				
Variable Name	**Generic Definition**	**Definition in data source**	**Call Report Item Codes**	**SNL Data Item Code**
Profits	Surplus	Net Income	661A	213861
Loans	Total Loans	Tot Loans & Leases receivable - Leases receivable	025B-002	213544-213731
Investments	Total investments	Total Investments	799I	213546
Labour	Employees	Full time employees+0.5 x part time employees	564A+(0.5X564B)	214094+0.5(214095)
Deposits	Deposits and borrowed funds	Member shares, non-member deposits and other borrowings	018	213775+213776+213777+213778+213791+213792+213780+213781
Price (Loans)	Price of Loans	Interest income on loans / loans	110/(025B-002))	213832/ (213544-213731
Price (Securities)	Price of Securities	(Interest income on securities + dividends on securities)/securities	120/799I	213834/213546
Price (Labour)	Price of Labour	(Salaries + benefits)/ ((full time employees) + (0.5 x part time employees))	210/(564A)+(0.5X564 B)	213850/(214094+0.5(214095))
Price (Deposits)	Price of Deposits	(Interest expenses on deposits and other borrowings)/deposits	380+381+340/018	(((214495×213775)/100+(214496×213776)/100 +(214497×213777)/100 + (214498×213780)/100+ (214459×213778)/100 +(213785×213791)/100+(213786×213792)/100+213839)/(213775+213776+213777+213778+213791+213792+213780+213781))
Premises	Fixed Assets	LAND AND BUILDINGS AND OTHER FIXED ASSETS	007+008	213743+213750
Equity	Equity	TOTAL NET WORTH	997	213547
Non-interest income	Non-interest income	Non-interest income	117	213849
Risk-weighted assets*	Risk-weighted assets	Risk-weighted assets (using NCUA)		(213696+213697+213698+213699+214272+213750+213547)+1.5(214002+214001+214000)+0.2(213644+213665+213668+213669+213670)+0.5(213687)+0.75(213688)
Assets	Total Assets	Total Assets	010	213543
Age	Year of establishment	Age in years	FOICU FILE	2009-(225998)
***Risk weighted assets are calculated by applying risk weights ranging from 0 to 150% to relevant asset categories**				

Appendix 4
Estimated *Inefficiency/Assets* Alternative Model Specifications

The following table displays values of ***Inefficiency/Assets*** from models that use alternative specifications. All estimations shown in this table use the matched pair data sample of 1,024 banks and credit unions over the 2005-2017 sample period. Panel A shows results for banks and credit unions using the benchmark specification from the main text. Panel B shows results for credit union inefficiency using two alternative methods for translating part-time credit unions workers into FTEs: Part-time employees work 16 hours per week (part-time = 0.4 FTEs) and part-time employees work 24 hours per week (part-time = 0.6 FTEs). Panel C shows results for banks and credit unions using a model that expands the vector of fixed netputs ***z*** to include *business loans* and *real estate loans*.

Panel A – Benchmark model

	Total	*Loans*	*Investments*	*Labour*	*Deposits*
Banks					
Internal Inefficiency/Assets	.02037	.00085	.00211	.00136	.01605
Market Inefficiency/Assets	.01984	.00068	.00145	.00190	.01582
Pricing inefficiency	.00053	.00017	.00066	-.00054	.00024
Credit unions					
Internal Inefficiency/Assets	.09393	.00066	.00283	.00132	.08912
Market Inefficiency/Assets	.02737	.00056	.00199	.00192	.02290
Pricing inefficiency	.06657	.00010	.00085	-.00060	.06622

Panel B – Alternative definitions for part-time workers at credit unions

	Total	*Loans*	*Investments*	*Labour*	*Deposits*
Credit unions (part-time = 0.4 FTE)					
Internal Inefficiency/Assets	.09396	.00066	.00283	.00134	.08912
Market Inefficiency/Assets	.02738	.00056	.00199	.00193	.02290
Pricing inefficiency	.06658	.00010	.00085	-.00058	.06622
Credit unions (part-time = 0.6 FTE)					
Internal Inefficiency/Assets	.09393	.00066	.00283	.00131	.08912
Market Inefficiency/Assets	.02738	.00056	.00199	.00193	.02290
Pricing inefficiency	.06655	.00010	.00085	-.00061	.06622

Panel C – Loan mix included as a fixed netput

	Total	*Loans*	*Investments*	*Labour*	*Deposits*
Banks					
Internal Inefficiency/Assets	.02102	.00088	.00161	.00181	.01672
Market Inefficiency/Assets	.02069	.00070	.00111	.00247	.01641
Pricing inefficiency	.00033	.00018	.00050	-.00066	.00031
Credit unions					
Internal Inefficiency/Assets	.09018	.00060	.00419	.00161	.08378
Market Inefficiency/Assets	.02740	.00051	.00296	.00232	.02161
Pricing inefficiency	.06278	.00009	.00123	-.00070	.06217

Appendix 5

Numbers of Survivors, Annual rates of Attrition, and Average Return on Assets

The following tables report the numbers of survivors, annual rates of attrition, and average return on assets (ROA) among banks and credit unions that reported Call Report data, with assets of at least $50 million and not more than $8,152 million (in 2010 prices), in the first quarter of 2005. Survivors and rates of attrition are calculated at yearly intervals, up to the first quarter of 2017. Average ROA is per calendar year. The analysis is reported for all locations, and for institutions located in metro, micro and rural locations separately.

All locations

	Banks			Credit unions		
Year	Number	% rate of attrition	Average ROA	Number	% rate of attrition	Average ROA
2005	6028	-	.01619	2181		.00742
2006	5782	4.1	.01572	2162	0.9	.00708
2007	5550	4.0	.01334	2129	1.5	.00601
2008	5303	4.5	.00162	2103	1.2	.00009
2009	5092	4.0	.00179	2080	1.1	-.00063
2010	4894	3.9	.00540	2045	1.7	.00279
2011	4649	5.0	.00810	2013	1.6	.00467
2012	4503	3.1	.01066	1989	1.2	.00573
2013	4340	3.6	.01091	1955	1.7	.00536
2014	4169	3.9	.01184	1937	0.9	.00572
2015	3980	4.5	.01240	1913	1.2	.00522
2016	3831	3.7	.01262	1884	1.5	.00497
2017	3680	3.9	.01325	1862	1.2	.00509

Metro

	Banks			Credit unions		
Year	Number	% rate of attrition	Average ROA	Number	% rate of attrition	Average ROA
2005	3578	-	.01684	1955	-	.00729
2006	3402	4.9	.01627	1937	0.9	.00695
2007	3230	5.1	.01283	1904	1.7	.00575
2008	3053	5.5	-.00495	1878	1.4	-.00046
2009	2899	5.0	-.00215	1856	1.2	-.00112
2010	2742	5.4	.00247	1821	1.9	.00256
2011	2545	7.2	.00646	1790	1.7	.00455
2012	2439	4.2	.00998	1768	1.2	.00563
2013	2339	4.1	.01048	1737	1.8	.00533
2014	2215	5.3	.01170	1720	1.0	.00566
2015	2091	5.6	.01251	1699	1.2	.00512
2016	1986	5.0	.01282	1671	1.6	.00481
2017	1892	4.7	.01378	1649	1.3	.00493

Micro

	Banks			Credit unions		
Year	Number	% rate of attrition	Average ROA	Number	% rate of attrition	Average ROA
2005	1056	-	.01496	167	-	.00846
2006	1026	2.8	.01458	166	0.6	.00793
2007	996	2.9	.01378	166	0.0	.00814
2008	962	3.4	.00980	166	0.0	.00429
2009	932	3.1	.00595	165	0.6	.00322
2010	910	2.4	.00809	165	0.0	.00452
2011	886	2.6	.00918	164	0.6	.00539
2012	869	1.9	.01116	162	1.2	.00657
2013	831	4.4	.01112	160	1.2	.00565
2014	809	2.6	.01204	159	0.6	.00652
2015	772	4.6	.01244	158	0.6	.00593
2016	750	2.8	.01258	158	0.0	.00631
2017	728	2.9	.01293	158	0.0	.00687

Rural

	Banks			Credit unions		
Year	Number	% rate of attrition	Average ROA	Number	% rate of attrition	Average ROA
2005	1394	-	.01548	59	-	.00890
2006	1354	2.9	.01523	59	0.0	.00888
2007	1324	2.2	.01425	59	0.0	.00822
2008	1288	2.7	.01081	59	0.0	.00546
2009	1261	2.1	.00754	59	0.0	.00360
2010	1242	1.5	.00961	59	0.0	.00498
2011	1218	1.9	.01070	59	0.0	.00613
2012	1195	1.9	.01167	59	0.0	.00648
2013	1170	2.1	.01160	58	1.7	.00567
2014	1145	2.1	.01197	58	0.0	.00536
2015	1117	2.4	.01218	56	3.4	.00611
2016	1095	2.0	.01229	55	1.8	.00577
2017	1060	3.2	.01253	55	0.0	.00496

Appendix 6
Profit Inefficiency Gaps under Various Matching Restrictions

Matching Restriction: All matched pairs must have the same metro/micro/rural classification
The following table reports mean values for the estimated *profit inefficiency gaps* for 1,024 matched pairs of commercial banks and credit unions over the 2005-2017 sample period, obtained by imposing the restriction that all matched pairs must have the same metro/micro/rural classification; i.e. only banks from a metro location are eligible to be matched with a CU from a metro location, and so on.

$$\textit{profit inefficiency gap}_{pair} = (\textit{Ineff/assets})_{credit\ union} - (\textit{Ineff/assets})_{bank}$$

All of the *inefficiency gaps* reported in this table are calculated in terms of average netput prices in local markets. ***, ** and * indicate statistically different from zero at the 1%, 5% and 10% levels.

	[1] *Profit inefficiency gap*	[2] *Loans*	[3] *Deposits*	[4] *Mandated (-2+3)*	[5] *Investments*	[6] *Labour*	[7] *Absolute (5+6)*
All matched pairs (n=1,024)	.00762***	-.00010**	.00717***	.00727***	.00047***	.00008	.00055***
By asset size:							
$50-$100 million (n=301)	.00754***	-.00001	.00716***	.00717***	.00039**	.00001	.00040***
$100-$200 million (n=292)	.00775***	-.00024***	.00726***	.00751***	.00047***	.00027***	.00073***
$200-$500 million (n=258)	.00760***	-.00007***	.00727***	.00733***	.00040***	.00000	.00040***
$500-$5,260 million (n=173)	.00760***	-.00004***	.00690***	.00694***	.00070***	.00005	.00074***

The following table illustrates the performance of the matching procedure when the restriction is imposed that all matched pairs must have the same metro/micro/rural classification. The table reports the average values of φ, ψ and η for the full sample (prior to application of the cut-off threshold) subdivided into deciles defined by η; and for the truncated sample in its entirety.

Deciles of η	Average φ	Average ψ	Average η
1st	.0202	20.8	.0302
2nd	.0452	34.7	.1029
3rd	.0573	48.5	.1905
4th	.0731	59.5	.2957
5th	.0906	73.0	.4357
6th	.1096	82.6	.6286
7th	.1313	106.3	.9520
8th	.1666	123.4	1.4748
9th	.2055	173.8	2.4116
10th	.4853	329.4	21.5194
Truncated sample (1st - 8th deciles)	.0867	68.6	.5138

Matching Restriction: All matched pairs must be more than 10 miles distant from each other
The following table reports mean values for the estimated *profit inefficiency gaps* for 1,024 matched pairs of commercial banks and credit unions over the 2005-2017 sample period, obtained by imposing the restriction that all matched pairs must be more than 10 miles distant from each other; i.e. institutions within 10 miles of each other are ineligible to be paired.

profit inefficiency gap$_{pair}$ = (*Ineff/assets*)$_{credit\ union}$ - (*Ineff/assets*)$_{bank}$

All of the *inefficiency gaps* reported in this table are calculated in terms of average netput prices in local markets. ***, ** and * indicate statistically different from zero at the 1%, 5% and 10% levels.

	[1] *Profit Ineffic-iency gap*	[2] *Loans*	[3] *Deposits*	[4] *Mandated (-2+3)*	[5] *Investments*	[6] *Labour*	[7] *Absolute (5+6)*
All matched pairs (n=1,024)	.00778***	-.00011***	.00717***	.00728***	.00060***	.00011**	.00071***
By asset size:							
$50-$100 million (n=301)	.00753***	.00002	.00657***	.00655***	.00068***	.00025	.00093***
$100-$200 million (n=292)	.00669***	-.00033***	.00645***	.00678***	.00045***	.00011*	.00057***
$200-$500 million (n=258)	.00895***	-.00006***	.00852***	.00858***	.00050***	-.00001	.00049***
$500-$5,260 million (n=173)	.00838***	-.00004***	.00752***	.00756***	.00088***	.00002	.00090***

The following table illustrates the performance of the matching procedure when the restriction is imposed that all matched pairs must have the same metro/micro/rural classification. The table reports the average values of φ, ψ and η for the full sample (prior to application of the cut-off threshold) subdivided into deciles defined by η; and for the truncated sample in its entirety.

Deciles of η	Average φ	Average ψ	Average η
1st	.0122	33.3	.0172
2nd	.0228	52.2	.0495
3rd	.0355	62.3	.0932
4th	.0492	69.1	.1573
5th	.0677	68.5	.2469
6th	.0811	87.2	.3823
7th	.1059	95.0	.6054
8th	.1385	117.7	.9787
9th	.2067	111.4	1.9765
10th	.4096	451.9	21.8825
Truncated sample (1st - 8th deciles)	.0641	73.1	.3163

Matching Restriction: Sampling without replacement

The following table reports mean values for the estimated *profit inefficiency gaps* for 1,024 matched pairs of commercial banks and credit unions over the 2005-2017 sample period, using sampling without replacement in the matching procedure. Each sample bank is eligible to be paired with no more than one sample credit union. The matching procedure is carried out iteratively, beginning with the full samples of credit unions and banks, from which the pairing that produces the closest match is selected. This pair of institutions is eliminated from the samples used in the second iteration, from which the pairing that produces the closest match is again selected. This pair of institutions is eliminated from the samples used in the third iteration. The iterative procedure continues until a different paired bank is identified for every credit union.

$$\textit{profit inefficiency gap}_{pair} = (\textit{Ineff/assets})_{credit\ union} - (\textit{Ineff/assets})_{bank}$$

All of the *inefficiency gaps* reported in this table are calculated in terms of average netput prices in local markets. ***, ** and * indicate statistically different from zero at the 1%, 5% and 10% levels.

	[1] *Profit inefficiency gap*	[2] *Loans*	[3] *Deposits*	[4] *Mandated (-2+3)*	[5] *Investments*	[6] *Labour*	[7] *Absolute (5+6)*
All matched pairs (n=1,024)	.00806***	-.00016***	.00734***	.00750***	.00074***	.00014***	.00088***
By asset size:							
$50-$100 million (n=301)	.00833***	-.00031**	.00735***	.00766***	.00094***	.00035**	.00129***
$100-$200 million (n=292)	.00692***	-.00017***	.00643***	.00660***	.00054***	.00012**	.00066***
$200-$500 million (n=258)	.00863***	-.00005***	.00795***	.00800***	.00074***	-.00001	.00073***
$500-$5,260 million (n=173)	.00861***	-.00002***	.00793***	.00795***	.00068***	.00002	.00070***

The following table illustrates the performance of the matching procedure when the paired banks are selected using sampling without replacement. The table reports the average values of φ, ψ and η for the full sample (prior to application of the cut-off threshold) subdivided into deciles defined by η; and for the truncated sample in its entirety.

Deciles of η	Average φ	Average ψ	Average η
1st	.0174	40.7	.0405
2nd	.0278	60.6	.0846
3rd	.0377	66.7	.1189
4th	.0430	86.3	.1580
5th	.0560	89.3	.1864
6th	.0795	150.7	.2686
7th	.1178	231.7	.4039
8th	.1645	490.2	.7941
9th	.1632	1008.4	1.4280
10th	1.1105	1403.3	46.5782
Truncated sample (1st - 8th deciles)	.0679	152.0	.2569

Matching Restriction: Banks located in states in the lowest two quartiles by average tax rate
The following table reports mean values for the estimated *profit inefficiency gaps* for 1,024 matched pairs of commercial banks and credit unions over the 2005-2017 sample period, obtained by restricting the pool of banks available for matching to those that are located in states in the lowest two quartiles of the distribution of states by average corporate tax rate. Matching is based on log asset size only.

$$\textit{profit inefficiency gap}_{pair} = (\textit{Ineff/assets})_{credit\ union} - (\textit{Ineff/assets})_{bank}$$

All of the *inefficiency gaps* reported in this table are calculated in terms of average netput prices in local markets. ***, ** and * indicate statistically different from zero at the 1%, 5% and 10% levels.

	[1] *Profit Inefficiency gap*	[2] *Loans*	[3] *Deposits*	[4] *Mandated (-2+3)*	[5] *Investments*	[6] *Labour*	[7] *Absolute (5+6)*
All matched pairs (n=1,024)	.00446***	-.00036***	.00395***	.00431***	.00053***	.00034***	.00087***
By asset size:							
$50-$100 million (n=301)	.00247***	-.00070***	.00188***	.00257***	.00064***	.00065***	.00129***
$100-$200 million (n=292)	.00459***	-.00024***	.00417***	.00442***	.00044***	.00022***	.00066***
$200-$500 million (n=258)	.00751***	-.00007***	.00704***	.00711***	.00048***	.00006***	.00054***
$500-$5,260 million (n=173)	.00422***	-.00001***	.00360**	.00361**	.00055**	.00009***	.00063***

The following table reports mean values for the estimated *profit inefficiency gaps* for 361 matched pairs of commercial banks and credit unions over the 2005-2017 sample period, when the sample is restricted to banks and credit unions located in states in the lowest two quartiles of the distribution of states by average corporate tax rate. Matching is based on log asset size and geographical distance.

$$\textit{profit inefficiency gap}_{pair} = (\textit{Ineff/assets})_{credit\ union} - (\textit{Ineff/assets})_{bank}$$

All of the *inefficiency gaps* reported in this table are calculated in terms of average netput prices in local markets. ***, ** and * indicate statistically different from zero at the 1%, 5% and 10% levels.

	[1] *Profit Inefficiency gap*	[2] *Loans*	[3] *Deposits*	[4] *Mandated (-2+3)*	[5] *Investments*	[6] *Labour*	[7] *Absolute (5+6)*
All matched pairs (n=361)	.00839***	-.00013*	.00779***	.00792***	.00063***	.00010	.00073***
By asset size:							
$50-$100 million (n=124)	.00715***	-.00001	.00646***	.00646***	.00063**	.00007	.00070***
$100-$200 million (n=110)	.00831***	-.00034***	.00763***	.00797***	.00079***	.00023**	.00102***
$200-$500 million (n=84)	.01004***	-.00007**	.01002***	.01009***	.00011	-.00002	.00009
$500-$5,260 million (n=43)	.00899***	-.00004***	.00769***	.00773***	.00127***	.00007*	.00133***

Appendix 7
Sensitivity of Measured Inefficiency to Survivorship/Non-Survivorship

The following table investigates the sensitivity of measured inefficiency to survivorship/non-survivorship. In Panel A, the inefficiency measure is calculated using the method described in the body of the paper, with the profit function estimated using 28 quarterly observations for institutions that met all of the criteria for inclusion in the sample over a shortened estimation period of 2005-2011. These criteria were met by 3,354 banks, and 1,446 credit unions. These institutions were then classified by survival or non-survival over the period 2012-2017. 2,794 banks survived and 560 banks failed to survive; 1,352 credit unions survived and 94 failed to survive. The upper panel of the table reports the principal inefficiency measure for the period 2005-2011, *Ineff/assets*, separately for survivors and non-survivors over the period 2012-2017. Panel B repeats this analysis, using an estimation period of 2005-2013, and survival and non-survival observed over the period 2014-2017. In this case the criteria for inclusion in the sample were met by 3,024 banks (2,675 survivors and 349 non-survivors) and 1,397 credit unions (1,329 survivors and 68 non-survivors).

	Number	*Ineff/assets*
Panel A. Estimation period 2005-2011		
All banks	3,354	.00649
Survivors 2012-2017	2,794	.00642
Non-survivors 2012-2017	560	.00684
All credit unions	1,446	.00806
Survivors 2012-2017	1,352	.00807
Non-survivors 2012-2017	94	.00790
Panel B. Estimation period 2005-2013		
All banks	3,024	.00595
Survivors 2014-2017	2,675	.00589
Non-survivors 2014-2017	349	.00643
All credit unions	1,397	.00777
Survivors 2014-2017	1,329	.00776
Non-survivors 2014-2017	68	.00794

Appendix 8
Annualized Loan Performance for Matched Pairs of Banks and Credit unions

The following tables report annualized loan performance measures for 1,024 matched pairs of commercial banks and credit unions over the 2005-2017 sample period. The four loan performance measures are as follows. Banks: (i) Provision for loan and lease losses/Total loans and leases (incl. HFS); (ii) [Delinquencies 30-89 days in arrears + Delinquencies 90+ days in arrears]/Total loans and leases (incl. HFS); (iii) Delinquencies 90+ days in arrears/Total loans and leases (incl.HFS); (iv) Net charge-offs measure(?)/Total loans and leases. Credit unions: (i) Provisions for loan and lease losses/Total loans and leases; (ii) [Delinquencies > 12 months in arrears + Delinquencies 6-12 months in arrears + Delinquencies 2-6 months in arrears + Delinquencies 1-2 months in arrears]/Total loans and leases; (iii) [Delinquencies > 12 months in arrears + Delinquencies 6-12 months in arrears + Delinquencies 2-6 months in arrears]/Total loans and leases; (iv) Net charge-offs measure(?)/Total loans and leases. Total loans and leases and delinquencies are yearly averages of the quarterly values reported in the Call Reports; provisions and charge-offs are yearly totals.

Banks	(i) provisions	(ii) 30+ days	(iii) 90+ days	(iv) charge-off
2005	.00339	.01332	.00181	.00440
2006	.00334	.01328	.00162	.00410
2007	.00370	.01430	.00201	.00477
2008	.00597	.01396	.00183	.00587
2009	.00582	.01470	.00207	.00634
2010	.00525	.01363	.00164	.00631
2011	.00440	.01274	.00149	.00557
2012	.00411	.01294	.00153	.00547
2013	.00345	.01242	.00139	.00493
2014	.00290	.01229	.00158	.00418
2015	.00293	.01178	.00158	.00439
2016	.00288	.01187	.00169	.00416
2017	.00304	.01115	.00133	.00407

Credit unions	(i) provisions	(ii) > 1 month	(iii) > 2 months	(iv) charge-off
2005	.00660	.02232	.00992	.00824
2006	.00624	.02161	.00965	.00784
2007	.00645	.02248	.00994	.00821
2008	.00829	.02396	.01110	.00881
2009	.00829	.02584	.01176	.00932
2010	.00746	.02434	.01130	.00837
2011	.00649	.02371	.01107	.00872
2012	.00640	.02342	.01064	.00838
2013	.00586	.02336	.01064	.00841
2014	.00590	.02246	.01006	.00827
2015	.00607	.02276	.00991	.00816
2016	.00642	.02281	.00994	.00819
2017	.00668	.02248	.00976	.00831

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